



Laney Library & Learning Resource Center (Building 100 Replacement)

**900 Fallon Street
Oakland, California**

PROJECT MANUAL

**Issue for Bid
DSA Application 01-119215**

March 31, 2023

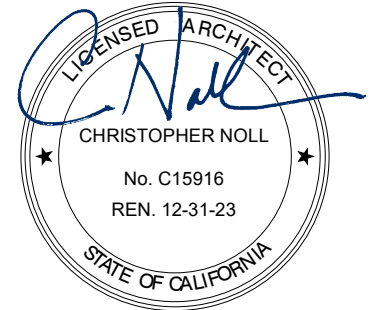
**Noll & Tam Architects
729 Heinz Avenue
Berkeley, CA 94710
510.542.2200**

**Mark Cavagnero Associates
1045 Sansome St, Suite 200
San Francisco, CA 94111
415.398.6944**

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SEALS PAGE

Architect:
Noll & Tam Architects
729 Heinz Avenue, #7
Berkeley, CA 94710



Civil Engineer:
CSW / Stuber-Stroeh Engineers
1936 University Ave, Suite 250
Berkeley, CA 94704



Landscape Architect:
Mantle Landscape Architecture
930 Carleton Street, Second Floor
Berkeley, CA 94710



Structural Engineer:
Thornton Tomasetti Inc.
650 California Street, Suite 1400
San Francisco, CA 94108



Mechanical Engineer:
Taylor Engineering LLC
1081 Marina Village Parkway Suite 501
Alameda, CA 94501



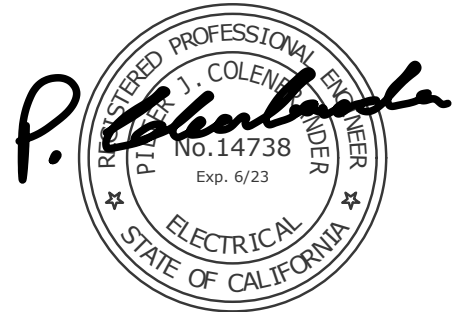
Plumbing Engineer:
Taylor Engineering LLC
1081 Marina Village Parkway Suite 501
Alameda, CA 94501



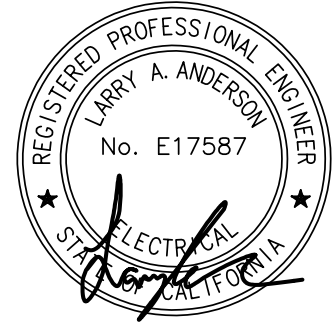
Fire Protection Engineer:
Fire & Risk Alliance LLC
2551 San Ramon Valley Blvd, Suite 207
San Ramon CA 94583



Electrical Engineer:
O'Mahony & Myer Inc.
4341 Redwood Highway Suite 245
San Rafael CA 94903



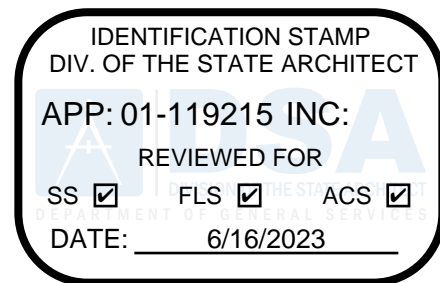
Telecom, AV + Acoustics Engineer:
TEECOM
1334 Broadway Suite 601
Oakland CA 94612-1906



Geotechnical Engineer:
Fugro
1777 Botelho Drive, Suite 262
Walnut Creek CA 94596



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FA.00	FIRE ALARM GENERAL NOTES AND LEGEND
FA.01	FIRE ALARM SEQUENCE OF OPERATIONS MATRIX
FA.02	LEVEL 1 FIRE ALARM PLAN

PERALTA COMMUNITY COLLEGE DISTRICT

Laney Library & LRC
Issue for Bid

DRAWINGS AND TABLES**DOCUMENT 00 01 15-6**

March 31, 2023

DRAWING**NAME**

FA.03	LEVEL 2 FIRE ALARM PLAN
FA.04	LEVEL 3 FIRE ALARM PLAN
FA.05	PENTHOUSE FIRE ALARM PLAN
FA.06	FIRE ALARM RISER DIAGRAM
FA.07	FIRE ALARM VOLTAGE DROP AND BATTERY CALCULATIONS
FA.08	FIRE ALARM VOLTGE DROP AND SPEAKER CALCULATIONS
FA.09	FIREFIGHTER'S SMOKE CONTROL PANEL
FS.00	FIRE SUPPRESSION GENERAL NOTES & LEGEND
FS.01	LEVEL 1 FIRE SUPPRESSION PLAN
FS.02	LEVEL 2 FIRE SUPPRESSION PLAN
FS.03	LEVEL 3 FIRE SUPPRESSION PLAN
FS.04	LEVEL 03M PENTHOUSE FIRE SUPPRESSION PLAN
FS.05	ROOF SKYLIGHT FIRE SUPPRESSION PLAN
FS.06	LEVEL 1 FIRE SUPPRESSION RCP
FS.07	LEVEL 2 FIRE SUPPRESSION RCP
FS.08	LEVEL 3 FIRE SUPPRESSION RCP
FS.09	LEVEL 03M PENTHOUSE FIRE SUPPRESSION RCP
FS.10	STANDPIPES AT STAIR A & B SECTIONS & ISOMETRICS
FS.11	FIRE PUMP ROOM & STANDPIPE RISERS
FS.12	FIRE SUPPRESSION TYPICAL DETAILS
FS.13	FIRE SUPPRESSION TYPICAL DETAILS

PLUMBING

P0.01	PLUMBING LEGENDS AND ABBREVIATIONS
P2.00	PLUMBING FLOOR PLAN - BELOW GRADE
P2.01	PLUMBING FLOOR PLAN - LEVEL 1
P2.02	PLUMBING FLOOR PLAN - LEVEL 2
P2.03	PLUMBING FLOOR PLAN - LEVEL 3
P2.03M	PLUMBING ROOF PLAN - PENTHOUSE LEVEL
P5.00	ENLARGED PLUMBING PLANS
P7.01	PLUMBING DOMESTIC WATER DIAGRAM
P7.02	PLUMBING SANITARY WASTE DIAGRAM
P7.03	PLUMBING STORM DRAIN DIAGRAM
PSBD1.01A	PLUMBING SEISMIC BRACING DETAILS
PSBD1.01B	PLUMBING SEISMIC DETAILS
PSBD1.02	PLUMBING SEISMIC BRACING DETAILS PLUMBING LEVEL 1 SEISMIC BRACING
PSBD1.03	ATTACHMENT PLAN
PSBD1.04	PLUMBING LEVEL 2 SEISMIC BRACING ATTACHMENT PLAN

PERALTA COMMUNITY COLLEGE DISTRICT

Laney Library & LRC
Issue for Bid

DRAWINGS AND TABLES**DOCUMENT 00 01 15-7**

March 31, 2023

DRAWING	NAME
PSBD1.05	PLUMBING LEVEL 3 SEISMIC BRACING ATTACHMENT PLAN
PSBD1.06	PLUMBING ROOF SEISMIC ATTACHMENT PLAN

MECHANICAL

M0.01	HVAC LEGENDS AND ABBREVIATIONS
M0.02	HVAC EQUIPMENT SCHEDULES
M0.03	HVAC EQUIPMENT SCHEDULES
M0.04	HVAC EQUIPMENT SCHEDULES
M1.01	HVAC ZONING PLAN - LEVEL 1
M1.02	HVAC ZONING PLAN - LEVEL 2
M1.03	HVAC ZONING PLAN - LEVEL 3
M2.01	HVAC FLOOR PLAN - LEVEL 1
M2.02	HVAC FLOOR PLAN - LEVEL 2
M2.03	HVAC FLOOR PLAN - LEVEL 3
M2.03M	HVAC PENTHOUSE PLAN
M2.04	HVAC ROOF PLAN
M3.01	HVAC SECTIONS – LEVEL 1
M3.02	HVAC SECTIONS – LEVEL 1
M3.03	HVAC SECTIONS – LEVEL 2
M3.04	HVAC SECTIONS – LEVEL 2
M3.05	HVAC SECTIONS – LEVEL 3
M3.06	HVAC SECTIONS – LEVEL 3
M3.07	HVAC SECTIONS HVAC SECTIONS AND AIR HANDLING UNIT
M3.08	DETAILS
M4.11	ENLARGED HVAC FLOOR PLAN LEVEL 1 -WEST ENLARGED HVAC FLOOR PLAN LEVEL 1 -
M4.12	NORTHEAST ENLARGED HVAC FLOOR PLAN LEVEL 1 -
M4.13	SOUTHEAST
M4.21	ENLARGED HVAC FLOOR PLAN LEVEL 2 -WEST ENLARGED HVAC FLOOR PLAN LEVEL 2 -
M4.22	NORTHEAST ENLARGED HVAC FLOOR PLAN LEVEL 2 -
M4.23	SOUTHEAST
M4.31	ENLARGED HVAC FLOOR PLAN LEVEL 3 -WEST ENLARGED HVAC FLOOR PLAN LEVEL 3 -
M4.32	NORTHEAST ENLARGED HVAC FLOOR PLAN LEVEL 3 -
M4.33	SOUTHEAST
M4.34M	ENLARGED HVAC PENTHOUSE FLOOR PLAN
M5.01	PIPING SCHEMATICS
M9.01	HVAC DETAILS
BAS0.01	HVAC CONTROLS DRAWINGS

DRAWING**NAME****ELECTRICAL**

E0.01	SYMBOLS LIST, GENERAL NOTES & LIST OF DRAWINGS
E0.02	LUMINAIRE SCHEDULE
E0.03	LUMINAIRE SCHEDULE
E1.01	SITE PLAN - ELECTRICAL
E1.02	SITE PLAN - LIGHTING
E2.41	FLOOR PLAN - LEVEL 1 - LIGHTING
E2.42	FLOOR PLAN - LEVEL 2 - LIGHTING
E2.43	FLOOR PLAN - LEVEL 3 - LIGHTING
E2.44	FLOOR PLAN - ROOF PENTHOUSE - LIGHTING
E3.31	FLOOR PLAN - LEVEL 1 - POWER & SIGNAL
E3.32	FLOOR PLAN - LEVEL 2 - POWER & SIGNAL
E3.33	FLOOR PLAN - LEVEL 3 - POWER & SIGNAL
E3.34	FLOOR PLAN - ROOF PENTHOUSE - POWER & SIGNAL
E3.35	ROOF PLAN - POWER & SIGNAL
E3.36	FLOOR PLAN - LEVEL 1 - ELECTRICAL CONNECTIONS TO MECH. EQUIPT. & SHADES
E3.37	FLOOR PLAN - LEVEL 2 - ELECTRICAL CONNECTIONS TO MECH. EQUIPT. & SHADES
E3.38	FLOOR PLAN - LEVEL 3 - ELECTRICAL CONNECTIONS TO MECH. EQUIPT. & SHADES
E4.01	PARTIAL PLANS - ELECTRICAL
E4.02	PARTIAL PLANS - ELECTRICAL
E5.01	DIAGRAMS
E5.02	DIAGRAMS
E5.03	DIAGRAMS
E5.04	METERING DIAGRAMS
E6.01	SCHEDULES
E6.02	SCHEDULES
E6.03	SCHEDULES
E6.04	SCHEDULES
E7.01	DETAILS
E7.02	DETAILS
E7.03	DETAILS
E7.04	DETAILS
E7.05	DETAILS
E8.01	TITLE 24 DOCUMENTATION

DRAWING NAME

TELECOM - AV - SECURITY

T0.01	TITLE SHEET AND DRAWING INDEX
T0.02	PATHWAY REQUIREMENTS
T0.03	SCHEDULE - ROUGH-IN & TELECOM CABLING
T0.10	DIAGRAM - BACKBONE PATHWAY RISER
T0.11	DIAGRAM - CABLING
T0.12	DIAGRAM - GROUNDING
T0.20	DIAGRAM - ACAMS
T0.21	DIAGRAM - VIDEO SURVEILLANCE
T0.22	DIAGRAM – AUDIO PAGING
T2.01	FLOOR PLAN - LEVEL 1
T2.02	FLOOR PLAN - LEVEL 2
T2.03	FLOOR PLAN - LEVEL 3
T3.01	REFLECTED CEILING PLAN - LEVEL 1
T3.02	REFLECTED CEILING PLAN - LEVEL 2
T3.03	REFLECTED CEILING PLAN - LEVEL 3
T5.01A	ENLARGED ROOM PLAN – EF/BDF-1.1
T5.01B	ENLARGED ROOM PLAN – EF/BDF-1.1
T5.02	ENLARGED PLAN – IDF -2.1
T5.03	ENLARGED PLAN – IDF -3.1
T5.11	ENLARGED ROOM PLAN - SMALL GROUP STUDY
T5.12	ENLARGED ROOM PLAN - MEDIUM GROUP STUDY
T5.13A	ENLARGED ROOM PLAN - LARGE GROUP STUDY
T5.13B	ENLARGED ROOM PLAN - LARGE GROUP STUDY
T5.14	ENLARGED ROOM PLAN - MEETING ROOM ENLARGED ROOM PLAN - OFFICE OF IT DIRECTOR
T5.15	
T5.16A	ENLARGED ROOM PLAN – CLASSROOM – TYPE 1
T5.16B	ENLARGED ROOM PLAN – CLASSROOM – TYPE 1
T5.17	ENLARGED ROOM PLAN – CLASSROOM – TYPE 2
T5.18	ENLARGED ROOM PLAN – CLASSROOM – TYPE 3
T5.19	ENLARGED ROOM PLAN – CLASSROOM – TYPE 4
T5.20A	ENLARGED ROOM PLAN – TUTORING LAB
T5.20B	ENLARGED ROOM PLAN – TUTORING LAB
T5.21A	ENLARGED ROOM PLAN – INSTRUCTIONAL LAB
T5.21B	ENLARGED ROOM PLAN – INSTRUCTIONAL LAB ENLARGED ROOM PLAN – WRITING CENTER LAB
T5.22	(DROP-IN) ENLARGED ROOM PLAN – LIBRARY READING OPEN AREA
T5.23	
T5.24A	ENLARGED ROOM PLAN – DESIGN SUITE
T5.24B	ENLARGED ROOM PLAN – DESIGN SUITE

DRAWING

T9.00	INSTALLATION DETAILS - TELECOMMUNICATION
T9.01	INSTALLATION DETAILS - TELECOMMUNICATION
T9.02	INSTALLATION DETAILS - TELECOMMUNICATION
T9.03	INSTALLATION DETAILS - TELECOMMUNICATION
T9.04	INSTALLATION DETAILS - TELECOMMUNICATION
T9.10	INSTALLATION DETAILS - SECURITY
T9.20	INSTALLATION DETAILS - AUDIOVISUAL

NAME**VERTICAL
TRANSPORTATION**

VT.01	VERTICAL TRANSPORTATION
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GEOTECH

GI.00	GENERAL NOTES
GI.01	GROUND IMPROVEMENT ZONES
GI.02	EXAMPLE LAYOUT – 3-FOOT DIAMETER
GI.03	EXAMPLE LAYOUT – 3-FOOT DIAMETER
GI.04	CROSS SECTION
GI.05	LAYOUT DETAILS

TOTAL SHEETS:**383**

END OF DOCUMENT

DOCUMENT 00 01 20

LIST OF SCHEDULES

SCHEDULES

END OF DOCUMENT

NOTICE TO BIDDERS

1. Notice is hereby given that the governing board ("Board") of the Peralta Community College District ("District") will receive, by electronic submission, bids for the following project, Bid No. _____, Bid Package _____ ("Project" or "Contract"):

Laney College Library and Learning Resource Center

2. The Project consists of:

Selective demolition and construction necessary for a new academic library and learning resource center on the Laney College campus. The project is a 75,622 square foot, three (3) story concrete and steel structure, Type IIA construction and consists of Type A-3 and B occupancies. Work includes site utilities and landscaping.

3. To bid on this Project, the Bidder is required to possess one or more of the following State of California contractor license(s):

A and/or B

The Bidder's license(s) must remain active and in good standing throughout the term of the Contract.

4. To bid on this Project, the Bidder is required to be registered as a public works contractor with the Department of Industrial Relations pursuant to the Labor Code.
5. Contract Documents will be available on or after _____, 20____, for review at the District Facilities Office, and may be downloaded from the District's website, www.XXXXXXXXXX.XXX, using the [**"Facilities Project and Information"**] link. In addition, Contract Documents are available for bidders' review at the following builders' exchanges:
 - A. Builder's Exchange of _____ County (____) _____ - _____
 - B. A list of these builders' exchanges is available at the District's Facilities Office.

6. Contract Documents are also available for purchase for _____ dollars (\$_____) at the District Facilities Office. This fee is refundable if the Contract Documents are returned in clean condition back to the District Facilities Office no later than ten (10) calendar days after the date of the bid opening.

7. **The District will only receive bids submitted electronically.** Bids will be received until ____a.m./p.m., ____, 20____, only at the following email address [INSERT], after which time the bids will be opened and publicly read aloud via video conference. A link to the video conference will be provided by Addendum. Any bid that is submitted after this time shall be nonresponsive and returned to the bidder.
Each bidder is solely responsible for timely submission of its bid; the District

is not responsible for any technological issues in a bidder's ability to timely submit its bid or portion thereof. Any claim by a bidder of error in its bid must be made in compliance with section 5100 et seq. of the Public Contract Code. Prior to publicly reading aloud bids at the video conference, the District reserves the right to verify the genuineness of any bid security.

8. at or after which time the bids will be opened and publicly read aloud. Any bid that is submitted after this time shall be non-responsive and returned to the bidder. Any claim by a bidder of error in its bid must be made in compliance with section 5100, et seq. of the Public Contract Code.
9. Pursuant to Public Contract Code section 20651.5, only prequalified bidders will be eligible to submit a bid for this Project. Any bid submitted by a bidder who is not prequalified shall be non-responsive and returned by email the bidder.
10. All bids shall be on the form provided by the District. Each bid must conform and be responsive to all pertinent Contract Documents, including, but not limited to, the Instructions to Bidders.
11. A bid bond by an admitted surety insurer on the form provided by the District, or a cashier's check or a certified check, drawn to the order of the Peralta Community College District, in the amount of ten percent (10%) of the total bid price, shall accompany the Bid Form and Proposal, as a guarantee that the Bidder will, within seven (7) calendar days after the date of the Notice of Award, enter into a contract with the District for the performance of the services as stipulated in the bid.
12. A mandatory pre-bid conference and site visit will be held on _____, 20____, at ____m. at _____, California. All participants are required to sign in front of the _____ Building, _____, California. The site visit is expected to take approximately _____. Failure to attend or tardiness will render bid ineligible.
13. The successful Bidder shall be required to furnish a 100% Performance Bond and a 100% Payment Bond if it is awarded the contract for the Work.
14. The successful Bidder may substitute securities for any monies withheld by the District to ensure performance under the Contract, in accordance with the provisions of section 22300 of the Public Contract Code.
15. The successful bidder will be required to certify that it either meets the Disabled Veteran Business Enterprise ("DVBE") goal of three percent (3%) participation or made a good faith effort to solicit DVBE participation in this Contract if it is awarded the contract for the Work.
16. The Contractor and all Subcontractors under the Contractor shall pay all workers on all work performed pursuant to this Contract not less than the general prevailing rate of per diem wages and the general prevailing rate for holiday and overtime work as determined by the Director of the Department of Industrial Relations, State of California, for the type of work performed and the locality in which the work is to be performed within the boundaries of the District, pursuant to section 1770, et seq. of

the California Labor Code. Prevailing wage rates are also available from the District or on the Internet at: <<http://www.dir.ca.gov>>.

17. This Project is subject to labor compliance monitoring and enforcement by the Department of Industrial Relations pursuant to Labor Code section 1771.4 and subject to the requirements of Title 8 of the California Code of Regulations. The successful Bidder shall comply with all requirements of Division 2, Part 7, Chapter 1, Articles 1-5 of the Labor Code.
18. The District has entered into a Project Labor Agreement that is applicable to this Project. A copy of the Project Labor Agreement is available for review at the District Facilities Office and may be downloaded from the District's website, www.XXXXXXXXXX.XXX, using the [**"Facilities Projects and Information"**] link. The successful bidder and all subcontractors will be required to agree to be bound by the Project Labor Agreement.
19. The Contractor and all Subcontractors under the Contractor shall comply with applicable federal, State, and local requirements relating to COVID-19 or other public health emergency/epidemic/pandemic including, if required, preparing, posting, and implementing a Social Distancing Protocol. Contractor shall further comply with the Board policy and procedures regarding vaccination against COVID-19 or testing for COVID-19.
20. The District's Board has found and determined that the following item(s) shall be used on this Project based on the purpose(s) indicated. (Public Contract Code section 3400(c).) A particular material, product, thing, or service is designated by specific brand or trade name for the following purpose(s):
 - (1) In order to match other products in use on a particular public improvement either completed or in the course of completion:
 - (a) Division 05, Metals: Epic Structural Deck; no known equal.
 - (b) Division 22, Plumbing: BAS to be Delta Controls.
 - (c) Division 23, HVAC: BAS to be Delta Controls.
 - (d) Division 25, Integrated Automation: BAS to be Delta Controls.
 - (e) Division 25, Integrated Automation: ICT; no known equal.
 - (f) Division 26, Electrical: BAS to be Delta Controls.
21. The District shall award the Contract, if it awards it at all, to the lowest responsive responsible bidder based on:
 - A. The base bid amount only.

22. The Board reserves the right to reject any and all bids and/or waive any irregularity in any bid received. If the District awards the Contract, the security of unsuccessful bidder(s) shall be returned within sixty (60) days from the time the award is made. Unless otherwise required by law, no bidder may withdraw its bid for ninety (90) days after the date of the bid opening.

END OF DOCUMENT

INSTRUCTIONS TO BIDDERS

Bidders shall follow the instructions in this document, and shall submit all documents, forms, and information required for consideration of a Bid.

Peralta Community College District ("District") will evaluate information submitted by the apparent low Bidder and, if incomplete or unsatisfactory to District, Bidder's bid may be rejected at the sole discretion of District.

1. Bids are requested for a general construction contract, or work described in general, for the following project ("Project" or "Contract"):

Laney College Library and Learning Resource Center

2. Bidder and its subcontractors must possess the appropriate State of California contractors' license and must maintain the license throughout the duration of the project. Bidders must also be registered as a public works contractor with the Department of Industrial Relations pursuant to the Labor Code. Bids submitted by a contractor who is not properly licensed or registered shall be deemed nonresponsive and will not be considered.

3. District will receive bids submitted electronically from bidders as stipulated in the Notice to Bidders.

- a. Email subject line must include the name of the Bidder, name of the Project, the Project Number and/or bid number, and time of bid opening.
- b. Bids must be electronically submitted to the following email address [INSERT] by date and time shown in the Notice to Bidders.
- c. Each bidder is solely responsible for timely submission of its bid; the District is not responsible for any technological issues affecting a bidder's ability to timely submit its bid or portion thereof.

Bid emails must attach all documents as required herein. District will receive sealed bids from bidders as stipulated in the Notice to Bidders.

4. Bidders are advised that on the date that bids are opened, the District Offices will **not** be open to bidders or their representatives.

5. Bids will be opened at or after the time indicated for receipt of bids. Bids will be opened and publicly read aloud via video conference. A link to the video conference will be provided by Addendum. Prior to publicly reading aloud bids at the video conference, the District reserves the right to verify the genuineness of any bid security.
6. Bidders must submit Bids on the documents titled Bid Form and Proposal, and must submit all other required District forms. Bids not submitted on the District's required forms shall be deemed nonresponsive and shall not be considered. Additional sheets required to fully respond to requested information are permissible.
7. Bidders shall not modify the Bid Form and Proposal or qualify their bids. Bidders shall not submit to the District a re-formatted, re-typed, altered, modified, or otherwise recreated version of the Bid Form and Proposal or other District-provided document.
8. Bids shall be clearly written and without erasure or deletions. District reserves the right to reject any bid containing erasures, deletions, or illegible contents.
9. Bidders must supply all information required by each Bid Document. Bids must be full and complete. District reserves the right in its sole discretion to reject any Bid as non-responsive as a result of any error or omission in the Bid. Bidders must complete and submit all of the following documents with the Bid Form and Proposal:
 - a. Photocopy of Bid Bond on the District's form, or other security.
 - b. Designated Subcontractors List.
 - c. Site Visit Certification, if a site visit was required.
 - d. Non-Collusion Declaration.
10. Bidders must submit with their bids a legible photocopy of (i) a cashier's check or (ii) a certified check payable to District, or (iii) a bid bond by an admitted surety insurer of not less than ten percent (10%) of amount of Base Bid, plus all additive alternates ("Bid Bond"). If Bidder chooses to provide a Bid Bond as security, Bidder must use the required form of corporate surety provided by District. The Surety on Bidder's Bid Bond must be an insurer admitted in the State of California and authorized to issue surety bonds in the State of California. Bidder must deposit the original of the bid bond, cashier's check, or certified check in the mail on the same day as the bid opening. Bids submitted without necessary bid security will be deemed non-responsive and will not be considered.
11. If Bidder to whom the Contract is awarded fails or neglects to enter into the Contract and submit required bonds, insurance certificates, and all other required documents, within **SEVEN (7)** calendar days after the date of the Notice of Award, District may deposit Bid Bond, cashier's check, or certified check for collection, and proceeds thereof may be retained by District as liquidated damages for failure of Bidder to enter into Contract, in the sole discretion of District. It is agreed that calculation of damages District may suffer as a result of Bidder's failure to enter into the Contract would be extremely difficult and impractical to determine and that the amount of the

Bidder's required bid security shall be the agreed and conclusively presumed amount of damages.

12. Bidders must submit with the Bid the Designated Subcontractors List for those subcontractors who will perform any portion of Work, including labor, rendering of service, or specially fabricating and installing a portion of the Work or improvement according to detailed drawings contained in the plans and specifications, in excess of one half of one percent (0.5%) of total Bid. Failure to submit this list when required by law shall result in bid being deemed nonresponsive and the bid will not be considered.
13. All of the listed subcontractors are required to be registered as a public works contractor with the Department of Industrial Relations pursuant to the Labor Code.
 - a. An inadvertent error in listing the California contractor license number on the Designated Subcontractors List shall not be grounds for filing a bid protest or grounds for considering the bid nonresponsive if the correct contractor's license number is submitted to the District within 24 hours after the bid opening and the corrected number corresponds with the submitted name and location for that subcontractor.
 - b. An inadvertent error listing an unregistered subcontractor shall not be grounds for filing a bid protest or grounds for considering the bid nonresponsive provided that any of the following apply:
 - (1) The subcontractor is registered prior to the bid opening.
 - (2) The subcontractor is registered and has paid the penalty registration fee within 24 hours after the bid opening.
 - (3) The subcontractor is replaced by another registered subcontractor pursuant to Public Contract Code section 4107.
14. If a mandatory pre-bid conference and site visit ("Site Visit") is required as referenced in the Notice to Bidders, then Bidders must submit the Site-Visit Certification with their Bid. District will transmit to all prospective Bidders of record such Addenda as District in its discretion considers necessary in response to questions arising at the Site Visit. Oral statements shall not be relied upon and will not be binding or legally effective. Addenda issued by the District as a result of the Site Visit, if any, shall constitute the sole and exclusive record and statement of the results of the Site Visit.
15. Bidders shall submit the Non-Collusion Declaration with their Bids. Bids submitted without the Non-Collusion Declaration shall be deemed non-responsive and will not be considered.
16. The Contractor and all Subcontractors under the Contractor shall pay all workers on all work performed pursuant to the Contract not less than the general prevailing rate of per diem wages and the general prevailing rate for holiday and overtime work as determined by the Director of the Department of Industrial Relations, State of California, for the type of work performed and the locality in which the work is to be

performed within the boundaries of the District, pursuant to sections 1770 et seq. of the California Labor Code. Copies of the general prevailing rates of per diem wages for each craft, classification, or type of worker needed to execute the Contract, as determined by Director of the Department of Industrial Relations, are available upon request at the District's principal office. Prevailing wage rates are also available on the internet at <http://www.dir.ca.gov>.

17. The District has entered into a Project Labor Agreement that is applicable to this Project. A copy of the Project Labor Agreement is available for review at the District Facilities Office and may be downloaded from the District's website, www.XXXXX.XXX, using the [**"Facilities Projects and Information"**] link. The successful bidder and all subcontractors will be required to agree to be bound by the Project Labor Agreement.
18. Pursuant to Education Code section 71028 and Public Contract Code section 10115, the District has a participation goal for disabled veteran business enterprises ("DVBE") of at least three percent (3%) per year of the overall dollar amount expended each year on District projects. In order to meet this requirement by demonstrating a good faith effort, Bidder must advertise for DVBE-certified subcontractors and suppliers before submitting its Bid. The lowest responsive responsible Bidder awarded the Contract must submit certification of compliance with the procedures for implementation of DVBE contracting goals with its signed Agreement. DVBE Certification form is attached. Do not submit this form with your Bid.
19. Submission of Bid signifies careful examination of Contract Documents and complete understanding of the nature, extent, and location of Work to be performed. Bidders must complete the tasks listed below as a condition to bidding, and submission of a Bid shall constitute the Bidder's express representation to District that Bidder has fully completed the following:
 - a. Bidder has visited the Site, if required, and has examined thoroughly and understood the nature and extent of the Contract Documents, Work, Site, locality, actual conditions, as-built conditions, and all local conditions and federal, state and local laws, and regulations that in any manner may affect cost, progress, performance, or furnishing of Work or that relate to any aspect of the means, methods, techniques, sequences, or procedures of construction to be employed by Bidder and safety precautions and programs incident thereto;
 - b. Bidder has conducted or obtained and has understood all examinations, investigations, explorations, tests, reports, and studies that pertain to the subsurface conditions, as-built conditions, underground facilities, and all other physical conditions at or contiguous to the Site or otherwise that may affect the cost, progress, performance, or furnishing of Work, as Bidder considers necessary for the performance or furnishing of Work at the Contract Sum, within the Contract Time, and in accordance with the other terms and conditions of Contract Documents, including specifically the provisions of the General Conditions; and no additional examinations, investigations,

explorations, tests, reports, studies, or similar information or data are or will be required by Bidder for such purposes;

- c. Bidder has correlated its knowledge and the results of all such observations, examinations, investigations, explorations, tests, reports, and studies with the terms and conditions of the Contract Documents;
- d. Bidder has given the District prompt written notice of all conflicts, errors, ambiguities, or discrepancies that it has discovered in or among the Contract Documents and the actual conditions, and the written resolution(s) thereof by the District, is/are acceptable to Bidder;
- e. Bidder has made a complete disclosure in writing to the District of all facts bearing upon any possible interest, direct or indirect, that Bidder believes any representative of the District or other officer or employee of the District presently has or will have in this Contract or in the performance thereof or in any portion of the profits thereof;
- f. Bidder must, prior to bidding, perform the work, investigations, research, and analysis required by this document and that Bidder represented in its Bid Form and Proposal and the Agreement that it performed prior to bidding. Contractor under this Contract is charged with all information and knowledge that a reasonable bidder would ascertain from having performed this required work, investigation, research, and analysis. Bid prices must include entire cost of all work "incidental" to completion of the Work.
- g. Conditions Shown on the Contract Documents: Information as to underground conditions, as-built conditions, or other conditions or obstructions, indicated in the Contract Documents, e.g., on Drawings or in Specifications, has been obtained with reasonable care, and has been recorded in good faith. However, District only warrants, and Bidder may only rely, on the accuracy of limited types of information.
 - (1) As to above-ground conditions or as-built conditions shown or indicated in the Contract Documents, there is no warranty, express or implied, or any representation express or implied, that such information is correctly shown or indicated. This information is verifiable by independent investigation and Bidder is required to make such verification as a condition to bidding. In submitting its Bid, Bidder shall rely on the results of its own independent investigation. In submitting its Bid, Bidder shall not rely on District-supplied information regarding above-ground conditions or as-built conditions.
 - (2) As to any subsurface condition shown or indicated in the Contract Documents, Bidder may rely only upon the general accuracy of actual reported depths, actual reported character of materials, actual reported soil types, actual reported water conditions, or actual obstructions shown or indicated. District is not responsible for the completeness of such information for bidding or construction; nor is District responsible in any way for any conclusions or opinions that the Bidder has drawn from such information; nor is the District responsible

for subsurface conditions that are not specifically shown (for example, District is not responsible for soil conditions in areas contiguous to areas where a subsurface condition is shown).

- h. Conditions Shown in Reports and Drawings Supplied for Informational Purposes: Reference is made to the document entitled Geotechnical Data, and the document entitled Existing Conditions, for identification of:
- (1) Subsurface Conditions: Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that have been utilized by Architect in preparing the Contract Documents; and
 - (2) Physical Conditions: Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that has been utilized by Architect in preparing the Contract Documents.
 - (3) These reports and drawings are **not** Contract Documents and, except for any "technical" data regarding subsurface conditions specifically identified in Geotechnical Data and Existing Conditions, and underground facilities data, Bidder may not in any manner rely on the information in these reports and drawings. Subject to the foregoing, Bidder must make its own independent investigation of all conditions affecting the Work and must not rely on information provided by District.
20. Bids shall be based on products and systems specified in Contract Documents or listed by name in Addenda. Whenever in the Specifications any materials, process, or article is indicated or specified by grade, patent, or proprietary name, or by name of manufacturer, that Specification shall be deemed to be followed by the words "or equal." Bidder may, unless otherwise stated, offer any material, process, or article that shall be substantially equal or better in every respect to that so indicated or specified. The District is not responsible and/or liable in any way for a Contractor's damages and/or claims related, in any way, to that Contractor's basing its bid on any requested substitution that the District has not approved in advance and in writing. Contractors and materials suppliers who submit requests for substitutions prior to the award of the Contract must do so in writing and in compliance with Public Contract Code section 3400. All requests must comply with the following:
- a. District must receive any notice of request for substitution of a specified item a minimum of **TEN (10)** calendar days prior to bid opening. The Successful Bidder will not be allowed to substitute specified items unless properly noticed.
 - b. Within 35 days after the date of the Notice of Award, the Successful Bidder shall submit data substantiating the request(s) for all substitution(s) containing sufficient information to assess acceptability of product or system and impact on Project, including, without limitation, the requirements specified in the Special Conditions and the Specifications. Insufficient information shall be grounds for rejection of substitution.

- c. Approved substitutions, if any, shall be listed in Addenda. District reserves the right not to act upon submittals of substitutions until after bid opening.
 - d. Substitutions may be requested after Contract has been awarded only if indicated in and in accordance with requirements specified in the Special Conditions and the Specifications.
21. Bidders may examine any available "as-built" drawings of previous work by giving District reasonable advance notice. District will not be responsible for accuracy of "as-built" drawings. The document entitled Existing Conditions applies to all supplied "as-built" drawings.
 22. All questions about the meaning or intent of the Contract Documents are to be directed via email to the District to _____. Interpretations or clarifications considered necessary by the District in response to such questions will be issued in writing by Addenda and emailed, faxed, mailed, or delivered to all parties recorded by the District as having received the Contract Documents or posted on the District's website at _____. Questions received less than **SEVEN (7)** calendar days prior to the date for opening Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.
 23. Addenda may also be issued to modify other parts of the Contract Documents as deemed advisable by the District.
 24. Each Bidder must acknowledge each Addendum in its Bid Form and Proposal by number or its Bid shall be considered non-responsive. Each Addendum shall be part of the Contract Documents. A complete listing of Addenda may be secured from the District.
 25. This Contract may include alternates. Alternates are defined as alternate products, materials, equipment, systems, methods, or major elements of the construction that may, at the District's option and under terms established in the Contract and pursuant to section 20103.8 of the Public Contract Code, be selected for the Work.
 26. The District shall award the Contract, if it awards it at all, to the lowest responsive responsible bidder based on the criteria as indicated in the Notice to Bidders. In the event two or more responsible bidders submit identical bids, the District shall select the Bidder to whom to award the Contract by lot.
 27. Discrepancies between written words and figures, or words and numeral, will be resolved in favor of figures or numerals.
 28. Bidders in contention for contract awards shall be required to attend a Post Bid interview, which will be set within three (3) calendar days following bid opening. A duly authorized representative of the apparent low bidder is required to attend the Post Bid Interview, in person. The apparent low bidder's authorized representative(s) must have (1) knowledge of how the bid submitted was prepared, (2) the person responsible for supervising performance of the Work, and (3) the authority to bind the apparent low bidder. Failure to attend the Post Bid Interview as

scheduled will be considered just cause for the District to reject the Bid as nonresponsive. .

29. Any bid protest by any Bidder regarding any other bid must be submitted in writing to the District, before 5:00 p.m. of the **THIRD (3rd)** business day following bid opening.
- a. Only a Bidder who has actually submitted a bid, and who could be awarded the Contract if the bid protest is upheld, is eligible to submit a bid protest. Subcontractors are not eligible to submit bid protests. A Bidder may not rely on the bid protest submitted by another Bidder.
 - b. A bid protest must contain a complete statement of any and all bases for the protest and all supporting documentation. Materials submitted after the bid protest deadline will not be considered.
 - c. The protest must refer to the specific portions of all documents that form the basis for the protest.
 - (1) Without limitation to any other basis for protest, an inadvertent error in listing the California contractor's license number on the Designated Subcontractors List shall not be grounds for filing a bid protest or grounds for considering the bid nonresponsive if the correct contractor's license number is submitted to the District within 24 hours after the bid opening and the corrected number corresponds with the submitted name and location for that subcontractor.
 - (2) Without limitation to any other basis for protest, an inadvertent error listing an unregistered subcontractor shall not be grounds for filing a bid protest or grounds for considering the bid nonresponsive provided that any of the following apply:
 - (i) The subcontractor is registered prior to the bid opening.
 - (ii) The subcontractor is registered and has paid the penalty registration fee within 24 hours after the bid opening.
 - (iii) The subcontractor is replaced by another registered subcontractor pursuant to Public Contract Code section 4107.
 - d. The protest must include the name, address and telephone number of the person representing the protesting party.
 - e. The party filing the protest must concurrently transmit a copy of the protest and any attached documentation to all other parties with a direct financial interest that may be adversely affected by the outcome of the protest. Such parties shall include all other bidders or proposers who appear to have a reasonable prospect of receiving an award depending upon the outcome of the protest.

- f. The procedure and time limits set forth in this paragraph are mandatory and are each bidder's sole and exclusive remedy in the event of bid protest. Failure to comply with these procedures shall constitute a waiver of any right to further pursue the bid protest, including filing a Government Code Claim or legal proceedings.
30. The Bidder to whom Contract is awarded shall execute and submit the following documents by 5:00 p.m. of the **SEVENTH (7th)** calendar day following the date of the Notice of Award. Failure to properly and timely submit these documents entitles District to reject the bid as nonresponsive.
- a. Agreement: To be executed by successful Bidder. Submit four (4) copies, each bearing an original signature. A facsimile or electronic signature shall be deemed to be the equivalent of the actual original signature.
 - b. Escrow of Bid Documentation: This must include all required documentation. See the document titled Escrow Bid Documentation for more information.
 - c. Performance Bond (100%): On the form provided in the Contract Documents and fully executed as indicated on the form.
 - d. Payment Bond (Contractor's Labor and Material Bond) (100%): On the form provided in the Contract Documents and fully executed as indicated on the form.
 - e. Insurance Certificates and Endorsements as required.
 - f. Workers' Compensation Certification.
 - g. Prevailing Wage and Related Labor Requirements Certification.
 - h. Disabled Veteran Business Enterprise Participation Certification.
 - i. Drug-Free Workplace Certification.
 - j. Tobacco-Free Environment Certification.
 - k. Hazardous Materials Certification.
 - l. Lead-Based Materials Certification.
 - m. Imported Materials Certification.
 - n. Sex Offender Registration Act_Certification.
 - o. Buy American Certification.
 - p. Roofing Project Certification: from Contractor, Material Manufacturer and/or Vendor.

- q. Registered Subcontractors List: Must include Department of Industrial Relations (DIR) registration number of each subcontractor for all tiers.
31. Time for Completion: District may issue a Notice to Proceed within **NINETY (90)** days from the date of the Notice of Award. Once Contractor has received the Notice to Proceed, Contractor shall complete the Work within the period of time indicated in the Contract Documents.
- a. In the event that the District desires to postpone issuing the Notice to Proceed beyond this 90-day period, it is expressly understood that with reasonable notice to the Contractor, the District may postpone issuing the Notice to Proceed.
- b. It is further expressly understood by Contractor that Contractor shall not be entitled to any claim of additional compensation as a result of the postponement of the issuance of the Notice to Proceed beyond a 90-day period. If the Contractor believes that a postponement of issuance of the Notice to Proceed will cause a hardship to the Contractor, the Contractor may terminate the Contract. Contractor's termination due to a postponement beyond this 90-day period shall be by written notice to District within **TEN (10)** calendar days after receipt by Contractor of District's notice of postponement.
- c. It is further understood by the Contractor that in the event that Contractor terminates the Contract as a result of postponement by the District, the District shall only be obligated to pay Contractor for the Work that Contractor had performed at the time of notification of postponement and which the District had in writing authorized Contractor to perform prior to issuing a Notice to Proceed.
- d. Should the Contractor terminate the Contract as a result of a notice of postponement, District shall have the authority to award the Contract to the next lowest responsive responsible bidder.
32. District reserves the right to reject any or all bids, including without limitation the right to reject any or all nonconforming, non-responsive, unbalanced, or conditional bids, to re-bid, and to reject the bid of any bidder if District believes that it would not be in the best interest of the District to make an award to that bidder, whether because the bid is not responsive or the bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by District. District also reserves the right to waive any inconsequential deviations or irregularities in any bid. For purposes of this paragraph, an "unbalanced bid" is one having nominal prices for some work items and/or enhanced prices for other work items.
33. It is the policy of the District that no qualified person shall be excluded from participating in, be denied the benefits of, or otherwise be subjected to discrimination in any consideration leading to the award of contract, based on race, color, gender, sexual orientation, political affiliation, age, ancestry, religion, marital status, national origin, medical condition or disability. The Successful Bidder and its subcontractors shall comply with applicable federal and state laws, including, but not

limited to the California Fair Employment and Housing Act, beginning with Government Code section 12900, and Labor Code section 1735.

34. Prior to the award of Contract, District reserves the right to consider the responsibility of the Bidder. District may conduct investigations as District deems necessary to assist in the evaluation of any bid and to establish the responsibility, including, without limitation, qualifications and financial ability of Bidders, proposed subcontractors, suppliers, and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to District's satisfaction within the prescribed time.
35. Bidder expressly acknowledges that it is familiar with and capable of complying with applicable federal, State, and local requirements relating to COVID-19 or other public health emergency/epidemic/pandemic including, if required, preparing, posting, and implementing a Social Distancing Protocol, and such costs shall be included in the bid as an allowance. Any unused portion of the allowance designated for COVID-19 or other public health emergency/epidemic/pandemic compliance will revert back to the District documented by a deductive change order.

END OF DOCUMENT

DOCUMENT 00 21 13.1

BIDDER INFORMATION AND FORMS

**[INTENTIONALLY LEFT BLANK UNLESS PROVIDED IN SPECIAL CONDITIONS
– SEPARATE PREQUALIFICATION PROCESS RECOMMENDED]**

END OF DOCUMENT

EXISTING CONDITIONS

1. Summary

This document describes existing conditions at or near the Project, and use of information available regarding existing conditions. This document is **not** part of the Contract Documents. See General Conditions for definition(s) of terms used herein.

2. Reports and Information on Existing Conditions

- a. Documents providing a general description of the Site and conditions of the Work may have been collected by Peralta Community College District ("District"), its consultants, contractors, and tenants. These documents may, but are not required to, include previous contracts, contract specifications, tenant improvement contracts, as-built drawings, utility drawings, and information regarding underground facilities.
- b. Information regarding existing conditions may be inspected at the District offices or the Construction Manager's offices, if any, and copies may be obtained at cost of reproduction and handling upon Bidder's agreement to pay for such copies. These reports, documents, and other information are **not** part of the Contract Documents. These reports, documents, and other information do **not** excuse Contractor from fulfilling Contractor's obligation to independently investigate any or all existing conditions or from using reasonable prudent measures to avoid damaging existing improvements.
- c. Information regarding existing conditions may also be included in the Project Manual, but shall **not** be considered part of the Contract Documents.
- d. Prior to commencing this Work, Contractor and the District's representative shall survey the Site to document the condition of the Site. Contractor will record the survey in digital videotape format and provide an electronic copy to the District within fourteen (14) days of the survey.
- e. Contractor may also document any pre-existing conditions in writing, provided that both the Contractor and the District's representative agree on said conditions and sign a memorandum documenting the same.
- f. The reports and other data or information regarding existing conditions and underground facilities at or contiguous to the Project are the following:
 - (1) Survey of Site.
 - (2) Geotechnical Report(s).
 - (3) Hazardous Material Report(s).

3. Use of Information

- a. Information regarding existing conditions was obtained only for use of District and its consultants, contractors, and tenants for planning and design and is **not** part of the Contract Documents.
- b. District does not warrant, and makes no representation regarding, the accuracy or thoroughness of any information regarding existing conditions. Bidder represents and agrees that in submitting a bid it is not relying on any information regarding existing conditions supplied by District.
- c. Under no circumstances shall District be deemed to warrant or represent existing above-ground conditions, as-built conditions, or other actual conditions, verifiable by independent investigation. These conditions are verifiable by Bidder by the performance of its own independent investigation that Bidder must perform as a condition to bidding and Bidder should not and shall not rely on this information or any other information supplied by District regarding existing conditions.
- d. Any information shown or indicated in the reports and other data supplied herein with respect to existing underground facilities at or contiguous to the Project may be based upon information and data furnished to District by the District's employees and/or consultants or builders of such underground facilities or others. District does not assume responsibility for the completeness of this information, and Bidder is solely responsible for any interpretation or conclusion drawn from this information.
- e. District shall be responsible only for the general accuracy of information regarding underground facilities, and only for those underground facilities that are owned by District, and only where Bidder has conducted the independent investigation required of it pursuant to the Instructions to Bidders, and discrepancies are not apparent.

4. Investigations/Site Examinations

- a. Before submitting a Bid, each Bidder is responsible for conducting or obtaining any additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and underground facilities) at or contiguous to the Site or otherwise, that may affect cost, progress, performance, or furnishing of Work or that relate to any aspect of the means, methods, techniques, sequences, or procedures of construction to be employed by Bidder and safety precautions and programs incident thereto or that Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of Contract Documents.
- b. On request, District will provide each Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies, as each Bidder deems necessary for submission of a Bid. Bidders must fill all holes and clean up and restore the Site to its former condition upon completion of its explorations, investigations, tests, and studies. Such investigations and Site examinations may be performed during any and all Site visits indicated in

the Notice to Bidders and only under the provisions of the Contract Documents, including, but not limited to, proof of insurance and obligation to indemnify against claims arising from such work, and District's prior approval.

END OF DOCUMENT

GEOTECHNICAL DATA

1. Summary

This document describes geotechnical data at or near the Project that is in the District's possession available for Contractor's review, and use of data resulting from various investigations. This document is **not** part of the Contract Documents. See General Conditions for definition(s) of terms used herein.

2. Geotechnical Reports

- a. Geotechnical reports may have been prepared for and around the Site and/or in connection with the Work by soil investigation engineers hired by Peralta Community College District ("District"), and its consultants, contractors, and tenants.
- b. Geotechnical reports may be inspected at the District offices or the Construction Manager's offices, if any, and copies may be obtained at cost of reproduction and handling upon Bidder's agreement to pay for such copies. These reports are **not** part of the Contract Documents.
- c. The reports and drawings of physical conditions that may relate to the Project are the following:
 - (1) Geotechnical investigation and Geologic Hazards Evaluation, Laney College Library Learning Resource Center, Oakland, California, dated February 28, 2020
 - (2) DMM Design and Recommendations, Addendum, Laney College Library Learning Resource Center, Oakland, California, dated June 22, 2022.

3. Use of Data

- a. Geotechnical data were obtained only for use of District and its consultants, contractors, and tenants for planning and design and are **not** a part of Contract Documents.
- b. Except as expressly set forth below, District does not warrant, and makes no representation regarding, the accuracy or thoroughness of any geotechnical data. Bidder represents and agrees that in submitting a Bid it is not relying on any geotechnical data supplied by District, except as specifically allowed below.
- c. Under no circumstances shall District be deemed to make a warranty or representation of existing above ground conditions, as-built conditions, geotechnical conditions, or other actual conditions verifiable by independent investigation. These conditions are verifiable by Bidder by the performance of its own independent investigation that Bidder should perform as a condition to

bidding and Bidder must not and shall not rely on information supplied by District.

4. Limited Reliance Permitted on Certain Information

a. Reference is made herein for identification of:

Reports of explorations and tests of subsurface conditions at or contiguous to the Site that have been utilized by District in preparation of the Contract Documents.

Drawings of physical conditions in or relating to existing subsurface structures (except underground facilities) that are at or contiguous to the Site and have been utilized by District in preparation of the Contract Documents.

b. Bidder may rely upon the general accuracy of the "technical data" contained in the reports and drawings identified above, but only insofar as it relates to subsurface conditions, provided Bidder has conducted the independent investigation required pursuant to Instructions to Bidders, and discrepancies are not apparent. The term "technical data" in the referenced reports and drawings shall be limited as follows:

- (1) The term "technical data" shall include actual reported depths, reported quantities, reported soil types, reported soil conditions, and reported material, equipment or structures that were encountered during subsurface exploration. The term "technical data" does not include, and Bidder may not rely upon, any other data, interpretations, opinions or information shown or indicated in such drawings or reports that otherwise relate to subsurface conditions or described structures.
- (2) The term "technical data" shall not include the location of underground facilities.
- (3) Bidder may not rely on the completeness of reports and drawings for the purposes of bidding or construction. Bidder may rely upon the general accuracy of the "technical data" contained in such reports or drawings.
- (4) Bidder is solely responsible for any interpretation or conclusion drawn from any "technical data" or any other data, interpretations, opinions, or information provided in the identified reports and drawings.

5. Investigations/Site Examinations

a. Before submitting a Bid, each Bidder is responsible for conducting or obtaining any additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and underground facilities) at or contiguous to the Site or otherwise, that may affect cost, progress, performance, or furnishing of Work or that relate to any aspect of the means, methods, techniques, sequences, or procedures of construction to be employed by Bidder and safety

precautions and programs incident thereto or that Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of Contract Documents.

- b. On request, District will provide each Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies, as each Bidder deems necessary for submission of a Bid. Bidders must fill all holes and clean up and restore the Site to its former condition upon completion of its explorations, investigations, tests, and studies. Such investigations and Site examinations may be performed during any and all Site visits indicated in the Notice to Bidders and only under the provisions of the Contract Documents, including, but not limited to, proof of insurance and obligation to indemnify against claims arising from such work, and District's prior approval.

END OF DOCUMENT

DOCUMENT 00 41 13
BID FORM AND PROPOSAL

To: Peralta Community College District ("District" or "Owner")

From: _____
(Proper Name of Bidder)

The undersigned declares that Bidder has read and understands the Contract Documents, including, without limitation, the Notice to Bidders and the Instructions to Bidders, and agrees and proposes to furnish all necessary labor, materials, and equipment to perform and furnish all work in accordance with the terms and conditions of the Contract Documents, including, without limitation, the Drawings and Specifications of Bid No. _ _____, for the following project known as:

_____ ("Project" or "Contract") and will accept in full payment for that Work the following total lump sum amount, all taxes included:

_____ dollars \$ _____
<i>BASE BID</i>
<i>Bidder acknowledges and agrees that the Base Bid accounts for any and all Allowance(s), Total Cost for Unit Prices, and OCIP excluded costs.</i>

Descriptions of alternates are primarily scope definitions and do not necessarily detail the full range of materials and processes needed to complete the construction.

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Additional Detail Regarding Calculation of Base Bid

1. **Unit Prices.** The Bidder’s Base Bid includes the following unit prices, which the Bidder must provide and the District may, at its discretion, utilize in valuing additive and/or deductive change orders (Unit Prices shall include all labor, materials, services, profit, overhead, insurance, bonds, taxes, and all other incidental costs of Contractor, subcontractors, and suppliers):

SCHEDULE OF UNIT PRICES

<u>Item No.</u>	<u>Description</u>	<u>Unit of Measure</u>	<u>Estimated Quantity</u>	<u>Unit Price</u>	<u>Total Cost = Unit Price x Estimated Quantity (Included in Base Bid)</u>
				\$ _____	\$ _____
				\$ _____	\$ _____

Where scope of Work is decreased, all Work pertaining to the item, whether specifically stated or not, shall be omitted, and where scope of Work is increased, all work pertaining to that item required to render same ready for use on the Project in accordance with intentions of the Drawings and Specifications shall be included in the above agreed-upon price amount.

2. **Allowance.** The Bidder’s Base Bid and each alternate shall include a ten percent (10%) allowance for Unforeseen Conditions and complying with applicable federal, State, and local requirements relating to COVID-19 or other public health emergency/epidemic/pandemic.

The above allowance shall only be allocated for unforeseen items or COVID-19 or other public health emergency/epidemic/pandemic compliance relating to the Work. Contractor shall not bill for or be due any portion of this allowance unless the District has identified specific work, Contractor has submitted a price for that work or the District has proposed a price for that work, the District has accepted the cost for that work, and the District has prepared an Allowance Expenditure Directive incorporating that work. Contractor hereby authorizes the District to execute a unilateral deductive change order at or near the end of the Project for all or any portion of the allowance not allocated. Any unused portion of the allowance will revert back to the District documented by a deductive change order.

3. The undersigned has reviewed the Work outlined in the Contract Documents and fully understands the scope of Work required in this Proposal, understands the construction and project management function(s) is described in the Contract Documents, and that each Bidder who is awarded a contract shall be in fact a prime contractor, not a subcontractor, to the District, and agrees that its Proposal, if accepted by the District, will be the basis for the Bidder to enter into a contract with the District in accordance with the intent of the Contract Documents.
4. The undersigned has notified the District in writing of any discrepancies or omissions or of any doubt, questions, or ambiguities about the meaning of any of the Contract Documents, and has contacted the Construction Manager before bid date to verify the issuance of any clarifying Addenda.
5. The undersigned agrees to commence work under this Contract on the date established in the Contract Documents and to complete all work within the time specified in the Contract Documents.
6. The liquidated damages clause of the General Conditions and Agreement is hereby acknowledged.
7. It is understood that the District reserves the right to reject this bid and that the bid shall remain open to acceptance and is irrevocable for a period of ninety (90) days.
8. The following documents are attached hereto:
 - Bid Bond on the District's form or other security
 - Designated Subcontractors List
 - Site Visit Certification
 - Non-Collusion Declaration
 - Iran Contracting Act Certification
9. Receipt and acceptance of the following Addenda is hereby acknowledged:

No. _____, Dated _____	No. _____, Dated _____
No. _____, Dated _____	No. _____, Dated _____
No. _____, Dated _____	No. _____, Dated _____

10. Bidder acknowledges that the license required for performance of the Work is a _____ license.
11. Bidder hereby certifies that Bidder is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work.
12. Bidder specifically acknowledges and understands that if it is awarded the Contract, that it shall perform the Work of the Project while complying with all requirements of the Department of Industrial Relations.

13. Bidder hereby certifies that its bid includes sufficient funds to permit Bidder to comply with all local, state or federal labor laws or regulations during the Project, including payment of prevailing wage, and that Bidder will comply with the provisions of Labor Code section 2810(d) if awarded the Contract.
14. Bidder agrees to comply with all requirements of the Project Labor Agreement.
15. The Bidder represents that it is competent, knowledgeable, and has special skills with respect to the nature, extent, and inherent conditions of the Work to be performed. Bidder further acknowledges that there are certain peculiar and inherent conditions existent in the construction of the Work that may create, during the Work, unusual or peculiar unsafe conditions hazardous to persons and property.
16. Bidder expressly acknowledges that it is aware of such peculiar risks and that it has the skill and experience to foresee and to adopt protective measures to adequately and safely perform the Work with respect to such hazards.
17. Bidder expressly acknowledges that it is familiar with and capable of complying with applicable federal, State, and local requirements relating to COVID-19 or other public health emergency/epidemic/pandemic including, if required, preparing, posting, and implementing a Social Distancing Protocol.
18. Bidder expressly acknowledges that it is aware that if a false claim is knowingly submitted (as the terms "claim" and "knowingly" are defined in the California False Claims Act, Gov. Code, § 12650 et seq.), the District will be entitled to civil remedies set forth in the California False Claim Act. It may also be considered fraud and the Contractor may be subject to criminal prosecution.
19. The undersigned Bidder certifies that it is, at the time of bidding, and shall be throughout the period of the Contract, licensed by the State of California to do the type of work required under the terms of the Contract Documents and registered as a public works contractor with the Department of Industrial Relations. Bidder further certifies that it is regularly engaged in the general class and type of work called for in the Contract Documents.

Furthermore, Bidder hereby certifies to the District that all representations, certifications, and statements made by Bidder, as set forth in this bid form, are true and correct and are made under penalty of perjury.

Dated this _____ day of _____ 20 ____

Name of Bidder: _____

Type of Organization: _____

Signature: _____

Print Name: _____

Title: _____

Address of Bidder: _____

Taxpayer Identification No. of Bidder: _____

Telephone Number: _____ Fax Number: _____

E-mail: _____ Web Page: _____

Contractor's License No(s): No.: _____ Class: _____ Expiration Date: _____

No.: _____ Class: _____ Expiration Date: _____

No.: _____ Class: _____ Expiration Date: _____

Public Works Contractor Registration No.: _____

END OF DOCUMENT

BID BOND

(Note: If Bidder is providing a bid bond as its bid security, Bidder must use this form, NOT a surety company form.)

KNOW ALL PERSONS BY THESE PRESENTS:

That the undersigned, _____, as Principal ("Principal"),
and, _____, as Surety ("Surety"), a corporation organized and existing under and by virtue of the laws of the State of ____ and authorized to do business as a surety in the State of California, are held and firmly bound unto the Peralta Community College District ("District") of Alameda County, State of California, as Obligee, in an amount equal to ten percent (10%) of the Base Bid plus alternates, in the sum of

_____ Dollars (\$ _____)

lawful money of the United States of America, for the payment of which sum well and truly to be made, we, and each of us, bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the Principal has submitted a bid to the District for all Work specifically described in the accompanying bid for the following project: _____ ("Project" or "Contract").

NOW, THEREFORE, if the Principal is awarded the Contract and, within the time and manner required under the Contract Documents, after the prescribed forms are presented to Principal for signature, enters into a written contract, in the prescribed form in accordance with the bid, and files two bonds, one guaranteeing faithful performance and the other guaranteeing payment for labor and materials as required by law, and meets all other conditions to the Contract between the Principal and the District becoming effective, or if the Principal shall fully reimburse and save harmless the District from any damage sustained by the District through failure of the Principal to enter into the written contract and to file the required performance and labor and material bonds, and to meet all other conditions to the Contract between the Principal and the District becoming effective, then this obligation shall be null and void; otherwise, it shall be and remain in full force and effect. The full payment of the sum stated above shall be due immediately if Principal fails to execute the Contract within seven (7) days of the date of the District's Notice of Award to Principal.

Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or the call for bids, or to the work to be performed thereunder, or the specifications accompanying the same, shall in any way affect its obligation under this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or the call for bids, or to the work, or to the specifications.

In the event suit is brought upon this bond by the District and judgment is recovered, the Surety shall pay all costs incurred by the District in such suit, including a reasonable attorneys' fee to be fixed by the Court.

If the District awards the bid, the security of unsuccessful bidder(s) shall be returned within sixty (60) days from the time the award is made. Unless otherwise required by law, no bidder may withdraw its bid for ninety (90) days after the date of the bid opening.

IN WITNESS WHEREOF, this instrument has been duly executed by the Principal and Surety above named, on the _____ day of _____, 20__.

Principal

By

Surety

By

Name of California Agent of Surety

Address of California Agent of Surety

Telephone Number of California Agent of Surety

Bidder must attach Power of Attorney and Certificate of Authority for Surety and a Notarial Acknowledgment for all Surety's signatures. The California Department of Insurance must authorize the Surety to be an admitted Surety Insurer.

END OF DOCUMENT

DESIGNATED SUBCONTRACTORS LIST
(Public Contract Code Sections 4100-4114)

PROJECT: _____

Bidder acknowledges and agrees that it must clearly set forth below the name, location and California contractor license number of each subcontractor who will perform work or labor or render service to the Bidder in or about the construction of the Work or who will specially fabricate and install a portion of the Work according to detailed drawings contained in the plans and specifications in an amount in excess of one-half of one percent (0.5%) of Bidder's total Base Bid and the kind of Work that each will perform. Vendors or suppliers of materials only do not need to be listed.

Bidder acknowledges and agrees that, if Bidder fails to list as to any portion of Work, or if Bidder lists more than one subcontractor to perform the same portion of Work, Bidder must perform that portion itself or be subjected to penalty under applicable law. In case more than one subcontractor is named for the same kind of Work, state the portion of the kind of Work that each subcontractor will perform.

If alternate bid(s) is/are called for and Bidder intends to use subcontractors different from or in addition to those subcontractors listed for work under the Base Bid, Bidder must list subcontractors that will perform Work in an amount in excess of one half of one percent (0.5%) of Bidder's total Base Bid, plus alternate(s).

If further space is required for the list of proposed subcontractors, attach additional copies of page 2 showing the required information, as indicated below.

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

DIR Registration #: _____

Portion of Work: _____

Date: _____

Proper Name of Bidder: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

SITE VISIT CERTIFICATION

TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID
IF SITE VISIT WAS MANDATORY

PROJECT: _____

Check option that applies:

_____ I certify that I visited the Site of the proposed Work, received the attached pages of information, and became fully acquainted with the conditions relating to construction and labor. I fully understand the facilities, difficulties, and restrictions attending the execution of the Work under contract.

_____ I certify that _____ (Bidder's representative) visited the Site of the proposed Work, received the attached ___ pages of information, and became fully acquainted with the conditions relating to construction and labor. The Bidder's representative fully understood the facilities, difficulties, and restrictions attending the execution of the Work under contract.

Bidder fully indemnifies the Peralta Community College District, its Architect, its Engineers, its Construction Manager, and all of their respective officers, agents, employees, and consultants from any damage, or omissions, related to conditions that could have been identified during my visit and/or the Bidder's representative's visit to the Site.

I certify under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Date: _____

Proper Name of Bidder: _____

Signature: _____

Print Name: _____

Title: _____

ATTACHMENTS:

- 1.**
- 2.**
- 3.**

END OF DOCUMENT

**NON-COLLUSION DECLARATION
(Public Contract Code Section 7106)**

The undersigned declares:

I am the _____ of _____, the party making the foregoing bid.
[Title] [Name of Firm]

The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid. The bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or to refrain from bidding. The bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder. All statements contained in the bid are true. The bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, to effectuate a collusive or sham bid, and has not paid, and will not pay, any person or entity for such purpose.

Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on _____,
[Date]

at _____, _____.
[City] [State]

Date: _____

Proper Name of Bidder: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

IRAN CONTRACTING ACT CERTIFICATION
(Public Contract Code Sections 2202-2208)

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District ("District") and _____ ("Contractor" or "Bidder") ("Contract" or "Project").

Prior to bidding on or submitting a proposal for a contract for goods or services of \$1,000,000 or more, the bidder/proposer must submit this certification pursuant to Public Contract Code section 2204.

The bidder/proposer must complete **ONLY ONE** of the following two options. To complete OPTION 1, check the corresponding box **and** complete the certification below. To complete OPTION 2, check the corresponding box, complete the certification below, and attach documentation demonstrating the exemption approval.

- OPTION 1.** Bidder/Proposer is not on the current list of persons engaged in investment activities in Iran created by the California Department of General Services ("DGS") pursuant to Public Contract Code section 2203(b), and we are not a financial institution extending twenty million dollars (\$20,000,000) or more in credit to another person, for 45 days or more, if that other person will use the credit to provide goods or services in the energy sector in Iran and is identified on the current list of persons engaged in investment activities in Iran created by DGS.
- OPTION 2.** Bidder/Proposer has received a written exemption from the certification requirement pursuant to Public Contract Code sections 2203(c) and (d). *A copy of the written documentation demonstrating the exemption approval is included with our bid/proposal.*

CERTIFICATION:

I, the official named below, CERTIFY UNDER PENALTY OF PERJURY, that I am duly authorized to legally bind the bidder/proposer to the OPTION selected above. This certification is made under the laws of the State of California.

<i>Vendor Name/Financial Institution (Printed)</i>	<i>Federal ID Number (or n/a)</i>
<i>By (Authorized Signature)</i>	
<i>Printed Name and Title of Person Signing</i>	<i>Date Executed</i>

END OF DOCUMENT

WORKERS' COMPENSATION CERTIFICATION

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District ("District") and _____ ("Contractor" or "Bidder") ("Contract" or "Project").

Labor Code section 3700, in relevant part, provides:

Every employer except the State shall secure the payment of compensation in one or more of the following ways:

- a. By being insured against liability to pay compensation by one or more insurers duly authorized to write compensation insurance in this state; and/or
- b. By securing from the Director of Industrial Relations a certificate of consent to self-insure, which may be given upon furnishing proof satisfactory to the Director of Industrial Relations of ability to self-insure and to pay any compensation that may become due to his employees.

I am aware of the provisions of section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the Work of this Contract.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

(In accordance with Labor Code sections 1860 and 1861, the above certificate must be signed and filed with the awarding body prior to performing any Work under this Contract.)

END OF DOCUMENT

**PREVAILING WAGE AND
RELATED LABOR REQUIREMENTS CERTIFICATION**

PROJECT/CONTRACT NO.: _____ between the Peralta Community
College District ("District") and _____
("Contractor" or "Bidder") ("Contract" or "Project").

I hereby certify that I will conform to the State of California Public Works Contract requirements regarding prevailing wages, benefits, on-site audits with 48-hours' notice, payroll records, and apprentice and trainee employment requirements, for all Work on the above Project including, without limitation, labor compliance monitoring and enforcement by the Department of Industrial Relations.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

**DISABLED VETERAN BUSINESS
ENTERPRISE PARTICIPATION CERTIFICATION**

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District ("District") and _____ ("Contractor" or "Bidder") ("Contract" or "Project").

GENERAL INSTRUCTIONS

Pursuant to Education Code section 71028 and Public Contract Code section 10115, the District has a participation goal for disabled veteran business enterprises ("DVBE") of at least three percent (3%) per year of the overall dollar amount expended each year by District on projects that receive state funding. Therefore, the lowest responsive responsible bidder awarded the Contract must submit this document to the District with its executed Agreement, identifying the steps contractor took to solicit DVBE participation in conjunction with this Contract. **Do not submit this form with your bids.** This form must be provided to the District no later than four (4) calendar days after bid opening.

PART I – Method of Compliance with DVBE Participation Goals. Check the appropriate box to indicate your method of committing the contract dollar amount.

YOUR BUSINESS ENTERPRISE IS:	AND YOU WILL	AND YOU WILL
A. <input type="checkbox"/> Disabled veteran owned and your forces will perform at least 3% of this Contract	Include a copy of your DVBE letter from Office of Small Business and Disabled Veterans Business Enterprise Services ("OSDS")*	Complete Part 1 of this form and the Certification
B. <input type="checkbox"/> Disabled veteran owned but is unable to perform 3% of this Contract with your forces	Use DVBE subcontractors /suppliers to bring the Contract participation to at least 3%	Include a copy of each DVBE's letter from OSDS (including yours, if applicable), and complete Part 1 of this form and the Certification
C. <input type="checkbox"/> NOT disabled veteran owned	Use DVBE subcontractors /suppliers for at least 3% of this Contract	Complete all of this form and the Certification
D. <input type="checkbox"/> Unable to meet the required participation goals after good faith efforts	Make good faith efforts, including contacts, advertisement and DVBE solicitation	Complete all of this form and the Certification

* A DVBE letter from OSDS is obtained from the participating DVBE.

You must complete the following table to show the dollar amount of DVBE participation:

	TOTAL CONTRACT PRICE
A. Prime Bidder, if DVBE (own participation)	\$
B. DVBE Subcontractor or Supplier	
1.	
2.	
3.	
4.	
C. Subtotal (A & B)	
D. Non-DVBE	
E. Total Bid	

PART II – Contacts. To identify DVBE subcontractors/suppliers for participation in your contract, you must contact each of the following categories. You should contact several DVBE organizations.

CATEGORY	TELEPHONE NUMBER	DATE CONTACTED	PERSON CONTACTED
1. The District, if any			*
2. OSDS, provides assistance locating DVBEs at https://caleprocure.ca.gov/pages/PublicSearch/supplier-search.aspx	(916) 375-4940		*
3. DVBE Organization (List)			*

*Write "recorded message" in this column, if applicable.

PART III – Advertisement. You must advertise for DVBE participation in both a trade and focus paper. List the advertisement you place to solicit DVBE participation. Advertisements should be published at least fourteen (14) days prior to bid/proposal opening; if you cannot advertise fourteen (14) days prior, advertisements should be published as soon as possible. Advertisements must include that your firm is seeking DVBE participation, the project name and location, and you firm’s name, your contact person, and telephone number. Attach copies of advertisements to this form.

FOCUS/TRADE PAPER NAME	CHECK ONE		DATE OF ADVERTISEMENT
	TRADE	FOCUS	

PART IV – DVBE Solicitations. List DVBE subcontractors/suppliers that were invited to bid. Use the following instructions to complete the remainder of this section (read the three columns as a sentence from left to right). If you need additional space to list DVBE solicitations, please use a separate page and attach to this form.

IF THE DVBE.....	THEN.....	AND.....		
was selected to participate	Check "YES" in the "SELECTED" column	include a copy of their DVBE letter(s) from OSDS		
was NOT selected to participate	Check "NO" in the "SELECTED" column	state why in the "REASON NOT SELECTED" column		
did not respond to your solicitation	Check the "NO RESPONSE" column.			
DVBE CONTACTED	SELECTED		REASON NOT SELECTED	NO RESPONSE
	YES	NO		

A copy of this form must be retained by you and may be subject to a future audit.

CERTIFICATION

I, _____, certify that I am the bidder's _____
_____ and that I have made a diligent effort to ascertain the facts with regard to the
representations made herein. In making this certification, I am aware of section 12650 et
seq. of the Government Code providing for the imposition of treble damages for making
false claims.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

DRUG-FREE WORKPLACE CERTIFICATION

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District ("District") and _____ ("Contractor" or "Bidder") ("Contract" or "Project").

This Drug-Free Workplace Certification form is required from the successful Bidder pursuant to Government Code section 8350 et seq., the Drug-Free Workplace Act of 1990. The Drug-Free Workplace Act of 1990 requires that every person or organization awarded a contract or grant for the procurement of any property or service from any state agency must certify that it will provide a drug-free workplace by doing certain specified acts. In addition, the Act provides that each contract or grant awarded by a state agency may be subject to suspension of payments or termination of the contract or grant, and the contractor or grantee may be subject to debarment from future contracting, if the contracting agency determines that specified acts have occurred.

The District is not a "state agency" as defined in the applicable section(s) of the Government Code, but the District is a local agency and community college district under California law and requires all contractors on District projects to comply with the provisions and requirements of the Drug-Free Workplace Act of 1990.

Contractor must also comply with the provisions of Health & Safety Code section 11362.3 which prohibits the consumption or possession of cannabis or cannabis products in any public place, including on campus.

Contractor shall certify that it will provide a drug-free workplace by doing all of the following:

- a. Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited in the person's or organization's workplace and specifying actions which will be taken against employees for violations of the prohibition.
- b. Establishing a drug-free awareness program to inform employees about all of the following:
 - (1) The dangers of drug abuse in the workplace.
 - (2) The person's or organization's policy of maintaining a drug-free workplace.
 - (3) The availability of drug counseling, rehabilitation, and employee-assistance programs.
 - (4) The penalties that may be imposed upon employees for drug abuse violations.
- c. Requiring that each employee engaged in the performance of the contract or grant be given a copy of the statement required above, and that, as a

condition of employment on the contract or grant, the employee agrees to abide by the terms of the statement.

I, the undersigned, agree to fulfill the terms and requirements of Government Code section 8355 listed above and will publish a statement notifying employees concerning (a) the prohibition of controlled substance at the workplace, (b) establishing a drug-free awareness program, and (c) requiring that each employee engaged in the performance of the Contract be given a copy of the statement required by section 8355(a), and requiring that the employee agree to abide by the terms of that statement.

I also understand that if the District determines that I have either (a) made a false certification herein, or (b) violated this certification by failing to carry out the requirements of section 8355, that the Contract awarded herein is subject to termination, suspension of payments, or both. I further understand that, should I violate the terms of the Drug-Free Workplace Act of 1990, I may be subject to debarment in accordance with the requirements of the aforementioned Act.

I acknowledge that I am aware of the provisions of and hereby certify that I will adhere to the requirements of the Drug-Free Workplace Act of 1990 and Health and Safety Code section 11362.3.

Date: _____
Proper Name of Contractor: _____
Signature: _____
Print Name: _____
Title: _____

END OF DOCUMENT

TOBACCO-FREE ENVIRONMENT CERTIFICATION

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District ("District") and _____ ("Contractor" or "Bidder") ("Contract" or "Project").

This Tobacco-Free Environment Certification form is required from the successful Bidder.

Pursuant to, without limitation, 20 U.S.C. section 6083, Labor Code section 6400 et seq., Health & Safety Code section 104350, et seq., Business and Professions Code section 22950 et seq., all District sites, including the Project site, are tobacco-free environments. Smoking and the use of tobacco products by all persons is prohibited on or in District property. District property includes school buildings, school grounds, school-owned vehicles and vehicles owned by others while on District property. The prohibition on smoking includes the use of any electronic smoking device that creates an aerosol or vapor, in any manner or in any form, and the use of any oral smoking device for the purpose of circumventing the prohibition of tobacco smoking. Further, Health & Safety Code section 11362.3 prohibits the smoking, ingestion or use of cannabis or cannabis products within 1000 feet of a school is prohibited.

I acknowledge that I am aware of the District's policy regarding tobacco-free environments at District sites, including the Project site and hereby certify that I will adhere to the requirements of that policy and not permit any of my firm's employees, agents, subcontractors, or my firm's subcontractors' employees or agents, to use tobacco and/or smoke on the Project site.

Date: _____
Proper Name of Contractor: _____
Signature: _____
Print Name: _____
Title: _____

END OF DOCUMENT

HAZARDOUS MATERIALS CERTIFICATION

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District ("District") and _____ ("Contractor" or "Bidder") ("Contract" or "Project").

1. Contractor hereby certifies that no asbestos, or asbestos-containing materials, polychlorinated biphenyl (PCB), or any material listed by the federal or state Environmental Protection Agency or federal or state health agencies as a hazardous material, or any other material defined as being hazardous under federal or state laws, rules, or regulations, ("New Hazardous Material"), shall be furnished, installed, or incorporated in any way into the Project or in any tools, devices, clothing, or equipment used to affect any portion of Contractor's work on the Project for District.
2. Contractor further certifies that it has instructed its employees with respect to the above-mentioned standards, hazards, risks, and liabilities.
3. Asbestos and/or asbestos-containing material shall be defined as all items containing but not limited to chrysotile, crocidolite, amosite, anthophyllite, tremolite, and actinolite. Any or all material containing greater than one-tenth of one percent (0.1%) asbestos shall be defined as asbestos-containing material.
4. Any disputes involving the question of whether or not material is New Hazardous Material shall be settled by electron microscopy or other appropriate and recognized testing procedure, at the District's determination. The costs of any such tests shall be paid by Contractor if the material is found to be New Hazardous Material.
5. All Work or materials found to be "New Hazardous Material" or Work or material installed with equipment containing "New Hazardous Material" will be immediately rejected and this Work will be removed at Contractor's expense at no additional cost to the District.
6. Contractor has read and understood the document titled Hazardous Materials Procedures & Requirements, and shall comply with all the provisions outlined therein. Contractor certifies that it is knowledgeable of, and shall comply with, all laws applicable to the Work including, but not limited to, all federal, state, and local laws, statutes, standards, rules, regulations, and ordinances applicable to the Work.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

LEAD-BASED MATERIALS CERTIFICATION

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District ("District") and _____ ("Contractor" or "Bidder") ("Contract" or "Project").

This certification provides notice to the Contractor that:

- (1) Contractor's work may disturb lead-containing building materials.
- (2) Contractor shall notify the District if any work may result in the disturbance of lead-containing building materials.
- (3) Contractor shall comply with the Renovation, Repair and Painting Rule, if lead-based paint is disturbed in a six-square-foot or greater area indoors or a 20-square-foot or greater area outdoors.

1. Lead as a Health Hazard

Lead poisoning is recognized as a serious environmental health hazard facing children today. Even at low levels of exposure, much lower than previously believed, lead can impair the development of a child's central nervous system, causing learning disabilities, and leading to serious behavioral problems. Lead enters the environment as tiny lead particles and lead dust disburse when paint chips, chalks, peels, wears away over time, or is otherwise disturbed. Ingestion of lead dust is the most common pathway of childhood poisoning; lead dust gets on a child's hands and toys and then into a child's mouth through common hand-to-mouth activity. Exposures may result from construction or remodeling activities that disturb lead paint, from ordinary wear and tear of windows and doors, or from friction on other surfaces.

Ordinary construction and renovation or repainting activities carried out without lead-safe work practices can disturb lead-based paint and create significant hazards. Improper removal practices, such as dry scraping, sanding, or water blasting painted surfaces, are likely to generate high volumes of lead dust.

Because the Contractor and its employees will be providing services for the District, and because the Contractor's work may disturb lead-containing building materials, CONTRACTOR IS HEREBY NOTIFIED of the potential presence of lead-containing materials located within certain buildings utilized by the District. All school buildings built prior to 1978 are presumed to contain some lead-based paint until sampling proves otherwise.

2. Overview of Law

Both the Federal Occupational Safety and Health Administration ("Fed/OSHA") and the California Division of Occupational Safety and Health ("Cal/OSHA") have implemented safety orders applicable to all construction work where a contractor's employee may be occupationally exposed to lead.

The OSHA Regulations apply to all construction work where a contractor's employee may be occupationally exposed to lead. The OSHA Regulations contain specific and detailed requirements imposed on contractors subject to those regulations. The OSHA Regulations define construction work as work for construction, alteration, and/or repair, including painting and decorating. Regulated construction work includes, but is not limited to, the following:

- a. Demolition or salvage of structures where lead or materials containing lead are present;
- b. Removal or encapsulation of materials containing lead;
- c. New construction, alteration, repair, or renovation of structures, substrates, or portions thereof, that contain lead, or materials containing lead;
- d. Installation of products containing lead;
- e. Lead contamination/emergency cleanup;
- f. Transportation, disposal, storage, or containment of lead or materials containing lead on the site or location at which construction activities are performed; and
- g. Maintenance operations associated with the construction activities described in the subsection.

Because it is assumed by the District that all painted surfaces (interior as well as exterior) within the District contain some level of lead, it is imperative that the Contractor, its workers and subcontractors fully and adequately comply with all applicable laws, rules and regulations governing lead-based materials (including title 8, California Code of Regulations, section 1532.1).

Contractor shall notify the District if any Work may result in the disturbance of lead-containing building materials. Any and all Work that may result in the disturbance of lead-containing building materials shall be coordinated through the District. A signed copy of this Certification shall be on file prior to beginning Work on the Project, along with all current insurance certificates.

3. Renovation, Repair and Painting Rule, Section 402(c)(3) of the Toxic Substances Control Act

The EPA requires lead safe work practices to reduce exposure to lead hazards created by renovation, repair and painting activities that disturb lead-based paint. Pursuant to the Renovation, Repair and Painting Rule (RRP), renovations in homes, childcare facilities, and schools built prior to 1978 must be conducted by certified renovations firms, using renovators with training by a EPA-accredited training provider, and fully and adequately complying with all applicable laws, rules and regulations governing lead-based materials, including those rules and regulations appearing within title 40 of the Code of Federal Regulations as part 745 (40 CFR 745).

The RRP requirements apply to all contractors who disturb lead-based paint in a six-square-foot or greater area indoors or a 20-square-foot or greater area outdoors. If a DPH-certified inspector or risk assessor determines that a home constructed before 1978 is lead-free, the federal certification is not required for anyone working on that particular building.

4. Contractor's Liability

If the Contractor fails to comply with any applicable laws, rules, or regulations, and that failure results in a site or worker contamination, the Contractor will be held solely responsible for all costs involved in any required corrective actions, and shall defend, indemnify, and hold harmless the District, pursuant to the indemnification provisions of the Contract, for all damages and other claims arising therefrom.

If lead disturbance is anticipated in the Work, only persons with appropriate accreditation, registrations, licenses, and training shall conduct this Work.

It shall be the responsibility of the Contractor to properly dispose of any and all waste products, including, but not limited to, paint chips, any collected residue, or any other visual material that may occur from the prepping of any painted surface. It will be the responsibility of the Contractor to provide the proper disposal of any hazardous waste by a certified hazardous waste hauler. This company shall be registered with the Department of Transportation (DOT) and shall be able to issue a current manifest number upon transporting any hazardous material from any school site within the District.

The Contractor shall provide the District with any sample results prior to beginning Work, during the Work, and after the completion of the Work. The District may request to examine, prior to the commencement of the Work, the lead training records of each employee of the Contractor.

THE CONTRACTOR HEREBY ACKNOWLEDGES, UNDER PENALTY OF PERJURY, THAT IT:

1. HAS RECEIVED NOTIFICATION OF POTENTIAL LEAD-BASED MATERIALS ON THE OWNER'S PROPERTY;
2. IS KNOWLEDGEABLE REGARDING AND WILL COMPLY WITH ALL APPLICABLE LAWS, RULES, AND REGULATIONS GOVERNING WORK WITH, AND DISPOSAL, OF LEAD.

THE UNDERSIGNED WARRANTS THAT HE/SHE HAS THE AUTHORITY TO SIGN ON BEHALF OF AND BIND THE CONTRACTOR. THE DISTRICT MAY REQUIRE PROOF OF SUCH AUTHORITY.

Date: _____
Proper Name of Contractor: _____
Signature: _____
Print Name: _____
Title: _____

END OF DOCUMENT

IMPORTED MATERIALS CERTIFICATION

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District ("District") and _____ ("Contractor" or "Bidder") ("Contract" or "Project").

This form shall be executed by all entities that, in any way, provide or deliver and/or supply any soils, aggregate, or related materials ("Fill") to the Project Site and shall be provided to the District at least ten (10) days before delivery. All Fill shall satisfy all requirements of any environmental review of the Project performed pursuant to the statutes and guidelines of the California Environmental Quality Act, section 21000, et seq., of the Public Resources Code ("CEQA"), and all requirements of section 17210, et seq., of the Education Code, including requirements for a Phase I environmental assessment acceptable to the State of California Community Colleges Chancellor's Office and Department of Toxic Substances Control.

Certification of: Delivery Firm/Transporter Supplier Manufacturer
 Wholesaler Broker Retailer
 Distributor Other _____

Type of Entity Corporation General Partnership
 Limited Partnership Limited Liability Company
 Sole Proprietorship Other _____

Name of firm ("Firm"): _____

Mailing address: _____

Addresses of branch office used for this Project: _____

If subsidiary, name and address of parent company: _____

By my signature below, I hereby certify that I am aware of section 25260 of the Health and Safety Code and the sections referenced therein regarding the definition of hazardous material. I further certify on behalf of the Firm that all soils, aggregates, or related materials provided, delivered, and/or supplied or that will be provided, delivered, and/or supplied by this Firm to the Project Site are free of any and all hazardous material as defined in section 25260 of the Health and Safety Code. I further certify that I am authorized to make this certification on behalf of the Firm.

Date: _____

Proper Name of Firm: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

SEX OFFENDER REGISTRATION ACT CERTIFICATION

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District ("District") and _____ ("Contractor" or "Bidder") ("Contract" or "Project").

This certification provides notice to the Contractor that:

- Penal Code section 290.001 requires every person required to register pursuant to sections 290 to 290.009, inclusive, of the Sex Offender Registration Act who is carrying on a vocation at the community college for more than fourteen (14) days, or for an aggregate period exceeding thirty (30) days in a calendar year, shall, in addition to the registration required by the Sex Offender Registration Act, register with the campus police department within five (5) working days of commencing employment at that community college on a form as may be required by the Department of Justice. The terms "employed or carries on a vocation" include employment whether or not financially compensated, volunteered, or performed for government or educational benefit.
- If the community college has no campus police department, the registrant shall instead register with the police of the city in which the campus is located or the sheriff of the county in which the campus is located if the campus is located in an unincorporated area or in a city that has no police department, on a form as may be required by the Department of Justice.
- The registrant shall also notify the campus police department within five (5) working days of ceasing to be employed, or ceasing to carry on a vocation, at the community college.

Contractor hereby acknowledges, under penalty of perjury, that it is aware of the provisions of section 290.001 of the Penal Code, and it will provide notice of the above provisions to all of its employees, subcontractors, and employees of subcontractors regardless of whether they are designated as employees or acting as independent contractors of the Contractor at least five (5) working days before commencing the performance of the Work of this Contract.

THE UNDERSIGNED WARRANTS THAT HE/SHE HAS THE AUTHORITY TO SIGN ON BEHALF OF AND BIND THE CONTRACTOR. THE DISTRICT MAY REQUIRE PROOF OF SUCH AUTHORITY.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

BUY AMERICAN CERTIFICATION

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District ("District") and _____ ("Contractor" or "Bidder") ("Contract" or "Project").

Federal regulations require that all of the iron, steel, and manufactured goods used in projects for the construction, installation, repairs, renovation, modernization, or maintenance of a public building or public work funded in part or in whole by federal stimulus funds, with the exception of projects funded by Qualified School Construction Bonds, be produced in the United States of America, unless a federal department waives this requirement because (1) it is inconsistent with the public interest, (2) the goods are not produced in sufficient quantities or of satisfactory quality in the United States, or (3) the requirement would increase the cost of the Project overall by more than twenty-five percent (25%) ("Buy American").

Contractor shall submit this Certification with its executed agreement, identifying the steps Contractor will take to use goods produced in the United States of America in carrying out this Contract. Bidder should not submit this form with its bid.

Contractor shall retain a copy of this form and may be subject to a future audit.

CERTIFICATION

On behalf of Contractor, I represent and covenant that Contractor will use on the Project only iron, steel and manufactured goods produced in the United States of America except goods for which a federal department has waived this requirement.

I, _____, certify that I am the Contractor's _____ and that the representations and covenants made herein are true and correct. In making this certification, I am aware of section 12650 et seq. of the Government Code providing for the imposition of treble damages for making false claims.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

By my signature below, I hereby certify that, to the best of my knowledge, the contents of this disclosure are true, or are believed to be true. I further certify on behalf of the Firm that I am aware of section 3000 et seq. of the California Public Contract Code, and the sections referenced therein regarding the penalties for providing false information or failing to disclose a financial relationship in this disclosure. I further certify that I am authorized to make this certification on behalf of the Firm.

Date: _____

Proper Name of Firm: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

**SMALL LOCAL BUSINESS ENTERPRISE and
SMALL EMERGING LOCAL BUSINESS ENTERPRISE PROGRAM**

The District is committed to ensure equal opportunity and equitable treatment in awarding and managing its public contracts and has established an annual overall program goal of twenty-five percent participation for small local businesses. Bidders are encouraged to meet the District's twenty-five percent goal.

Definitions:

SLBE: A Small Local Business Enterprise is a business that has not exceeded gross annual revenue of 8.5 million dollars for a construction firm, or 6 million dollars for goods and nonprofessional services firm, or 3 million dollars for architecture, engineering and professional services firm, for the past three consecutive years and meets the below geographic location requirements.

SELBE: A Small Local Emerging Business Enterprise is a business that has not exceeded gross annual revenue of 1.5 million dollars for the past three consecutive years and meets the below geographic location requirements.

Commercially Useful Function: Shall mean a business is directly responsible for providing the materials, equipment, supplies or services to the District as required by the contract solicitation. The business performs work that is normal for its business services and carries out its obligation by actually performing, managing, or supervising the work involved. The business is **not** Commercially Useful if its role is limited to that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of SLBE or SELBE participation.

Geographic Location Requirements:

- The business must be located at a fixed, established commercial address located in the District's market area of Albany, Alameda, Berkeley, Emeryville, Oakland, or Piedmont, and not a temporary or movable office, a post office box, or a telephone answering service.
- If the business has an office outside of the District's market area as well as an office within the market area, the office within the District's market area must be staffed on a full time permanent basis with someone employed by the business.
- If requested, the business that has an office outside of the District's market area must provide proof of one or more past contracts citing the business address (such as contracts to perform work, to rent space or equipment, or for other business services) was within the District's market area at least one (1) year prior to the date of contract award. The one year requirement does not apply to businesses whose sole establishment is located within the District's market area.

Subcontractors:

Non-SLBE/SELBE Prime Contractors are encouraged to use subcontractors, who meet the district definitions of SLBE and SELBE and the following requirements:

1. The Subcontractors must provide a Commercially Useful Function.

2. The Prime Contractor must maintain the Subcontractor percentages (based on the portion of work) indicated in the Registered Subcontractor List form at the time the Contract is awarded and throughout the term of the Contract.
3. The Prime Contractor must fill out and sign this SLBE/SELBE form and return it with the bid documents, and 48 hours after the bid opening the Prime Contractor must submit this signed SLBE/SELBE form from each of the SLBE and SELBE subcontractors listed in the Subcontractor form. The Subcontractor must agree to provide the requested documentation to verify the SLBE/SELBE status.
4. No Substitutions can be made to the SLBE and SELBE subcontractor without the prior written approval of the District. The District will approve a subcontractor substitution on the following conditions:
 - a. A written statement from the subcontractor agreeing to the substitution.
 - b. When the subcontractor has been given a reasonable opportunity to execute the subcontract, yet fails to, or refuses to execute the subcontract, or refuses to satisfy contractual obligations.
 - c. When the subcontractor becomes insolvent.
 - d. When the District determines the work performed by the subcontractor is not in accordance with the contract agreement, or the subcontractor is substantially and unduly delaying or disrupting the progress of work. Firms that meet the District criteria for an SLBE and SELBE can complete this form under penalty of perjury. Firms claiming SLBE and SELBE status will be required to submit proof of residency and revenue 48 hours after bid opening. Such proof shall consist of a copy of a contract to perform work, to rent space or equipment, or for other business services, executed from their local address, and the firm's tax returns for the past three consecutive years.

I certify under penalty of perjury that my firm (____) does (____does not) meet the District's definition of a Small Local Business Enterprise or a Small Emerging Local Business Enterprise and resides in the geographic location of the District's market area. I acknowledge and have been advised and hereby agree that my firm will be required to provide proof (and if applicable, my SLBE and SELBE Contractors will provide proof) of status.

Bid # _____ Bid Name _____

Signed Date

Printed or typed name Title

Name of Company Telephone # Email

REGISTERED SUBCONTRACTORS LIST
(Labor Code Section 1771.1)

PROJECT: _____

Date Submitted (for Updates): _____

Contractor acknowledges and agrees that it must clearly set forth below the name and Department of Industrial Relations (DIR) registration number of each subcontractor **for all tiers** who will perform work or labor or render service to Contractor or its subcontractors in or about the construction of the Work **at least two (2) weeks before the subcontractor is scheduled to perform work**. This document is to be updated as all tiers of subcontractors are identified.

Contractor acknowledges and agrees that, if Contractor fails to list as to any subcontractor of any tier who performs any portion of Work, the Contract is subject to cancellation and the Contractor will be subjected to penalty under applicable law.

If further space is required for the list of proposed subcontractors, attach additional copies of page 2 showing the required information, as indicated below.

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

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Subcontractor Name: _____

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Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Date: _____

Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00 45 90

POST BID INTERVIEW

PART 1 – GENERAL

1.01 SUMMARY

If requested by the District, this Section requires the apparent low bidder to attend and participate in a Post Bid Interview with the Construction Manager, prior to award of any contract by the District. The Post Bid Interview will be scheduled by the Construction Manager within three (3) calendar days after the date of bid.

1.02 REQUIRED ATTENDANCE

- A. A duly authorized representative of the apparent low bidder is required to attend the Post Bid Interview, in person.
- B. The apparent low bidder's authorized representative(s) must have (1) knowledge of how the bid submitted was prepared, (2) the person responsible for supervising performance of the Work, and (3) the authority to bind the apparent low bidder.
- C. Failure to attend the Post Bid Interview as scheduled will be considered just cause for the District to reject the Bid as nonresponsive.

1.03 POST BID INTERVIEW PROCEDURE

- A. The Construction Manager will review the Bid with the attendees.
- B. The Construction Manager will review the Contract Documents with the attendees, including but not limited to:
 - (1) Insurance
 - (2) Bonding
 - (3) Addenda
 - (4) Pre-Bid Clarifications
 - (5) Scope of Work
 - (6) Bid Packages Descriptions
 - (7) Bid Alternates
 - (8) Contract Plans
 - (9) Contract Specifications

- (10) Project Schedule and Schedule Requirements
- (11) Critical Dates Requirement for Other Bid Packages
- (12) Prevailing Wage Requirements
- (13) Liquidated Damages
- (14) Required Documentation for Contract Administration
- (15) Contract Coordination Requirements

1.04 POST BID INTERVIEW DOCUMENTATION

The Construction Manager will document the Post Bid Interview on the form attached to this Section. Both the apparent low bidder and the Construction Manager are required to sign the Post Bid Interview Documentation.

POST BID INTERVIEW

CONSTRUCTION MANAGER

[Name]
[Address 1]
[Address 2]
[Phone]

[Fax]

BIDDER: _____

DATE: _____ TIME: _____ PHONE: _____

I. INTRODUCTIONS:

A. Present

CONTRACTOR

CONTRACTOR

[CM]

[CM]

II. PROPOSED CONTRACT:

III. PURPOSE OF INTERVIEW IS TO ASSURE A MUTUAL UNDERSTANDING OF THE FOLLOWING:

- A. Do you acknowledge submission of a complete and accurate bid? Yes No
- B. Do you acknowledge the Bid Document submittal timelines after NOA and NTP and can you meet those timelines? Yes No
- C. Do you acknowledge the requirements for the escrow of bid documents? Yes No
- D. Are you comfortable with your listed subcontractors? Yes No

IV. CONTRACTUAL REQUIREMENTS:

- A. Do you understand you are a prime contractor? Yes No
- B. Can you meet specified insurance requirements? Yes No
 - 1. Do any of your policies that require Additional Insured endorsements exceed the minimum coverage requirements? Yes No

- 2. Are you requesting that the District accept an Umbrella or Excess Liability Insurance Policy to meet the policy limit? Yes No
- 3. Will there be a gap between the per occurrence amount of any underlying policy and the start of the coverage under the Umbrella or Excess Liability Insurance Policy? Yes No
- C. Will you provide the Performance Bond and Labor and Material Bond for 100% of the Contract Price as stipulated? Yes No
 - 1. Cost for bond: _____% Yes No
 - 2. Is the cost of your bond in your base bid? Yes No
 - 3. Is your surety licensed to issue bonds in California? Yes No
- D. Do you understand the sex offender registration requirements? Yes No
- E. Is it understood that all workers must be paid prevailing wage? Yes No
- F. Is it understood that all subcontractors of every tier must be registered as a public works contractor with the Department of Industrial Relations? Yes No

Commented [A1]: Optional. Delete if not used.

V. SCOPE OF WORK:

- A. Acknowledged Receipt of Addenda #1-___ Yes No
- B. Are the costs for addenda items included in your bid? (if applicable) Yes No
- C. Do you have a complete understanding of your Scope of Work under the proposed Agreement? Yes No
- D. You have re-reviewed the documents and understand the Scope of the Work. Are there any items that require clarification? Yes No

If yes, please identify them.

- 1. _____
- 2. _____
- 3. _____

-
-
- | | | |
|---|-----|----|
| Is (are) there additional cost(s) for the above item(s)? | Yes | No |
| E. Have you reviewed bid alternative(s) #1-___? (If applicable) | Yes | No |
| F. Are the costs for bid alternatives included in your bid? | Yes | No |
| G. Are the plans and specifications clear and understandable to your satisfaction? | Yes | No |
| H. Do you acknowledge that the time to submit notice of requests for substitution of specified materials has expired? | Yes | No |

VI. SCHEDULE:

- | | | |
|---|-----|----|
| A. Do you acknowledge and agree to the stipulated completion dates and milestones in the contract? | Yes | No |
| 1. Will you provide a detailed construction schedule to _____ within the required ten (10) days of the Notice to Proceed, per the contract? | Yes | No |
| 2. Can you meet the submittal deadline? | Yes | No |
| 3. It is understood that the Project schedule is critical and that that weekend and overtime work may be required to meet the milestones. | Yes | No |
| 4. It is understood that if rain does occur, then all dewatering and protection of work is required, per the contract. If not, what do you believe must change and why? _____ | Yes | No |
-
-

- | | | |
|--|-----|----|
| B. Identify critical materials, deliveries, long lead items and other dependencies, including Owner Furnished items that could affect the completion of your work. | Yes | No |
| 1. _____ | | |
| 2. _____ | | |
| 3. _____ | | |

IX. CONTRACTOR

You agree the information contained herein is part of your contractual obligations. Your signature acknowledges your agreement to perform all Work in the Contract Documents, and that costs for all Work are included in your bid.

The foregoing information is true and accurate, and I am authorized to sign as an officer of the company I am representing.

[Company Name]

Signature _____ Title: _____

Date: _____

X. CONSTRUCTION MANAGER

Signature _____ Title: _____

Date: _____

Title of Document: POST BID INTERVIEW

Number of Pages: _____

Date of Document: _____

END OF DOCUMENT

DOCUMENT 00 51 00

NOTICE OF AWARD

Dated: _____ 20__

To: _____ (Contractor)

(Address)

From: Governing Board ("Board") of the Peralta Community College District ("District")

Re: _____, Project No. _____ ("Project").

Contractor has been awarded the Contract for the above referenced Project on _____, 20__, by action of the District's Board.

The Contract Price is _____ Dollars (\$_____), and includes alternates _____.

Three (3) copies of each of the Contract Documents (except Drawings) accompany this Notice of Award. Three (3) sets of the Drawings will be delivered separately or otherwise made available. Additional copies are available at cost of reproduction.

You must comply with the following conditions precedent within **SEVEN (7)** calendar days of the date of this Notice of Award.

The Contractor shall execute and submit the following documents by 5:00 p.m. of the **SEVENTH (7th)** calendar day following the date of the Notice of Award.

- a. Agreement: To be executed by successful Bidder. Submit three (3) copies, each bearing an original signature.
- b. Escrow of Bid Documentation: This must include all required documentation. See document titled Escrow Bid Documentation for more information.
- c. Performance Bond (100%): On the form provided in the Contract Documents and fully executed as indicated on the form.
- d. Payment Bond (Contractor's Labor & Material Bond) (100%): On the form provided in the Contract Documents and fully executed as indicated on the form.
- e. Insurance Certificates and Endorsements as required.
- f. Workers' Compensation Certification.
- g. Prevailing Wage and Related Labor Requirements Certification.
- h. Disabled Veteran Business Enterprise Participation Certification.
- i. Drug-Free Workplace Certification.

Commented [DWK1]: OR "by action of the chancellor/president or chancellor/president's designee pursuant to a delegation of authority by the District's Board pending ratification."

Commented [DWK2]: Delete if not applicable

Commented [DWK3]: Delete if not applicable

- j. Tobacco-Free Environment Certification.
- k. Hazardous Materials Certification.
- l. Lead-Based Materials Certification.
- m. Imported Materials Certification.
- n. Sex Offender Registration Act Certification.
- o. Buy American Certification.
- p. Roof Project Certification: From Contractor, Material Manufacturer and/or Vendor.
- q. COVID-19 Vaccination/Testing Certification

Commented [DWK4]: Delete if not applicable

Commented [DWK5]: Delete if not applicable

Commented [DWK6]: Delete if not applicable

Commented [DWK7]: Delete if not applicable

Commented [DWK8]: Optional. Delete if not used.

Commented [DWK9]: Delete if not applicable

Commented [DWK10]: Delete if not applicable

Failure to comply with these conditions within the time specified will entitle District to consider your bid abandoned, to annual this Notice of Award, and to declare your Bid Security forfeited, as well as any other rights the District may have against the Contractor.

After you comply with those conditions, District will return to you one fully signed counterpart of the Agreement.

PERALTA COMMUNITY COLLEGE DISTRICT

BY: _____

NAME: _____

TITLE: _____

END OF DOCUMENT

4. **Time for Completion:** It is hereby understood and agreed that the Work under this Contract shall be completed within Seven Hundred Thirty (730) consecutive calendar days ("Contract Time") from the date specified in the District's Notice to Proceed.
5. **Completion - Extension of Time:** Should the Contractor fail to complete this Contract, and the Work provided herein, within the time fixed for completion, due allowance being made for the contingencies provided for herein, the Contractor shall become liable to the District for all loss and damage that the District may suffer on account thereof. The Contractor shall coordinate its Work with the Work of all other contractors. The District shall not be liable for delays resulting from Contractor's failure to coordinate its Work with other contractors in a manner that will allow timely completion of Contractor's Work. Contractor shall be liable for delays to other contractors caused by Contractor's failure to coordinate its Work with the Work of other contractors.
6. **Liquidated Damages:** Time is of the essence for all work under this Agreement. It is hereby understood and agreed that it is and will be difficult and/or impossible to ascertain and determine the actual damage that the District will sustain in the event of and by reason of Contractor's delay; therefore, Contractor agrees that it shall pay to the District the sum of Five Thousand 00/100 dollars (\$5,000.00) per day as liquidated damages for each and every day's delay beyond the time herein prescribed in completion of the Work.

It is hereby understood and agreed that this amount is not a penalty.

In the event that any portion of the liquidated damages is not paid to the District, the District may deduct that amount from any money due or that may become due the Contractor under this Agreement, and such deduction does not constitute a withholding or penalty. The District's right to assess liquidated damages is as indicated herein and in the General Conditions.

The time during which the Contract is delayed for cause, as hereinafter specified, may extend the time of completion for a reasonable time as the District may grant, provided that Contractor has complied with the claims procedure of the Contract Documents. This provision does not exclude the recovery of damages by either party under other provisions in the Contract Documents.

7. **Loss Or Damage:** The District and its agents and authorized representatives shall not in any way or manner be answerable or suffer loss, damage, expense, or liability for any loss or damage that may happen to the Work, or any part thereof, or in or about the same during its construction and before acceptance, and the Contractor shall assume all liabilities of every kind or nature arising from the Work, either by accident, negligence, theft, vandalism, or any cause whatsoever; and shall hold the District and its agents and authorized representatives harmless from all liability of every kind and nature arising from accident, negligence, or any cause whatsoever.
8. **Limitation Of District Liability:** District's financial obligations under this Contract shall be limited to the payment of the compensation provided in this Contract. Notwithstanding any other provision of this Contract, in no event shall District be liable, regardless of whether any claim is based on contract or tort, for any special, consequential, indirect or incidental damages, including, but not limited to, lost

profits or revenue, lost bonding capacity, arising out of or in connection with this Contract for the services performed in connection with this Contract.

- 9. Insurance and Bonds:** Prior to issuance of the Notice to Proceed by the District, Contractor shall provide all required certificates of insurance, insurance endorsements, and payment and performance bonds as evidence thereof.
- 10. Prosecution of Work:** If the Contractor should neglect to prosecute the Work properly or fail to perform any provisions of this Contract, the District, may, pursuant to the General Conditions and without prejudice to any other remedy it may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor.
- 11. Authority of Architect, Project Inspector, and DSA:** Contractor hereby acknowledges that the Architect(s), the Project Inspector(s), and the Division of the State Architect ("DSA") have authority to approve and/or suspend Work if the Contractor's Work does not comply with the requirements of the Contract Documents, Title 24 of the California Code of Regulations, and all applicable laws and regulations. The Contractor shall be liable for any delay caused by its non-compliant Work.
- 12. Assignment of Contract:** Neither the Contract, nor any part thereof, nor any moneys due or to become due thereunder, may be assigned by the Contractor without the prior written approval of the District, nor without the written consent of the Surety on the Contractor's Performance Bond (the "Surety"), unless the Surety has waived in writing its right to notice of assignment.
- 13. Classification of Contractor's License:** Contractor hereby acknowledges that it currently holds valid Type A and/or B Contractor's license(s) issued by the State of California, Contractors' State License Board, in accordance with division 3, chapter 9, of the Business and Professions Code and in the classification called for in the Contract Documents.
- 14. Registration as Public Works Contractor:** The Contractor and all Subcontractors currently are registered as public works contractors with the Department of Industrial Relations, State of California, in accordance with Labor Code section 1771.1.
- 15. Payment of Prevailing Wages:** The Contractor and all Subcontractors shall pay all workers on all Work performed pursuant to this Contract not less than the general prevailing rate of per diem wages and the general prevailing rate for holiday and overtime work as determined by the Director of the Department of Industrial Relations, State of California, for the type of work performed and the locality in which the work is to be performed within the boundaries of the District, pursuant to sections 1770 et seq. of the California Labor Code.

16. Labor Compliance Monitoring and Enforcement: This Project is subject to labor compliance monitoring and enforcement by the Department of Industrial Relations pursuant to Labor Code section 1771.4 and Title 8 of the California Code of Regulations. Contractor specifically acknowledges and understands that it shall perform the Work of this Agreement while complying with all the applicable provisions of Division 2, Part 7, Chapter 1, of the Labor Code, including, without limitation, the requirement that the Contractor and all of its Subcontractors shall timely submit complete and accurate electronic certified payroll records as required by the Contract Documents, or the District may not issue payment.

17. Contract Price: In consideration of the foregoing covenants, promises, and agreements on the part of the Contractor, and the strict and literal fulfillment of each and every covenant, promise, and agreement, and as compensation agreed upon for the Work and construction, erection, and completion as aforesaid, the District covenants, promises, and agrees that it will well and truly pay and cause to be paid to the Contractor in full, and as the full Contract Price and compensation for construction, erection, and completion of the Work hereinabove agreed to be performed by the Contractor, the following price:

_____ Dollars

(\$ _____),

in lawful money of the United States, which sum is to be paid according to the schedule provided by the Contractor and accepted by the District and subject to additions and deductions as provided in the Contract. This amount supersedes any previously stated and/or agreed to amount(s).

18. No Representations: No representations have been made other than as set forth in writing in the Contract Documents, including this Agreement. Each of the Parties to this Agreement warrants that it has carefully read and understood the terms and conditions of this Agreement and all Contract Documents, and that it has not relied upon the representations or advice of any other Party or any attorney not its own.

19. Entire Agreement: The Contract Documents, including this Agreement, set forth the entire agreement between the parties hereto and fully supersede any and all prior agreements, understandings, written or oral, between the parties hereto pertaining to the subject matter thereof.

20. Severability: If any term, covenant, condition, or provision in any of the Contract Documents is held by a court of competent jurisdiction to be invalid, void or unenforceable, the remainder of the provisions in the Contract Documents shall remain in full force and effect and shall in no way be affected, impaired, or invalidated thereby.

21. Authority of Signatories: Each party has the full power and authority to enter into and perform this Contract, and the person signing this Contract on behalf of each party has been properly authorized and empowered to enter into this Contract. This Contract may be executed in one or more counterparts, each of which shall be

deemed an original. For this Agreement, and for all Contract Documents requiring a signature, a facsimile or electronic signature shall be deemed to be the equivalent of the actual original signature. All counterparts so executed shall constitute one Contract binding all the Parties hereto.

[SIGNATURES ON FOLLOWING PAGE]

IN WITNESS WHEREOF, accepted and agreed on the date indicated above:

CONTRACTOR

**PERALTA COMMUNITY COLLEGE
DISTRICT**

By: _____

By: _____

Title: _____

Title: _____

NOTE: If the party executing this Contract is a corporation, a certified copy of the by-laws, or of the resolution of the Board of Directors, authorizing the officers of said corporation to execute the Contract and the bonds required thereby must be attached hereto.

END OF DOCUMENT

NOTICE TO PROCEED

Dated: _____, 20__

TO: _____
("Contractor")

ADDRESS: _____

PROJECT: _____

PROJECT/CONTRACT NO.: _____ between the Peralta Community College District and Contractor ("Contract").

You are notified that the Contract Time under the above Contract will commence to run on _____, 20__. By that date, you are to start performing your obligations under the Contract Documents. In accordance with the Agreement executed by Contractor, the date of completion is _____, 20__.

You must submit the following documents by 5:00 p.m. of the TENTH (10th) calendar day following the date of this Notice to Proceed:

- a. Contractor's preliminary schedule of construction.
- b. Contractor's preliminary schedule of values for all of the Work.
- c. Contractor's preliminary schedule of submittals, including Shop Drawings, Product Data, and Samples submittals
- d. Contractor's Safety Plan specifically adapted for the Project.
- e. Registered Subcontractors List: A complete subcontractors list for all tiers, including the name, address, telephone number, email address, facsimile number, California State Contractors License number, license classification, Department of Industrial Relations registration number, and monetary value of all Subcontracts.

Thank you. We look forward to a very successful Project.

PERALTA COMMUNITY COLLEGE DISTRICT

BY: _____

NAME: _____

TITLE: _____

END OF DOCUMENT

ESCROW BID DOCUMENTATION

1. Requirement to Escrow Bid Documentation

- a. Contractor shall submit, within **SEVEN (7)** calendar days after the date of the Notice of Award, one copy of all documentary information received or generated by Contractor in preparation of bid prices for this Contract, as specified herein. This material is referred to herein as "Escrow Bid Documentation." The Escrow Bid Documentation of the Contractor will be held in escrow for the duration of the Contract.
- b. Contractor agrees, as a condition of award of the Contract, that the Escrow Bid Documentation constitutes all written information used in the preparation of its bid, and that no other written bid preparation information shall be considered in resolving disputes or claims. Contractor also agrees that nothing in the Escrow Bid Documentation shall change or modify the terms or conditions of the Contract Documents.
- c. The Escrow Bid Documentation will not be opened by District except as indicated herein. The Escrow Bid Documentation will be used only for the resolution of change orders and claims disputes.
- d. Contractor's submission of the Escrow Bid Documentation, as with the bonds and insurance documents required, is considered an essential part of the Contract award. Should the Contractor fail to make the submission within the allowed time specified above, District may deem the Contractor to have failed to enter into the Contract, and the Contractor shall forfeit the amount of its bid security, accompanying the Contractor's bid, and District may award the Contract to the next lowest responsive responsible bidder.
- e. NO PAYMENTS WILL BE MADE, NOR WILL DISTRICT ACCEPT PROPOSED CHANGE ORDERS UNTIL THE ABOVE REQUIRED INFORMATION IS SUBMITTED AND APPROVED.
- f. The Escrow Bid Documentation shall be submitted in person by an authorized representative of the Contractor to the District.

2. Ownership of Escrow Bid Documentation

- a. The Escrow Bid Documentation is, and shall always remain, the property of Contractor, subject to review by District, as provided herein.
- b. Escrow Bid Documentation constitute trade secrets, not known outside Contractor's business, known only to a limited extent and only by a limited number of employees of Contractor, safeguarded while in Contractor's possession, extremely valuable to Contractor, and could be extremely valuable to Contractor's competitors by virtue of it reflecting Contractor's contemplated techniques of construction. Subject to the provisions herein,

District agrees to safeguard the Escrow Bid Documentation, and all information contained therein, against disclosure to the fullest extent permitted by law.

3. Format and Contents of Escrow Bid Documentation

- a. Contractor may submit Escrow Bid Documentation in its usual cost-estimating format; a standard format is not required. The Escrow Bid Documentation shall be submitted in the language (e.g., English) of the specification.
- b. Escrow Bid Documentation must clearly itemize the estimated costs of performing the work of each bid item contained in the bid schedule, separating bid items into sub-items as required to present a detailed cost estimate and allow a detailed cost review. The Escrow Bid Documentation shall include all subcontractor bids or quotes, supplier bids or quotes, quantity takeoffs, crews, equipment, calculations of rates of production and progress, copies of quotes from subcontractors and suppliers, and memoranda, narratives, add/deduct sheets, and all other information used by the Contractor to arrive at the prices contained in the bid proposal. Estimated costs should be broken down into Contractor's usual estimate categories such as direct labor, repair labor, equipment ownership and operation, expendable materials, permanent materials, and subcontract costs as appropriate. All labor rates must be broken down to specify any and all burden costs including, but not limited to, health and welfare pay, vacation and holiday pay, pension contributions, training rates, benefits of any kind, insurance of any kind, workers' compensation, liability insurance, truck expenses, supply expenses of any kind, payroll taxes, and any other taxes of any kind. Plant and equipment and indirect costs should be detailed in the Contractor's usual format. The Contractor's allocation of indirect costs, contingencies, markup, and other items to each bid item shall be identified.
- c. All costs shall be identified. For bid items amounting to less than \$10,000, estimated unit costs are acceptable without a detailed cost estimate, provided that labor, equipment, materials, and subcontracts, as applicable, are included and provided that indirect costs, contingencies, and markup, as applicable, are allocated.
- d. Bid Documentation provided by District should not be included in the Escrow Bid Documentation unless needed to comply with the following requirements.

4. Submittal of Escrow Bid Documentation

- a. The Escrow Bid Documentation shall be submitted by the Contractor in a sealed container within **SEVEN (7)** calendar days after the date of the Notice of Award. The container shall be clearly marked on the outside with the Contractor's name, date of submittal, project name and the words "Escrow Bid Documentation – Intended to be opened in the presence of Authorized Representatives of Both District and Contractor".
- b. By submitting Escrow Bid Documentation, Contractor represents that the material in the Escrow Bid Documentation constitutes all the documentary

information used in preparation of the bid and that the Contractor has personally examined the contents of the Escrow Bid Documentation container and has found that the documents in the container are complete.

- c. If Contractor's proposal is based upon subcontracting any part of the work, each subcontractor whose total subcontract price exceeds 5 percent of the total contract price proposed by Contractor, shall provide separate Escrow Documents to be included with those of Contractor. Those documents shall be opened and examined in the same manner and at the same time as the examination described above for Contractor.
- d. If Contractor wishes to subcontract any portion of the Work after award, District retains the right to require Contractor to submit Escrow Documents for the Subcontractor before the subcontract is approved.

5. Storage, Examination and Final Disposition of Escrow Bid Documentation

- a. The Escrow Bid Documentation will be placed in escrow, for the life of the Contract, in a mutually agreeable institution. The cost of storage will be paid by Contractor for the duration of the project until final Contract payment. The storage facilities shall be the appropriate size for all the Escrow Bid Documentation and located conveniently to both District's and Contractor's offices.
- b. The Escrow Bid Documentation shall be examined by both District and Contractor, at any time deemed necessary by either District or Contractor, to assist in the negotiation of price adjustments and change orders or the settlement of disputes and claims. In the case of legal proceedings, Escrow Bid Documentation shall be used subject to the terms of an appropriate protective order if requested by Contractor and ordered by a court of competent jurisdiction. Examination of the Escrow Bid Documentation is subject to the following conditions:
 - (1) As trade secrets, the Escrow Bid Documentation is proprietary and confidential to the extent allowed by law.
 - (2) District and Contractor shall each designate, in writing to the other party **SEVEN (7)** calendar days prior to any examination, the names of representatives who are authorized to examine the Escrow Bid Documentation. No other person shall have access to the Escrow Bid Documentation.
 - (3) Access to the documents may take place only in the presence of duly designated representatives of the District and Contractor. If Contractor fails to designate a representative or appear for joint examination on **SEVEN (7)** calendar days' notice, then the District representative may examine the Escrow Bid Documents alone upon an additional **THREE (3)** calendar days' notice if a representative of the Contractor does not appear at the time set.

- (4) If a subcontractor has submitted sealed information to be included in the Escrow Bid Documents, access to those documents may take place only in the presence of a duly designated representative of the District, Contractor and that subcontractor. If that subcontractor fails to designate a representative or appear for joint examination on **SEVEN (7)** calendar days' notice, then the District representative and/or the Contractor may examine the Escrow Bid Documentation without that subcontractor present upon an additional **THREE (3)** calendar days' notice if a representative of that subcontractor does not appear at the time set.
- c. The Escrow Bid Documentation will be returned to Contractor at such time as the Contract has been completed and final settlement has been achieved.

END OF DOCUMENT

ESCROW AGREEMENT IN LIEU OF RETENTION
(Public Contract Code Section 22300)

(Note: Contractor must use this form.)

This Escrow Agreement in Lieu of Retention ("Escrow Agreement") is made and entered into this _____ day of _____, 20____, by and between the Peralta Community College District ("District"), whose address is 333 East 8th Street, Oakland, California 94606, and _____ ("Contractor"), whose address is _____, and _____ ("Escrow Agent"), a state or federally chartered bank in the state of California, whose address is _____.

For the consideration hereinafter set forth, District, Contractor, and Escrow Agent agree as follows:

1. Pursuant to section 22300 of Public Contract Code of the State of California, which is hereby incorporated by reference, Contractor has the following two (2) options:
 - Deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by District pursuant to the Construction Contract No. _____ entered into between District and Contractor for the _____ Project, in the amount of _____ Dollars (\$ _____) dated, _____, 20____, (the "Contract"); **or**
 - On written request of Contractor, District shall make payments of the retention earnings for the above referenced Contract directly to Escrow Agent.

When Contractor deposits the securities as a substitute for Contract earnings (first option), Escrow Agent shall notify District within ten (10) calendar days of the deposit. The market value of the securities at the time of substitution and at all times from substitution until the termination of the Escrow Agreement shall be at least equal to the cash amount then required to be withheld as retention under the terms of the Contract between District and Contractor.

Securities shall be held in name of Peralta Community College School District, and shall designate Contractor as beneficial owner.

2. District shall make progress payments to Contractor for those funds which otherwise would be withheld from progress payments pursuant to Contract provisions, provided that Escrow Agent holds securities in form and amount specified above.
3. When District makes payment of retention earned directly to Escrow Agent, Escrow Agent shall hold them for the benefit of Contractor until the time that the escrow created under this Escrow Agreement is terminated. Contractor may direct the investment of the payments into securities. All terms and conditions of this Escrow

Agreement and the rights and responsibilities of the Parties shall be equally applicable and binding when District pays Escrow Agent directly.

4. Contractor shall be responsible for paying all fees for the expenses incurred by Escrow Agent in administering the Escrow Account, and all expenses of District. The District will charge Contractor \$_____ for each of District's deposits to the escrow account. These expenses and payment terms shall be determined by District, Contractor, and Escrow Agent.
5. Interest earned on securities or money market accounts held in escrow and all interest earned on that interest shall be for sole account of Contractor and shall be subject to withdrawal by Contractor at any time and from time to time without notice to District.
6. Contractor shall have the right to withdraw all or any part of the principal in the Escrow Account only by written notice to Escrow Agent accompanied by written authorization from District to Escrow Agent that District consents to withdrawal of amount sought to be withdrawn by Contractor.
7. District shall have the right to draw upon the securities and/or withdraw amounts from the Escrow Account in the event of default by Contractor. Upon seven (7) days' written notice to Escrow Agent from District of the default, if applicable, Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by District. Escrow Agent shall not be authorized to determine the validity of any notice of default given by District pursuant to this paragraph, and shall promptly comply with District's instructions to pay over said escrowed assets. Escrow Agent further agrees to not interplead the escrowed assets in response to a conflicting demand.
8. Upon receipt of written notification from District certifying that the Contract is final and complete, and that Contractor has complied with all requirements and procedures applicable to the Contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and charges of the Escrow Account. The escrow shall be closed immediately upon disbursement of all monies and securities on deposit and payments of fees and charges.
9. Escrow Agent shall rely on written notifications from District and Contractor pursuant to Paragraphs 5 through 8, inclusive, of this Escrow Agreement and District and Contractor shall hold Escrow Agent harmless from Escrow Agent's release and disbursement of securities and interest as set forth above.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

10. Names of persons who are authorized to give written notice or to receive written notice on behalf of District and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures are as follows:

On behalf of District:

On behalf of Contractor:

Title

Title

Name

Name

Signature

Signature

Address

Address

On behalf of Escrow Agent:

Title

Name

Signature

Address

At the time that the Escrow Account is opened, District and Contractor shall deliver to Escrow Agent a fully executed copy of this Agreement.

IN WITNESS WHEREOF, the parties have executed this Agreement by their proper officers on the date first set forth above.

On behalf of District:

On behalf of Contractor:

Title

Title

Name

Name

Signature

Signature

Address

Address

END OF DOCUMENT

PERFORMANCE BOND
(100% of Contract Price)

(Note: Contractor must use this form, NOT a surety company form.)

KNOW ALL PERSONS BY THESE PRESENTS:

WHEREAS, the governing board ("Board") of the Peralta Community College District ("District") and _____ ("Principal") have entered into a contract for the furnishing of all materials and labor, services and transportation, necessary, convenient, and proper to perform the following project: **Laney College Library and Learning Resource Center** ("Contract") which Contract dated _____, 20____, and all of the Contract Documents attached to or forming a part of the Contract, are hereby referred to and made a part hereof; and

WHEREAS, said Principal is required under the terms of the Contract to furnish a bond for the faithful performance of the Contract.

NOW, THEREFORE, the Principal and _____ ("Surety") are held and firmly bound unto the Board of the District in the penal sum of _____ Dollars (\$ _____), lawful money of the United States, for the payment of which sum well and truly to be made we bind ourselves, our heirs, executors, administrators, successors, and assigns jointly and severally, firmly by these presents, to:

- Promptly perform all the work required to complete the Project; and
- Pay to the District all damages the District incurs as a result of the Principal's failure to perform all the Work required to complete the Project.

Or, at the District's sole discretion and election, the Surety shall obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by the District of the lowest responsible bidder, arrange for a contract between such bidder and the District and make available as Work progresses sufficient funds to pay the cost of completion less the "balance of the Contract Price," and to pay and perform all obligations of Principals under the Contract, including, without limitation, all obligations with respect to warranties, guarantees and the payment of liquidated damages. The term "balance of the Contract Price," as used in this paragraph, shall mean the total amount payable to Principal by the District under the Contract and any modifications thereto, less the amount previously paid by the District to the Principal, less any withholdings by the District allowed under the Contract. District shall not be required or obligated to accept a tender of a completion contractor from the Surety for any or no reason.

The condition of the obligation is such that, if the above bound Principal, its heirs, executors, administrators, successors, or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions, and agreements in the Contract and any alteration thereof made as therein provided, on its part to be kept and performed at the time and in the intent and meaning, including all contractual guarantees and warranties of materials and workmanship, and shall indemnify and save harmless the

District, its trustees, officers and agents, as therein stipulated, then this obligation shall become null and void, otherwise it shall be and remain in full force and virtue.

Surety expressly agrees that the District may reject any contractor or subcontractor proposed by Surety to fulfill its obligations in the event of default by the Principal. Surety shall not utilize Principal in completing the Work nor shall Surety accept a Bid from Principal for completion of the Work if the District declares the Principal to be in default and notifies Surety of the District's objection to Principal's further participation in the completion of the Work.

As a condition precedent to the satisfactory completion of the Contract, the above obligation shall hold good for a period equal to the warranty and/or guarantee period of the Contract, during which time Surety's obligation shall continue if Contractor shall fail to make full, complete, and satisfactory repair and replacements and totally protect the District from loss or damage resulting from or caused by defective materials or faulty workmanship. The obligations of Surety hereunder shall continue so long as any obligation of Contractor remains. Nothing herein shall limit the District's rights or the Contractor or Surety's obligations under the Contract, law or equity, including, but not limited to, California Code of Civil Procedure section 337.15.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the contract or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this bond. The Surety also stipulates and agrees that it shall not be exonerated or released from the obligation of this bond by any overpayment or underpayment by the District that is based upon estimates approved by the Architect. The Surety does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the Contract or to the work or to the specifications.

IN WITNESS WHEREOF, two (2) identical counterparts of this instrument, each of which shall for all purposes be deemed an original thereof, have been duly executed by the Principal and Surety above named, on the _____ day of _____, 20__.

Principal	Surety
By	By
	_____ Name of California Agent of Surety
	_____ Address of California Agent of Surety
	_____ Telephone No. of California Agent of Surety

Contractor must attach a Notarial Acknowledgment for all Surety's signatures and a Power of Attorney and Certificate of Authority for Surety. The California Department of Insurance must authorize the Surety to be an admitted surety insurer.

END OF DOCUMENT

PAYMENT BOND
Contractor's Labor & Material Bond
(100% Of Contract Price)

(Note: Contractor must use this form, NOT a surety company form.)

KNOW ALL PERSONS BY THESE PRESENTS:

WHEREAS, the governing board ("Board") of the Peralta Community College District, ("District") and _____, ("Principal") have entered into a contract for the furnishing of all materials and labor, services and transportation, necessary, convenient, and proper to perform the following project:

Laney College Library and Learning Resource Center ("Project" or "Contract") which Contract dated _____, 20____, and all of the Contract Documents attached to or forming a part of the Contract, are hereby referred to and made a part hereof; and

WHEREAS, pursuant to law and the Contract, the Principal is required, before entering upon the performance of the work, to file a good and sufficient bond with the body by which the Contract is awarded in an amount equal to one hundred percent (100%) of the Contract price, to secure the claims to which reference is made in sections 9000 through 9510 and 9550 through 9566 of the Civil Code, and division 2, part 7, of the Labor Code.

NOW, THEREFORE, the Principal and _____ ("Surety") are held and firmly bound unto all laborers, material men, and other persons referred to in said statutes in the sum of _____ Dollars (\$_____), lawful money of the United States, being a sum not less than the total amount payable by the terms of Contract, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, or assigns, jointly and severally, by these presents.

The condition of this obligation is that if the Principal or any of its subcontractors, or the heirs, executors, administrators, successors, or assigns of any, all, or either of them shall fail to pay for any labor, materials, provisions, or other supplies, used in, upon, for or about the performance of the work contracted to be done, or for any work or labor thereon of any kind, or for amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of the Principal or any of its subcontractors of any tier under Section 13020 of the Unemployment Insurance Code with respect to such work or labor, that the Surety will pay the same in an amount not exceeding the amount herein above set forth, and also in case suit is brought upon this bond, will pay a reasonable attorney's fee to be awarded and fixed by the court, and to be taxed as costs and to be included in the judgment therein rendered.

It is hereby expressly stipulated and agreed that this bond shall inure to the benefit of any and all persons, companies, and corporations entitled to file claims under section 9100 of the Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond.

Should the condition of this bond be fully performed, then this obligation shall become null and void; otherwise it shall be and remain in full force and affect.

And the Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of Contract or the specifications accompanying the same shall in any manner affect its obligations on this bond, and it does hereby waive notice of any such change, extension, alteration, or addition.

IN WITNESS WHEREOF, two (2) identical counterparts of this instrument, each of which shall for all purposes be deemed an original thereof, have been duly executed by the Principal and Surety above named, on the _____ day of _____, 20__.

_____	_____
Principal	Surety
_____	_____
By	By

	Name of California Agent of Surety

	Address of California Agent of Surety

	Telephone No. of California Agent of Surety

Contractor must attach a Notarial Acknowledgment for all Surety's signatures and a Power of Attorney and Certificate of Authority for Surety. The California Department of Insurance must authorize the Surety to be an admitted surety insurer.

END OF DOCUMENT

ALLOWANCE EXPENDITURE DIRECTIVE FORM

Peralta Community College District
 333 East 8th Street
 Oakland, CA 94606

ALLOWANCE EXPENDITURE DIRECTIVE NO.:

ALLOWANCE EXPENDITURE DIRECTIVE

Project:
Bid No.:

Date:
DSA File No.:
DSA Appl. No.:

The following parties agree to the terms of this Allowance Expenditure Directive ("AED"):

Owner Name, Address, Telephone:

Contractor Name, Address, Telephone:

Reference	Description	Allowance Authorized for Expenditure
Request for AED # Requested by: Performed by: Reason:	[Description of unforeseen item relating to Work] [Requester] [Performer] [Reason]	\$
Request for AED # Requested by: Performed by: Reason:	[Description of unforeseen item relating to Work] [Requester] [Performer] [Reason]	\$
Request for AED # Requested by: Performed by: Reason:	[Description of unforeseen item relating to Work] [Requester] [Performer] [Reason]	\$

Total Contract Allowance Amount:	\$
Amount of Previously Approved Allowance Expenditure Directive(s):	\$
Amount of this Allowance Expenditure Directive:	\$

The undersigned Contractor approves the foregoing release of allowance for completion of each specified item, and agrees to furnish all labor, materials and services and perform all work necessary to complete any additional work specified for the consideration stated therein ("Work"). Submission of sums which have no basis in fact or which Contractor knows are false are at the sole risk of Contractor and may be a violation of the False Claims Act set forth under Government Code section 12650, et seq.

This Allowance Expenditure Directive must be signed by an authorized District representative.

It is expressly understood that the authorized allowance expenditure granted herein represent a full accord and satisfaction for any and all cost impacts of the items herein, and Contractor waives any and all further compensation based on the items herein. The value of the extra work or changes expressly includes any and all of the Contractor's costs and expenses, and its subcontractors, both direct and indirect. Any costs, expenses, or damages not included are deemed waived.

Signatures:

<p>DISTRICT:</p> <p>PERALTA COMMUNITY COLLEGE DISTRICT</p> <p>Date: _____</p> <p>By: _____ [Print Name and Title here]</p>	<p>CONTRACTOR:</p> <p>_____</p> <p>Date: _____</p> <p>By: _____ [Print Name and Title here]</p>
<p>ARCHITECT:</p> <p>_____</p> <p>Date: _____</p> <p>By: _____ [Print Name and Title here]</p>	<p>PROJECT INSPECTOR:</p> <p>_____</p> <p>Date: _____</p> <p>By: _____ [Print Name and Title here]</p>

END OF DOCUMENT

DAILY FORCE ACCOUNT REPORT

From: Contractor
[Name/Address]

To: Owner
[Name/Address]

Project: _____

Contractor hereby submits this Daily Force Account Report for Work performed, pursuant to Force Account Directive No. _____, on _____.
[Date of Work]

Contractor attests that the material, labor, and equipment itemized herein were used only on the force account work.

A. Material: *Attach all applicable invoices not provided in prior Daily Force Account Reports and complete the information below.*

Description	Unit Price	Quantity	Cost

Daily subtotal (w/out markup): \$ _____

B. Labor: *Labor must be fully Burdened. Attach timesheets, if applicable, and complete the information below.*

Name	Craft	Regular Hrs.	Rate	OT Hrs.	Rate

Daily subtotal (w/out markup): \$ _____

C. **Equipment:** Attach all applicable invoices not provided in prior Daily Force Account Reports and complete the information below.

Type / Model	Hrs. Operated	Rate

Daily subtotal (w/out markup): \$ _____

Complete based on information reported above.

	<u>WORK PERFORMED OTHER THAN BY CONTRACTOR</u>	<u>ADD</u>
i.	<u>Material</u>	
ii.	<u>Add Labor</u>	
iii.	<u>Add Equipment</u>	
iv.	<u>Subtotal</u>	
v.	<u>Add overhead and profit for any and all tiers of Subcontractor</u> , the total not to exceed ten percent (10%) of Item (d)	
vi.	<u>Subtotal</u>	
vii.	<u>Add Overhead and Profit for Contractor</u> , not to exceed five percent (5%) of Item (f)	
viii.	<u>Subtotal</u>	
ix.	<u>Add Bond and Insurance</u> , not to exceed two percent (2%) of Item (h)	
x.	<u>TOTAL</u>	

	<u>WORK PERFORMED BY CONTRACTOR</u>	<u>ADD</u>
(a)	<u>Material</u>	
xi.	<u>Add Labor</u>	
xii.	<u>Add Equipment</u>	
xiii.	<u>Subtotal</u>	
xiv.	<u>Add Overhead and Profit for Contractor</u> , not to exceed fifteen percent (15%) of Item (d)	
xv.	<u>Subtotal</u>	
xvi.	<u>Add Bond and Insurance</u> , not to exceed two percent (2%) of Item (f)	
xvii.	<u>TOTAL</u>	

Submission of sums which have no basis in fact or which Contractor knows are false are at the sole risk of Contractor and may be a violation of the False Claims Act (Gov. Code, § 12650, et seq.).

It is expressly understood that all force account work for the date stated above must be reported herein, and Contractor may not claim any labor, equipment, material or any other costs or expenses not reported herein. Contractor is not entitled to separately recover amounts for overhead or other indirect costs. Any costs, expenses, or damages, not included are deemed waived.

SUBMITTED BY:

REVIEWED BY:

Contractor: _____

_____ Community College:

[Name]

Date

[Name]

Date

District may require additional information from Contractor to review this Daily Force Account Report. Upon District's return of the Daily Force Account Report, Contractor may invoice the Work reflected therein. District's review and return of the Daily Force Account Report and/or payment for the force account work does not constitute acceptance of the Work or waiver of any Contract rights or criteria.

END OF DOCUMENT

PROPOSED CHANGE ORDER FORM

Peralta Community College District
333 East 8th Street
Oakland, CA 94606

PCO NO.:

Project:
Bid No.:
RFI #:

Date:
DSA File No.:
DSA Appl. No.:

Contractor hereby submits for District's review and evaluation this Proposed Change Order ("PCO"), submitted in accordance with and subject to the terms of the Contract Documents, including Sections 17.7 and 17.8 of the General Conditions. Any spaces left blank below are deemed no change to cost or time.

Contractor understands and acknowledges that documentation supporting Contractor's PCO must be attached and included for District review and evaluation. Contractor further understands and acknowledges that failure to include documentation sufficient to, in District's discretion, support some or all of the PCO, shall result in a rejected PCO.

	<u>WORK PERFORMED OTHER THAN BY CONTRACTOR</u>	<u>ADD</u>	<u>DEDUCT</u>
(a)	<u>Material</u> (attach suppliers' invoice or itemized quantity and unit cost plus sales tax)		
(b)	<u>Add Labor</u> (attach itemized hours and rates, fully Burdened, and specify the hourly rate for each additional labor burden, for example, payroll taxes, fringe benefits, etc.)		
(c)	<u>Add Equipment</u> (attach suppliers' invoice)		
(d)	<u>Subtotal</u>		
(e)	<u>Add overhead and profit for any and all tiers of Subcontractor</u> , the total not to exceed ten percent (10%) of Item (d)		
(f)	<u>Subtotal</u>		
(g)	<u>Add General Conditions</u> (if Time is Compensable) (attach supporting documentation)		
(h)	<u>Subtotal</u>		
(i)	<u>Add Overhead and Profit for Contractor</u> , not to exceed five percent (5%) of Item (h)		
(j)	<u>Subtotal</u>		
(k)	<u>Add Bond and Insurance</u> , not to exceed two percent (2%) of Item (j)		
(l)	<u>TOTAL</u>		
(m)	<u>Time</u> (zero unless indicated; "TBD" not permitted)	____ Calendar Days	

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	WORK PERFORMED BY CONTRACTOR	ADD	DEDUCT
(a)	Material (attach itemized quantity and unit cost plus sales tax)		
(b)	Add Labor (attach itemized hours and rates, fully Burdened, and specify the hourly rate for each additional labor burden, for example, payroll taxes, fringe benefits, etc.)		
(c)	Add Equipment (attach suppliers' invoice)		
(d)	Add General Conditions (if Time is Compensable) (attach supporting documentation)		
(e)	Subtotal		
(f)	Add Overhead and Profit for Contractor , not to exceed fifteen percent (15%) of Item (e)		
(g)	Subtotal		
(h)	Add Bond and Insurance , not to exceed two percent (2%) of Item (g)		
(i)	TOTAL		
(j)	Time (zero unless indicated; "TBD" not permitted)	_____ Calendar Days	

The undersigned Contractor approves the foregoing as to the changes, if any, to the Contract Price specified for each item, and as to the extension of time allowed, if any, for completion of the entire Work as stated herein, and agrees to furnish all labor, materials, and service, and perform all work necessary to complete any additional work specified for the consideration stated herein. Submission of sums which have no basis in fact or which Contractor knows are false are at the sole risk of Contractor and may be a violation of the False Claims Act set forth under Government Code section 12650 et seq. It is understood that the changes herein to the Contract shall only be effective when approved by the governing board of the District.

It is expressly understood that the value of the extra Work or changes expressly includes any and all of the Contractor's costs and expenses, direct and indirect, resulting from additional time required on the Project or resulting from delay to the Project including, without limitation, cumulative impacts. Contractor is not entitled to separately recover amounts for overhead or other indirect costs. Any costs, expenses, damages, or time extensions not included are deemed waived.

SUBMITTED BY:

Contractor:

[Name]

Date

END OF DOCUMENT

CHANGE ORDER FORM

Peralta Community College District
333 East 8th Street
Oakland, CA 94606

CHANGE ORDER NO.:

CHANGE ORDER**Project:****Bid No.:****Date:****DSA File No.:****DSA Appl. No.:**

The following parties agree to the terms of this Change Order:

Owner:

[Name / Address]

Contractor:

[Name / Address]

Architect:

[Name / Address]

Project Inspector:

[Name / Address]

Reference	Description	Cost	Days Ext.
PCO # Requested by: Performed by: Reason:	[Description of change] [Requester] [Performer] [Reason]	\$	
PCO # Requested by: Performed by: Reason:	[Description of change] [Requester] [Performer] [Reason]	\$	
PCO # Requested by: Performed by: Reason:	[Description of change] [Requester] [Performer] [Reason]	\$	
Contract time will be adjusted as follows: Previous Completion Date: __[Date] _____[#] Calendar Days Extension (zero unless otherwise indicated) Current Completion Date: __[Date]		Original Contract Amount:	\$
		Amount of Previously Approved Change Order(s):	\$
		Amount of this Change Order:	\$
		Contract Amount:	\$

AGREEMENT AND RELEASE OF ANY AND ALL CLAIMS

THIS AGREEMENT AND RELEASE OF CLAIMS ("Agreement and Release") IS MADE AND ENTERED INTO THIS _____ DAY OF _____, 20____ by and between the PERALTA COMMUNITY COLLEGE DISTRICT ("District") and _____ ("Contractor"), whose place of business is _____.

RECITALS

WHEREAS, District and Contractor entered into PROJECT/CONTRACT NO.: _____ ("Contract" or "Project") in the County of Alameda, California; and

WHEREAS, the Work under the Contract was completed on _____, and a Notice of Completion was recorded with the County Recorder on _____.

Commented [A1]: If a NOC is recorded.

NOW, THEREFORE, it is mutually agreed between District and Contractor as follows:

AGREEMENT AND RELEASE

1. Contractor will only be assessed liquidated damages as detailed below:

- Original Contract Sum \$ _____
- Modified Contract Sum \$ _____
- Payment to Date \$ _____
- Liquidated Damages \$ _____
- Payment Due Contractor \$ _____

2. Subject to the provisions hereof, District shall forthwith pay to Contractor the undisputed sum of _____ Dollars (\$_____) under the Contract, less any amounts represented by any notice to withhold funds on file with District as of the date of such payment.

3. Contractor acknowledges and hereby agrees that there are no unresolved or outstanding claims in dispute against District arising from the performance of work under the Contract, except for the claims described in Paragraph 6 and continuing obligations described in Paragraph 8. It is the intention of the parties in executing this Agreement and Release that this Agreement and Release shall be effective as a full, final and general release of all claims, demands, actions, causes of action, obligations, costs, expenses, damages, losses and liabilities of Contractor against District and all of its respective agents, employees, trustees, inspectors, assignees, consultants and transferees, except for any Disputed Claim that may be set forth in Paragraph 4 and the continuing obligations described in Paragraph 6 hereof.

4. The following claims are disputed (hereinafter, the "Disputed Claims") and are specifically excluded from the operation of this Agreement and Release:

<u>Claim No.</u>	<u>Description of Claim</u>	<u>Amount of Claim</u>	<u>Date Claim Submitted</u>
_____	_____	\$ _____	_____
_____	_____	\$ _____	_____
_____	_____	\$ _____	_____
_____	_____	\$ _____	_____

[If further space is required, attach additional sheets showing the required information.]

5. Consistent with California Public Contract Code section 7100, Contractor hereby agrees that, in consideration of the payment set forth in Paragraph 4 hereof, Contractor hereby releases and forever discharges District, all its agents, employees, inspectors, assignees, and transferees from any and all liability, claims, demands, actions, or causes of action of whatever kind or nature arising out of or in any way concerned with the Work under the Contract.
6. Guarantees and warranties for the Work, and any other continuing obligation of Contractor including, without limitation, the duty to defend, indemnify and hold harmless the District, shall remain in full force and effect as specified in the Contract Documents.
7. Contractor hereby waives the provisions of California Civil Code section 1542 which provides as follows:
- A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS THAT THE CREDITOR OR RELEASING PARTY DOES NOT KNOW OR SUSPECT TO EXIST IN HIS OR HER FAVOR AT THE TIME OF EXECUTING THE RELEASE, AND THAT, IF KNOWN BY HIM OR HER WOULD HAVE MATERIALLY AFFECTED HIS OR HER SETTLEMENT WITH THE DEBTOR OR RELEASED PARTY.
8. The provisions of this Agreement and Release are contractual in nature and not mere recitals and shall be considered independent and severable. If any such provision or any part thereof shall be at any time held invalid in whole or in part under any federal, state, county, municipal, or other law, ruling, or regulations, then such provision, or part thereof, shall remain in force and effect to the extent permitted by law, and the remaining provisions of this Agreement and Release shall also remain in full force and effect, and shall be enforceable.

9. All rights of District shall survive completion of the Work or termination of Contract, and execution of this Release.

* * * CAUTION: THIS IS A RELEASE - READ BEFORE EXECUTING * * *

PERALTA COMMUNITY COLLEGE DISTRICT

Signature: _____

Print Name: _____

Title: _____

CONTRACTOR: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

GUARANTEE FORM

_____ ("Contractor") hereby agrees that the _____
_____ ("Work" of Contractor) which Contractor has installed for the Peralta
Community College District ("District") for the following project:

PROJECT: _____

("Project" or "Contract") has been performed in accordance with the requirements of the
Contract Documents and that the Work as installed will fulfill the requirements of the
Contract Documents.

The undersigned agrees to repair or replace any or all of such Work that may prove to be
defective in workmanship or material together with any other adjacent Work that may be
displaced in connection with such replacement within a period of one year(s) from the date
of completion as defined in Public Contract Code section 7107, subdivision (c), ordinary
wear and tear and unusual abuse or neglect excepted. The date of completion is
_____, 20__.

In the event of the undersigned's failure to comply with the above-mentioned conditions
within a reasonable period of time, as determined by the District, but not later than seven
(7) days after being notified in writing by the District, the undersigned authorizes the
District to proceed to have said defects repaired and made good at the expense of the
undersigned. The undersigned shall pay the costs and charges therefor upon demand.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

Representatives to be contacted for service subject to terms of Contract:

Name: _____

Address: _____

Phone No.: _____

Email: _____

END OF DOCUMENT

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GENERAL CONDITIONS

1. CONTRACT TERMS AND DEFINITIONS

1.1 Definitions

Wherever used in the Contract Documents, the following terms shall have the meanings indicated, which shall be applicable to both the singular and plural thereof:

1.1.1 Adverse Weather: Shall be only weather that satisfies all of the following conditions: (1) unusually severe precipitation, sleet, snow, hail, or extreme temperature conditions in excess of the norm for the location and time of year it occurred based on the closest weather station data averaged over the past five years, (2) that is unanticipated and would cause unsafe work conditions and/or is unsuitable for scheduled work that should not be performed during inclement weather (i.e., exterior finishes), and (3) at the Project.

1.1.2 Allowance Expenditure Directive: Written authorization for expenditure of allowance, if any.

1.1.3 Approval, Approved, and/or Accepted: Written authorization, unless stated otherwise.

1.1.4 Architect (or "Design Professional in General Responsible Charge"): The individual, partnership, corporation, joint venture, or any combination thereof, named as Architect, who will have the rights and authority assigned to the Architect in the Contract Documents. The term Architect means the Design Professional in General Responsible Charge as defined in DSA PR 13-02 on this Project or the Architect's authorized representative.

1.1.5 As-Builts: Reproducible blue line prints of drawings to be prepared on a monthly basis pursuant to the Contract Documents, that reflect changes made during the performance of the Work, recording differences between the original design of the Work and the Work as constructed since the preceding monthly submittal. See **Record Drawings**.

1.1.6 Bidder: A contractor who intends to provide a proposal to the District to perform the Work of this Contract.

1.1.7 Burdened: The labor rate for Contractor or any Subcontractor inclusive of any and all burden costs including, but not limited to, health and welfare pay, vacation and holiday pay, pension contributions, training rates, benefits of any kind, insurance of any kind, workers' compensation, liability insurance, truck expenses, supply expenses of any kind, payroll taxes, and any other taxes of any kind.

1.1.8 Change Order: A written order to the Contractor authorizing an addition to, deletion from, or revision in the Work, and/or authorizing an adjustment in the Contract Price or Contract Time.

1.1.9 Claim: A Dispute that remains unresolved at the conclusion of the all the applicable Dispute Resolution requirements provided herein.

1.1.10 Construction Change Directive: A written order prepared and issued by the District, the Construction Manager, and/or the Architect and signed by the District and the Architect, directing a change in the Work.

1.1.11 Construction Manager: The individual, partnership, corporation, joint venture, or any combination thereof, or its authorized representative, named as such by the District. If no Construction Manager is used on the Project that is the subject of this Contract, then all references to Construction Manager herein shall be read to refer to District.

1.1.12 Construction Schedule: The progress schedule of construction of the Project as provided by Contractor and approved by District.

1.1.13 Contract, Contract Documents: The Contract consists exclusively of the documents evidencing the agreement of the District and Contractor, identified as the Contract Documents. The Contract Documents consist of the following documents:

- 1.1.13.1** Notice to Bidders
- 1.1.13.2** Instructions to Bidders
- 1.1.13.3** Bid Form and Proposal
- 1.1.13.4** Bid Bond
- 1.1.13.5** Designated Subcontractors List
- 1.1.13.6** Site Visit Certification (if a site visit was required)
- 1.1.13.7** Non-Collusion Declaration
- 1.1.13.8** Notice of Award
- 1.1.13.9** Notice to Proceed
- 1.1.13.10** Agreement
- 1.1.13.11** Escrow of Bid Documentation
- 1.1.13.12** Escrow Agreement for Security Deposits in Lieu of Retention (if applicable)
- 1.1.13.13** Performance Bond
- 1.1.13.14** Payment Bond (Contractor's Labor & Material Bond)
- 1.1.13.15** General Conditions
- 1.1.13.16** Special Conditions (if applicable)
- 1.1.13.17** Project Labor Agreement (if applicable)
- 1.1.13.18** Hazardous Materials Procedures and Requirements
- 1.1.13.19** Workers' Compensation Certification
- 1.1.13.20** Prevailing Wage Certification
- 1.1.13.21** Disabled Veteran Business Enterprise Participation Certification (if applicable)
- 1.1.13.22** Drug-Free Workplace Certification (if applicable)
- 1.1.13.23** Tobacco-Free Environment Certification
- 1.1.13.24** Hazardous Materials Certification (if applicable)
- 1.1.13.25** Lead-Based Materials Certification (if applicable)
- 1.1.13.26** Imported Materials Certification (if applicable)
- 1.1.13.27** Sex Offender Registration Act Certification (if applicable)
- 1.1.13.28** Buy American Certification (if certain federal funds used)
- 1.1.13.29** Roofing Project Certification (if applicable)
- 1.1.13.30** Registered Subcontractors List

- 1.1.13.31** Iran Contracting Act Certification (if applicable)
- 1.1.13.32** COVID-19 Vaccination/Testing Certification
- 1.1.13.33** Federal Debarment Certification (if applicable)
- 1.1.13.34** Federal Byrd Anti-Lobbying Certification (if applicable)
- 1.1.13.35** Post Bid Interview
- 1.1.13.36** All Plans, Technical Specifications, and Drawings
- 1.1.13.37** Any and all addenda to any of the above documents
- 1.1.13.38** Any and all change orders or written modifications to the above documents if approved in writing by the District

1.1.14 Contract Price: The total monies payable to the Contractor under the terms and conditions of the Contract Documents.

1.1.15 Contract Time: The time period stated in the Agreement for the completion of the Work.

1.1.16 Contractor: The person or persons identified in the Agreement as contracting to perform the Work to be done under this Contract, or the legal representative of such a person or persons.

1.1.17 Daily Job Report(s): Daily Project reports prepared by the Contractor's employee(s) who are present on Site, which shall include the information required herein.

1.1.18 Day(s): Unless otherwise designated, day(s) means calendar day(s).

1.1.19 Department of Industrial Relations (or "DIR"): is responsible, among other things, for labor compliance monitoring and enforcement of California prevailing wage laws and regulations for public works contracts.

1.1.20 Design Professional in General Responsible Charge: See definition of **Architect** above.

1.1.21 Dispute: A separate demand by Contractor for a time extension, or payment of money or damages arising from Work done by or on behalf of the Contractor pursuant to the Contract and payment of which is not otherwise expressly provided for or Contractor is not otherwise entitled to; or an amount of payment disputed by the District.

1.1.22 District: The public agency or the district for which the Work is performed. The governing board of the District or its designees will act for the District in all matters pertaining to the Contract. The District may, at any time,

1.1.22.1 Direct the Contractor to communicate with or provide notice to the Construction Manager or the Architect on matters for which the Contract Documents indicate the Contractor will communicate with or provide notice to the District; and/or

1.1.22.2 Direct the Construction Manager or the Architect to communicate with or direct the Contractor on matters for which the Contract Documents indicate the District will communicate with or direct the Contractor.

1.1.23 Drawings (or "Plans"): The graphic and pictorial portions of the Contract Documents showing the design, location, scope and dimensions of the work, generally including plans, elevations, sections, details, schedules, sequence of operation, and diagrams.

1.1.24 DSA: Division of the State Architect.

1.1.25 Force Account Directive: A process that may be used when the District and the Contractor cannot agree on a price for a specific portion of work or before the Contractor prepares a price for a specific portion of work and whereby the Contractor performs the work as indicated herein on a time and materials basis.

1.1.26 Job Cost Reports: Any and all reports or records detailing the costs associated with work performed on or related to the Project that Contractor shall maintain for the Project. Specifically, Job Cost Reports shall contain, but are not limited by or to, the following information: a description of the work performed or to be performed on the Project; quantity, if applicable, of work performed (hours, square feet, cubic yards, pounds, etc.) for the Project; Project budget; costs for the Project to date; estimated costs to complete the Project; and expected costs at completion. The Job Cost Reports shall also reflect all Contract cost codes, change orders, elements of non-conforming work, back charges, and additional services.

1.1.27 Labor Commissioner's Office (or "Labor Commissioner", also known as the Division of Labor Standards Enforcement ("DLSE")): Division of the DIR responsible for adjudicating wage claims, investigating discrimination and public works complaints, and enforcing Labor Code statutes and Industrial Welfare Commission orders.

1.1.28 Municipal Separate Storm Sewer System (or "MS4"): A system of conveyances used to collect and/or convey storm water, including, without limitation, catch basins, curbs, gutters, ditches, man-made channels, and storm drains.

1.1.29 Plans: See **Drawings**.

1.1.30 Premises: The real property owned by the District on which the Site is located.

1.1.31 Product(s): New material, machinery, components, equipment, fixtures and systems forming the Work, including existing materials or components required and approved by the District for reuse.

1.1.32 Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate a material, product, or system for some portion of the Work.

1.1.33 Program Manager: The individual, partnership, corporation, joint venture, or any combination thereof, or its authorized representative, named as such by the District. If no Program Manager is designated for Project that is the subject of this Contract, then all references to Project Manager herein shall be read to refer to District.

1.1.34 Project: The planned undertaking as provided for in the Contract Documents.

1.1.35 Project Inspector (or "Inspector"): The individual(s) retained by the District in accordance with title 24 of the California Code of Regulations to monitor and inspect the Project.

1.1.36 Project Labor Agreement (or "PLA"): a prehire collective bargaining agreement in accordance with Public Contract Code section 2500 *et seq.* that establishes terms and conditions of employment for a specific construction project or projects and/or is an agreement described in Section 158(f) of Title 29 of the United States Code.

1.1.37 Proposed Change Order (or "PCO"): a written request prepared by the Contractor requesting that the District and the Architect issue a Change Order based upon a proposed change to the Work.

1.1.38 Provide: Shall include "provide complete in place," that is, "furnish and install," and "provide complete and functioning as intended in place" unless specifically stated otherwise.

1.1.39 Qualified SWPPP Practitioners (or "QSP"): certified personnel that attended a State Water Resources Control Board sponsored or approved training class and passed the qualifying exam.

1.1.40 Record Drawings: Reproducible drawings (or Plans) prepared pursuant to the requirements of the Contract Documents that reflect all changes made during the performance of the Work, recording differences between the original design of the Work and the Work as constructed upon completion of the Project. See also **As-Builts**.

1.1.41 Request for Information (or "RFI"): A written request prepared by the Contractor requesting that the Architect provide additional information necessary to clarify or amplify an item in the Contract Documents that the Contractor believes is not clearly shown or called for in the Drawings or Specifications or other portions of the Contract Documents, or to address problems that have arisen under field conditions.

1.1.42 Request for Substitution for Specified Item: A request by Contractor to substitute an equal or superior material, product, thing, or service for a specific material, product, thing, or service that has been designated in the Contract Documents by a specific brand or trade name.

1.1.43 Safety Orders: Written and/or verbal orders for construction issued by the California Division of Occupational Safety and Health ("CalOSHA") or by the United States Occupational Safety and Health Administration ("OSHA").

1.1.44 Safety Plan: Contractor's safety plan specifically adapted for the Project. Contractor's Safety Plan shall comply with all provisions regarding Project safety, including all applicable provisions in these General Conditions.

1.1.45 Samples: Physical examples that illustrate materials, products, equipment, finishes, colors, or workmanship and that, when approved in accordance with the Contract Documents, establish standards by which portions of the Work will be judged.

1.1.46 Shop Drawings: All drawings, prints, diagrams, illustrations, brochures, schedules, and other data that are prepared by the Contractor, a subcontractor, manufacturer, supplier, or distributor, that illustrate how specific portions of the Work shall be fabricated or installed.

1.1.47 Site: The Project site as shown on the Drawings.

1.1.48 Specifications: That portion of the Contract Documents, Division 1 through Division 49, and all technical sections, and addenda to all of these, if any, consisting of written descriptions and requirements of a technical nature of materials, equipment, construction methods and systems, standards, and workmanship.

1.1.49 State: The State of California.

1.1.50 Storm Water Pollution Prevention Plan (or "SWPPP"): A document which identifies sources and activities at a particular facility that may contribute pollutants to storm water and contains specific control measures and time frames to prevent or treat such pollutants.

1.1.51 Subcontractor: A contractor and/or supplier who is under contract with the Contractor or with any other subcontractor, regardless of tier, to perform a portion of the Work of the Project.

1.1.52 Submittal Schedule: The schedule of submittals as provided by Contractor and approved by District.

1.1.53 Surety: The person, firm, or corporation that executes as surety the Contractor's Performance Bond and Payment Bond, and must be a California admitted surety insurer as defined in the Code of Civil Procedure section 995.120.

1.1.54 Work: All labor, materials, equipment, components, appliances, supervision, coordination, and services required by, or reasonably inferred from, the Contract Documents, that are necessary for the construction and completion of the Project.

1.2 Laws Concerning the Contract

Contract is subject to all provisions of the Constitution and laws of California and the United States governing, controlling, or affecting District, or the property, funds, operations, or powers of District, and such provisions are by this reference made a part hereof. Any provision required by law to be included in this Contract shall be deemed to be inserted.

1.3 No Oral Agreements

No oral agreement or conversation with any officer, agent, or employee of District, either before or after execution of Contract, shall affect or modify any of the terms or obligations contained in any of the documents comprising the Contract.

1.4 No Assignment

Contractor shall not assign this Contract or any part thereof including, without limitation, any Work or money to become due hereunder without the prior written consent of the District. Assignment without District's prior written consent shall be null and void. Any assignment of money due or to become due under this Contract shall be subject to a prior lien for services rendered or material supplied for performance of work called for under this Contract in favor of all persons, firms, or corporations rendering services or supplying material to the extent that claims are filed pursuant to the Civil Code, Code of Civil Procedure, Government Code, Labor Code, and/or Public Contract Code, and shall also be subject to deductions for liquidated damages or withholding of payments as determined by District in accordance with this Contract. Contractor shall not assign or transfer in any manner to a Subcontractor or supplier the right to prosecute or maintain an action against the District.

1.5 Notice and Service Thereof

1.5.1 Any notice from one party to the other or otherwise under Contract shall be in writing and shall be dated and signed by the party giving notice or by a duly authorized representative of that party. Any notice shall not be effective for any purpose whatsoever unless served in one of the following manners:

1.5.1.1 If notice is given by personal delivery thereof, it shall be considered delivered on the day of delivery.

1.5.1.2 If notice is given by overnight delivery service, it shall be considered delivered one (1) day after date deposited, as indicated by the delivery service.

1.5.1.3 If notice is given by depositing same in United States mail, enclosed in a sealed envelope, it shall be considered delivered three (3) days after date deposited, as indicated by the postmarked date.

1.5.1.4 If notice is given by registered or certified mail with postage prepaid, return receipt requested, it shall be considered delivered on the day the notice is signed for.

1.5.1.5 Electronic mail may be used for convenience but is not a substitute for the notice and service requirements herein.

1.6 No Waiver

The failure of District in any one or more instances to insist upon strict performance of any of the terms of this Contract or to exercise any option herein conferred shall not be construed as a waiver or relinquishment to any extent of the right to assert or rely upon any such terms or option on any future occasion. No action or failure to act by the District, Architect, or Construction Manager shall constitute a waiver of any right or duty afforded the District under the Contract, nor shall any action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

1.7 Substitutions for Specified Items

Unless the Special Conditions contain different provisions, Contractor shall not substitute different items for any items identified in the Contract Documents without prior written approval of the District.

1.8 Materials and Work

1.8.1 Except as otherwise specifically stated in this Contract, Contractor shall provide and pay for all materials, labor, tools, equipment, transportation, supervision, temporary constructions of every nature, and all other services, management, and facilities of every nature whatsoever necessary to execute and complete this Contract, in a good and workmanlike manner, within the Contract Time.

1.8.2 Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and grades as noted or specified, workmanship shall be of good quality, and Contractor shall use all diligence to inform itself fully as to the required manufacturer's instructions and to comply therewith.

1.8.3 Materials shall be furnished in ample quantities and at such times as to ensure uninterrupted progress of Work and shall be stored properly and protected from the elements, theft, vandalism, or other loss or damage as required.

1.8.4 For all materials and equipment specified or indicated in the Drawings, the Contractor shall provide all labor, materials, equipment, and services necessary for complete assemblies and complete working systems, functioning as intended. Incidental items not indicated on Drawings, nor mentioned in the Specifications, that can legitimately and reasonably be inferred to belong to the Work described, or be necessary in good practice to provide a complete assembly or system, shall be furnished as though itemized here in every detail. In all instances, material and equipment shall be installed in strict accordance with each manufacturer's most recent published recommendations and specifications.

1.8.5 Contractor shall, after award of Contract by District and after relevant submittals have been reviewed, place orders for materials and/or equipment as specified so that delivery of same may be made without delays to the Work. Contractor shall, upon five (5) days' demand from District, present documentary evidence showing that orders have been placed.

1.8.6 District reserves the right but has no obligation, in response to Contractor's neglect or failure in complying with the above instructions, to place orders for such materials and/or equipment as the District may deem advisable in order that the Work may be completed at the date specified in the Contract, and all expenses incidental to the procuring of said materials and/or equipment shall be paid for by Contractor or deducted from payment(s) to Contractor.

1.8.7 Contractor warrants good title to all material, supplies, and equipment installed or incorporated in Work and agrees upon completion of all Work to deliver the Site to District, together with all improvements and appurtenances constructed or placed thereon by it, and free from any claims, liens, or charges. Contractor further agrees that neither it nor any person, firm, or corporation furnishing any

materials or labor for any work covered by the Contract shall have any right to lien any portion of the Premises or any improvement or appurtenance thereon, except that Contractor may install metering devices or other equipment of utility companies or of political subdivision, title to which is commonly retained by utility company or political subdivision. In the event of installation of any such metering device or equipment, Contractor shall advise District as to owner thereof.

1.8.7.1 If a lien or a claim based on a stop payment notice of any nature should at any time be filed against the Work or any District property, by any entity that has supplied material or services at the request of the Contractor, Contractor and Contractor's Surety shall promptly, on demand by District and at Contractor's and Surety's own expense, take any and all action necessary to cause any such lien or a claim based on a stop payment notice to be released or discharged immediately therefrom.

1.8.7.2 If the Contractor fails to furnish to the District within ten (10) calendar days after demand by the District, satisfactory evidence that a lien or a claim based on a stop payment notice has been so released, discharged, or secured, the District may discharge such indebtedness and deduct the amount required therefor, together with any and all losses, costs, damages, and attorney's fees and expense incurred or suffered by District from any sum payable to Contractor under the Contract.

1.8.8 Nothing contained in this Article, however, shall defeat or impair the rights of persons furnishing materials or labor under any bond given by Contractor for their protection or any rights under any law permitting such protection or any rights under any law permitting such persons to look to funds due Contractor in hands of District (e.g., stop payment notices), and this provision shall be inserted in all subcontracts and material contracts and notice of its provisions shall be given to all persons furnishing material for work when no formal contract is entered into for such material.

1.8.9 Title to new materials and/or equipment for the Work of this Contract and attendant liability for its protection and safety shall remain with Contractor until incorporated in the Work of this Contract and accepted by District. No part of any materials and/or equipment shall be removed from its place of storage except for immediate installation in the Work of this Contract. Should the District, in its discretion, allow the Contractor to store materials and/or equipment for the Work off-site, Contractor will store said materials and/or equipment at a bonded warehouse and with appropriate insurance coverage at no cost to District. Contractor shall keep an accurate inventory of all materials and/or equipment in a manner satisfactory to District or its authorized representative and shall, at the District's request, forward it to the District.

1.8.10 [RESERVED]

2. [RESERVED]

3. ARCHITECT

3.1 The Architect shall represent the District during the Project and will observe the progress and quality of the Work on behalf of the District. Architect shall

have the authority to act on behalf of District to the extent expressly provided in the Contract Documents and to the extent determined by District. Architect shall have authority to reject materials, workmanship, and/or the Work whenever rejection may be necessary, in Architect's reasonable opinion, to ensure the proper execution of the Contract.

3.2 Architect shall, with the District and on behalf of the District, determine the amount, quality, acceptability, and fitness of all parts of the Work, and interpret the Specifications, Drawings, and shall, with the District, interpret all other Contract Documents.

3.3 Architect shall have all authority and responsibility established by law, including title 24 of the California Code of Regulations.

3.4 Contractor shall provide District and the Construction Manager with a copy of all written communication between Contractor and Architect at the same time as that communication is made to Architect, including, without limitation, all RFIs, correspondence, submittals, claims, and proposed change orders.

4. CONSTRUCTION MANAGER

4.1 If a Construction Manager is used on this Project ("Construction Manager" or "CM"), the Construction Manager will provide administration of the Contract on the District's behalf. After execution of the Contract and Notice to Proceed, all correspondence and/or instructions from Contractor and/or District shall be forwarded through the Construction Manager. The Construction Manager will not be responsible for and will not have control or charge of construction means, methods, techniques, sequences, or procedures or for safety precautions in connection with the Work, which shall all remain the Contractor's responsibility.

4.2 The Construction Manager, however, will have authority to reject materials and/or workmanship not conforming to the Contract Documents, as determined by the District, the Architect, and/or the Project Inspector. The Construction Manager shall also have the authority to require special inspection or testing of any portion of the Work, whether it has been fabricated, installed, or fully completed. Any decision made by the Construction Manager, in good faith, shall not give rise to any duty or responsibility of the Construction Manager to: the Contractor; any Subcontractor; the Contractor or Subcontractor's respective agents, employees; or other persons performing any of the Work. The Construction Manager shall have free access to any or all parts of Work at any time.

4.3 If the District does not use a Construction Manager on this Project, all references within the Contract Documents to Construction Manager or CM shall be read as District.

5. INSPECTOR, INSPECTIONS, AND TESTS

5.1 Project Inspector

5.1.1 One or more Project Inspector(s), including special Project Inspector(s), as required, will be assigned to the Work by District, in accordance with requirements of title 24, part 1, of the California Code of Regulations, to enforce the building code

and monitor compliance with Plans and Specifications for the Project previously approved by the DSA. Duties of Project Inspector(s) are specifically defined in section 4-342 of said part 1 of title 24.

5.1.2 No Work shall be carried on except with the knowledge and under the inspection of the Project Inspector(s). The Project Inspector(s) shall have free access to any or all parts of Work at any time. Contractor shall furnish Project Inspector(s) reasonable opportunities for obtaining such information as may be necessary to keep Project Inspector(s) fully informed respecting progress and manner of work and character of materials, including, but not limited to, submission of form DSA 156 (or the most current version applicable at the time the Work is performed) to the Project Inspector at least 48 hours in advance of the commencement and completion of construction of each and every aspect of the Work. Forms are available on the DSA's website at: <http://www.dgs.ca.gov/dsa/Forms.aspx>. Inspection of Work shall not relieve Contractor from an obligation to fulfill this Contract. Project Inspector(s) and the DSA are authorized to suspend work whenever the Contractor and/or its Subcontractor(s) are not complying with the Contract Documents. Any work stoppage by the Project Inspector(s) and/or DSA shall be without liability to the District. Contractor shall instruct its Subcontractors and employees accordingly.

5.1.3 If Contractor and/or any Subcontractor requests that the Project Inspector(s) perform any inspection off-site, this shall only be done if it is allowable pursuant to applicable regulations and DSA approval, if the Project Inspector(s) agree to do so, and at the expense of the Contractor.

5.2 Tests and Inspections

5.2.1 Tests and Inspections shall comply with title 24, part 1, California Code of Regulations, group 1, article 5, section 4-335, and with the provisions of the Specifications.

5.2.2 The District will select an independent testing laboratory to conduct the tests. Selection of the materials required to be tested shall be by the laboratory or the District's representative and not by the Contractor. The Contractor shall notify the District's representative a sufficient time in advance of its readiness for required observation or inspection.

5.2.3 The Contractor shall notify the District's representative a sufficient time in advance of the manufacture of material to be supplied under the Contract Documents, which must by terms of the Contract Documents be tested, in order that the District may arrange for the testing of same at the source of supply. This notice shall be provided, at a minimum, seventy-two (72) hours prior to the manufacture of the material that needs to be tested.

5.2.4 Any material shipped by the Contractor from the source of supply prior to having satisfactorily passed such testing and inspection or prior to the receipt of notice from said representative that such testing and inspection will not be required, shall not be incorporated into and/or onto the Project.

5.2.5 The District will select the testing laboratory and pay for the costs of all tests and inspections, excepting those inspections performed at Contractor's request and

expense. Contractor shall reimburse the District for any and all laboratory costs or other testing costs for any materials found to be not in compliance with the Contract Documents. At the District's discretion, District may elect to deduct laboratory or other testing costs for noncompliant materials from the Contract Price, and such deduction shall not constitute a withholding.

5.3 Costs for After Hours and/or Off Site Inspections

If the Contractor performs Work outside the Inspector's regular working hours or requests the Inspector to perform inspections off Site, costs of any inspections required outside regular working hours or off Site shall be borne by the Contractor and may be invoiced to the Contractor by the District or the District may deduct those expenses from the next Progress Payment.

6. CONTRACTOR

Contractor shall construct and complete, in a good and workmanlike manner, the Work for the Contract Price including any adjustment(s) to the Contract Price pursuant to provisions herein regarding changes to the Contract Price. Except as otherwise noted, Contractor shall provide and pay for all labor, materials, equipment, permits (excluding DSA), fees, licenses, facilities, transportation, taxes, bonds and insurance, and services necessary for the proper execution and completion of the Work, except as indicated herein.

6.1 Status of Contractor

6.1.1 Contractor is and shall at all times be deemed to be an independent contractor and shall be wholly responsible for the manner in which it and its Subcontractors perform the services required of it by the Contract Documents. Nothing herein contained shall be construed as creating the relationship of employer and employee, or principal and agent, between the District, or any of the District's employees or agents, and Contractor or any of Contractor's Subcontractors, agents or employees. Contractor assumes exclusively the responsibility for the acts of its agents, and employees as they relate to the services to be provided during the course and scope of their employment. Contractor, its Subcontractors, agents, and its employees shall not be entitled to any rights or privileges of District employees. District shall be permitted to monitor the Contractor's activities to determine compliance with the terms of this Contract.

6.1.2 As required by law, Contractor and all Subcontractors shall be properly licensed and regulated by the Contractors State License Board, 9821 Business Park Drive, Sacramento, California 95827, <http://www.cslb.ca.gov>.

6.1.3 As required by law, Contractor and all Subcontractors shall be properly registered as public works contractors by the Department of Industrial Relations at: <https://efiling.dir.ca.gov/PWCR/ActionServlet?action=displayPWCRRegistrationForm> or current URL.

6.1.4 Contractor represents that Contractor and all Subcontractors shall not be presently debarred, suspended, proposed for disbarment, declared ineligible or excluded pursuant to either Labor Code section 1777.1 or Labor Code section 1777.7.

6.1.5 [RESERVED]

6.1.6 Contractor represents that it has no existing interest and will not acquire any interest, direct or indirect, which could conflict in any manner or degree with the performance of the Work required under this Contract and that no person having any such interest shall be employed by Contractor.

6.1.7 [RESERVED]

6.1.8 If Contractor intends to make any change in the name or legal nature of the Contractor's entity, Contractor must first notify the District in writing prior to making any contemplated change. The District shall determine in writing if Contractor's intended change is permissible while performing this Contract.

6.2 Project Inspection Card(s)

Contractor shall verify that forms DSA 152 (or the current version applicable at the time the Work is performed) are issued for the Project prior to the commencement of construction.

6.3 Contractor's Supervision

6.3.1 During progress of the Work, Contractor shall keep on the Premises, and at all other locations where any Work related to the Contract is being performed, an experienced and competent project manager and construction superintendent who are employees of the Contractor, to whom the District does not object and at least one of whom shall be fluent in English, written and verbal.

6.3.2 The project manager and construction superintendent shall both speak fluently the predominant language of the Contractor's employees.

6.3.3 Before commencing the Work herein, Contractor shall give written notice to District of the name of its project manager and construction superintendent. Neither the Contractor's project manager nor construction superintendent shall be changed except with prior written notice to District. If the Contractor's project manager and/or construction superintendent proves to be unsatisfactory to Contractor, or to District, any of the District's employees, agents, the Construction Manager, or the Architect, the unsatisfactory project manager and/or construction superintendent shall be replaced. However, Contractor shall notify District in writing before any change occurs, but no less than two (2) business days prior. Any replacement of the project manager and/or construction superintendent shall be made promptly and must be satisfactory to the District. The Contractor's project manager and construction superintendent shall each represent Contractor, and all directions given to Contractor's project manager and/or construction superintendent shall be as binding as if given to Contractor.

6.3.4 Contractor shall give efficient supervision to Work, using its best skill and attention. Contractor shall carefully study and compare all Contract Documents, Drawings, Specifications, and other instructions and shall at once report to District, Construction Manager, and Architect any error, inconsistency, or omission that Contractor or its employees and Subcontractors may discover, in writing, with a copy

to District's Project Inspector(s). The Contractor shall have responsibility for discovery of errors, inconsistencies, or omissions.

6.4 Duty to Provide Fit Workers

6.4.1 Contractor and Subcontractor(s) shall at all times enforce strict discipline and good order among their employees and shall not employ or work any unfit person or anyone not skilled in work assigned to that person. It shall be the responsibility of Contractor to ensure compliance with this requirement. District may require Contractor to permanently remove unfit persons from Project Site.

6.4.2 Any person in the employ of Contractor or Subcontractor(s) whom District may deem incompetent or unfit shall be excluded from working on the Project and shall not again be employed on the Project except with the prior written consent of District.

6.4.3 The Contractor shall furnish labor that can work in harmony with all other elements of labor employed or to be employed in the Work.

6.5 Field Office

6.5.1 Contractor shall provide a temporary office on the Site for the District's use exclusively, during the term of the Contract.

6.6 Purchase of Materials and Equipment

The Contractor is required to order, obtain, and store materials and equipment sufficiently in advance of its Work at no additional cost or advance payment from District to assure that there will be no delays.

6.7 Documents on Work

6.7.1 Contractor shall at all times keep on the Site, or at another location as the District may authorize in writing, one (1) legible copy of all Contract Documents, including Addenda and Change Orders, and Titles 19 and 24 of the California Code of Regulations, the specified edition(s) of the Uniform Building Code, all approved Drawings, Plans, Schedules, and Specifications, and all codes and documents referred to in the Specifications, and made part thereof. These documents shall be kept in good order and available to District, Construction Manager, Architect, Architect's representatives, the Project Inspector(s), and all authorities having jurisdiction. Contractor shall be acquainted with and comply with the provisions of these titles as they relate to this Project. (See particularly the duties of Contractor, Title 24, Part 1, California Code of Regulations, section 4-343.) Contractor shall also be acquainted with and comply with all California Code of Regulations provisions relating to conditions on this Project, particularly Titles 8 and 17. Contractor shall coordinate with Architect and Construction Manager and shall submit its verified report(s) according to the requirements of Title 24.

6.7.2 Daily Job Reports.

6.7.2.1 Contractor shall maintain, at a minimum, at least one (1) set of Daily Job Reports on the Project. These must be prepared by the Contractor's

employee(s) who are present on Site, and must include, at a minimum, the following information:

- 6.7.2.1.1** A brief description of all Work performed on that day.
- 6.7.2.1.2** A summary of all other pertinent events and/or occurrences on that day.
- 6.7.2.1.3** The weather conditions on that day.
- 6.7.2.1.4** A list of all Subcontractor(s) working on that day, including DIR registration numbers.
- 6.7.2.1.5** A list of each Contractor employee working on that day and the total hours worked for each employee.
- 6.7.2.1.6** A complete list of all equipment on Site that day, whether in use or not.
- 6.7.2.1.7** A complete list of all materials, supplies, and equipment delivered on that day.
- 6.7.2.1.8** A complete list of all inspections and tests performed on that day.

6.7.2.2 Each day Contractor shall provide a copy of the previous day's Daily Job Report to the District or the Construction Manager.

6.8 Preservation of Records

Contractor shall maintain, and District shall have the right to inspect, Contractor's financial records for the Project, including, without limitation, Job Cost Reports for the Project in compliance with the criteria set forth herein. The District shall have the right to examine and audit all Daily Job Reports or other Project records of Contractor's project manager(s), project superintendent(s), and/or project foreperson(s), all certified payroll records and/or related documents including, without limitation, Job Cost Reports, payroll, payment, timekeeping and tracking documents; all books, estimates, records, contracts, documents, bid documents, bid cost data, subcontract job cost reports, and other data of the Contractor, any Subcontractor, and/or supplier, including computations and projections related to bidding, negotiating, pricing, or performing the Work or Contract modification, in order to evaluate the accuracy, completeness, and currency of the cost, manpower, coordination, supervision, or pricing data at no additional cost to the District. These documents may be duplicative and/or be in addition to any Bid Documents held in escrow by the District. The Contractor shall make available at its office at all reasonable times the materials described in this paragraph for the examination, audit, or reproduction until three (3) years after final payment under this Contract. Notwithstanding the provisions above, Contractor shall provide any records requested by any governmental agency, if available, after the time set forth above.

6.9 Integration of Work

6.9.1 Contractor shall do all cutting, fitting, patching, and preparation of Work as required to make its several parts come together properly, to fit it to receive or be received by work of other contractors, and to coordinate tolerances to various pieces of work, showing upon, or reasonably implied by, the Drawings and Specifications for the completed structure, and shall conform them as District and/or Architect may direct.

6.9.2 Contractor shall make its own layout of lines and elevations and shall be responsible for the accuracy of both Contractor's and Subcontractors' work resulting therefrom.

6.9.3 Contractor and all Subcontractors shall take all field dimensions required in performance of the Work, and shall verify all dimensions and conditions on the Site. All dimensions affecting proper fabrication and installation of all Work must be verified prior to fabrication by taking field measurements of the true conditions. If there are any discrepancies between dimensions in drawings and existing conditions which will affect the Work, Contractor shall bring such discrepancies to the attention of the District and Architect for adjustment before proceeding with the Work. In doing so, it is recognized that Contractor is not acting in the capacity of a licensed design professional, and that Contractor's examination is made in good faith to facilitate construction and does not create an affirmative responsibility of a design professional to detect errors, omissions or inconsistencies in the Contract Documents or to ascertain compliance with applicable laws, building codes or regulations. However, nothing in this provision shall abrogate Contractor's responsibilities for discovering and reporting any error, inconsistency, or omission pursuant to the Contract within the Contractor's standard of care including, without limitation, any applicable laws, ordinance, rules, or regulations. Following receipt of written notice from Contractor, the District and/or Architect shall inform Contractor what action, if any, Contractor shall take with regard to such discrepancies.

6.9.4 All costs caused by noncompliant, defective, or delayed Work shall be borne by Contractor, inclusive of repair work. Schedule delays resulting from unauthorized work shall be Contractor's responsibility.

6.9.5 Contractor shall not endanger any work performed by it or anyone else by cutting, excavating, or otherwise altering work and shall not cut or alter work of any other contractor except with consent of District.

6.10 Notifications

6.10.1 Contractor shall notify the Architect and Project Inspector, in writing, of the commencement of construction of each and every aspect of the Work at least 48 hours in advance by submitting form DSA 156 (or the most current version applicable at the time the Work is performed) to the Project Inspector. Forms are available on the DSA's website at: <http://www.dgs.ca.gov/dsa/Forms.aspx>.

6.10.2 Contractor shall notify the Architect and Project Inspector, in writing, of the completion of construction of each and every aspect of the Work at least 48 hours in advance by submitting form DSA 156 (or current version) to the Project Inspector.

6.11 Obtaining of Permits, Licenses and Registrations

6.11.1 Contractor shall secure and pay for all permits (except DSA), licenses, registrations, approvals and certificates necessary for prosecution of Work, including but not limited to those listed in the Special Conditions, if any, before the date of the commencement of the Work or before the permits, licenses, registrations, approvals and certificates are legally required to continue the Work without interruption. The Contractor shall obtain and pay, only when legally required, for all licenses, registrations, approvals, permits, inspections, and inspection certificates required to

be obtained from or issued by any authority having jurisdiction over any part of the Work included in the Contract. All final permits, licenses, registrations, approvals and certificates shall be delivered to District before demand is made for final payment.

6.11.2 General Permit For Storm Water Discharges Associated With Construction and Land Disturbance Activities.

6.11.2.1 Contractor acknowledges that all California community college districts are obligated to develop and implement the following requirements for the discharge of storm water to surface waters from its construction and land disturbance activities pursuant to the Clean Water Act and Porter Cologne Water Quality Act. District has determined that the construction of this Project requires enrollment in the Construction Storm Water Permit. District has filed certain submittals referred to as Permit Registration Documents ("PRDS") with the Regional Water Control Board ("Storm Water Pollution Prevention Plan" or "SWPPP").

6.11.2.2 Contractor shall comply with any District SWPPP that is approved by the District and applicable to the Project, at no additional cost to the District. Contractor shall pay any fees and any penalties that may imposed by a regulatory agency for its non-compliance with the SWPPP during the course of Work.

6.11.2.3 Contractor shall provide a Qualified Storm Water Practitioner ("QSP") at no additional cost to the District, who shall be onsite and implement and monitor any and all SWPPP requirements applicable to the Project, including but not limited to:

6.11.2.3.1 All required visual observations, sampling, analysis, reporting and record keeping, including any Numeric Action Levels ("NALs"), if applicable;

6.11.2.3.2 Rain Event Action Plan ("REAP") at least forty eight (48) hours prior to any forecasted rain event requiring implementation of the REAP, including any erosion and sediment control measures needed to protect all exposed portions of the site, if applicable;

6.11.2.3.3 Active Treatment System ("ATS"), if applicable; and

6.11.2.3.4 Best management practices ("BMPs").

6.12 Royalties and Patents

6.12.1 Contractor shall obtain and pay, only when legally required, all royalties and license fees necessary for prosecution of Work before the earlier of the date of the commencement of the Work or the date that the license is legally required to continue the Work without interruption. Contractor shall defend suits or claims of infringement of patent, copyright, or other rights and shall hold the District, the Architect, and the Construction Manager harmless and indemnify them from loss on account thereof except when a particular design, process, or make or model of product is required by the Contract Documents. However, if the Contractor has

reason to believe that the required design, process, or product is an infringement of a patent or copyright, the Contractor shall indemnify and defend the District, Architect and Construction Manager against any loss or damage unless the Contractor promptly informs the District of its information.

6.12.2 The review by the District or Architect of any method of construction, invention, appliance, process, article, device, or material of any kind shall be only its adequacy for the Work and shall not approve use by the Contractor in violation of any patent or other rights of any person or entity.

6.13 Work to Comply With Applicable Laws and Regulations

6.13.1 Contractor shall give all notices and comply with the following specific laws, ordinances, rules, and regulations and all other applicable laws, ordinances, rules, and regulations bearing on conduct of Work as indicated and specified, including but not limited to the appropriate statutes and administrative code sections. If Contractor observes that Drawings and Specifications are at variance therewith, or should Contractor become aware of the development of conditions not covered by Contract Documents that may result in finished Work being at variance therewith, Contractor shall promptly notify District in writing and any changes deemed necessary by District shall be made as provided in Contract for changes in Work.

6.13.1.1 National Electrical Safety Code, U. S. Department of Commerce

6.13.1.2 National Board of Fire Underwriters' Regulations

6.13.1.3 International Building Code, latest addition, and the California Code of Regulations, title 24, and other amendments

6.13.1.4 Manual of Accident Prevention in Construction, latest edition, published by A.G.C. of America

6.13.1.5 Industrial Accident Commission's Safety Orders, State of California

6.13.1.6 Regulations of the State Fire Marshall (title 19, California Code of Regulations) and Pertinent Local Fire Safety Codes

6.13.1.7 Americans with Disabilities Act

6.13.1.8 Education Code of the State of California

6.13.1.9 Government Code of the State of California

6.13.1.10 Labor Code of the State of California, division 2, part 7, Public Works and Public Agencies

6.13.1.11 Public Contract Code of the State of California

6.13.1.12 California Art Preservation Act

6.13.1.13 U. S. Copyright Act

6.13.1.14 U. S. Visual Artists Rights Act

6.13.2 Contractor shall comply with all applicable mitigation measures, if any, adopted by any public agency with respect to this Project pursuant to the California Environmental Quality Act (Public Resources Code section 21000 et seq.).

6.13.3 If Contractor performs any Work that it knew, or through exercise of reasonable care should have known, to be contrary to any applicable laws, ordinance, rules, or regulations, Contractor shall bear all costs arising therefrom and arising from the correction of said Work.

6.13.4 Where Specifications or Drawings state that materials, processes, or procedures must be approved by the DSA, State Fire Marshall, or other body or agency, Contractor shall be responsible for satisfying requirements of such bodies or agencies applicable at the time the Work is performed, and as determined by those bodies or agencies.

6.13.5 [RESERVED]

6.14 Safety/Protection of Persons and Property

6.14.1 The Contractor will be solely and completely responsible for conditions of the Site, including safety of all persons and property during performance of the Work. This requirement will apply continuously and not be limited to normal working hours.

6.14.2 The wearing of hard hats will be mandatory at all times for all personnel on Site. Contractor shall supply sufficient hard hats to properly equip all employees and visitors.

6.14.3 Any construction review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the Site.

6.14.4 Implementation and maintenance of safety programs shall be the sole responsibility of the Contractor.

6.14.5 The Contractor shall furnish to the District a copy of the Contractor's safety plan within the time frame indicated in the Contract Documents and specifically adapted for the Project.

6.14.6 Contractor shall be responsible for all damages to persons or property that occur as a result of its fault or negligence in connection with the prosecution of this Contract and shall take all necessary measures and be responsible for the proper care and completion and final acceptance by District. All Work shall be solely at Contractor's risk with the exception of damage to the Work caused by "acts of God" as defined in Public Contract Code section 7105.

6.14.7 Contractor shall take, and require Subcontractors to take, all necessary precautions for safety of workers on the Project and shall comply with all applicable federal, state, local, and other safety laws, standards, orders, rules, regulations, and building codes to prevent accidents or injury to persons on, about, or adjacent to premises where Work is being performed and to provide a safe and healthful place of employment. Contractor shall furnish, erect, and properly maintain at all times, all necessary safety devices, safeguards, construction canopies, signs, nets, barriers,

lights, and watchmen for protection of workers and the public and shall post danger signs warning against hazards created by such features in the course of construction.

6.14.8 Hazards Control – Contractor shall store volatile wastes in covered metal containers and remove them from the Site daily. Contractor shall prevent accumulation of wastes that create hazardous conditions. Contractor shall provide adequate ventilation during use of volatile or noxious substances.

6.14.9 Contractor shall designate a responsible member of its organization on the Project, whose duty shall be to post information regarding protection and obligations of workers and other notices required under occupational safety and health laws, to comply with reporting and other occupational safety requirements, and to protect the life, safety, and health of workers. Name and position of person so designated shall be reported to District by Contractor.

6.14.10 Contractor shall correct any violations of safety laws, rules, orders, standards, or regulations. Upon the issuance of a citation or notice of violation by the Division of Occupational Safety and Health, Contractor shall correct such violation promptly.

6.14.11 Contractor shall comply with any District storm water requirements that are approved by the District and applicable to the Project, at no additional cost to the District.

6.14.12 In an emergency affecting safety of life or of work or of adjoining property, Contractor, without special instruction or authorization, shall act, at its discretion, to prevent such threatened loss or injury. Any compensation claimed by Contractor on account of emergency work shall be determined by agreement.

6.14.13 All salvage materials will become the property of the Contractor and shall be removed from the Site unless otherwise called for in the Contract Documents. However, the District reserves the right to designate certain items of value that shall be turned over to the District unless otherwise directed by District.

6.14.14 All connections to public utilities and/or existing on-site services, including, without limitation, internet, phone and data connections, shall be made and maintained in such a manner as to not interfere with the continuing use of same by the District during the entire progress of the Work.

6.14.15 Contractor shall provide such heat, covering, and enclosures as are necessary to protect all Work, materials, equipment, appliances, and tools against damage by weather conditions, such as extreme heat, cold, rain, snow, dry winds, flooding, or dampness.

6.14.16 The Contractor shall protect and preserve the Work from all damage or accident, providing any temporary roofs, window and door coverings, boxings, or other construction as required by the Architect. The Contractor shall be responsible for existing structures, walks, roads, trees, landscaping, and/or improvements in working areas; and shall provide adequate protection therefore. If temporary removal is necessary of any of the above items, or damage occurs due to the Work, the Contractor shall replace same at its expense with same kind, quality, and size of

Work or item damaged. This shall include any adjoining property of the District and others.

6.14.17 Contractor shall take adequate precautions to protect existing roads, sidewalks, curbs, pavements, utilities, adjoining property, and structures (including, without limitation, protection from settlement or loss of lateral support), and to avoid damage thereto, and repair any damage thereto caused by construction operations.

6.14.18 Contractor shall confine apparatus, the storage of materials, and the operations of workers to limits indicated by law, ordinances, permits, or directions of Architect, and shall not interfere with the Work or unreasonably encumber Premises or overload any structure with materials. Contractor shall enforce all instructions of District and Architect regarding signs, advertising, fires, and smoking, and require that all workers comply with all regulations while on Project Site.

6.14.19 Contractor, Contractor's employees, Subcontractors, Subcontractors' employees, or any person associated with the Work shall conduct themselves in a manner appropriate for a school site. No verbal or physical contact with neighbors, students, and faculty, profanity, or inappropriate attire and/or logos, or behavior will be permitted. District may require Contractor to temporarily or permanently remove non-complying persons from Project Site.

6.14.20 Contractor shall take care to prevent disturbing or covering any survey markers, monuments, or other devices marking property boundaries or corners. If such markers are disturbed, Contractor shall have a civil engineer, registered as a professional engineer in California, replace them at no cost to District.

6.14.21 In the event that the Contractor enters into any agreement with owners of any adjacent property to enter upon the adjacent property for the purpose of performing the Work, Contractor shall fully indemnify, defend, and hold harmless each person, entity, firm, or agency that owns or has any interest in adjacent property. The form and content of the agreement of indemnification shall be approved by the District prior to the commencement of any Work on or about the adjacent property. The Contractor shall also indemnify the District as provided in the indemnification provision herein. These provisions shall be in addition to any other requirements of the owners of the adjacent property.

6.15 Working Evenings and Weekends

Contractor may be required to work increased hours, evenings, and/or weekends at no additional cost to the District. Contractor shall give the District seventy-two (72) hours' notice prior to performing any evening and/or weekend work. Contractor shall perform all evening and/or weekend work only upon District's approval and in compliance with all applicable rules, regulations, laws, and local ordinances including, without limitation, all noise and light limitations. Contractor shall reimburse the District for any increased or additional Inspector charges as a result of Contractor's increased hours, or evening and/or weekend work.

6.16 Cleaning Up

6.16.1The Contractor shall provide all services, labor, materials, and equipment necessary for protecting and securing the Work, all school occupants, furnishings, equipment, and building structure from damage until its completion and final acceptance by District. Dust barriers shall be provided to isolate dust and dirt from construction operations. At completion of the Work and portions thereof, Contractor shall clean to the original state any areas beyond the Work area that become dust laden as a result of the Work. The Contractor must erect the necessary warning signs and barricades to ensure the safety of all school occupants. The Contractor at all times must maintain good housekeeping practices to reduce the risk of fire damage and must make a fire extinguisher, fire blanket, and/or fire watch, as applicable, available at each location where cutting, braising, soldering, and/or welding is being performed or where there is an increased risk of fire.

6.16.2Contractor at all times shall keep Premises, including property immediately adjacent thereto, free from debris such as waste, rubbish (including personal rubbish of workers, e.g., food wrappers, etc.), and excess materials and equipment caused by the Work. Contractor shall not leave debris under, in, or about the Premises (or surrounding property or neighborhood), but shall promptly remove same from the Premises on a daily basis. If Contractor fails to clean up, District may do so and the cost thereof shall be charged to Contractor. If Contract is for work on an existing facility, Contractor shall also perform specific clean-up on or about the Premises upon request by the District as it deems necessary for continued operations. Contractor shall comply with all related provisions of the Specifications.

6.16.3If the Construction Manager, Architect, or District observes the accumulation of trash and debris, the District will give the Contractor a 24-hour written notice to mitigate the condition.

6.16.4Should the Contractor fail to perform the required clean-up, or should the clean-up be deemed unsatisfactory by the District, the District may, at its sole discretion, then perform the clean-up. All cost associated with the clean-up work (including all travel, payroll burden, and costs for supervision) will be deducted from the Contract Price.

6.17 No Relief from Obligations Based on Review by Other Persons

6.17.1Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents by act or omission of the District, Architect, Construction Manager, Project Inspector, or DSA or other entities having jurisdiction including, but not limited to, administration of the Contract, review of submittals, or by tests, observation, inspection, or permit/interconnection approvals.

7. SUBCONTRACTORS

7.1 Contractor shall provide the District with information for all Subcontracts as indicated in the Contractor's Submittals and Schedules Section herein.

7.2 No contractual relationship exists between the District and any Subcontractor, supplier, or sub-subcontractor by reason of this Contract.

7.3 Contractor agrees to bind every Subcontractor by terms of this Contract as far as those terms that are applicable to Subcontractor's work including, without limitation, all labor, wage & hour, apprentice and related provisions and requirements. If Contractor shall subcontract any part of this Contract, Contractor shall be as fully responsible to District for acts and omissions of any Subcontractor and of persons either directly or indirectly employed by any Subcontractor, including Subcontractor caused Project delays, as it is for acts and omissions of persons directly employed by Contractor. The divisions or sections of the Specifications and/or the arrangement of the drawings are not intended to control the Contractor in dividing the Work among Subcontractors or limit the work performed by any trade.

7.4 District's consent to, or approval of, or failure to object to, any Subcontractor under this Contract shall not in any way relieve Contractor of any obligations under this Contract and no such consent shall be deemed to waive any provisions of this Contract.

7.5 Contractor is directed to familiarize itself with sections 4100 through 4114 of the Public Contract Code of the State of California, as regards subletting and subcontracting, and to comply with all applicable requirements therein. In addition, Contractor is directed to familiarize itself with sections 1720 through 1861 of the Labor Code of the State of California, as regards the payment of prevailing wages and related issues, and to comply with all applicable requirements therein including, without limitation, section 1775 and the Contractor's and Subcontractors' obligations and liability for violations of prevailing wage law and other applicable laws.

7.6 No Contractor whose Bid is accepted shall, without consent of the awarding authority and in full compliance with section 4100 et seq. of the Public Contract Code, including, without limitation, sections 4107, 4107.5, and 4109 of the Public Contract Code, and section 1771.1 of the Labor Code, either:

7.6.1 Substitute any person as a Subcontractor in place of the Subcontractor designated in the original Bid; or

7.6.2 Permit any Subcontract to be assigned or transferred, or allow any portion of the Work to be performed by anyone other than the original Subcontractor listed in the Bid; or

7.6.3 Sublet or subcontract any portion of the Work in excess of one-half of one percent (0.5%) of the Contractor's total bid as to which its original bid did not designate a Subcontractor.

7.7 The Contractor shall be responsible for the coordination of the trades, Subcontractors, sub-subcontractors, and material or equipment suppliers working on the Project.

7.7.1 Contractor is responsible for ensuring that all Subcontractors are properly registered as public works contractors by the Department of Industrial Relations.

7.8 Contractor is solely responsible for settling any differences between the Contractor and its Subcontractor(s) or between Subcontractors.

7.9 Contractor must include in all of its subcontracts the assignment provisions as indicated in the Termination section of these General Conditions.

8. OTHER CONTRACTS/CONTRACTORS

8.1 District reserves the right to let other contracts, and/or to perform work with its own forces, in connection with the Project. Contractor shall afford other contractors reasonable opportunity for introduction and storage of their materials and execution of their work and shall properly coordinate and connect Contractor's Work with the work of other contractors.

8.2 In addition to Contractor's obligation to protect its own Work, Contractor shall protect the work of any other contractor that Contractor encounters while working on the Project.

8.3 If any part of Contractor's Work depends for proper execution or results upon work of District or any other contractor, the Contractor shall inspect and, before proceeding with its Work, promptly report to the District in writing any defects in District's or any other contractor's work that render Contractor's Work unsuitable for proper execution and results. Contractor shall be held accountable for damages to District for District's or any other contractor's work that Contractor failed to inspect or should have inspected. Contractor's failure to inspect and report shall constitute Contractor's acceptance of all District's or any other contractor's work as fit and proper for reception of Contractor's Work, except as to defects that may develop in District's or any other contractor's work after execution of Contractor's Work and not caused by execution of Contractor's Work.

8.4 To ensure proper execution of its subsequent work, Contractor shall measure and inspect work already in place and shall at once report to the District in writing any discrepancy between that executed work and the Contract Documents.

8.5 Contractor shall ascertain to its own satisfaction the scope of the Project and nature of District's or any other contracts that have been or may be awarded by District in prosecution of the Project to the end that Contractor may perform this Contract in light of the other contracts, if any.

8.6 Nothing herein contained shall be interpreted as granting to Contractor exclusive occupancy of the Site, the Premises, or of the Project. Contractor shall not cause any unnecessary hindrance or delay to the use and/or operation(s) of the Premises and/or to District or any other contractor working on the Project. If simultaneous execution of any contract or Premises operation is likely to cause interference with performance of Contractor's Contract, Contractor shall coordinate with those contractor(s), person(s), and/or entity(s) and shall notify the District of the resolution.

9. DRAWINGS AND SPECIFICATIONS

9.1 A complete list of all Drawings that form a part of the Contract is to be found as an index on the Drawings themselves, and/or may be provided to the Contractor and/or in the Table of Contents.

9.2 Materials or Work described in words that so applied have a well-known technical or trade meaning shall be deemed to refer to recognized standards, unless noted otherwise.

9.3 Trade Name or Trade Term. It is not the intention of this Contract to go into detailed descriptions of any materials and/or methods commonly known to the trade under "trade name" or "trade term." The mere mention or notation of "trade name" or "trade term" shall be considered a sufficient notice to Contractor that it will be required to complete the work so named, complete, finished, and operable, with all its appurtenances, according to the best practices of the trade.

9.4 The naming of any material and/or equipment shall mean furnishing and installing of same, including all incidental and accessory items thereto and/or labor therefor, as per best practices of the trade(s) involved, unless specifically noted otherwise.

9.5 Contract Documents are complementary, and what is called for by one shall be binding as if called for by all. As such, Drawings and Specifications are intended to be fully cooperative and to agree. However, if Contractor observes that Drawings and Specifications are in conflict with the Contract Documents, Contractor shall promptly notify District and Architect in writing, and any necessary changes shall be made as provided in the Contract Documents.

9.6 In the case of discrepancy or ambiguity in the Contract Documents, the order of precedence in the Agreement shall prevail. However, in the case of discrepancy or ambiguity solely between and among the Drawings and Specifications, the discrepancy or ambiguity shall be resolved in favor of the interpretation that will provide District with the functionally complete and operable Project described in the Drawings and Specifications. In case of ambiguity, conflict, or lack of information, District will furnish clarifications with reasonable promptness.

9.7 Drawings and Specifications are intended to comply with all laws, ordinances, rules, and regulations of constituted authorities having jurisdiction, and where referred to in the Contract Documents, the laws, ordinances, rules, and regulations shall be considered as a part of the Contract within the limits specified. Contractor shall bear all expense of correcting work done contrary to said laws, ordinances, rules, and regulations.

9.9 As required by Section 4-317(c), Part 1, Title 24, CCR: "Should any existing conditions such as deterioration or non-complying construction be discovered which is not covered by the DSA-approved documents wherein the finished work will not comply with Title 24, California Code of Regulations, a construction change document, or a separate set of plans and specifications, detailing and specifying the required repair work shall be submitted to and approved by DSA before proceeding with the repair work."

9.9 Ownership of Drawings

All copies of Plans, Drawings, Designs, Specifications, and copies of other incidental architectural and engineering work, or copies of other Contract Documents furnished by District, are the property of District. They are not to be used by Contractor in other work and, with the exception of signed sets of Contract Documents, are to be returned

to District on request at completion of Work, or may be used by District as it may require without any additional costs to District. Neither the Contractor nor any Subcontractor, or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications, and other documents prepared by the Architect. District hereby grants the Contractor, Subcontractors, sub-subcontractors, and material or equipment suppliers a limited license to use applicable portions of the Drawings prepared for the Project in the execution of their Work under the Contract Documents.

10. CONTRACTOR'S SUBMITTALS AND SCHEDULES

Contractor's submittals shall comply with the provisions and requirements of the Specifications including, without limitation Submittals.

10.1 Schedule of Work, Schedule of Submittals, and Schedule of Values

10.1.1 Within **TEN (10)** calendar days after the date of the Notice to Proceed (unless otherwise specified in the Specifications), the Contractor shall prepare and submit to the District for review, in a form supported by sufficient data to substantiate its accuracy as the District may require:

10.1.1.1 Preliminary Schedule. A preliminary schedule of construction indicating the starting and completion dates of the various stages of the Work, including any information and following any form as may be specified in the Specifications. Once approved by District, this shall become the Construction Schedule. This schedule shall include and identify all tasks that are on the Project's critical path with a specific determination of the start and completion of each critical path task as well as all Contract milestones and each milestone's completion date(s) as may be required by the District.

10.1.1.1.1 The District is not required to approve a preliminary schedule of construction with early completion, i.e., one that shows early completion dates for the Work and/or milestones. Contractor shall not be entitled to extra compensation if the District approves a Construction Schedule with an early completion date and Contractor completes the Project beyond the date shown in the schedule but within the Contract Time. A Construction Schedule showing the Work completed in less than the Contract Time, the time between the early completion date and the end of the Contract Time shall be Float

10.1.1.2 Preliminary Schedule of Values. A preliminary schedule of values for all of the Work, which must include quantities and prices of items aggregating the Contract Price and must subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Unless the Special Conditions contain different limits, this preliminary schedule of values shall include, at a minimum, the following information and the following structure:

10.1.1.2.1 Divided into at least the following categories:

- 10.1.1.2.1.1** Overhead and profit;
- 10.1.1.2.1.2** Supervision;
- 10.1.1.2.1.3** General conditions;

- 10.1.1.2.1.4** Layout;
- 10.1.1.2.1.5** Mobilization;
- 10.1.1.2.1.6** Submittals;
- 10.1.1.2.1.7** Bonds and insurance;
- 10.1.1.2.1.8** Close-out/Certification documentation;
- 10.1.1.2.1.9** Demolition;
- 10.1.1.2.1.10** Installation;
- 10.1.1.2.1.11** Rough-in;
- 10.1.1.2.1.12** Finishes;
- 10.1.1.2.1.13** Testing;
- 10.1.1.2.1.14** Punchlist and District acceptance.

10.1.1.2.2 And also divided by each of the following areas:

- 10.1.1.2.2.1** Site work;
- 10.1.1.2.2.2** By each building;
- 10.1.1.2.2.3** By each floor.

10.1.1.2.3 The preliminary schedule of values shall not provide for values any greater than the following percentages of the Contract value:

- 10.1.1.2.3.1** Mobilization and layout combined to equal not more than 1%;
- 10.1.1.2.3.2** Submittals, samples and shop drawings combined to equal not more than 3%;
- 10.1.1.2.3.3** Bonds and insurance combined to equal not more than 2%.
- 10.1.1.2.3.4** Closeout documentation shall have a value in the preliminary schedule of not less than 5%.

10.1.1.2.4 Notwithstanding any provision of the Contract Documents to the contrary, payment of the Contractor's overhead, supervision, general conditions costs, and profit, as reflected in the Cost Breakdown, shall be paid based on percentage complete, with the disbursement of Progress Payments and the Final Payment.

10.1.1.2.5 Contractor shall certify that the preliminary schedule of values as submitted to the District is accurate and reflects the costs as developed in preparing Contractor's bid. For example, without limiting the foregoing, Contractor shall not "front-load" the preliminary schedule of values with dollar amounts greater than the value of activities performed early in the Project.

10.1.1.2.6 The preliminary schedule of values shall be subject to the District's review and approval of the form and content thereof. In the event that the District objects to any portion of the preliminary schedule of values, the District shall notify the Contractor, in writing, of the District's objection(s) to the preliminary schedule of values. Within five (5) calendar days of the date of the District's written objection(s), Contractor shall submit a revised preliminary schedule of values to the District for review and approval. The foregoing procedure for the preparation, review and approval of the preliminary schedule of values shall continue until the District has approved the entirety of the preliminary schedule of values.

10.1.1.2.7 Once the preliminary schedule of values is approved by the District, this shall become the Schedule of Values. The Schedule of Values shall not be thereafter modified or amended by the Contractor without the prior consent and approval of the District, which may be granted or withheld in the sole discretion of the District.

10.1.1.3 Preliminary Schedule of Submittals. A preliminary schedule of submittals, including Shop Drawings, Product Data, and Samples submittals. Once approved by District, this shall become the Submittal Schedule. All submittals shall be forwarded to the District by the date indicated on the approved Submittal Schedule, unless an earlier date is necessary to maintain the Construction Schedule, in which case those submittals shall be forwarded to the District so as not to delay the Construction Schedule. Upon request by the District, Contractor shall provide an electronic copy of all submittals to the District. All submittals shall be submitted no later than 90 days after the Notice to Proceed.

10.1.1.4 Safety Plan. Contractor's Safety Plan specifically adapted for the Project. Contractor's Safety Plan shall comply with the following requirements:

10.1.1.4.1 All applicable requirements of California Division of Occupational Safety and Health ("CalOSHA") and/or of the United States Occupational Safety and Health Administration ("OSHA").

10.1.1.4.2 All provisions regarding Project safety, including all applicable provisions in these General Conditions.

10.1.1.4.3 Contractor's Safety Plan shall be in English and in the language(s) of the Contractor's and its Subcontractors' employees.

10.1.1.5 Complete Registered Subcontractors List. The name, address, telephone number, facsimile number, California State Contractors License number, classification, DIR registration number and monetary value of all Subcontracts of any tier for parties furnishing labor, material, or equipment for completion of the Project.

10.1.2 Contractor must provide all schedules both in hard copy and electronically, in a format (e.g., Microsoft Project or Primavera) approved in advance by the District.

10.1.3 The District will review the schedules submitted and the Contractor shall make changes and corrections in the schedules as requested by the District and resubmit the schedules until approved by the District.

10.1.4 The District shall have the right at any time to revise the schedule of values if, in the District's sole opinion, the schedule of values does not accurately reflect the value of the Work performed.

10.1.5 All schedules must be approved by the District before Contractor can rely on them as a basis for payment.

10.2 Monthly Progress Schedule(s)

10.2.1 Contractor shall provide Monthly Progress Schedule(s) to the District. A Monthly Progress Schedule shall update the approved Construction Schedule or the last Monthly Progress Schedule, showing all work completed and to be completed as well as updating the Registered Subcontractors List. The monthly Progress Schedule shall be sent within the timeframe requested by the District and shall be in a format acceptable to the District and contain a written narrative of the progress of work that month and any changes, delays, or events that may affect the work. The process for District approval of the Monthly Progress Schedule shall be the same as the process for approval of the Construction Schedule.

10.2.2 Contractor shall submit Monthly Progress Schedule(s) with all payment applications.

10.2.3 Contractor must provide all schedules both in hard copy and electronically, in a format (e.g., Microsoft Project or Primavera) approved in advance by the District.

10.2.4 The District will review the schedules submitted and the Contractor shall make changes and corrections in the schedules as requested by the District and resubmit the schedules until approved by the District.

10.2.5 The District shall have the right at any time to revise the schedule of values if, in the District's sole opinion, the schedule of values does not accurately reflect the value of the Work performed.

10.2.6 All schedules must be approved by the District before Contractor can rely on them as a basis for payment.

10.3 Material Safety Data Sheets (MSDS)

Contractor is required to ensure Material Safety Data Sheets are available in a readily accessible place at the Site for any material requiring a Material Safety Data Sheet per the federal "Hazard Communication" standard, or employees' "right to know" law. The Contractor is also required to ensure proper labeling on substances brought onto the job site and that any person working with the material or within the general area of the material is informed of the hazards of the substance and follows proper handling and protection procedures. Two additional copies of the Material Safety Data Sheets shall also be submitted directly to the District.

10.4 Submittals

Architect's favorable review shall neither be construed as a complete check nor relieve the Contractor, Subcontractor, manufacturer, fabricator, or supplier from responsibility for any deficiency that may exist or from any departures or deviations from the requirements of the Contract Documents unless the Contractor has, in writing, called Architect's attention to the deviations at the time of submission and the Architect has given specific written response. "Favorable review" shall mean merely that Architect has no objection to Contractor using, upon Contractor's own full responsibility, plan or method of Work proposed, or furnishing materials or equipment proposed.

11. SITE ACCESS, CONDITIONS, AND REQUIREMENTS

11.1 Site Investigation

Before bidding on this Work, Contractor shall make a careful investigation of the Site and thoroughly familiarize itself with the requirements of the Contract. By the act of submitting a bid for the Work included in this Contract, Contractor shall be deemed to have made a complete study and investigation, and to be familiar with and accepted the existing conditions of the Site.

Prior to commencing the Work, Contractor and the District's representative shall survey the Site to document the condition of the Site. Contractor will record the survey in digital videotape format and provide an electronic copy to the District within fourteen (14) days of the survey. This electronic record shall serve as a basis for determining any damages caused by the Contractor during the Project. The Contractor may also document any pre-existing conditions in writing, provided that both the Contractor and the District's representative agree on said conditions and sign a memorandum documenting the same.

11.2 Soils Investigation Report

11.2.1 When a soils investigation report obtained from test holes at Site or for the Project is available, that report may be available to the Contractor but shall not be a part of this Contract and shall not alleviate or excuse the Contractor's obligation to perform its own investigation. Any information obtained from that report or any information given on Drawings as to subsurface soil condition or to elevations of existing grades or elevations of underlying rock is approximate only, is not guaranteed, does not form a part of this Contract, and Contractor may not rely thereon. By submitting its bid, Contractor acknowledges that it has made visual examination of Site and has made whatever tests Contractor deems appropriate to determine underground condition of soil. Although any such report is not a part of this Contract, recommendations from the report may be included in the Drawings, Specifications, or other Contract Documents. It is Contractor's sole responsibility to thoroughly review all Contract Documents, Drawings, and Specifications.

11.2.2 Contractor agrees that no claim against District will be made by Contractor for damages and hereby waives any rights to damages if, during progress of Work, Contractor encounters subsurface or latent conditions at Site materially differing from those shown on Drawings or indicated in Specifications, or for unknown conditions of an unusual nature that differ materially from those ordinarily encountered in the work of the character provided for in Plans and Specifications, except as indicated in the provisions of these General Conditions regarding trenches, trenching, and/or existing utility lines.

11.3 Access to Work

District and its representatives shall at all times have access to Work wherever it is in preparation or progress, including storage and fabrication. Contractor shall provide safe and proper facilities for such access so that District's representatives may perform their functions.

11.4 Layout and Field Engineering

11.4.1 All field engineering required for layout of this Work and establishing grades for earthwork operations shall be furnished by Contractor at its expense. This Work shall be done by a qualified, California-registered civil engineer approved in writing by District and Architect. Any required Record and/or As-Builts of Site development shall be prepared by the approved civil engineer.

11.4.2 The Contractor shall be responsible for having ascertained pertinent local conditions such as location, accessibility, and general character of the Site and for having satisfied itself as to the conditions under which the Work is to be performed. Contractor shall follow best practices, including but not limited to potholing to avoid utilities. District shall not be liable for any claim for allowances because of Contractor's error, failure to follow best practices, or negligence in acquainting itself with the conditions at the Site.

11.4.3 Contractor shall protect and preserve established benchmarks and monuments and shall make no changes in locations without the prior written approval of District. Contractor shall replace any benchmarks or monuments that are lost or destroyed subsequent to proper notification of District and with District's approval.

11.5 Utilities

Utilities shall be provided as indicated in the Specifications.

11.6 Sanitary Facilities

Sanitary facilities shall be provided as indicated in the Specifications.

11.7 Surveys

Contractor shall provide surveys done by a California-licensed civil engineer surveyor to determine locations of construction, grading, and site work as required to perform the Work.

11.8 Regional Notification Center

The Contractor, except in an emergency, shall contact the appropriate regional notification center at least two (2) days prior to commencing any excavation if the excavation will be conducted in an area or in a private easement that is known, or reasonably should be known, to contain subsurface installations other than the underground facilities owned or operated by the District, and obtain an inquiry identification number from that notification center. No excavation shall be commenced and/or carried out by the Contractor unless an inquiry identification number has been assigned to the Contractor or any Subcontractor and the Contractor has given the District the identification number. Any damages arising from Contractor's failure to make appropriate notification shall be at the sole risk and expense of the Contractor. Any delays caused by failure to make appropriate notification shall be at the sole risk of the Contractor and shall not be considered for an extension of the Contract Time.

11.9 Existing Utility Lines

11.9.1 Pursuant to Government Code section 4215, District assumes the responsibility for removal, relocation, and protection of main or trunk utility lines and facilities located on the construction Site at the time of commencement of construction under this Contract with respect to any such utility facilities that are not identified in the Plans and Specifications. Contractor shall not be assessed for liquidated damages for delay in completion of the Project caused by failure of District or the owner of a utility to provide for removal or relocation of such utility facilities.

11.9.2 Locations of existing utilities provided by District shall not be considered exact, but approximate within a reasonable margin and shall not relieve Contractor of responsibilities to exercise reasonable care or costs of repair due to Contractor's failure to do so. District shall compensate Contractor for the costs of locating and repairing damage not due to the failure of Contractor to exercise reasonable care, and removing or relocating such utility facilities not indicated in the Plans and Specifications with reasonable accuracy, and for equipment necessarily idle during such work.

11.9.3 No provision herein shall be construed to preclude assessment against Contractor for any other delays in completion of the Work. Nothing in this Article shall be deemed to require District to indicate the presence of existing service laterals, appurtenances, or other utility lines, within the exception of main or trunk utility lines or whenever the presence of these utilities on the Site of the construction Project can be inferred from the presence of other visible facilities, such as buildings, meter junction boxes, on or adjacent to the Site of the construction.

11.9.4 If Contractor, while performing Work under this Contract, discovers utility facilities not identified by District in Contract Plans and Specifications, Contractor shall immediately notify the District and the utility in writing. The cost of repair for damage to above-mentioned visible facilities without prior written notification to the District shall be borne by the Contractor.

11.10 Notification

Contractor understands, acknowledges and agrees that the purpose of prompt notification to the District pursuant to these provisions is to allow the District to investigate the condition(s) so that the District shall have the opportunity to decide how the District desires to proceed as a result of the condition(s). Accordingly, failure of Contractor to promptly notify the District in writing, pursuant to these provisions, shall constitute Contractor's waiver of any claim for damages or delay incurred as a result of the condition(s).

11.11 Hazardous Materials

Contractor shall comply with all provisions and requirements of the Contract Documents related to hazardous materials including, without limitation, Hazardous Materials Procedures and Requirements.

11.12 No Signs

Neither the Contractor nor any other person or entity shall display any signs not required by law or the Contract Documents at the Site, fences trailers, offices, or elsewhere on the Site without specific prior written approval of the District.

12. TRENCHES

12.1 Trenches Greater Than Five Feet

Pursuant to Labor Code section 6705, if the Contract Price exceeds \$25,000 and involves the excavation of any trench or trenches five (5) feet or more in depth, the Contractor shall, in advance of excavation, promptly submit to the District and/or a registered civil or structural engineer employed by the District or Architect, a detailed plan, stamped by a licensed engineer retained by the Contractor, showing the design of shoring for protection from the hazard of caving ground during the excavation of such trench or trenches.

12.2 Excavation Safety

If such plan varies from the Shoring System Standards established by the Construction Safety Orders, the plan shall be prepared by a registered civil or structural engineer, but in no case shall such plan be less effective than that required by the Construction Safety Orders. No excavation of such trench or trenches shall be commenced until said plan has been accepted by the District or by the person to whom authority to accept has been delegated by the District.

12.3 No Tort Liability of District

Pursuant to Labor Code section 6705, nothing in this Article shall impose tort liability upon the District or any of its employees.

12.4 No Excavation without Permits

The Contractor shall not commence any excavation Work until it has secured all necessary permits including the required CalOSHA excavation/shoring permit. Any permits shall be prominently displayed on the Site prior to the commencement of any excavation.

12.5 Discovery of Hazardous Waste and/or Unusual Conditions

12.5.1 Pursuant to Public Contract Code section 7104, if the Work involves digging trenches or other excavations that extend deeper than four feet below the Surface, the Contractor shall promptly, and before the following conditions are disturbed, notify the District, in writing, of any:

12.5.1.1 Material that the Contractor believes may be material that is hazardous waste, as defined in section 25117 of the Health and Safety Code, is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law.

12.5.1.2 Subsurface or latent physical conditions at the Site differing from those indicated.

12.5.1.3 Unknown physical conditions at the Site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract.

12.5.2 The District shall promptly investigate the conditions, and if it finds that the conditions do materially so differ, or do involve hazardous waste, and cause a decrease or increase in the Contractor's cost of, or the time required for, performance of any part of the Work, shall issue a Change Order under the procedures described herein.

12.5.3 In the event that a dispute arises between District and the Contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the Contractor's cost of, or time required for, performance of any part of the Work, the Contractor shall not be excused from any scheduled completion date provided for by the Contract, but shall proceed with all work to be performed under the Contract. The Contractor shall retain any and all rights provided either by Contract or by law that pertain to the resolution of disputes and protests.

13. INSURANCE AND BONDS

13.1 Insurance

Unless different provisions and/or limits are indicated in the Special Conditions, all insurance required of Contractor and/or its Subcontractor(s) shall be at least as broad as the amounts and include the provisions set forth herein.

13.1.1 Commercial General Liability and Automobile Liability Insurance

13.1.1.1 Contractor shall procure and maintain, during the life of this Contract, Commercial General Liability Insurance and Automobile Liability Insurance that shall protect Contractor, District, State, Construction Manager(s), Project Inspector(s), and Architect(s) from all claims for bodily injury, property damage, personal injury, death, advertising injury, and medical payments arising from, or in connection with, operations under this Contract. This coverage shall be provided in a form at least as broad as Insurance Services (ISO) Form CG 0001 11188. Contractor shall ensure that Products Liability and Completed Operations coverage, Fire Damage Liability coverage, and Automobile Liability Insurance coverage including owned, non-owned, and hired automobiles, are included within the above policies and at the required limits, or Contractor shall procure and maintain these coverages separately.

13.1.1.2 Contractor's deductible or self-insured retention for its Commercial General Liability Insurance policy shall not exceed \$25,000 unless approved in writing by District.

13.1.1.3 All such policies shall be written on an occurrence form.

13.1.2 Excess Liability Insurance

13.1.2.1 If Contractor's underlying policy limits are less than required, subject to the District's sole discretion, Contractor may procure and maintain, during the life of this Contract, an Excess Liability Insurance Policy to meet the policy limit requirements of the required policies in order to satisfy, in the aggregate with its underlying policy, the insurance requirements herein.

13.1.2.2 There shall be no gap between the per occurrence amount of any underlying policy and the start of the coverage under the Excess Liability Insurance Policy. Any Excess Liability Insurance Policy shall be written on a following form and shall protect Contractor, District, State, Construction Manager(s), Project Manager(s), and Architect(s) in amounts and including the provisions as set forth in the Supplementary Conditions (if any) and/or Special Conditions, and that complies with all requirements for Commercial General Liability and Automobile Liability and Employers' Liability Insurance.

13.1.2.3 The District, in its sole discretion, may accept an Excess Liability Insurance Policy that brings Contractor's primary limits to the minimum requirements herein.

13.1.3 Subcontractor(s): Contractor shall require its Subcontractor(s), if any, to procure and maintain Commercial General Liability Insurance, Automobile Liability Insurance, and Excess Liability Insurance (if Subcontractor elects to satisfy, in part the insurance required herein by procuring and maintaining an Excess Liability Insurance Policy) with forms of coverage and limits equal to the amounts required of the Contractor.

13.1.4 Workers' Compensation and Employers' Liability Insurance

13.1.4.1 In accordance with provisions of section 3700 of the California Labor Code, the Contractor and every Subcontractor shall be required to secure the payment of compensation to its employees.

13.1.4.2 Contractor shall procure and maintain, during the life of this Contract, Workers' Compensation Insurance and Employers' Liability Insurance for all of its employees engaged in work under this Contract, on/or at the Site of the Project. This coverage shall cover, at a minimum, medical and surgical treatment, disability benefits, rehabilitation therapy, and survivors' death benefits. Contractor shall require its Subcontractor(s), if any, to procure and maintain Workers' Compensation Insurance and Employers' Liability Insurance for all employees of Subcontractor(s). Any class of employee or employees not covered by a Subcontractor's insurance shall be covered by Contractor's insurance. If any class of employee or employee engaged in Work under this Contract, on or at the Site of the Project, is not protected under the Workers' Compensation Insurance, Contractor shall provide, or shall cause a Subcontractor to provide, adequate insurance coverage for the protection of any employee(s) not otherwise protected before any of those employee(s) commence work.

13.1.5 Builder's Risk Insurance: Builder's Risk "All Risk" Insurance

Contractor shall procure and maintain, during the life of this Contract, Builder's Risk (Course of Construction), or similar first party property coverage acceptable to the District, issued on a replacement cost value basis. The cost shall be consistent with the total replacement cost of all insurable Work of the Project included within the Contract Documents. Coverage is to insure against all risks of accidental physical loss and shall include without limitation the perils of vandalism and/or malicious mischief (both without any limitation regarding vacancy or occupancy), sprinkler leakage, civil authority, theft, sonic disturbance, earthquake, flood, collapse, wind, rain, dust, fire, war, terrorism, lightning, smoke, and rioting. Coverage shall include debris removal, demolition, increased costs due to enforcement of all applicable ordinances and/or laws in the repair and replacement of damaged and undamaged portions of the property, and reasonable costs for the Architect's and engineering services and expenses required as a result of any insured loss upon the Work and Project, including completed Work and Work in progress, to the full insurable value thereof.

13.1.6 Pollution Liability Insurance

13.1.6.1 Contractor shall procure and maintain Pollution Liability Insurance that shall protect Contractor, District, State, Construction Manager(s), Project Inspector(s), and Architect(s) from all claims for bodily injury, property damage, including natural resource damage, cleanup costs, removal, storage, disposal, and/or use of the pollutant arising from operations under this Contract, and defense, including costs and expenses incurred in the investigation, defense, or settlement of claims. Coverage shall apply to sudden and/or gradual pollution conditions resulting from the escape or release of smoke, vapors, fumes, acids, alkalis, toxic chemicals, liquids, or gases, natural gas, waste materials, or other irritants, contaminants, or pollutants, including asbestos. This coverage shall be provided in a form at least as broad as Insurance Services Offices, Inc. (ISO) Form CG 2415, or Contractor shall procure and maintain these coverages separately.

13.1.6.2 Contractor warrants that any retroactive date applicable to coverage under the policy shall predate the effective date of the Contract and that continuous coverage will be maintained or an extended reporting or discovery period will be exercised for a period of three (3) years, beginning from the time that the Work under the Contract is completed.

13.1.6.3 If Contractor is responsible for removing any pollutants from a site, then Contractor shall ensure that Any Auto, including owned, non-owned, and hired, is included within the above policies and at the required limits, to cover its automobile exposure from transporting the pollutants from the site to an approved disposal site. This coverage shall include the Motor Carrier Act Endorsement, MCS 90.

13.1.7 Proof of Insurance and Other Requirements: Endorsements and Certificates

13.1.7.1 Contractor shall not commence Work nor shall it allow any Subcontractor to commence Work under this Contract, until Contractor and its

Subcontractor(s) have procured all required insurance and Contractor has delivered in duplicate to the District complete endorsements (or entire insurance policies) and certificates indicating the required coverages have been obtained, and the District has approved these documents.

13.1.7.2 Endorsements, certificates, and insurance policies shall include the following:

13.1.7.2.1 A clause stating the following, or other language acceptable to the District:

"This policy shall not be canceled until written notice to District, Architect, and Construction Manager stating date of the cancellation by the insurance carrier. Date of cancellation may not be less than thirty (30) days after date of mailing notice."

13.1.7.2.2 Language stating in particular those insured, extent of insurance, location and operation to which insurance applies, expiration date, to whom cancellation and reduction notice will be sent, and length of notice period.

13.1.7.2.3 All endorsements, certificates and insurance policies shall state that District, its trustees, employees and agents, the State of California, Construction Manager(s), Project Manager(s), Inspector(s) and Architect(s) are named additional insureds under all policies except Workers' Compensation Insurance and Employers' Liability Insurance.

13.1.7.2.4 All endorsements shall waive any right to subrogation against any of the named additional insureds.

13.1.7.2.5 Contractor's and Subcontractors' insurance policy(s) shall be primary and non-contributory to any insurance or self-insurance maintained by District, its trustees, employees and/or agents, the State of California, Construction Manager(s), Project Manager(s), Inspector(s), and/or Architect(s).

13.1.7.2.6 Contractor's insurance limit shall apply separately to each insured against whom a claim is made or suit is brought.

13.1.7.3 No policy shall be amended, canceled or modified, and the coverage amounts shall not be reduced, until Contractor or Contractor's broker has provided written notice to District, Architect(s), and Construction Manager(s) stating date of the amendment, modification, cancellation or reduction, and a description of the change. Date of amendment, modification, cancellation or reduction may not be less than thirty (30) days after date of mailing notice.

13.1.7.4 Insurance written on a "claims made" basis shall be retroactive to a date that coincides with or precedes Contractor's commencement of Work, including subsequent policies purchased as renewals or replacements. Said policy is to be renewed by the Contractor and all Subcontractors for a period of five (5) years following completion of the Work or termination of this Agreement. Such insurance must have the same coverage and limits as the policy that was in

effect during the term of this Agreement, and will cover the Contractor and all Subcontractors for all claims made.

13.1.7.5 Unless otherwise stated in the Special Conditions, all of Contractor’s insurance shall be with insurance companies with an A.M. Best rating of no less than **A: VII**.

13.1.7.6 The insurance requirements set forth herein shall in no way limit the Contractor’s liability arising out of or relating to the performance of the Work or related activities.

13.1.7.7 Failure of Contractor and/or its Subcontractor(s) to comply with the insurance requirements herein shall be deemed a material breach of the Contract.

13.1.8 Insurance Policy Limits

13.1.8.1 Unless different limits are indicated in the Special Conditions, the limits of insurance shall not be less than the following amounts:

Commercial General Liability	Product Liability and Completed Operations, Fire Damage Liability – Split Limit	\$2,000,000 per occurrence; \$4,000,000 aggregate
Automobile Liability – Any Auto	Combined Single Limit	\$1,000,000
Workers’ Compensation		Statutory limits pursuant to State law
Employers’ Liability		\$1,000,000
Builder’s Risk (Course of Construction)		Issued for the value and scope of Work indicated herein.
Pollution Liability		\$1,000,000 per claim; \$2,000,000 aggregate

13.1.8.2 If Contractor normally carries insurance in an amount greater than the minimum amounts required by District, that greater amount shall become the minimum required amount of insurance for purposes of the Contract. Therefore, Contractor hereby acknowledges and agrees that all insurance carried by it shall be deemed liability coverage for all actions it performs in connection with the Contract.

13.2 Contract Security - Bonds

13.2.1 Contractor shall furnish two surety bonds issued by a California admitted surety insurer as follows:

13.2.1.1 Performance Bond: A bond in an amount at least equal to one hundred percent (100%) of Contract Price as security for faithful performance of this Contract.

13.2.1.2 Payment Bond: A bond in an amount at least equal to one hundred percent (100%) of the Contract Price as security for payment of persons performing labor and/or furnishing materials in connection with this Contract.

13.2.2 Cost of bonds shall be included in the Bid and Contract Price.

13.2.3 All bonds related to this Project shall be in the forms set forth in these Contract Documents and shall comply with all requirements of the Contract Documents, including, without limitation, the bond forms.

14. WARRANTY/GUARANTEE/INDEMNITY

14.1 Warranty/Guarantee

14.1.1 The Contractor shall obtain and preserve for the benefit of the District, manufacturer's warranties on materials, fixtures, and equipment incorporated into the Work.

14.1.2 In addition to guarantees required elsewhere, Contractor shall, and hereby does guarantee and warrant all Work furnished on the job against all defects for a period of **ONE (1)** year after the later of the following dates, unless a longer period is provided for in the Contract Documents:

14.1.2.1 The acceptance by the District's governing board of the Work, subject to these General Conditions, or

14.1.2.2 The date that commissioning for the Project, if any, was completed.

At the District's sole option, Contractor shall repair or replace any and all of that Work, together with any other Work that may be displaced in so doing, that may prove defective in workmanship and/or materials within a **ONE (1)** year period from date of completion as defined above, unless a longer period is provided for in the Contract Documents, without expense whatsoever to District. In the event of failure of Contractor and/or Surety to commence and pursue with diligence said replacements or repairs within ten (10) days after being notified in writing, Contractor and Surety hereby acknowledge and agree that District is authorized to proceed to have defects repaired and made good at expense of Contractor and/or Surety who hereby agree to pay costs and charges therefore immediately on demand.

If, in the opinion of District, defective work creates a dangerous condition or requires immediate correction or attention to prevent further loss to District or to prevent interruption of District operations, District will attempt to give the notice

required above. If Contractor or Surety cannot be contacted or neither complies with District's request for correction within a reasonable time as determined by District, District may, notwithstanding the above provision, proceed to make any and all corrections and/or provide attentions the District believes are necessary. The costs of correction or attention shall be charged against Contractor and Surety of the guarantees provided in this Article or elsewhere in this Contract.

14.1.3 The above provisions do not in any way limit the guarantees on any items for which a longer guarantee is specified or on any items for which a manufacturer gives a guarantee for a longer period. Contractor shall furnish to District all appropriate guarantee or warranty certificates as indicated in the Specifications or upon request by District.

14.1.4 Nothing herein shall limit any other rights or remedies available to District.

14.2 Indemnity and Defense

14.2.1 To the furthest extent permitted by California law, the Contractor shall indemnify, keep and hold harmless the District, the Architect(s), and the Construction Manager(s), their respective consultants, separate contractors, board members, officers, representatives, agents, and employees, in both individual and official capacities ("Indemnitees"), against all suits, claims, injury, damages, losses, and expenses ("Claims"), including but not limited to attorney's fees, caused by, arising out of, resulting from, or incidental to, in whole or in part, the performance of the Work under this Contract by the Contractor, its Subcontractors, vendors, or suppliers. However, the Contractor's indemnification and hold harmless obligation shall be reduced by the proportion of the Indemnitees' and/or Architect's liability to the extent the Claim(s) is/are caused by the sole negligence, active negligence, or willful misconduct of the Indemnitees, and/or defects in design furnished by the Architect, as found by a court or arbitrator of competent jurisdiction. This indemnification and hold harmless obligation of the Contractor shall not be construed to negate, abridge, or otherwise reduce any right or obligation of indemnity that would otherwise exist or arise as to Indemnitee or other person described herein. This indemnification and hold harmless obligation includes, but is not limited to, any failure or alleged failure by Contractor to comply with any provision of law, any failure or alleged failure to timely and properly fulfill all of its obligations under the Contract Documents in strict accordance with their terms, and without limitation, any failure or alleged failure of Contractor's obligations regarding any stop payment notice actions or liens, including Civil Wage and Penalty Assessments and/or Orders by the DIR.

14.2.2 To the furthest extent permitted by California law, Contractor shall also defend Indemnitees, at its own expense, including but not limited to attorneys' fees and costs, against all Claims caused by, arising out of, resulting from, or incidental to, in whole or in part, the performance of the Work under this Contract by the Contractor, its Subcontractors, vendors, or suppliers. However, without impacting Contractor's obligation to provide an immediate and ongoing defense of Indemnitees, the Contractor's defense obligation shall be retroactively reduced by the proportion of the Indemnitees' and/or Architect's liability to the extent caused by the sole negligence, active negligence, or willful misconduct of the Indemnitees, and/or defects in design furnished by the Architect, as found by a court or arbitrator of competent jurisdiction. The District shall have the right to accept or reject any legal

representation that Contractor proposes to defend the Indemnitees. If any Indemnitee provides its own defense due to failure to timely respond to tender of defense, rejection of tender of defense, or conflict of interest of proposed counsel, Contractor shall reimburse such Indemnitee for any expenditures. Contractor's defense obligation shall not be construed to negate, abridge, or otherwise reduce any right or obligation of defense that would otherwise exist as to any Indemnitee or other person described herein. Contractor's defense obligation includes, but is not limited to, any failure or alleged failure by Contractor to comply with any provision of law, any failure or alleged failure to timely and properly fulfill all of its obligations under the Contract Documents in strict accordance with their terms, and without limitation, any failure or alleged failure of Contractor's obligations regarding any stop payment notice actions or liens, including Civil Wage and Penalty Assessments and/or Orders by the DIR. The Contractor shall give prompt notice to the District in the event of any Claim(s).

14.2.3 Without limitation of the provisions herein, if the Contractor's obligation to indemnify and hold harmless the Indemnitees or its obligation to defend Indemnitees as provided herein shall be determined to be void or unenforceable, in whole or in part, it is the intention of the parties that these circumstances shall not otherwise affect the validity or enforceability of the Contractor's agreement to indemnify, defend, and hold harmless the rest of the Indemnitees, as provided herein. Further, the Contractor shall be and remain fully liable on its agreements and obligations herein to the fullest extent permitted by law.

14.2.4 Pursuant to Public Contract Code section 9201, the District shall provide timely notification to Contractor of the receipt of any third-party claim relating to this Contract. The District shall be entitled to recover its reasonable costs incurred in providing said notification.

14.2.5 In any and all claims against any of the Indemnitees by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the Contractor's indemnification obligation herein shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the Contractor or any Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

14.2.6 The District may retain so much of the moneys due the Contractor as shall be considered necessary, until disposition of any such Claims or until the District, Architect(s) and Construction Manager(s) have received written agreement from the Contractor that they will unconditionally defend the District, Architect(s) and Construction Manager(s), their respective officers, agents and employees, and pay any damages due by reason of settlement or judgment.

14.2.7 The Contractor's defense and indemnification obligations hereunder shall survive the completion of Work, the warranty/guarantee period, and the termination of the Contract.

15. TIME

15.1 Notice to Proceed

15.1.1 District may issue a Notice to Proceed within ninety (90) days from the date of the Notice of Award. Once Contractor has received the Notice to Proceed, Contractor shall complete the Work within the period of time indicated in the Contract Documents.

15.1.2 In the event that the District desires to postpone issuing the Notice to Proceed beyond ninety (90) days from the date of the Notice of Award, it is expressly understood that with reasonable notice to the Contractor, the District may postpone issuing the Notice to Proceed. It is further expressly understood by Contractor that Contractor shall not be entitled to any claim of additional compensation as a result of the postponement of the issuance of the Notice to Proceed.

15.1.3 If the Contractor believes that a postponement of issuance of the Notice to Proceed will cause a hardship to Contractor, Contractor may terminate the Contract. Contractor's termination due to a postponement shall be by written notice to District within ten (10) days after receipt by Contractor of District's notice of postponement. It is further understood by Contractor that in the event that Contractor terminates the Contract as a result of postponement by the District, the District shall only be obligated to pay Contractor for the Work that Contractor had performed at the time of notification of postponement. Should Contractor terminate the Contract as a result of a notice of postponement, District shall have the authority to award the Contract to the next lowest responsive responsible bidder.

15.2 Computation of Time / Adverse Weather

15.2.1 The Contractor will only be allowed a time extension for Adverse Weather conditions if requested by Contractor in compliance with the time extension request procedures and only if all of the following conditions are met:

15.2.1.1 The weather conditions constitute Adverse Weather, as defined herein;

15.2.1.2 Contractor can verify that the Adverse Weather caused delays in excess of five (5) hours of the indicated labor required to complete the scheduled tasks of Work on the day affected by the Adverse Weather;

15.2.1.3 The Contractor's crew is dismissed as a result of the Adverse Weather;

15.2.1.4 Said delay adversely affects the critical path in the Construction Schedule; and

15.2.1.5 Exceeds twelve (12) days of delay per year.

15.2.2 If the aforementioned conditions are met, a non-compensable day-for-day extension will only be allowed for those days in excess of those indicated herein.

15.2.3 The Contractor shall work seven (7) days per week, if necessary, irrespective of inclement weather, to maintain access and the Construction Schedule,

and to protect the Work under construction from the effects of Adverse Weather, all at no further cost to the District.

15.2.4 The Contract Time has been determined with consideration given to the average climate weather conditions prevailing in the County in which the Project is located.

15.3 Hours of Work

15.3.1 Sufficient Forces

Contractor and Subcontractors shall continuously furnish sufficient and competent work forces with the required levels of familiarity with the Project and skill, training and experience to ensure the prosecution of the Work in accordance with the Construction Schedule.

15.3.2 Performance During Working Hours

Work shall be performed during regular working hours as permitted by the appropriate governmental agency except that in the event of an emergency, or when required to complete the Work in accordance with job progress, Work may be performed outside of regular working hours with the advance written consent of the District and approval of any required governmental agencies.

15.3.3 No Work during Testing

Contractor shall, at no additional cost to the District and at the District's request, coordinate its Work to not disturb District students including, without limitation, not performing any Work when students at the Site are taking tests. The District or District's Representative will provide Contractor with a schedule of test dates concurrent with the District's issuance of the Notice to Proceed, or as soon as test dates are made available to the District.

15.4 Progress and Completion

15.4.1 Time of the Essence

Time limits stated in the Contract Documents are of the essence to the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

15.4.2 No Commencement Without Insurance or Bonds

The Contractor shall not commence operations on the Project or elsewhere prior to the effective date of insurance and bonds. The date of commencement of the Work shall not be changed by the effective date of such insurance or bonds. If Contractor commences Work without insurance and bonds, all Work is performed at Contractor's peril and shall not be compensable until and unless Contractor secures bonds and insurance pursuant to the terms of the Contract Documents and subject to District claim for damages.

15.5 Schedule

Contractor shall provide to District, Construction Manager, and Architect a schedule in conformance with the Contract Documents and as required in the Notice to Proceed and the Contractor's Submittals and Schedules section of these General Conditions.

15.6 Expeditious Completion

The Contractor shall proceed expeditiously with adequate forces and shall achieve Completion within the Contract Time.

16. EXTENSIONS OF TIME – LIQUIDATED DAMAGES

16.1 Liquidated Damages

Contractor and District hereby agree that the exact amount of damages for failure to complete the Work within the time specified is extremely difficult or impossible to determine. If the Work is not completed within the time specified in the Contract Documents, it is understood that the District will suffer damage. It being impractical and unfeasible to determine the amount of actual damage, it is agreed the Contractor shall pay to District as fixed and liquidated damages, and not as a penalty, the amount set forth in the Agreement for each calendar day of delay in completion. Contractor and its Surety shall be liable for the amount thereof pursuant to Government Code section 53069.85.

16.2 Excusable Delay

16.2.1 Contractor shall not be charged for liquidated damages because of any delays in completion of the Work which are not the fault of Contractor or its Subcontractors, including acts of God as defined in Public Contract Code section 7105, acts of enemy, epidemics, and quarantine restrictions. Contractor shall, within five (5) calendar days of beginning of any delay, notify District in writing of causes of delay including documentation and facts explaining the delay and the direct correlation between the cause and effect. District shall review the facts and extent of any delay and shall grant extension(s) of time for completing Work when, in its judgment, the findings of fact justify an extension. Extension(s) of time shall apply only to that portion of Work affected by delay, and shall not apply to other portions of Work not so affected. An extension of time may only be granted if Contractor has timely submitted the Construction Schedule as required herein.

16.2.2 Contractor shall notify the District pursuant to the claims provisions in these General Conditions of any anticipated delay and its cause. Following submission of a claim, the District may determine whether the delay is to be considered avoidable or unavoidable, how long it continues, and to what extent the prosecution and completion of the Work might be delayed thereby.

16.2.3 In the event the Contractor requests an extension of Contract Time for unavoidable delay, such request shall be submitted in accordance with the provisions in the Contract Documents governing changes in Work. When requesting time, requests must be submitted with full justification and documentation. If the Contractor fails to submit justification, it waives its right to a time extension at a later date. Such justification must be based on the official Construction Schedule as

updated at the time of occurrence of the delay or execution of Work related to any changes to the Scope of Work. Any claim for delay must include the following information as support, without limitation:

16.2.3.1 The duration of the activity relating to the changes in the Work and the resources (manpower, equipment, material, etc.) required to perform the activities within the stated duration.

16.2.3.1 Specific logical ties to the Contract Schedule for the proposed changes and/or delay showing the activity/activities in the Construction Schedule that are affected by the change and/or delay. In particular, Contractor must show an actual impact to the schedule, after making a good faith effort to mitigate the delay by rescheduling the work, by providing an analysis of the schedule ("Time Impact Analysis"). Such Time Impact Analysis shall describe in detail the cause and effect of the delay and the impact on the critical dates in the Project schedule. (A portion of any delay of seven (7) days or more must be provided.)

16.2.3.2 A recovery schedule must be submitted within twenty (20) calendar days of written notification to the District of causes of delay.

16.3 No Additional Compensation for Delays Within Contractor's Control

16.3.1 Contractor is aware that governmental agencies, including, without limitation, the Division of the State Architect, the Department of General Services, gas companies, electrical utility companies, water districts, and other agencies may have to approve Contractor-prepared drawings or approve a proposed installation. Accordingly, Contractor shall include in its bid, time for possible review of its drawings and for reasonable delays and damages that may be caused by such agencies. Thus, Contractor is not entitled to make a claim for damages or delays arising from the review of Contractor's drawings.

16.3.2 Contractor shall only be entitled to compensation for delay when all of the following conditions are met:

16.3.2.1 The District is responsible for the delay;

16.3.2.2 The delay is unreasonable under the circumstances involved;

16.3.2.3 The delay was not within the contemplation of the District and Contractor;

16.3.2.4 The delay could not have been avoided or mitigated by Contractor's reasonable diligence; and

16.3.2.5 Contractor timely complies with the claims procedure of the Contract Documents.

16.3.3 Where a change in the Work extends the Contract Time, Contractor may request and recover additional, actual direct costs, provided that Contractor can demonstrate such additional costs are:

16.3.3.1 Actually incurred performing the Work;

16.3.3.2 Not compensated by the Markup allowed; and

16.3.3.3 Directly result from the extended Contract Time.

Contractor shall comply with all required procedures, documentation and time requirements in the Contract Documents. Contractor may not seek or recover such costs using formulas (e.g. Eichleay, labor factors).

16.4 Float or Slack in the Schedule

Float or slack is the amount of time between the early start date and the late start date, or the early finish date and the late finish date, of any of the activities in the schedule. Float or slack is not for the exclusive use of or benefit of either the District or the Contractor, but its use shall be determined solely by the District.

17. CHANGES IN THE WORK

17.1 No Changes Without Authorization

17.1.1 There shall be no change whatsoever in the Drawings, Specifications, or in the Work without an executed Change Order or a written Construction Change Directive authorized by the District as herein provided. District shall not be liable for the cost of any extra work or any substitutions, changes, additions, omissions, or deviations from the Drawings and Specifications unless the District's governing board has authorized the same and the cost thereof has been approved in writing by Change Order or Construction Change Directive in advance of the changed Work being performed. No extension of time for performance of the Work shall be allowed hereunder unless claim for such extension is made at the time changes in the Work are ordered, and such time duly adjusted and approved in writing in the Change Order or Construction Change Directive. Contractor shall be responsible for any costs incurred by the District for professional services and DSA fees and/or delay to the Project Schedule, if any, for DSA to review any request for changes to the DSA approved plans and specifications for the convenience of the Contractor and/or to accommodate the Contractor's means and methods. The provisions of the Contract Documents shall apply to all such changes, additions, and omissions with the same effect as if originally embodied in the Drawings and Specifications.

17.1.2 Contractor shall perform immediately all work that has been authorized by a fully executed Change Order or Construction Change Directive. Contractor shall be fully responsible for any and all delays and/or expenses caused by Contractor's failure to expeditiously perform this Work.

17.1.3 Should any Change Order result in an increase in the Contract Price or extend the Contract Time, the cost of or length of extension in that Change Order shall be agreed to, in writing, by the District in advance of the Work by Contractor, and shall be subject to the monetary limitations set forth in Public Contract Code section 20118.4. In the event that Contractor proceeds with any change in Work without a Change Order executed by the District or Construction Change Directive, Contractor waives any claim of additional compensation or time for that additional work. Under no circumstances shall Contractor be entitled to any claim of additional compensation or time not expressly requested by Contractor in a Proposed Change Order or approved by District in an executed Change Order.

17.1.4A Change Order or Construction Change Directive will become effective when approved by the Board, notwithstanding that Contractor has not signed it. A Change Order or Construction Change Directive will become effective without Contractor's signature provided District indicates it as a "Unilateral Change Order". Any dispute as to the adjustment in the Contract Price or Contract Time, if any, of the Unilateral Change Order shall be resolved pursuant to the Payment and Claims and Disputes provisions herein.

17.1.5 Contractor understands, acknowledges, and agrees that the reason for District authorization is so that District may have an opportunity to analyze the Work and decide whether the District shall proceed with the Change Order or alter the Project so that a change in Work becomes unnecessary.

17.2 Architect Authority

The Architect will have authority to order minor changes in the Work not involving any adjustment in the Contract Price, or an extension of the Contract Time, or a change that is inconsistent with the intent of the Contract Documents. These changes shall be effected by written Change Order, Construction Change Directive, by Architect's response(s) to RFI(s), or by Architect's Supplemental Instructions ("ASI").

17.3 Change Orders

17.3.1A Change Order is a written instrument prepared and issued by the District and/or the Architect and signed by the District (as authorized by the District's Governing Board), the Contractor, the Architect, and approved by the Project Inspector (if necessary) and DSA (if necessary), stating their agreement regarding all of the following:

17.3.1.1 A description of a change in the Work;

17.3.1.2 The amount of the adjustment in the Contract Price, if any; and

17.3.1.3 The extent of the adjustment in the Contract Time, if any.

17.4 Construction Change Directives

17.4.1A Construction Change Directive is a written order prepared and issued by the District, the Construction Manager, and/or the Architect and signed by the District and the Architect, directing a change in the Work. The District may, as provided by law, by Construction Change Directive and without invalidating the Contract, order changes in the Work consisting of additions, deletions, or other revisions. The adjustment to the Contract Price or Time, if any, is subject to the provisions of this section regarding Changes in the Work. If all or a portion of the Project is being funded by funds requiring approval by the State Allocation Board ("SAB"), these revisions may be subject to compensation once approval of same is received and funded by the SAB, and funds are released by the Office of Public School Construction ("OPSC"). Any dispute as to the adjustment in the Contract Price, if any, of the Construction Change Directive or timing of payment shall be resolved pursuant to the Payment and Claims and Disputes provisions herein.

17.4.2The District may issue a Construction Change Directive in the absence of agreement on the terms of a Change Order.

17.5 Force Account Directives

17.5.1When work, for which a definite price has not been agreed upon in advance, is to be paid for on a force account basis, all direct costs necessarily incurred and paid by the Contractor for labor, material, and equipment used in the performance of that Work, shall be subject to the approval of the District and compensation will be determined as set forth herein.

17.5.2The District will issue a Force Account Directive to proceed with the Work on a force account basis, and a not-to-exceed budget will be established by the District.

17.5.3All requirements regarding direct cost for labor, labor burden, material, equipment, and markups on direct costs for overhead and profit described in this section shall apply to Force Account Directives. However, the District will only pay for actual costs verified in the field by the District or its authorized representative(s) on a daily basis.

17.5.4The Contractor shall be responsible for all cost related to the administration of Force Account Directive. The markup for overhead and profit for Contractor modifications shall be full compensation to the Contractor to administer Force Account Directive, and Contractor shall not be entitled to separately recover additional amounts for overhead and/or profit.

17.5.5The Contractor shall notify the District or its authorized representative(s) at least twenty-four (24) hours prior to proceeding with any of the force account work. Furthermore, the Contractor shall notify the District when it has consumed eighty percent (80%) of the budget, and shall not exceed the budget unless specifically authorized in writing by the District. The Contractor will not be compensated for force account work in the event that the Contractor fails to timely notify the District regarding the commencement of force account work, or exceeding the force account budget.

17.5.6The Contractor shall diligently proceed with the work, and on a daily basis, submit a daily force account report using Document 00 63 47, "Daily Force Account Report," no later than 5:00 p.m. each day. The report shall contain a detailed itemization of the daily labor, material, and equipment used on the force account work only. The names of the individuals performing the force account work shall be included on the daily force account reports. The type and model of equipment shall be identified and listed. The District will review the information contained in the reports, and sign the reports no later than the next work day, and return a copy of the report to the Contractor for their records. The District will not sign, nor will the Contractor receive compensation for work the District cannot verify. The Contractor will provide a weekly force account summary indicating the status of each Force Account Directive in terms of percent complete of the not-to-exceed budget and the estimated percent complete of the work.

17.5.7In the event the Contractor and the District reach a written agreement on a set cost for the work while the work is proceeding based on a Force Account

Directive, the Contractor's signed daily force account reports shall be discontinued and all previously signed reports shall be invalid.

17.6 Price Request

17.6.1 Definition of Price Request

A Price Request ("PR") is a written request prepared by the Architect requesting the Contractor to submit to the District and the Architect an estimate of the effect of a proposed change in the Work on the Contract Price and the Contract Time.

17.6.2 Scope of Price Request

A Price Request shall contain adequate information, including any necessary Drawings and Specifications, to enable Contractor to provide the cost breakdowns required herein. The Contractor shall not be entitled to any additional compensation for preparing a response to a Price Request, whether ultimately accepted or not.

17.7 Proposed Change Order

17.7.1 Definition of Proposed Change Order

A Proposed Change Order ("PCO") is a written request prepared by the Contractor requesting that the District and the Architect issue a Change Order based upon a proposed change to the Work.

17.7.2 Changes in Contract Price

A PCO shall include breakdowns and backup documentation pursuant to the revisions herein and sufficient, in the District's judgment, to validate any change in Contract Price. In no case shall Contractor or any of its Subcontractors be permitted to reserve rights for additional compensation for Change Order Work.

17.7.3 Changes in Time

A PCO shall also include any changes in time required to complete the Project. Any additional time requested shall not be the number of days to make the proposed change, but must be based upon the impact to the Construction Schedule as defined in the Contract Documents. The Contractor shall justify the proposed change in time by submittal of a schedule analysis that accurately shows the impact of the change on the critical path of the Construction Schedule ("Time Impact Analysis"). If Contractor fails to request a time extension in a PCO, including the Time Impact Analysis then the Contractor is thereafter precluded from requesting, and waives any right to request, additional time and/or claim a delay. In no case shall Contractor or any of its Subcontractors be permitted to reserve rights for additional time for Change Order Work. A PCO that leaves the amount of time requested blank, or states that such time requested is "to be determined", is not permitted and shall also constitute a waiver of any right to request additional time and/or claim a delay.

17.7.4 Unknown and/or Unforeseen Conditions

If there is an Allowance, then Contractor must submit a Request for Allowance Expenditure Directive, including supporting documentation as described below, to receive authorization for the release of funds from the Allowance. Allowance Expenditure Directives shall be based on Contractor's costs, without overhead and profit, for products, delivery, installation, labor, insurance, payroll, taxes, bonding and equipment rental will be included in Allowance Expenditure Directive authorizing expenditure of funds from this Allowance. No overhead and profit shall be added to the Allowance Expenditure Directive. If cost of the unforeseen condition(s) exceed the Allowance, Contractor must submit a PCO for amounts in excess of the Allowance requesting an increase in Contract Price and/or Contract Time that is based at least partially on Contractor's assertion that Contractor has encountered unknown and/or unforeseen condition(s) on the Project, then Contractor shall base the PCO on provable information that, beyond a reasonable doubt and to the District's satisfaction, demonstrates that the unknown and/or unforeseen condition(s) were actually unknown and/or unforeseen and that the condition(s) were reasonably unknown and/or unforeseen. If not, the District shall deny the PCO as unsubstantiated, and the Contractor shall complete the Project without any increase in Contract Price and/or Contract Time based on that PCO.

17.7.5 Time to Submit Proposed Change Order

Contractor shall submit its PCO within five (5) working days of the date Contractor discovers, or reasonably should have discovered, the circumstances giving rise to the PCO, unless additional time to submit a PCO is granted in writing by the District. Time is of the essence in Contractor's submission of PCOs so that the District can promptly investigate the basis for the PCO. Accordingly, if Contractor fails to submit its PCO within this timeframe, Contractor waives, releases, and discharges any right to assert or claim any entitlement to an adjustment of the Contract Price and/or Time based on circumstances giving rise to the PCO

17.7.6 Proposed Change Order Certification

In submitting a PCO, Contractor certifies and affirms that the cost and/or time request is submitted in good faith, that the cost and/or time request is accurate and in accordance with the provisions of the Contract Documents, and the Contractor submits the cost and/or request for extension of time recognizing the significant civil penalties and treble damages which follow from making a false claim or presenting a false claim under Government Code section 12650 et seq.

It is expressly understood that the value of the extra Work or changes expressly includes any and all of the Contractor's costs and expenses, direct and indirect, resulting from additional time required on the Project or resulting from delay to the Project including, without limitation, cumulative impacts. Contractor is not entitled to separately recover amounts for overhead or other indirect costs. Any costs, expenses, damages, or time extensions not included are deemed waived.

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17.8 Format for Proposed Change Order

17.8.1 The following format shall be used as applicable by the District and the Contractor (e.g. Change Orders, PCO's) to communicate proposed additions and deductions to the Contract, supported by attached documentation. Any spaces left blank will be deemed no change to cost or time.

	<u>WORK PERFORMED OTHER THAN BY CONTRACTOR</u>	<u>ADD</u>	<u>DEDUCT</u>
(a)	<u>Material</u> (attach suppliers' invoice or itemized quantity and unit cost plus sales tax)		
(b)	<u>Add Labor</u> (attach itemized hours and rates, fully Burdened, and specify the hourly rate for each additional labor burden, for example, payroll taxes, fringe benefits, etc.)		
(c)	<u>Add Equipment</u> (attach suppliers' invoice)		
(d)	<u>Subtotal</u>		
(e)	<u>Add overhead and profit for any and all tiers of Subcontractor</u> , the total not to exceed ten percent (10%) of Item (d)		
(f)	<u>Subtotal</u>		
(g)	<u>Add General Conditions Cost</u> (if Time is Compensable) (attach supporting documentation)		
(h)	<u>Subtotal</u>		
(i)	<u>Add Overhead and Profit for Contractor</u> , not to exceed five percent (5%) of Item (h)		
(j)	<u>Subtotal</u>		
(k)	<u>Add Bond and Insurance</u> , not to exceed two percent (2%) of Item (j)		
(l)	<u>TOTAL</u>		
(m)	<u>Time</u> (zero unless indicated; "TBD" not permitted)	<u> </u> Calendar Days	

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	WORK PERFORMED BY CONTRACTOR	ADD	DEDUCT
(a)	Material (attach itemized quantity and unit cost plus sales tax)		
(b)	Add Labor (attach itemized hours and rates, fully Burdened, and specify the hourly rate for each additional labor burden, for example, payroll taxes, fringe benefits, etc.)		
(c)	Add Equipment (attach suppliers' invoice)		
(d)	Add General Conditions Cost (if Time is Compensable) (attach supporting documentation)		
(e)	Subtotal		
(f)	Add Overhead and Profit for Contractor , not to exceed fifteen percent (15%) of Item (e)		
(g)	Subtotal		
(h)	Add Bond and Insurance , not to exceed two percent (2%) of Item (g)		
(i)	TOTAL		
(j)	Time (zero unless indicated; "TBD" not permitted)		Calendar Days

17.8.2 Labor. Contractor shall be compensated for the costs of labor actually and directly utilized in the performance of the Work. Such labor costs shall be the actual cost, use of any formulas (e.g., labor factors) is not allowed, not to exceed prevailing wage rates in the locality of the Site and shall be in the labor classification(s) necessary for the performance of the Work, fully Burdened. Labor costs shall exclude costs incurred by the Contractor in preparing estimate(s) of the costs of the change in the Work, in the maintenance of records relating to the costs of the change in the Work, coordination and assembly of materials and information relating to the change in the Work or performance thereof, or the supervision and other overhead and general conditions costs associated with the change in the Work or performance thereof, including but not limited to the cost for the job superintendent. If applicable, District will pay Contractor the reasonable costs for room and board, supported with appropriate backup documentation, without markup for profit or overhead as provided by U.S. General Services Administration per diem rates for California lodging, meals and incidentals, <https://www.gsa.gov/travel/plan-book/per-diem-rates/per-diem-rates-lookup>.

17.8.3 Materials. Contractor shall be compensated for the costs of materials necessarily and actually used or consumed in connection with the performance of the change in the Work. Costs of materials may include reasonable costs of transportation from a source closest to the Site of the Work and delivery to the Site. If discounts by material suppliers are available for materials necessarily used in the performance of the change in the Work, they shall be credited to the District. If materials necessarily used in the performance of the change in the Work are obtained from a supplier or source owned in whole or in part by the Contractor, compensation therefor shall not exceed the current wholesale price for such materials. If, in the reasonable opinion of the District, the costs asserted by the Contractor for materials in connection with any change in the Work are excessive, or if the Contractor fails to provide satisfactory evidence of the actual costs of such materials from its supplier or vendor of the same, the costs of such materials and the District's obligation to pay for the same shall be limited to the then lowest wholesale price at which similar materials are available in the quantities required to perform

the change in the Work. The District may elect to furnish materials for the change in the Work, in which event the Contractor shall not be compensated for the costs of furnishing such materials or any mark-up thereon.

17.8.4 Equipment. As a precondition for the District's duty to pay for Equipment rental or loading and transportation, Contractor shall provide satisfactory evidence of the actual costs of Equipment from the supplier, vendor or rental agency of same. Contractor shall be compensated for the actual cost of the necessary and direct use of Equipment in the performance of the change in the Work. Use of such Equipment in the performance of the change in the Work shall be compensated in increments of fifteen (15) minutes. Rental time for Equipment moved by its own power shall include time required to move such Equipment to the site of the Work from the nearest available rental source of the same. If Equipment is not moved to the Site by its own power, Contractor will be compensated for the loading and transportation costs in lieu of rental time. The foregoing notwithstanding, neither moving time or loading and transportation time shall be allowed if the Equipment is used for performance of any portion of the Work other than the change in the Work. Unless prior approval in writing is obtained by the Contractor from the Architect, the Project Inspector and the District, no costs or compensation shall be allowed for time while Construction Equipment is inoperative, idle or on standby, for any reason. Contractor shall not be entitled to an allowance or any other compensation for Equipment or tools used in the performance of change in the Work where such Equipment or tools have a replacement value of \$500.00 or less. Equipment costs claimed by the Contractor in connection with the performance of any Work shall not exceed rental rates established by distributors or construction equipment rental agencies in the locality of the Site; any costs asserted which exceed such rental rates shall not be allowed or paid. Unless otherwise specifically approved in writing by the Architect, the Project Inspector and the District, the allowable rate for the use of Equipment in connection with the Work shall constitute full compensation to the Contractor for the cost of rental, fuel, power, oil, lubrication, supplies, necessary attachments, repairs or maintenance of any kind, depreciation, storage, insurance, labor (exclusive of labor costs of the Equipment operator), and any and all other costs incurred by the Contractor incidental to the use of such Equipment.

17.8.5 General Conditions Cost. The phrase "General Conditions Cost" shall mean, other than expressly limited or excluded herein, the costs of Contractor during the construction phase, including but not limited to: payroll costs for project manager for Work conducted at the Site, payroll costs for the superintendent and full-time general foremen, workers not included as direct labor costs engaged in support functions (e.g., loading/unloading, clean-up), costs of offices and temporary facilities including office materials, office supplies, office equipment, minor expenses, utilities, fuel, sanitary facilities and telephone services at the Site, costs of consultants not in the direct employ of Contractor or Subcontractors, and fees for permits and licenses.

17.8.6 Overhead and Profit. The phrase "Overhead and Profit" shall include field and office supervisors and assistants, watchperson, use of small tools, consumable, insurance other than construction bonds and insurance required herein, general conditions costs and home office expenses.

17.9 Change Order Certification

17.9.1 All Change Orders and PCOs include the following certification by the Contractor, either in the form specifically or incorporated by this reference:

17.9.1.1 The undersigned Contractor approves the foregoing as to the changes, if any, to the Contract Price specified for each item, and as to the extension of time allowed, if any, for completion of the entire Work as stated herein, and agrees to furnish all labor, materials, and service, and perform all work necessary to complete any additional work specified for the consideration stated herein. Submission of sums which have no basis in fact or which Contractor knows are false are at the sole risk of Contractor and may be a violation of the False Claims Act set forth under Government Code section 12650 et seq. It is understood that the changes herein to the Contract shall only be effective when approved by the governing board of the District.

17.9.1.2 It is expressly understood that the value of the extra Work or changes expressly includes any and all of the Contractor's costs and expenses, direct and indirect, resulting from additional time required on the Project or resulting from delay to the Project including, without limitation, cumulative impacts. Contractor is not entitled to separately recover amounts for overhead or other indirect costs. Any costs, expenses, damages, or time extensions not included are deemed waived.

17.9.2 Accord and Satisfaction: Contractor's execution of any Change Order shall constitute a full accord and satisfaction, and release, of all Contractor (and if applicable, Subcontractor) claims for additional time, money or other relief arising from or relating to the subject matter of the change including, without limitation, impacts of all types, cumulative impacts, inefficiency, overtime, delay and any other type of claim.

17.10 Determination of Change Order Cost

17.10.1 The amount of the increase or decrease in the Contract Price from a Change Order, if any, shall be determined in one or more of the following ways as applicable to a specific situation and at the District's discretion:

17.10.1.1 District acceptance of a PCO;

17.10.1.2 By unit prices contained in Contractor's original bid;

17.10.1.3 By agreement between District and Contractor.

17.11 Deductive Change Orders

All deductive Change Order(s) must be prepared pursuant to the provisions herein. Where a portion of the Work is deleted from the Contract, the reasonable value of the deducted work less the value of work performed shall be considered the appropriate deduction. The value submitted on the Schedule of Values shall be used to calculate the credit amount unless the bid documentation is being held in escrow as part of the Contract Documents. Unit Prices, if any, may be used in District's discretion in calculating reasonable value. If Contractor offers a proposed amount for a deductive

Change Order(s), Contractor shall include a minimum of five percent (5%) total profit and overhead to be deducted with the amount of the work of the Change Order(s). If Subcontractor work is involved, Subcontractors shall also include a minimum of five percent (5%) profit and overhead to be deducted with the amount of its deducted work. Any deviation from this provision shall not be allowed.

17.12 Addition or Deletion of Alternate Bid Item(s)

If the Bid Form and Proposal includes proposal(s) for Alternate Bid Item(s), during Contractor's performance of the Work, the District may elect to add or delete any such Alternate Bid Item(s) if not included in the Contract at the time of award. If the District elects to add or delete Alternate Bid Item(s) after Contract award, the cost or credit for such Alternate Bid Item(s) shall be as set forth in the Bid Form and Proposal unless the parties agree to a different price and the Contract Time shall be adjusted by the number of days allocated in the Contract Documents. If days are not allocated in the Contract Documents, the Contract Time shall be equitably adjusted.

17.13 Discounts, Rebates, and Refunds

For purposes of determining the cost, if any, of any change, addition, or omission to the Work hereunder, all trade discounts, rebates, refunds, and all returns from the sale of surplus materials and equipment shall accrue and be credited to the Contractor, and the Contractor shall make provisions so that such discounts, rebates, refunds, and returns may be secured, and the amount thereof shall be allowed as a reduction of the Contractor's cost in determining the actual cost of construction for purposes of any change, addition, or omission in the Work as provided herein.

17.14 Accounting Records

With respect to portions of the Work performed by Change Orders and Construction Change Directives, the Contractor shall keep and maintain cost-accounting records satisfactory to the District, including, without limitation, Job Cost Reports as provided in these General Conditions, which shall be available to the District on the same terms as any other books and records the Contractor is required to maintain under the Contract Documents. Such records shall include without limitation hourly records for Labor and Equipment and itemized records of materials and Equipment used that day in connection with the performance of any Work. All records maintained hereunder shall be subject to inspection, review and/or reproduction by the District, the Architect or the Project Inspector upon request. In the event that the Contractor fails or refuses, for any reason, to maintain or make available for inspection, review and/or reproduction such records, the District's reasonable good faith determination of the extent of adjustment to the Contract Price shall be final, conclusive, dispositive and binding upon Contractor.

17.15 Notice Required

If the Contractor desires to make a claim for an increase in the Contract Price, or any extension in the Contract Time for completion, it shall notify the District pursuant to the provisions herein, including the Article on Claims and Disputes. No claim shall be considered unless made in accordance with this subparagraph. Contractor shall proceed to execute the Work even though the adjustment may not have been agreed upon. Any change in the Contract Price or extension of the Contract Time resulting from such claim shall be authorized by a Change Order.

17.16 Applicability to Subcontractors

Any requirements under this Article shall be equally applicable to Change Orders or Construction Change Directives issued to Subcontractors by the Contractor to the extent as required by the Contract Documents.

17.17 Alteration to Change Order Language

Contractor shall not alter Change Orders or reserve time in Change Orders. Change Orders altered in violation of this provision, if in conflict with the terms set forth herein, shall be construed in accordance with the terms set forth herein. Contractor shall execute finalized Change Orders and proceed under the provisions herein with proper notice.

17.18 Failure of Contractor to Execute Change Order

Contractor shall be in default of the Contract if Contractor fails to execute a Change Order when the Contractor agrees with the addition and/or deletion of the Work in that Change Order.

18. REQUEST FOR INFORMATION

18.1 Any Request for Information shall reference all applicable Contract Document(s), including Specification section(s), detail(s), page number(s), drawing number(s), and sheet number(s), etc. The Contractor shall make suggestions and interpretations of the issue raised by each Request for Information. A Request for Information cannot modify the Contract Price, Contract Time, or the Contract Documents. Upon request by the District, Contractor shall provide an electronic copy of the Request for Information in addition to the hard copy.

18.2 The Contractor shall be responsible for any costs incurred for professional services that District may deduct from any amounts owing to the Contractor, if a Request for Information requests an interpretation or decision of a matter where the information sought is equally available to the party making the request. District, at its sole discretion, shall deduct from and/or invoice Contractor for all the professional services arising herein.

19. PAYMENTS

19.1 Contract Price

The Contract Price is stated in the Agreement and, including authorized adjustments, is the total amount payable by the District to the Contractor for performance of the Work under the Contract Documents.

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19.2 Applications for Progress Payments

19.2.1 Procedure for Applications for Progress Payments

19.2.1.1 Application for Progress Payment

19.2.1.1.1 Not before the fifth (5th) day of each calendar month during the progress of the Work, Contractor shall submit to the District and the Architect an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be notarized, if required, and supported by the following or each portion thereof unless waived by the District in writing:

19.2.1.1.1.1 The amount paid to the date of the Application to the Contractor, to all its Subcontractors, and all others furnishing labor, material, or equipment for its Contract;

19.2.1.1.1.2 The amount being requested under the Application for Payment by the Contractor on its own behalf and separately stating the amount requested on behalf of each of the Subcontractors and all others furnishing labor, material, and equipment under the Contract;

19.2.1.1.1.3 The balance that will be due to each of such entities after said payment is made;

19.2.1.1.1.4 A certification that the As-Builts and annotated Specifications are current;

19.2.1.1.1.5 Itemized breakdown of work done for the purpose of requesting partial payment;

19.2.1.1.1.6 An updated and acceptable construction schedule in conformance with the provisions herein;

19.2.1.1.1.7 The additions to and subtractions from the Contract Price and Contract Time;

19.2.1.1.1.8 A total of the retentions held;

19.2.1.1.1.9 Material invoices, evidence of equipment purchases, rentals, and other support and details of cost as the District may require from time to time;

19.2.1.1.1.10 The percentage of completion of the Contractor's Work by line item;

19.2.1.1.1.11 Schedule of Values updated from the preceding Application for Payment;

19.2.1.1.1.12 A duly completed and executed conditional waiver and release upon progress payment compliant with Civil Code section 8132 from the Contractor and each subcontractor of any tier and supplier to be paid from the current progress payment;

19.2.1.1.1.13 A duly completed and executed unconditional waiver and release upon progress payment compliant with Civil Code section 8134 from the Contractor and each subcontractor of any tier and supplier that was paid from the previous progress payment(s); and

19.2.1.1.1.14 A certification by the Contractor of the following:

The Contractor warrants title to all Work performed as of the date of this payment application has been completed in accordance with the Contract Documents for the Project. The Contractor further warrants that all amounts have been paid for work which previous Certificates for Payment were issued and payments received and all Work performed as of the date of this payment application is free and clear of liens, claims, security interests, or encumbrances in favor of the Contractor, Subcontractors, material and equipment suppliers, workers, or other persons or entities making a claim by reason of having provided labor, materials, and equipment relating to the Work, except those of which the District has been informed. Submission of sums which have no basis in fact or which Contractor knows are false are at the sole risk of Contractor and may be a violation of the False Claims Act set forth under Government Code section 12650 et seq.

19.2.1.1.1.15 The Contractor shall be subject to the False Claims Act set forth in Government Code section 12650 et seq. for information provided with any Application for Progress Payment.

19.2.1.1.1.16 All remaining certified payroll records ("CPR(s)") for each journeyman, apprentice, worker, or other employee employed by the Contractor and/or each Subcontractor in connection with the Work for the period of the Application for Payment. As indicated herein, the District shall not make any payment to Contractor until:

19.2.1.1.1.16.1 Contractor and/or its Subcontractor(s) provide electronic CPRs directly to the DIR on no less than every 30 days while Work is being performed and within 30 days after the final day of Work performed on the Project for any journeyman, apprentice, worker or other employee was employed in connection with the Work, or within ten (10) days of any request by the District or the DIR to the requesting entity, and

19.2.1.1.1.16.2 Any delay in Contractor and/or its Subcontractor(s) providing CPRs in a timely manner may directly delay the Contractor's payment.

19.2.1.1.2 Applications received after June 20th will not be paid until the second week of July and applications received after December 12th will not be paid until the first week of January.

19.2.2 Prerequisites for Progress Payments

19.2.2.1 First Payment Request: The following items, if applicable, must be completed before the District will accept and/or process the Contractor's first payment request:

19.2.2.1.1 Installation of the Project sign;

19.2.2.1.2 Installation of field office;

19.2.2.1.3 Installation of temporary facilities and fencing;

19.2.2.1.4 Schedule of Values;

19.2.2.1.5 Contractor's Construction Schedule;

19.2.2.1.6 Schedule of unit prices, if applicable;

19.2.2.1.7 Submittal Schedule;

19.2.2.1.8 Receipt by Architect of all submittals due as of the date of the payment application;

19.2.2.1.9 Copies of necessary permits;

19.2.2.1.10 Copies of authorizations and licenses from governing authorities;

19.2.2.1.11 Initial progress report;

19.2.2.1.12 Surveyor qualifications;

19.2.2.1.13 Written acceptance of District's survey of rough grading, if applicable;

19.2.2.1.14 List of all Subcontractors, with names, license numbers, telephone numbers, and Scope of Work;

19.2.2.1.15 All bonds and insurance endorsements; and

19.2.2.1.16 Resumes of Contractor's project manager, and if applicable, job site secretary, record documents recorder, and job site superintendent.

19.2.2.2 Second Payment Request: The District will not process the second payment request until and unless all submittals and Shop Drawings have been accepted for review by the Architect.

19.2.2.3 No Waiver of Criteria: Any payments made to Contractor where criteria set forth herein have not been met shall not constitute a waiver of said criteria by District. Instead, such payment shall be construed as a good faith effort by District to resolve differences so Contractor may pay its Subcontractors and suppliers. Contractor agrees that failure to submit such items may constitute a breach of contract by Contractor and may subject Contractor to termination.

19.3 Progress Payments

19.3.1 District's Approval of Application for Payment

19.3.1.1 Upon receipt of an Application for Payment, The District shall act in accordance with both of the following:

19.3.1.1.1 Each Application for Payment shall be reviewed by the District as soon as practicable after receipt for the purpose of determining that the Application for Payment is a proper Application for Payment.

19.3.1.1.2 Any Application for Payment determined not to be a proper Application for Payment suitable for payment shall be returned to the Contractor as soon as practicable, but not later than seven (7) days, after receipt. An Application for Payment returned pursuant to this paragraph shall be accompanied by a document setting forth in writing the reasons why the Application for Payment is not proper. The number of days available to the District to make a payment without incurring interest pursuant to this section shall be reduced by the number of days by which the District exceeds this seven-day return requirement.

19.3.1.1.3 An Application for Payment shall be considered properly executed if funds are available for payment of the Application for Payment, and payment is not delayed due to an audit inquiry by the financial officer of the District.

19.3.1.2 The District's review of the Contractor's Application for Payment will be based on the District's and the Architect's observations at the Site and the data comprising the Application for Payment that the Work has progressed to the point indicated and that, to the best of the District's and the Architect's knowledge, information, and belief, the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to:

19.3.1.2.1 Observation of the Work for general conformance with the Contract Documents,

19.3.1.2.2 Results of subsequent tests and inspections,

19.3.1.2.3 Minor deviations from the Contract Documents correctable prior to completion, and

19.3.1.2.4 Specific qualifications expressed by the Architect.

19.3.1.3 District's approval of the certified Application for Payment shall be based on Contractor complying with all requirements for a fully complete and valid certified Application for Payment.

19.3.2 Payments to Contractor

19.3.2.1 Within thirty (30) days after approval of the Application for Payment, Contractor shall be paid a sum equal to ninety-five percent (95%) of the value of the Work performed (as verified by Architect and Inspector and certified by

Contractor) up to the last day of the previous month, less the aggregate of previous payments and amount to be withheld. The value of the Work completed shall be Contractor's best estimate. No inaccuracy or error in said estimate shall operate to release the Contractor, or any Surety upon any bond, from damages arising from such Work, or from the District's right to enforce each and every provision of this Contract, and the District shall have the right subsequently to correct any error made in any estimate for payment.

19.3.2.2 The Contractor shall not be entitled to have any payment requests processed, or be entitled to have any payment made for Work performed, so long as any lawful or proper direction given by the District concerning the Work, or any portion thereof, remains incomplete.

19.3.2.3 If the District fails to make any progress payment within thirty (30) days after receipt of an undisputed and properly submitted Application for Payment from the Contractor, the District shall pay interest to the Contractor equivalent to the legal rate set forth in subdivision (a) of Section 685.010 of the Code of Civil Procedure.

19.3.3 No Waiver

No payment by District hereunder shall be interpreted so as to imply that District has inspected, approved, or accepted any part of the Work. Notwithstanding any payment, the District may enforce each and every provision of this Contract. The District may correct or require correction of any error subsequent to any payment.

19.4 Decisions to Withhold Payment

19.4.1 Reasons to Withhold Payment

The District may withhold payment in whole, or in part, to the extent reasonably necessary to protect the District if, in the District's opinion, the representations to the District required herein cannot be made. The District may withhold payment, in whole, or in part, to such extent as may be necessary to protect the District from loss because of, but not limited to any of the following:

19.4.1.1 Defective Work not remedied within **FORTY-EIGHT (48)** hours of written notice to Contractor.

19.4.1.2 Stop Payment Notices or other liens served upon the District as a result of the Contract. Contractor agrees that the District may withhold up to 125% of the amount claimed in the Stop Payment Notice to answer the claim and to provide for the District's reasonable cost of any litigation pursuant to the stop payment notice.

19.4.1.3 Written notice from payment and/or performance bond surety(ies) to withhold payment from Contractor.

19.4.1.4 Liquidated damages assessed against the Contractor.

19.4.1.5 The cost of completion of the Contract if there exists a reasonable doubt that the Work can be completed for the unpaid balance of the Contract Price or by the completion date.

19.4.1.6 Damage to the District or other contractor(s).

19.4.1.7 Unsatisfactory prosecution of the Work by the Contractor.

19.4.1.8 Failure to store and properly secure materials.

19.4.1.9 Failure of the Contractor to submit, on a timely basis, proper, sufficient, and acceptable documentation required by the Contract Documents, including, without limitation, a Construction Schedule, Schedule of Submittals, Schedule of Values, Monthly Progress Schedules, Shop Drawings, Product Data and samples, Proposed product lists, executed Change Orders, and/or verified reports.

19.4.1.10 Failure of the Contractor to maintain As-Builts.

19.4.1.11 Erroneous estimates by the Contractor of the value of the Work performed, or other false statements in an Application for Payment.

19.4.1.12 Unauthorized deviations from the Contract Documents.

19.4.1.13 Failure of the Contractor to prosecute the Work in a timely manner in compliance with the Construction Schedule, established progress schedules, and/or completion dates.

19.4.1.14 Failure to provide acceptable electronic certified payroll records, as required by the Labor Code, by these Contract Documents, or by written request; for each journeyman, apprentice, worker, or other employee employed by the Contractor and/or by each Subcontractor in connection with the Work for the period of the Application for Payment or if payroll records are delinquent or inadequate.

19.4.1.15 Failure to properly pay prevailing wages as required in Labor Code section 1720 et seq., failure to comply with any other Labor Code requirements, and/or failure to comply with labor compliance monitoring and enforcement by the DIR.

19.4.1.16 Allowing an unregistered subcontractor, as described in Labor Code section 1725.5, to engage in the performance of any work under this Contract.

19.4.1.17 Failure to comply with any applicable federal statutes and regulations regarding minimum wages, withholding, payrolls and basic records, apprentice and trainee employment requirements, equal employment opportunity requirements, Copeland Act requirements, Davis-Bacon Act and related requirements, Contract Work Hours and Safety Standards Act requirements, if applicable.

19.4.1.18 Failure to properly maintain or clean up the Site.

19.4.1.19 Failure to timely indemnify, defend, or hold harmless the District.

19.4.1.20 Any payments due to the District, including but not limited to payments for failed tests, utilities changes, or permits.

19.4.1.21 Failure to pay Subcontractor(s) or supplier(s) as required by law and by the Contract Documents.

19.4.1.22 Failure to pay any royalty, license or similar fees.

19.4.1.23 Contractor is otherwise in breach, default, or in substantial violation of any provision of this Contract.

19.4.1.24 Failure to perform any implementation and/or monitoring required by any SWPPP for the Project and/or the imposition of any penalties or fines therefore whether imposed on the District or Contractor.

19.4.2 Reallocation of Withheld Amounts

19.4.2.1 District may, in its discretion, apply any withheld amount to pay outstanding claims or obligations as defined herein. In so doing, District shall make such payments on behalf of Contractor. If any payment is so made by District, then that amount shall be considered a payment made under Contract by District to Contractor and District shall not be liable to Contractor for any payment made in good faith. These payments may be made without prior judicial determination of claim or obligation. District will render Contractor an accounting of funds disbursed on behalf of Contractor.

19.4.2.2 If Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents or fails to perform any provision thereof, District may, after **FORTY-EIGHT (48)** hours' written notice to the Contractor and, without prejudice to any other remedy, make good such deficiencies. The District shall adjust the total Contract Price by reducing the amount thereof by the cost of making good such deficiencies. If District deems it inexpedient to correct Work that is damaged, defective, or not done in accordance with Contract provisions, an equitable reduction in the Contract Price (of at least one hundred fifty percent (150%) of the estimated reasonable value of the nonconforming Work) shall be made therefor.

19.4.3 Payment After Cure

When Contractor removes the grounds for declining approval, payment shall be made for amounts withheld because of them. No interest shall be paid on any retainage or amounts withheld due to the failure of the Contractor to perform in accordance with the terms and conditions of the Contract Documents.

19.5 Subcontractor Payments

19.5.1 Payments to Subcontractors

No later than seven (7) days after receipt, or pursuant to Business and Professions Code section 7108.5 and Public Contract Code section 7107, the Contractor shall pay to each Subcontractor, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is

entitled. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to its Sub-subcontractors in a similar manner.

19.5.2 No Obligation of District for Subcontractor Payment

The District shall have no obligation to pay, or to see to the payment of, money to a Subcontractor except as may otherwise be required by law.

19.5.3 Joint Checks

District shall have the right in its sole discretion, if necessary for the protection of the District, to issue joint checks made payable to the Contractor and Subcontractors and/or material or equipment suppliers. The joint check payees shall be responsible for the allocation and disbursement of funds included as part of any such joint payment. In no event shall any joint check payment be construed to create any contract between the District and a Subcontractor of any tier, or a material or equipment supplier, any obligation from the District to such Subcontractor or a material or equipment supplier, or rights in such Subcontractor or a material or equipment supplier against the District.

20. COMPLETION OF THE WORK

20.1 Completion

20.1.1 District will accept completion of Contract and have the Notice of Completion recorded when the entire Work shall have been completed to the satisfaction of District.

20.1.2 The Work may only be accepted as complete by action of the governing board of the District.

20.1.3 District, at its sole option, may accept completion of Contract and have the Notice of Completion recorded when the entire Work shall have been completed to the satisfaction of District, except for minor corrective items, as distinguished from incomplete items. If Contractor fails to complete all minor corrective items within fifteen (15) days after the date of the District's acceptance of completion, District shall withhold from the final payment one hundred fifty percent (150%) of an estimate of the amount sufficient to complete the corrective items, as determined by District, until the item(s) are completed.

20.1.4 At the end of the 15-day period, if there are any items remaining to be corrected, District may elect to proceed as provided herein related to adjustments to Contract Price, and/or District's right to perform the Work of the Contractor.

20.2 Close-Out/Certification Procedures

20.2.1 Punch List

The Contractor shall notify the Architect when Contractor considers the Work complete. Upon notification, Architect will prepare a list of minor items to be completed or corrected ("Punch List"). The Contractor and/or its Subcontractors

shall proceed promptly to complete and correct items on the Punch List. Failure to include an item on Punch List does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

20.2.2 Close-Out/Certification Requirements

20.2.2.1 Utility Connections

Buildings shall be connected to water, gas, sewer, and electric services, complete and ready for use. Service connections shall be made and existing services reconnected.

20.2.2.2 Record Drawings and Record Specifications

20.2.2.2.1 Contractor shall provide exact Record Drawings of the Work ("As-BUILTS") and Record Specifications upon completion of the Project and as a condition precedent to approval of final payment.

20.2.2.2.2 Contractor shall obtain the Inspector's approval of the corrected prints and employ a competent draftsman to transfer the Record Drawings information to the most current version of AutoCAD that is, at that time, currently utilized for plan check submission by either the District, the Architect, OPSC, and/or DSA, and print a complete set of transparent sepias. When completed, Contractor shall deliver corrected sepias and diskette/CD/other

20.2.2.2.3 Contractor is liable and responsible for any and all inaccuracies in the Record Drawings and Record Specifications, even if inaccuracies become evident at a future date.

20.2.2.3 Construction Storm Water Permit, if applicable

Contractor shall submit to District all electronic or hard copy records required by the Construction Storm Water Permit, if applicable, within seven (7) days of Completion of the Project.

20.2.2.4 Maintenance Manuals: Contractor shall prepare all operation and maintenance manuals and date as indicated in the Specifications.

20.2.2.5 Source Programming: Contractor shall provide all source programming for all items in the Project.

20.2.2.6 Verified Reports: Contractor shall completely and accurately fill out and file forms DSA 6-C or DSA 152 (or current form), as appropriate. Refer to section 4-336 and section 4-343 of Part 1, Title 24 of the California Code of Regulations.

20.3 Final Inspection

20.3.1 Contractor shall comply with Punch List procedures as provided herein, and maintain the presence of a Project Superintendent and Project Manager until the Punch List is complete to ensure proper and timely completion of the Punch List.

Under no circumstances shall Contractor demobilize its forces prior to completion of

the Punch List without District's prior written approval. Upon receipt of Contractor's written notice that all of the Punch List items have been fully completed and the Work is ready for final inspection and District acceptance, Architect and Project Inspector will inspect the Work and shall submit to Contractor and District a final inspection report noting the Work, if any, required in order to complete in accordance with the Contract Documents. Absent unusual circumstances, this report shall consist of the Punch List items not yet satisfactorily completed.

20.3.2 Upon Contractor's completion of all items on the Punch List and any other uncompleted portions of the Work, the Contractor shall notify the District and Architect, who shall again inspect such Work. If the Architect finds the Work complete and acceptable under the Contract Documents, the Architect will notify Contractor, who shall then jointly submit to the Architect and the District its final Application for Payment.

20.3.3 Final Inspection Requirements

20.3.3.1 Before calling for final inspection, Contractor shall determine that the following have been performed:

20.3.3.1.1 The Work has been completed.

20.3.3.1.2 All life safety items are completed and in working order.

20.3.3.1.3 Mechanical and electrical Work including, without limitation, security system, data, and fire alarm, are complete and tested, fixtures are in place, connected, and ready for tryout.

20.3.3.1.4 Electrical circuits scheduled in panels and disconnect switches labeled.

20.3.3.1.5 Painting and special finishes complete.

20.3.3.1.6 Doors complete with hardware, cleaned of protective film, relieved of sticking or binding, and in working order.

20.3.3.1.7 Tops and bottoms of doors sealed.

20.3.3.1.8 Floors waxed and polished as specified.

20.3.3.1.9 Broken glass replaced and glass cleaned.

20.3.3.1.10 Grounds cleared of Contractor's equipment, raked clean of debris, and trash removed from Site.

20.3.3.1.11 Work cleaned, free of stains, scratches, and other foreign matter, and damaged and broken material replaced.

20.3.3.1.12 Finished and decorative work shall have marks, dirt, and superfluous labels removed.

20.3.3.1.13 Final cleanup, as provided herein.

20.4 Costs of Multiple Inspections

More than two (2) requests of the District to make a final inspection shall be considered an additional service of District, Architect, Construction Manager, and/or Project Inspector, and all subsequent costs will be invoiced to Contractor and if funds are available, withheld from remaining payments.

20.5 Partial Occupancy or Use Prior to Completion

20.5.1 District's Rights to Occupancy

The District may occupy or use any completed or partially completed portion of the Work at any stage, and such occupancy shall not constitute the District's Final Acceptance of any part of the Work. Neither the District's Final Acceptance, the making of Final Payment, any provision in Contract Documents, nor the use or occupancy of the Work, in whole or in part, by District shall constitute acceptance of Work not in accordance with the Contract Documents nor relieve the Contractor or the Contractor's Performance Bond Surety from liability with respect to any warranties or responsibility for faulty or defective Work or materials, equipment and workmanship incorporated therein. In the event that the District occupies or uses any completed or partially completed portion of the Work, the Contractor shall remain responsible for payments, security, maintenance, heat, utilities, damage to the Work, insurance, the period for correction of the Work, and the commencement of warranties required by the Contract Documents unless the Contractor requests in writing, and the District agrees, to otherwise divide those responsibilities. Any dispute as to responsibilities shall be resolved pursuant to the Claims and Disputes provisions herein, with the added provision that during the dispute process, the District shall have the right to occupy or use any portion of the Work that it needs or desires to use.

20.5.2 Inspection Prior to Occupancy or Use

Immediately prior to partial occupancy or use, the District, the Contractor, and the Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

20.5.3 No Waiver

Unless otherwise agreed upon, partial or entire occupancy or use of a portion or portions of the Work shall not constitute beneficial occupancy or District's acceptance of the Work not complying with the requirements of the Contract Documents.

21. FINAL PAYMENT AND RETENTION

21.1 Final Payment

Upon receipt and approval of a valid and final Application for Payment, the Architect will issue a final Certificate of Payment. The District shall thereupon jointly inspect the Work and either accept the Work as complete or notify the Architect and the Contractor in writing of reasons why the Work is not complete. Upon District's acceptance of the Work of the Contractor as fully complete by the Governing Board of the District (that, absent unusual circumstances, will occur when the Punch List items have been satisfactorily

completed), the District shall record a Notice of Completion with the County Recorder, and the Contractor shall, upon receipt of final payment from the District, pay the amount due Subcontractors.

21.2 Prerequisites for Final Payment

The following conditions must be fulfilled prior to Final Payment:

21.2.1A full release of all Stop Payment Notices served in connection with the Work shall be submitted by Contractor.

21.2.2A duly completed and executed conditional waiver and release upon final payment compliant with Civil Code section 8136, from the Contractor and each subcontractor of any tier and supplier to be paid from the final payment.

21.2.3A duly completed and executed unconditional waiver and release upon progress payment compliant with Civil Code section 8134, from the Contractor and each subcontractor of any tier and supplier that was paid from the previous progress payments.

21.2.4A duly completed and executed Document 00 65 19.26, "AGREEMENT AND RELEASE OF ANY AND ALL CLAIMS" from the Contractor.

21.2.5The Contractor shall have made all corrections to the Work that are required to remedy any defects therein, to obtain compliance with the Contract Documents or any requirements of applicable codes and ordinances, or to fulfill any of the orders or directions of District required under the Contract Documents.

21.2.6Each Subcontractor shall have delivered to the Contractor all written guarantees, warranties, applications, and bonds required by the Contract Documents for its portion of the Work.

21.2.7Contractor must have completed all requirements set forth under "Close-Out/Certification Procedures," including, without limitation, submission of an approved set of complete Record Drawings.

21.2.8Architect shall have issued its written approval that final payment can be made.

21.2.9The Contractor shall have delivered to the District all manuals and materials required by the Contract Documents, which must be approved by the District.

21.2.10 The Contractor shall have completed final clean-up as provided herein.

21.3 Retention

21.3.1The retention, less any amounts disputed by the District or that the District has the right to withhold pursuant to provisions herein, shall be paid:

21.3.1.1 After approval by the Architect of the Application and Certificate of Payment,

21.3.1.2 After the satisfaction of the conditions set forth herein, and

21.3.1.3 After forty-five (45) days after the recording of the Notice of Completion by District.

21.3.2 No interest shall be paid on any retention, or on any amounts withheld due to a failure of the Contractor to perform, in accordance with the terms and conditions of the Contract Documents, except as provided to the contrary in any Escrow Agreement between the District and the Contractor pursuant to Public Contract Code section 22300.

21.4 Substitution of Securities

The District will permit the substitution of securities in accordance with the provisions of Public Contract Code section 22300.

22. UNCOVERING OF WORK

If a portion of the Work is covered without Inspector or Architect approval or not in compliance with the Contract Documents, it must, if required in writing by the District, the Project Inspector, or the Architect, be uncovered for the Project Inspector's or the Architect's observation and be corrected, replaced, and/or recovered at the Contractor's expense without change in the Contract Price or Contract Time.

23. NONCONFORMING WORK AND CORRECTION OF WORK

23.1 Nonconforming Work

23.1.1 Contractor shall promptly remove from Premises all Work identified by District as failing to conform to the Contract Documents whether incorporated or not. Contractor shall promptly replace and re-execute its own Work to comply with the Contract Documents without additional expense to the District and shall bear the expense of making good all work of other contractors destroyed or damaged by any removal or replacement pursuant hereto and/or any delays to the District or other Contractors caused thereby.

23.1.2 If Contractor does not remove Work that District has identified as failing to conform to the Contract Documents within a reasonable time, not to exceed **FORTY-EIGHT (48)** hours, District may remove it and may store any material at Contractor's expense. If Contractor does not pay expense(s) of that removal within ten (10) days' time thereafter, District may, upon ten (10) days' written notice, sell any material at auction or at private sale and shall deduct all costs and expenses incurred by the District and/or District may withhold those amounts from payment(s) to Contractor.

23.2 Correction of Work

23.2.1 Correction of Rejected Work

Pursuant to the notice provisions herein, the Contractor shall immediately correct the Work rejected by the District, the Architect, or the Project Inspector as failing to conform to the requirements of the Contract Documents, whether observed before or after Completion and whether or not fabricated, installed, or completed. The Contractor shall bear costs of correcting the rejected Work, including additional

testing, inspections, and compensation for the Inspector's or the Architect's services and expenses made necessary thereby.

23.2.2 One-Year Warranty Corrections

If, within one (1) year after the date of Completion of the Work or a designated portion thereof, or after the date for commencement of warranties established hereunder, or by the terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the District to do so. This period of one (1) year shall be extended with respect to portions of the Work first performed after Completion by the period of time between Completion and the actual performance of the Work. This obligation hereunder shall survive District's acceptance of the Work under the Contract and termination of the Contract. The District shall give such notice promptly after discovery of the condition.

23.3 District's Right to Perform Work

23.3.1 If the Contractor should neglect to prosecute the Work properly or fail to perform any provisions of this contract, the District, after **FORTY-EIGHT (48)** hours written notice to the Contractor, may, without prejudice to any other remedy it may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor.

23.3.2 If it is found at any time, before or after completion of the Work, that Contractor has varied from the Drawings and/or Specifications, including, but not limited to, variation in material, quality, form, or finish, or in the amount or value of the materials and labor used, District may require at its option:

23.3.2.1 That all such improper Work be removed, remade or replaced, and all work disturbed by these changes be made good by Contractor at no additional cost to the District;

23.3.2.2 That the District deduct from any amount due Contractor the sum of money equivalent to the difference in value between the work performed and that called for by the Drawings and Specifications; or

23.3.2.3 That the District exercise any other remedy it may have at law or under the Contract Documents, including but not limited to the District hiring its own forces or another contractor to replace the Contractor's nonconforming Work, in which case the District shall either issue a deductive Change Order, a Construction Change Directive, or invoice the Contractor for the cost of that work. Contractor shall pay any invoices within thirty (30) days of receipt of same or District may withhold those amounts from payment(s) to Contractor.

24. TERMINATION AND SUSPENSION

24.1 District's Request for Assurances

If District at any time reasonably believes Contractor is or may be in default under this Contract, District may in its sole discretion notify Contractor of this fact and request

written assurances from Contractor of performance of Work and a written plan from Contractor to remedy any potential default under the terms this Contract that the District may advise Contractor of in writing. Contractor shall, within ten (10) calendar days of District's request, deliver a written cure plan that meets the District's requirements in its request for assurances. Contractor's failure to provide such written assurances of performance and the required written plan, within ten (10) calendar days of request, will constitute a material breach of this Contract sufficient to justify termination for cause.

24.2 District's Right to Terminate Contractor for Cause

24.2.1 Grounds for Termination: The District, in its sole discretion, may terminate the Contract and/or terminate the Contractor's right to perform the work of the Contract based upon any of the following:

24.2.1.1 Contractor refuses or fails to execute the Work or any separable part thereof with sufficient diligence as will ensure its completion within the time specified or any extension thereof, or

24.2.1.2 Contractor fails to complete said Work within the time specified or any extension thereof, or

24.2.1.3 Contractor persistently fails or refuses to perform Work or provide material of sufficient quality as to be in compliance with Contract Documents; or

24.2.1.4 Contractor persistently refuses, or repeatedly fails, except in cases for which extension of time is provided, to supply enough properly skilled workers or proper materials to complete the Work in the time specified; or

24.2.1.5 Contractor fails to make prompt payment to Subcontractors, or for material, or for labor; or

24.2.1.6 Contractor persistently disregards laws, or ordinances, or instructions of District; or

24.2.1.7 Contractor fails to supply labor, including that of Subcontractors, that is sufficient to prosecute the Work or that can work in harmony with all other elements of labor employed or to be employed on the Work; or

24.2.1.8 Contractor or its Subcontractor(s) is/are otherwise in breach, default, or in substantial violation of any provision of this Contract, including but not limited to a lapse in licensing or registration.

24.2.2 Notification of Termination

24.2.2.1 Upon the occurrence at District's sole determination of any of the above conditions, District may, without prejudice to any other right or remedy, serve written notice upon Contractor and its Surety of District's termination of this Contract and/or the Contractor's right to perform the work of the Contract. This notice will contain the reasons for termination. Unless, within three (3) days after the service of the notice, any and all condition(s) shall cease, and any and all violation(s) shall cease, or arrangement satisfactory to District for the

correction of the condition(s) and/or violation(s) be made, this Contract and/or the Contractor's right to perform the Work of the Contract shall cease and terminate. Upon termination, Contractor shall not be entitled to receive any further payment until the entire Work is finished.

24.2.2.2 Upon Termination, District may immediately serve written notice of tender upon Surety whereby Surety shall have the right to take over and perform this Contract only if Surety:

24.2.2.2.1 Within three (3) days after service upon it of the notice of tender, gives District written notice of Surety's intention to take over and perform this Contract; and

24.2.2.2.2 Commences performance of this Contract within three (3) days from date of serving of its notice to District.

24.2.2.3 Surety shall not utilize Contractor in completing the Project if the District notifies Surety of the District's objection to Contractor's further participation in the completion of the Project. Surety expressly agrees that any contractor which Surety proposes to fulfill Surety's obligations is subject to District's approval. District's approval shall not be unreasonably withheld, conditioned or delayed.

24.2.2.4 If Surety fails to notify District or begin performance as indicated herein, District may take over the Work and execute the Work to completion by any method it may deem advisable at the expense of Contractor and/or its Surety. Contractor and/or its Surety shall be liable to District for any excess cost or other damages the District incurs thereby. Time is of the essence in this Contract. If the District takes over the Work as herein provided, District may, without liability for so doing, take possession of and utilize in completing the Work such materials, appliances, plan, and other property belonging to Contractor as may be on the Site of the Work, in bonded storage, or previously paid for.

24.3 Termination of Contractor for Convenience

24.3.1 District in its sole discretion may terminate the Contract in whole or in part upon three (3) days' written notice to the Contractor.

24.3.2 Upon notice, Contractor shall:

24.3.2.1 Cease operations as directed by the District in the notice;

24.3.2.2 Take necessary actions for the protection and preservation of the Work as soon as possible; and

24.3.2.3 Terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

24.3.3 Within 30 days of the notice, Contractor submit to the District a payment application for the actual cost for labor, materials, and services performed, including all Contractor's and Subcontractor(s)' mobilization and/or demobilization costs, that

is unpaid. Contractor shall have no claims against the District except for the actual cost for labor, materials, and services performed that adequately documented through timesheets, invoices, receipts, or otherwise. District shall pay all undisputed invoice(s) for work performed until the notice of termination.

24.3.4 Under a termination for convenience, the District retains the right to all the options available to the District if there is a termination for cause.

24.4 Effect of Termination

24.4.1 Contractor shall, only if ordered to do so by the District, immediately remove from the Site all or any materials and personal property belonging to Contractor that have not been incorporated in the construction of the Work, or which are not in place in the Work. The District retains the right, but not the obligation, to keep and use any materials and personal property belonging to Contractor that have not been incorporated in the construction of the Work, or which are not in place in the Work. The Contractor and its Surety shall be liable upon the Performance Bond for all damages caused to the District by reason of the Contractor's failure to complete the Contract.

24.4.2 In the event that the District shall perform any portion of, or the whole of the Work, pursuant to the provisions of the General Conditions, the District shall not be liable nor account to the Contractor in any way for the time within which, or the manner in which, the Work is performed by the District or for any changes the District may make in the Work or for the money expended by the District in satisfying claims and/or suits and/or other obligations in connection with the Work.

24.4.3 In the event termination for cause is determined to have not been for cause, the termination shall be deemed to have been a termination for convenience effective as of the same date as the purported termination for cause.

24.4.4 In the event that the Contract is terminated for any reason, no allowances or compensation will be granted for the loss of any anticipated profit by the Contractor or any impact or impairment of Contractor's bonding capacity.

24.4.5 If the expense to the District to finish the Work exceeds the unpaid Contract Price, Contractor and Surety shall pay difference to District within twenty-one (21) days of District's request.

24.4.6 The District shall have the right (but shall have no obligation) to assume and/or assign to a general contractor or construction manager or other third party who is qualified and has sufficient resources to complete the Work, the rights of the Contractor under its subcontracts with any or all Subcontractors. In the event of an assumption or assignment by the District, no Subcontractor shall have any claim against the District or third party for Work performed by Subcontractor or other matters arising prior to termination of the Contract. The District or any third party, as the case may be, shall be liable only for obligations to the Subcontractor arising after assumption or assignment. Should the District so elect, the Contractor shall execute and deliver all documents and take all steps, including the legal assignment of its contractual rights, as the District may require, for the purpose of fully vesting in the District the rights and benefits of its Subcontractor under Subcontracts or other obligations or commitments. All payments due the Contractor hereunder shall

be subject to a right of offset by the District for expenses and damages suffered by the District as a result of any default, acts, or omissions of the Contractor. Contractor must include this assignment provision in all of its contracts with its Subcontractors.

24.4.7 The foregoing provisions are in addition to and not in limitation of any other rights or remedies available to District.

24.5 Emergency Termination of Public Contracts Act of 1949

24.5.1 This Contract is subject to termination as provided by sections 4410 and 4411 of the Government Code of the State of California, being a portion of the Emergency Termination of Public Contracts Act of 1949.

24.5.1.1 Section 4410 of the Government Code states:

In the event a national emergency occurs, and public work, being performed by contract, is stopped, directly or indirectly, because of the freezing or diversion of materials, equipment or labor, as the result of an order or a proclamation of the President of the United States, or of an order of any federal authority, and the circumstances or conditions are such that it is impracticable within a reasonable time to proceed with a substantial portion of the work, then the public agency and the contractor may, by written agreement, terminate said contract.

24.5.1.2 Section 4411 of the Government Code states:

Such an agreement shall include the terms and conditions of the termination of the contract and provision for the payment of compensation or money, if any, which either party shall pay to the other or any other person, under the facts and circumstances in the case.

24.5.2 Compensation to the Contractor shall be determined at the sole discretion of District on the basis of the reasonable value of the Work done, including preparatory work. As an exception to the foregoing and at the District's discretion, in the case of any fully completed separate item or portion of the Work for which there is a separate previously submitted unit price or item on the accepted schedule of values, that price shall control. The District, at its sole discretion, may adopt the Contract Price as the reasonable value of the work done or any portion thereof.

24.6 Suspension of Work

24.6.1 District in its sole discretion may suspend, delay or interrupt the Work in whole or in part for such period of time as the District may determine upon three (3) days written notice to the Contractor.

24.6.1.1 An adjustment may be made for changes in the cost of performance of the Work caused by any such suspension, delay or interruption. No adjustment shall be made to the extent:

24.6.1.1.1 That performance is, was or would have been so suspended, delayed or interrupted by another cause for which Contractor is responsible; or

24.6.1.1.2 That an equitable adjustment is made or denied under another provision of the Contract; or

24.6.1.1.3 That the suspension of Work was the direct or indirect result of Contractor's failure to perform any of its obligations hereunder.

24.6.1.2 Any adjustments in cost of performance may have a fixed or percentage fee as provided in the section on Format for Proposed Change Order herein. This amount shall be full compensation for all Contractor's and its Subcontractor(s)' changes in the cost of performance of the Contract caused by any such suspension, delay or interruption.

25. CLAIMS PROCESS

25.1 Obligation to File Claims for Disputed Work

25.1.1 Should Contractor otherwise seek extra time or compensation for any reason whatsoever ("Disputed Work"), then Contractor shall first follow procedures set forth in the Contract Documents including, without limitation, Articles 15, 16 and 17, all of which are conditions precedent to submitting a Claim pursuant to Article 25. A Notice of Delay or Proposed Change Order are less formal procedures that proceed the formal claim and do not constitute a Claim. A Claim also does not include correspondence, RFIs, vouchers, invoices, progress payment applications, or other routine or authorized form of requests for progress payments in compliance with the Contract. If a dispute remains, then Contractor shall give written notice to District that expressly invokes this Article 25 within the time limits set forth herein.

25.1.2 Contractor's sole and exclusive remedy for Disputed Work is to file a written claim setting forth Contractor's position as required herein within the time limits set forth herein.

25.2 Duty to Perform during during Claims Process

Contractor and its subcontractors shall continue to perform its Work under the Contract including the disputed work, and shall not cause a delay of the Work during any dispute, claim, negotiation, mediation, or arbitration proceeding, except by written agreement by the District.

25.3 Definition of a Claim

25.3.1 Pursuant to Public Contract Code section 9204, the term "Claim" means a separate demand by the Contractor, sent by registered mail or certified mail with return receipt requested, for one or more of the following:

25.3.1.1 A time extension, including without limitation, for relief of damages or penalties for delay assessed by the District under the Contract;

25.3.1.2 Payment by the District of money or damages arising from work done by, or on behalf of, the Contractor pursuant to the Contract and payment of which is not otherwise expressly provided for or to which Contractor is not otherwise entitled to; or

25.3.1.3 An amount of payment disputed by the District.

25.4 Claims Presentation

25.4.1 Form and Contents of Claim

25.4.1.1 If Contractor intends to submit a Claim for an increase in the Contract Price and/or Contract Time for any reason including, without limitation, the acts of District or its agents, Contractor shall, within thirty (30) days after the event giving rise to the Claim, give notice of the Claim ("Notice of Potential Claim") in writing specifically identifying Contractor is invoking this Article 25 Claims Presentation. The Notice of Potential Claim shall provide Contractor's preliminary request for an adjustment to the Contract Price and/or Contract Time, with a description of the grounds therefore.

25.4.1.2 Within thirty (30) days after serving the written Notice of Potential Claim, Contractor shall provide a Claim including an itemized statement of the details and amounts of its Claim for any increase in the Contract Price of Contract Time as provided below, including a Time Impact Analysis and any and all other documentation substantiating Contractor's claimed damages:

25.4.1.2.1 The issues, events, conditions, circumstances and/or causes giving rise to the dispute, and shall show, in detail, the cause and effect of same;

25.4.1.2.2 Citation to provisions in the Contract Documents, statute sections, and/or case law entitling Contractor to an increase in the Contract Price or Contract Time;

25.4.1.2.3 The pertinent dates and/or durations and actual and/or anticipated effects on the Contract Price, Contract Schedule milestones and/or Contract Time adjustments;

25.4.1.2.4 The Time Impact Analysis of all time delays that shows actual time impact on the critical path; and

25.4.1.2.5 The line-item costs for labor, material, and/or equipment, if applicable, for all cost impacts priced like a change order according to Article 17 and must be updated monthly as to cost and entitlement if a continuing claim.

25.4.1.3 The Claim shall include the following certification by the Contractor:

25.4.1.3.1 The undersigned Contractor certifies under penalty of perjury that the attached dispute is made in good faith; that the supporting data is accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the adjustment for which Contractor

believes the District is liable; and that I am duly authorized to certify the dispute on behalf of the Contractor.

25.4.1.3.2 Furthermore, Contractor understands that the value of the attached dispute expressly includes any and all of the Contractor's costs and expenses, direct and indirect, resulting from the Work performed on the Project, additional time required on the Project and/or resulting from delay to the Project including, without limitation, cumulative impacts. Contractor may not separately recover for overhead or other indirect costs. Any costs, expenses, damages, or time extensions not included are deemed waived.

25.4.2 Contractor shall bear all costs incurred in the preparation and submission of a Claim.

25.4.3 Failure to timely submit a Claim and the requisite supporting documentation shall constitute a waiver of Contractor's claim(s) against the District and Contractor's Claims for compensation or an extension of time shall be deemed waived, released, and discharged as to any entitlement for adjustment to the Contract Price and. or Contract Time.

25.5 Claim Resolution pursuant to Public Contract Code section 9204

Contractor may request to waive the claims procedure under Public Contract Code section 9204 and proceed directly to the commencement of a civil action or binding arbitration. If Contractor chooses to proceed, Contractor shall comply with the following steps.

25.5.1 STEP 1:

25.5.1.1 Upon receipt of a Claim by registered or certified mail, return receipt requested, including the documents necessary to substantiate it, the District shall conduct a reasonable review of the Claim and, within a period not to exceed 45 days, shall provide the Contractor a written statement identifying what portion of the Claim is disputed and what portion is undisputed. Upon receipt of a Claim, the District and Contractor may, by mutual agreement, extend the time period to provide a written statement. If the District needs approval from its governing body to provide the Contractor a written statement identifying the disputed portion and the undisputed portion of the Claim, and the governing body does not meet within the 45 days or within the mutually agreed to extension of time following receipt of Claim sent by registered mail or certified mail, return receipt requested, the District shall have up to three (3) days following the next duly publicly noticed meeting of the governing body after the 45-day period, or extension, expires to provide Contractor a written statement identifying the disputed portion and the undisputed portion.

25.5.1.1.1 Any payment due on an undisputed portion of the Claim shall be processed and made within 60 days after the District issues its written statement. Amounts not paid in a timely manner as required by this section, section 25.4, shall bear interest at seven percent (7%) per annum.

25.5.1.2 Upon receipt of a Claim, the parties may mutually agree to waive, in writing, mediation and proceed directly to the commencement of a civil action or

binding arbitration, as applicable. In this instance, District and Contractor must comply with the sections below regarding Public Contract Code section 20104 et seq. and Government Code Claim Act Claims.

25.5.1.3 If the District fails to issue a written statement, or to otherwise meet the time requirements of this section, this shall result in the Claim being deemed rejected in its entirety. A claim that is denied by reason of the District's failure to have responded to a claim, or its failure to otherwise meet the time requirements of this section, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of Contractor.

25.5.2STEP 2:

25.5.2.1 If Contractor disputes the District's written response, or if the District fails to respond to a Claim within the time prescribed, Contractor may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the District shall schedule a meet and confer conference within 30 days for settlement of the dispute. Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the District shall provide the Contractor a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed.

25.5.2.1.1.1 Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the District issues its written statement. Amounts not paid in a timely manner as required by this section, section 25.4, shall bear interest at seven percent (7%) per annum.

25.5.3STEP 3:

25.5.3.1 Any disputed portion of the claim, as identified by Contractor in writing, shall be submitted to nonbinding mediation, with the District and Contractor sharing the associated costs equally. The District and Contractor shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.

25.5.3.1.1 For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this section.

25.5.3.2 Unless otherwise agreed to by the District and Contractor in writing, the mediation conducted pursuant to this section shall excuse any further

obligation under Public Contract Code section 20104.4 to mediate after litigation has been commenced.

25.5.4 STEP 4:

25.5.4.1 If mediation under this section does not resolve the parties' dispute, the District may, but does not require arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program.

25.6 Subcontractor Pass-Through Claims

25.6.1 If a subcontractor or a lower tier subcontractor lacks legal standing to assert a claim against a District because privity of contract does not exist, the contractor may present to the District a Claim on behalf of a subcontractor or lower tier subcontractor. A subcontractor may request in writing, either on his or her own behalf or on behalf of a lower tier subcontractor, that Contractor present a Claim for work which was performed by the subcontractor or by a lower tier subcontractor on behalf of the subcontractor. The subcontractor requesting that the Claim be presented to the District shall furnish reasonable documentation to support the Claim.

25.6.2 Within 45 days of receipt of this written request from a subcontractor, Contractor shall notify the subcontractor in writing as to whether the Contractor presented the Claim to the District and, if Contractor did not present the Claim, provide the subcontractor with a statement of the reasons for not having done so.

25.6.3 The Contractor shall bind all its Subcontractors to the provisions of this section and will hold the District harmless against Claims by Subcontractors.

25.7 Government Code Claim Act Claim

25.7.1 If a claim, or any portion thereof, remains in dispute upon satisfaction of all applicable Claim Resolution requirements the Contractor shall comply with all claims presentation requirements as provided in Chapter 1 (commencing with section 900) and Chapter 2 (commencing with section 910) of Part 3 of Division 3.6 of Title 1 of Government Code as a condition precedent to the Contractor's right to bring a civil action against the District.

25.7.2 Contractor shall bear all costs incurred in the preparation, submission and administration of a Claim. Any claims presented in accordance with the Government Code must affirmatively indicate Contractor's prior compliance with the claims procedure herein of the claims asserted.

25.7.3 For purposes of those provisions, the running of the time within which a claim pursuant to Public Contract Code section 20104.2 only must be presented to the District shall be tolled from the time the claimant submits his or her written claim pursuant to subdivision (a) until the time that claim is denied as a result of the meet and confer process, including any period of time utilized by the meet and confer process.

25.8 Claim Resolution pursuant to Public Contract Code section 20104 et seq.

25.8.1 In the event of a disagreement between the parties as to performance of the Work, the interpretation of this Contract, or payment or nonpayment for Work performed or not performed, the parties shall attempt to resolve all Claims of three hundred seventy-five thousand dollars (\$375,000) or less which arise between Contractor and District by those procedures set forth in Public Contract Code section 20104, et seq., to the extent applicable.

25.8.1.1 Contractor shall file with the District any written Claim, including the documents necessary to substantiate it, upon the application for final payment.

25.8.1.2 For claims of less than fifty thousand dollars (\$50,000), the District shall respond in writing within forty-five (45) days of receipt of the Claim or may request in writing within thirty (30) days of receipt of the Claim any additional documentation supporting the claim or relating to defenses or claims the District may have against the Contractor.

25.8.1.2.1 If additional information is required, it shall be requested and provided by mutual agreement of the parties.

25.8.1.2.2 District's written response to the documented Claim shall be submitted to the Contractor within fifteen (15) days after receipt of the further documentation or within a period of time no greater than that taken by the Contractor to produce the additional information, whichever is greater.

25.8.1.3 For claims of over fifty thousand dollars (\$50,000) and less than or equal to three hundred seventy-five thousand dollars (\$375,000), the District shall respond in writing to all written Claims within sixty (60) days of receipt of the claim, or may request, in writing, within thirty (30) days of receipt of the Claim any additional documentation supporting the Claim or relating to defenses or claims the District may have against the Contractor.

25.8.1.3.1 If additional information is required, it shall be requested and provided upon mutual agreement of the District and the Contractor.

25.8.1.3.2 The District's written response to the claim, as further documented, shall be submitted to the Contractor within thirty (30) days after receipt of the further documentation, or within a period of time no greater than that taken by the Contractor to produce the additional information or requested documentation, whichever is greater.

25.8.1.4 If Contractor disputes the District's written response, or the District fails to respond within the time prescribed, Contractor may so notify the District, in writing, either within fifteen (15) days of receipt of the District's response or within fifteen (15) days of the District's failure to respond within the time prescribed, respectively, and demand an informal conference to meet and confer for settlement of the issues in dispute. Upon a demand, the District shall schedule a meet and confer conference within thirty (30) days for settlement of the dispute.

25.8.1.5 Following the meet and confer conference, if the claim or any portion of it remains in dispute, the Contractor may file a claim as provided in Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code. For purposes of those provisions the running of the time within which a claim must be filed shall be tolled from the time the Contractor submits its written Claim until the time the Claim is denied, including any period of time utilized by the meet and confer process.

25.8.1.6 For any civil action filed to resolve claims filed pursuant to this section, within sixty (60) days, but no earlier than thirty (30) days, following the filing of responsive pleadings, the court shall submit the matter to nonbinding mediation unless waived by mutual stipulation of both parties. The mediation process shall provide for the selection within fifteen (15) days by both parties of a disinterested third person as mediator, shall be commenced within thirty (30) days of the submittal, and shall be concluded within fifteen (15) days from the commencement of the mediation unless a time requirement is extended upon a good cause showing to the court or by stipulation of both parties. If the parties fail to select a mediator within the 15-day period, any party may petition the court to appoint the mediator.

25.8.1.7 If the matter remains in dispute, the case shall be submitted to judicial arbitration pursuant to Chapter 2.5 (commencing with Section 1141.10) of the Title 3 of Part 3 of the Code of Civil Procedure, notwithstanding Section 1141.11 of that code. The Civil Discovery Act of 1986, (Article 3 (commencing with Section 2016) of Chapter 3 of Title 3 of part 4 of the Code of Civil Procedure) shall apply to any proceeding brought under this subdivision consistent with the rules pertaining to judicial arbitration.

25.8.1.8 The District shall not fail to pay money as to any portion of a Claim which is undisputed except as otherwise provided in the Contract Documents. In any suit filed pursuant to this section, the District shall pay interest due at the legal rate on any arbitration award or judgment. Interest shall begin to accrue on the date the suit is filed in a court of law.

25.8.2 Contractor shall bind its Subcontractors to the provisions of this Section and will hold the District harmless against disputes by Subcontractors.

25.9 Claim Procedure Compliance

25.9.1 Failure to submit and administer claims as required in Article 25 shall waive Contractor's right to claim on any specific issues not included in a timely submitted claim. Claim(s) not raised in a timely protest and timely claim submitted under this Article 25 may not be asserted in any subsequent litigation, Government Code Claim, or legal action.

25.9.2 District shall not be deemed to waive any provision under this Article 25, if at District's sole discretion, a claim is administered in a manner not in accord with this Article 25. Waivers or modifications of this Article 25 may only be made by a signed change order approved as to form by legal counsel for both District and Contractor; oral or implied modifications shall be ineffective.

25.10 Claim Resolution Non-Applicability

25.10.1 The procedures for dispute and claim resolutions set forth in this Article shall not apply to the following:

25.10.1.1 Personal injury, wrongful death or property damage claims;

25.10.1.2 Latent defect or breach of warranty or guarantee to repair;

25.10.1.3 Stop payment notices;

25.10.1.4 District's rights set forth in the Article on Suspension and Termination;

25.10.1.5 Disputes arising out of labor compliance enforcement by the Department of Industrial Relations; or

25.10.1.6 District rights and obligations as a public entity set forth in applicable statutes; provided, however, that penalties imposed against a public entity by statutes, including, but not limited to, Public Contract Code sections 20104.50 and 7107, shall be subject to the Claim Resolution requirements provided in this Article.

25.11 Attorney's Fees

Should litigation be necessary to enforce any terms or provisions of this Agreement, then each party shall bear its own litigation and collection expenses, witness fees, court costs, and attorney's fees.

26. STATE LABOR, WAGE & HOUR, APPRENTICE, AND RELATED PROVISIONS

26.1 Labor Compliance and Enforcement

Since this Project is subject to labor compliance and enforcement by the Department of Industrial Relations ("DIR"), Contractor specifically acknowledges and understands that it shall perform the Work of this Agreement while complying with all the applicable provisions of Division 2, Part 7, Chapter 1, of the Labor Code and Title 8 of the California Code of Regulations, including, without limitation, the requirement that the Contractor and all Subcontractors shall timely furnish complete and accurate electronic certified payroll records directly to the DIR. The District may not issue payment if this requirement is not met.

26.2 Wage Rates, Travel, and Subsistence

26.2.1 Pursuant to the provisions of Article 2 (commencing at section 1770), Chapter 1, Part 7, Division 2, of the Labor Code, the general prevailing rate of per diem wages and the general prevailing rate for holiday and overtime work in the locality in which this public work is to be performed for each craft, classification, or type of worker needed to execute this Contract are on file at the District's principal office and copies will be made available to any interested party on request. Contractor shall obtain and post a copy of these wage rates at the job site.

26.2.2 Holiday and overtime work, when permitted by law, shall be paid for at the general prevailing rate of per diem wages for holiday and overtime work on file with

the Director of the Department of Industrial Relations, unless otherwise specified. The holidays upon which those rates shall be paid need not be specified by the District, but shall be all holidays recognized in the applicable collective bargaining agreement. If the prevailing rate is not based on a collectively bargained rate, the holidays upon which the prevailing rate shall be paid shall be as provided in Section 6700 of the Government Code.

26.2.3 Contractor shall pay and shall cause to be paid each worker engaged in Work on the Project the general prevailing rate of per diem wages determined by the Director of the Department of Industrial Relations, regardless of any contractual relationship which may be alleged to exist between Contractor or any Subcontractor and such workers.

26.2.4 If during the period this bid is required to remain open, the Director of the Department of Industrial Relations determines that there has been a change in any prevailing rate of per diem wages in the locality in which the Work under the Contract is to be performed, such change shall not alter the wage rates in the Notice to Bidders or the Contract subsequently awarded.

26.2.5 Pursuant to Labor Code section 1775, Contractor shall, as a penalty to District, forfeit the statutory amount (believed by the District to be currently up to two hundred dollars (\$200) for each calendar day, or portion thereof, for each worker paid less than the prevailing rates, determined by the District and/or the Director, for the work or craft in which that worker is employed for any public work done under Contract by Contractor or by any Subcontractor under it. The difference between such prevailing wage rates and the amount paid to each worker for each calendar day or portion thereof for which each worker was paid less than the prevailing wage rate shall be paid to each worker by Contractor.

26.2.6 Any worker employed to perform Work on the Project, which Work is not covered by any classification listed in the general prevailing wage rate of per diem wages determined by the Director, shall be paid not less than the minimum rate of wages specified therein for the classification which most nearly corresponds to Work to be performed by him, and such minimum wage rate shall be retroactive to time of initial employment of such person in such classification.

26.2.7 Pursuant to Labor Code section 1773.1, per diem wages are deemed to include employer payments for health and welfare, pension, vacation, travel time, subsistence pay, and apprenticeship or other training programs authorized by Labor Code section 3093, and similar purposes.

26.2.8 Contractor shall post at appropriate conspicuous points on the Site of Project, a schedule showing all determined minimum wage rates and all authorized deductions, if any, from unpaid wages actually earned. In addition, Contractor shall post a sign-in log for all workers and visitors to the Site, a list of all subcontractors of any tier on the Site, and the required Equal Employment Opportunity poster(s).

26.3 Hours of Work

26.3.1 As provided in article 3 (commencing at section 1810), chapter 1, part 7, division 2, of the Labor Code, eight (8) hours of labor shall constitute a legal day's work. The time of service of any worker employed at any time by Contractor or by

any Subcontractor on any subcontract under this Contract upon the Work or upon any part of the Work contemplated by this Contract shall be limited and restricted by Contractor to eight (8) hours per day, and forty (40) hours during any one week, except as hereinafter provided. Notwithstanding the provisions hereinabove set forth, Work performed by employees of Contractor in excess of eight (8) hours per day and forty (40) hours during any one week, shall be permitted upon this public work upon compensation for all hours worked in excess of eight (8) hours per day at not less than one and one-half times the basic rate of pay.

26.3.2 Contractor shall keep and shall cause each Subcontractor to keep an accurate record showing the name of and actual hours worked each calendar day and each calendar week by each worker employed by Contractor in connection with the Work or any part of the Work contemplated by this Contract. The record shall be kept open at all reasonable hours to the inspection of District and to the Division of Labor Standards Enforcement of the DIR.

26.3.3 Pursuant to Labor Code section 1813, Contractor shall as a penalty to the District forfeit the statutory amount (believed by the District to be currently twenty-five dollars (\$25)) for each worker employed in the execution of this Contract by Contractor or by any Subcontractor for each calendar day during which such worker is required or permitted to work more than eight (8) hours in any one calendar day and forty (40) hours in any one calendar week in violation of the provisions of article 3 (commencing at section 1810), chapter 1, part 7, division 2, of the Labor Code.

26.3.4 Any Work necessary to be performed after regular working hours, or on Sundays or other holidays shall be performed without additional expense to the District.

26.4 Payroll Records

26.4.1 Contractor shall upload, and shall cause each Subcontractor performing any portion of the Work under this Contract to upload, an accurate and complete certified payroll record ("CPR") electronically using DIR's eCPR System by uploading the CPRs by electronic XML file or entering each record manually using the DIR's iform (or current form) online on no less than every 30 days while Work is being performed and within 30 days after the final day of Work performed on the Project and within ten (10) days of any request by the District or Labor Commissioner at <http://www.dir.ca.gov/Public-Works/Certified-Payroll-Reporting.html> or current application and URL, showing the name, address, social security number, work classification, straight-time, and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by the Contractor and/or each Subcontractor in connection with the Work.

26.4.1.1 The CPRs enumerated hereunder shall be filed directly with the DIR on a weekly basis or to the requesting party, whether the District or DIR, within ten (10) days after receipt of each written request. The CPRs from the Contractor and each Subcontractor for each week shall be provided on or before Wednesday of the week following the week covered by the CPRs. District may not make any payment to Contractor until:

26.4.1.1.1 Contractor and/or its Subcontractor(s) provide CPRs acceptable to the DIR; and

26.4.1.1.2 Any delay in Contractor and/or its Subcontractor(s) providing CPRs to the DIR in a timely manner may directly delay Contractor's payment.

26.4.2 All CPRs shall be available for inspection at all reasonable hours at the principal office of Contractor on the following basis:

26.4.2.1 A certified copy of an employee's CPR shall be made available for inspection or furnished to the employee or his/her authorized representative on request.

26.4.2.2 CPRs shall be made available for inspection or furnished upon request to a representative of District, Division of Labor Standards Enforcement, Division of Apprenticeship Standards, and/or the DIR.

26.4.2.3 CPRs shall be made available upon request by the public for inspection or copies thereof made; provided, however, that a request by the public shall be made through the District, Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement. If the requested CPRs have not been provided pursuant to the provisions herein, the requesting party shall, prior to being provided the records, reimburse the costs of preparation by Contractor, Subcontractors, and the entity through which the request was made. The public shall not be given access to the records at the principal office of Contractor.

26.4.3 Any copy of records made available for inspection as copies and furnished upon request to the public or any public agency by District, Division of Apprenticeship Standards, or Division of Labor Standards Enforcement shall be marked or obliterated in such a manner as to prevent disclosure of an individual's name, address, and social security number. The name and address of Contractor awarded Contract or performing Contract shall not be marked or obliterated.

26.4.4 Contractor shall inform District of the location of the records enumerated hereunder, including the street address, city, and county, and shall, within five (5) working days, provide a notice of change of location and address.

26.4.5 In the event of noncompliance with the requirements of this section, Contractor shall have ten (10) days in which to comply subsequent to receipt of written notice specifying in what respects Contractor must comply with this section. Should noncompliance still be evident after the ten (10) day period, Contractor shall, as a penalty to District, forfeit up to one hundred dollars (\$100) for each calendar day, or portion thereof, for each worker, until strict compliance is effectuated. Upon the request of the Labor Commissioner, these penalties shall be withheld from progress payments then due.

26.4.6 [RESERVED]

26.5 [RESERVED]

26.6 Apprentices

26.6.1 Contractor acknowledges and agrees that, if this Contract involves a dollar amount greater than or a number of working days greater than that specified in Labor Code section 1777.5, then this Contract is governed by the provisions of Labor Code Section 1777.5. It shall be the responsibility of Contractor to ensure compliance with this Article and with Labor Code section 1777.5 for all apprenticeship occupations.

26.6.2 Apprentices of any crafts or trades may be employed and, when required by Labor Code section 1777.5, shall be employed provided they are properly registered in full compliance with the provisions of the Labor Code.

26.6.3 Every such apprentice shall be paid the standard wage paid to apprentices under the regulations of the craft or trade at which he/she is employed, and shall be employed only at the work of the craft or trade to which she/he is registered.

26.6.4 Only apprentices, as defined in section 3077 of the Labor Code, who are in training under apprenticeship standards and written apprentice agreements under chapter 4 (commencing at section 3070), division 3, of the Labor Code, are eligible to be employed. The employment and training of each apprentice shall be in accordance with the provisions of the apprenticeship standards and apprentice agreements under which he/she is training.

26.6.5 Pursuant to Labor Code section 1777.5, if that section applies to this Contract as indicated above, Contractor and any Subcontractors employing workers in any apprenticeable craft or trade in performing any Work under this Contract shall apply to the applicable joint apprenticeship committee for a certificate approving the Contractor or Subcontractor under the applicable apprenticeship standards and fixing the ratio of apprentices to journeymen employed in performing the Work.

26.6.6 Pursuant to Labor Code section 1777.5, if that section applies to this Contract as indicated above, Contractor and any Subcontractor may be required to make contributions to the apprenticeship program.

26.6.7 If Contractor or Subcontractor willfully fails to comply with Labor Code section 1777.5, then, upon a determination of noncompliance by the Administrator of Apprenticeship, it shall:

26.6.7.1 Be denied the right to bid on any subsequent project for one (1) year from the date of such determination;

26.6.7.2 Forfeit as a penalty to District the full amount as stated in Labor Code section 1777.7. Interpretation and enforcement of these provisions shall be in accordance with the rules and procedures of the California Apprenticeship Council and under the authority of the Chief of the Division of Apprenticeship Standards.

26.6.8 Contractor and all Subcontractors shall comply with Labor Code section 1777.6, which section forbids certain discriminatory practices in the employment of apprentices.

26.6.9 Contractor shall become fully acquainted with the law regarding apprentices prior to commencement of the Work. Special attention is directed to sections 1777.5, 1777.6, and 1777.7 of the Labor Code, and title 8, California Code of Regulations, section 200 et seq. Questions may be directed to the State Division of Apprenticeship Standards, 455 Golden Gate Avenue, 9th floor, San Francisco, California 94102.

26.7 Non-Discrimination

26.7.1 Contractor herein agrees to comply with the provisions of the California Fair Employment and Housing Act as set forth in part 2.8 of division 3 of the California Government Code, commencing at section 12900; the Federal Civil Rights Act of 1964, as set forth in Public Law 88-352, and all amendments thereto; Executive Order 11246; and all administrative rules and regulations found to be applicable to Contractor and Subcontractor.

26.7.2 Special requirements for Federally Assisted Construction Contracts: During the performance of this Contract, Contractor agrees to incorporate in all subcontracts the provisions set forth in Chapter 60-1.4(b) of Title 41 published in Volume 33 No. 104 of the Federal Register dated May 28, 1968.

26.8 Labor First Aid

Contractor shall maintain emergency first aid treatment for Contractor's workers on the Project which complies with the Federal Occupational Safety and Health Act of 1970 (29 U.S.C. § 651 *et seq.*) and the California Occupational Safety and Health Act of 1973 (Lab. Code, § 6300, *et seq.*; 8 Cal. Code of Regs., § 330, *et seq.*).

27. [RESERVED]

28. MISCELLANEOUS

28.1 Assignment of Antitrust Actions

28.1.1 Section 7103.5(b) of the Public Contract Code states:

In entering into a public works contract or subcontract to supply goods, services, or materials pursuant to a public works contract, the Contractor or subcontractor offers and agrees to assign to the awarding body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Sec. 15) or under the Cartwright Act (Chapter 2 (commencing with Section 16700) of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, which assignment shall be made and become effective at the time the awarding body tenders final payment to the Contractor, without further acknowledgment by the parties.

28.1.2 Section 4552 of the Government Code states:

In submitting a bid to a public purchasing body, the bidder offers and agrees that if the bid is accepted, it will assign to the purchasing body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Sec. 15) or under the Cartwright Act (Chapter 2 (commencing with Section

16700) of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, materials, or services by the bidder for sale to the purchasing body pursuant to the bid. Such assignment shall be made and become effective at the time the purchasing body tenders final payment to the bidder.

28.1.3 Section 4553 of the Government Code states:

If an awarding body or public purchasing body receives, either through judgment or settlement, a monetary recovery for a cause of action assigned under this chapter, the assignor shall be entitled to receive reimbursement for actual legal costs incurred and may, upon demand, recover from the public body any portion of the recovery, including treble damages, attributable to overcharges that were paid by the assignor but were not paid by the public body as part of the bid price, less the expenses incurred in obtaining that portion of the recovery.

28.1.4 Section 4554 of the Government Code states:

Upon demand in writing by the assignor, the assignee shall, within one year from such demand, reassign the cause of action assigned under this part if the assignor has been or may have been injured by the violation of law for which the cause of action arose and (a) the assignee has not been injured thereby, or (b) the assignee declines to file a court action for the cause of action.

28.1.5 Under this Article, "public purchasing body" is District and "bidder" is Contractor.

28.2 Excise Taxes

If, under Federal Excise Tax Law, any transaction hereunder constitutes a sale on which a Federal Excise Tax is imposed and the sale is exempt from such Federal Excise Tax because it is a sale to a State or Local Government for its exclusive use, District, upon request, will execute documents necessary to show (1) that District is a political subdivision of the State for the purposes of such exemption, and (2) that the sale is for the exclusive use of District. No Federal Excise Tax for such materials shall be included in any Contract Price.

28.3 Taxes

Contract Price is to include any and all applicable sales taxes or other taxes that may be due in accordance with section 7051 et seq. of the Revenue and Taxation Code, Regulation 1521 of the State Board of Equalization or any other tax code that may be applicable.

28.4 Shipments

Contractor is responsible for any or all damage or loss to shipments until delivered and accepted on Site, as indicated in the Contract Documents. There must be no charge for containers, packing, unpacking, drayage, or insurance. The total Contract Price shall be all inclusive (including sales tax) and no additional costs of any type will be considered.

28.5 Compliance with Government Reporting Requirements

If this Contract is subject to federal or other governmental reporting requirements because of federal or other governmental financing in whole or in part for the Project of which it is part, or for any other reason, Contactor shall comply with those reporting requirements at the request of the District at no additional cost.

END OF DOCUMENT

DOCUMENT 00 73 13

SPECIAL CONDITIONS

THIS DOCUMENT MUST BE ADAPTED FOR EACH PROJECT – Delete any provision that is not applicable or if no change from the provision in the General Conditions.

*** THIS LIST OF SPECIAL CONDITION PROVISIONS IS FOR REFERENCE ONLY. REMOVE THIS PAGE BEFORE USING THIS DOCUMENT. ***

1. Mitigation Measures
2. Modernization Projects
3. Badge Policy for Contractors
4. Substitution for Specified Items
5. Weather Days
6. Owner-Controlled or Wrap-Up Insurance Program
7. Insurance Policy Limits
8. Permits, Certificates, Licenses, Fees, Approval
9. Project Labor Agreement/Payroll Records
10. As-Builts and Record Drawings
11. Disabled Veteran Business Enterprises
12. Construction Manager
13. Program Manager
14. Federal Funds – Wages
15. Federal Funds – Debarment
16. Federal Funds - Domestic preferences for procurements
17. Preliminary Schedule of Values
18. COVID-19 Safety Requirements
19. COVID-19 Vaccination/Testing Requirements

SPECIAL CONDITIONS

1. Mitigation Measures

Contractor shall comply with all applicable mitigation measures, if any, adopted by any public agency with respect to this Project pursuant to the California Environmental Quality Act. (Public Resources Code section 21000 *et seq.*)

Commented [DWK1]: If used, attach the Mitigation Monitoring and Reporting Program measures to this document

2. Modernization Projects

2.1 Access. Access to the school buildings and entry to buildings, classrooms, restrooms, mechanical rooms, electrical rooms, or other rooms, for construction purposes, must be coordinated with District and onsite District personnel before Work is to start. Unless agreed to otherwise in writing, only a school custodian will be allowed to unlock and lock doors in existing building(s). The custodian will be available only while school is in session. If a custodian is required to arrive before 7:00 a.m. or leave after 3:30 p.m. to accommodate Contractor's Work, the overtime wages for the custodian will be paid by the Contractor, unless at the discretion of the District, other arrangements are made in advance.

Commented [AW2R1]: OK as is.

Commented [AW3R1]:

2.2 Keys. Upon request, the District may, at its own discretion, provide keys to the school site for the convenience of the Contractor. The Contractor agrees to pay all expenses to re-key the entire school site and all other affected District buildings if the keys are lost or stolen, or if any unauthorized party obtains a copy of a key or access to the school.

2.3 Maintaining Services. The Contractor is advised that Work is to be performed in spaces regularly scheduled for instruction. Interruption and/or periods of shutdown of public access, electrical service, water service, lighting, or other utilities shall be only as arranged in advance with the District. Contractor shall provide temporary services to all facilities interrupted by Contractor's Work.

2.4 Maintaining Utilities. The Contractor shall maintain in operation during duration of Contract, drainage lines, storm drains, sewers, water, gas, electrical, steam, and other utility service lines within working area.

2.5 Confidentiality. Contractor shall maintain the confidentiality of all information, documents, programs, procedures and all other items that Contractor encounters while performing the Work. This requirement shall be ongoing and shall survive the expiration or termination of this Contract and specifically includes, without limitation, all student, parent, and employee disciplinary information and health information.

2.6 Work during Instructional Time. By submitting its bid, Contractor affirms that Work may be performed during ongoing instruction in existing facilities. If so, Contractor agrees to cooperate to the best of its ability to minimize any disruption to

school operations and any use of school facilities by the public up to, and including, rescheduling specific work activities, at no additional cost to District.

2.7 No Work during Student Testing. Contractor shall, at no additional cost to the District and at the District's request, coordinate its Work to not disturb District students including, without limitation, not performing any Work when students at the Site are taking State or Federally-required tests.

3. Badge Policy for Contractors

All Contractors doing work for the District will provide their workers with identification badges. These badges will be worn by all members of the Contractor's staff who are working in a District facility.

3.1 Badges must be filled out in full and contain the following information:

3.1.1 Name of Contractor

3.1.2 Name of Employee

3.1.3 Contractor's address and phone number

3.2 Badges are to be worn when the Contractor or his/her employees are on site and must be visible at all times. Contractors must inform their employees that they are required to allow District employees, the Architect, the Construction Manager, the Program Manager, or the Project Inspector to review the information on the badges upon request.

3.3 Continued failure to display identification badges as required by this policy may result in the individual being removed from the Project or assessment of fines against the Contractor.

4. Substitutions for Specified Items

Replace Section 1.7 in the General Conditions with the following provisions:

1.7.1 Whenever in the Specifications any materials, process, or article is indicated or specified by grade, patent, or proprietary name, or by name of manufacturer, that Specification shall be deemed to be followed by the words "or equal." Contractor may, unless otherwise stated, offer any material, process, or article that shall be substantially equal or better in every respect to that so indicated or specified.

1.7.1.1 If the material, process, or article offered by Contractor is not, in the opinion of the District, substantially equal or better in every respect to that specified, then Contractor shall furnish the material, process, or article specified in the Specifications without any additional compensation or change order.

1.7.1.2 This provision shall not be applicable with respect to any material, product, thing or service for which District made findings and gave notice in accordance with Public Contract Code section 3400(c);

therefore, Contractor shall not be entitled to request a substitution with respect to those materials, products or services.

1.7.2 A request for a substitution shall be submitted as follows:

1.7.2.1 Contractor shall notify the District in writing of any request for a substitution at least ten (10) days prior to bid opening as indicated in the Instructions to Bidders.

1.7.2.2 Requests for Substitutions after award of the Contract shall be submitted within thirty-five (35) days of the date of the Notice of Award.

1.7.3 Within 35 days after the date of the Notice of Award, Contractor shall provide data substantiating a request for substitution of "an equal" item, including but not limited to the following:

1.7.3.1 All variations of the proposed substitute from the material specified including, but not limited to, principles of operation, materials, or construction finish, thickness or gauge of materials, dimensions, weight, and tolerances;

1.7.3.2 Available maintenance, repair or replacement services;

1.7.3.3 Increases or decreases in operating, maintenance, repair, replacement, and spare parts costs;

1.7.3.4 Whether or not acceptance of the substitute will require other changes in the Work (or in work performed by the District or others under Contract with the District); and

1.7.3.5 The time impact on any part of the Work resulting directly or indirectly from acceptance of the proposed substitute.

1.7.4 No substitutions shall be made until approved, in writing, by the District. The burden of proof as to equality of any material, process, or article shall rest with Contractor. The Contractor warrants that if substitutes are approved:

1.7.4.1 The proposed substitute is equal or superior in all respects to that specified, and that such proposed substitute is suitable and fit for the intended purpose and will perform adequately the function and achieve the results called for by the general design and the Contract Documents;

1.7.4.2 The Contractor provides the same warranties and guarantees for the substitute that would be provided for that specified;

1.7.4.3 The Contractor shall be fully responsible for the installation of the substitute and any changes in the Work required, either directly or indirectly, because of the acceptance of such substitute, with no increase in Contract Price or Contract Time. Incidental changes or extra component parts required to accommodate the substitute will be

Commented [DWK4]: Delete if District chooses not to allow requests after Notice of Award

Commented [AW5R4]: Coordinated with Spec Section 01 25 13, Item 1.02.D.2
CLOSED

made by the Contractor without a change in the Contract Price or Contract Time;

1.7.4.4 The Contractor shall be responsible for any re-design costs occasioned by District's acceptance and/or approval of any substitute; and

1.7.4.5 The Contractor shall, in the event that a substitute is less costly than that specified, credit the District with one hundred percent (100%) of the net difference between the substitute and the originally specified material. In this event, the Contractor agrees to execute a deductive Change Order to reflect that credit.

1.7.5 In the event Contractor furnishes a material, process, or article more expensive than that specified, the difference in the cost of that material, process, or article so furnished shall be borne by Contractor.

1.7.6 In no event shall the District be liable for any increase in Contract Price or Contract Time due to any claimed delay in the evaluation of any proposed substitute or in the acceptance or rejection of any proposed substitute.

1.7.7 Contractor shall be responsible for any costs the District incurs for professional services, DSA fees, or delay to the Project Schedule, if applicable, while DSA reviews changes for the convenience of Contractor and/or to accommodate Contractor's means and methods. District may deduct those costs from any amounts owing to the Contractor for the review of the request for substitution, even if the request for substitution is not approved. District, at its sole discretion, shall deduct from the payments due to and/or invoice Contractor for all the professional services and/or DSA fees or delay to the Project Schedule, if applicable, while DSA reviews changes for the convenience of Contractor and/or to accommodate Contractor's means and methods arising herein.

1.7.8 When substitutions affect DSA regulated items, a Construction Change Directive (CCD) shall be prepared by the Design Team and approved by DSA prior to Contractor fabrication and/ or installation. The CCD shall be signed by the Architect of Record, the Structural Engineer of Record (when applicable), other delegated Engineer of Record (when applicable) and DSA.

5. Weather Days

Replace Section 15.2.1.5 in the General Conditions with the following:

15.2.1.5 The number of days of Adverse Weather exceeds the following parameters:

January		July	
February		August	
March		September	
April		October	
May		November	
June		December	

Commented [DWK6]: If District plans to use the number of days for Adverse Weather in the General Conditions (15.2.1.5), **delete** this language and **replace** with "[RESERVED]" here.

Adjust number of days for your location OR change to number of days per year

Commented [AW7R6]: Coordinate with General Conditions Item 15.2.1.5

Coordinate with Buyer.

Month	Calendar Days
January	6
February	6
March	7
April	4
May	3
June	1
July	0
August	1
September	2
October	2
November	3
December	5
Total Annual Inclement Weather Days	40

[THE REMAINDER OF THIS PAGE LEFT BLANK INTENTIONALLY]

[THE REMAINDER OF THIS PAGE LEFT BLANK INTENTIONALLY]

6. Insurance Policy Limits

All of Contractor’s insurance shall be with insurance companies with an A.M. Best rating of no less than _____. The limits of insurance shall not be less than:

Commercial General Liability	Product Liability and Completed Operations, Fire Damage Liability – Split Limit	[E.G.] Low Risk: \$1,000,000 per occurrence; \$2,000,000 aggregate
		Intermediate Risk: \$2,000,000 per occurrence; \$4,000,000 aggregate
		High Risk: \$5,000,000 per occurrence; \$10,000,000 aggregate]
Automobile Liability – Any Auto	Combined Single Limit	[E.G.] Personal vehicles: \$500,000 Commercial vehicles: \$1,000,000
		Personal vehicles: \$100,000 per person/ \$300,000 per accident]
Workers’ Compensation		Statutory limits pursuant to State law
Employers’ Liability		[E.G. \$0]
Builder’s Risk (Course of Construction)		Issued for the value and scope of Work indicated herein.
Pollution Liability		[E.G. \$0]

Commented [DWK8]: Check with District’s Risk Manager or insurance advisor. Coverages and amounts below are placeholders only.

Commented [AW9R8]: Coordinate with General Conditions Item 13.1.8, Insurance Limits
Buyer to determine.

7. Permits, Certificates, Licenses, Fees, Approvals

7.1 Payment for Permits, Certificates, Licenses, Fees, and Approvals. As required in the General Conditions, the Contractor shall secure and pay for all permits, licenses, approvals, and certificates necessary for the prosecution of the Work with the exception of the following:

With respect to the above-listed items, Contractor shall be responsible for securing such items; however, District will be responsible for payment of these charges or

Commented [DWK10]: For example, water connection fees, sewer connection fees, etc.

Commented [AW11R10]: Coordinate with Buyer

fees. Contractor shall notify the District of the amount due with respect to such items and to whom the amount is payable. Contractor shall provide the District with an invoice and receipt with respect to such charges or fees.

8. Project Labor Agreement/Payroll Records

The District has entered into a Project Labor Agreement ("PLA"), which covers this Project.

Accordingly, the following provision is added as Section 26.4.6:

26.4.6 As Contractor and its subcontractors have agreed to be bound by the terms of the PLA entered into by the District [on or about / dated] _____, Contractor and its subcontractors may be excused from uploading CPRs electronically using DIR's eCPR System by uploading the CPRs by electronic XML file or entering each record manually using the DIR's iform (or current form) online at <http://www.dir.ca.gov/Public-Works/Certified-Payroll-Reporting.html> , or by using a more current application and URL. However, within ten (10) days of any request by the District or Labor Commissioner, Contractor and its subcontractors shall provide CPRs showing the name, address, social security number, work classification, straight time, and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by the Contractor and/or each subcontractor in connection with the Work.

9. As-Builts and Record Drawings

9.1 When called for by Division 01, Contractor shall submit As-Built Drawings pursuant to the Contract Documents consisting of one set of Building Information Modeling ("BIM") files, plus one full sized set of As Built Drawings.

9.2 Contractor shall submit Record Drawings pursuant to the Contract Documents consisting of one set of computer-aided design and drafting ("CADD") files in the following format _____, plus one set of Record Drawings.

10. Disabled Veteran Business Enterprise

Pursuant to Education Code section 71028 and Public Contract Code section 10115, the District has a participation goal for disabled veteran business enterprises ("DVBE") of at least three percent (3%) per year of the overall dollar amount expended each year on projects that receive state funding. If this Contract uses state funds, and/or as required by the bid documents, the lowest responsive responsible bidder awarded the Contract must submit the Disabled Veteran Business Enterprise Participation Certification to the District with its executed Agreement, identifying the steps contractor took to solicit DVBE participation in conjunction with this Contract.

11. Construction Manager

The District will use a Construction Manager on the Project that is the subject of this Contract. Swinerton Management & Consulting is the Construction Manager for this Project.

Commented [DWK12]: Delete this provision if the District has not entered into a Project Labor Agreement.

Commented [AW13R12]: Stays

Commented [DWK14]: Optional: Building Information Modeling ("BIM")

Commented [DWK15]: Building Information Modeling ("BIM")

Commented [AW16R15]: Coordinate with N&T and Buyer

Commented [DWK17]: Describe

Commented [DWK18]: If project funded in part or whole by the State School Facility Program

Commented [DWK19]: Insert name and contact information

12. Program Manager

AECOM is the Program Manager designated for the Project that is the subject of this Contract.

1.8.10.1 .

15. Preliminary Schedule of Values

The preliminary schedule of values shall include, at a minimum, the following information and the following structure:

Replace Section 10.1.1.2.3 in the General Conditions with the following provisions:

10.1.1.2.3 The preliminary schedule of values shall not provide for values any greater than the following percentages of the Contract value:

- 10.1.1.2.3.1** Mobilization and layout combined to equal not more than [2]%;
- 10.1.1.2.3.2** Submittals, samples and shop drawings combined to equal not more than [4]%;
- 10.1.1.2.3.3** Bonds and insurance combined to equal not more than [2.5]%;
- 10.1.1.2.3.4** Closeout documentation shall have a value in the preliminary schedule of not less than [10]%;

16. COVID-19 Safety Requirements

Contractor shall, at its cost, timely comply with all applicable federal, State, and local requirements relating to COVID-19 or other public health emergency/epidemic/pandemic. Further, except to the extent the Order provides otherwise, Contractor and Contractor’s personnel, subcontractors and suppliers shall continue to comply with all applicable terms in the California Department of Public Health’s State Public Health Officer Orders.

17. COVID-19 Vaccination / Testing Requirements

On _____, 2021, the District announced a policy to implement a COVID-19 vaccine mandate for people entering District property (“site”), which is consistent with guidance issued by the California Community Colleges Chancellor’s Office. Pursuant to that policy, the District has adopted an Administrative Procedure (“Policy”), requiring the District to begin checking vaccination status and exemption requests, effective _____, 2021.

In light of the Policy, Contractor shall fill out, sign, date and submit to District the COVID-19 Vaccination/Testing Certification Form, attached hereto as **Attachment “A.”**

[ATTACHMENT “A” ON NEXT PAGE]

Commented [DWK20]: Either use provision to adjust percentages to District’s preference if different from the amount identified in the General Conditions or delete provision and replace with “[RESERVED]”

Percentages shown in [brackets] are placeholders only.

Commented [AW21R20]: OK as is

Commented [DWK22]: Check to be sure District policy is not stricter than what is required by the CDPH, and revise if necessary. CDPH policy requires vaccination OR weekly testing, but District policy may require vaccination unless there is a medical or religious exemption.

Commented [AW23R22]: Coordinate with Buyer

**ATTACHMENT "A"
COVID-19 VACCINATION/TESTING CERTIFICATION**

Contractor: _____

1. It is the Contractor's sole responsibility to comply with the District's *Administrative Procedure: COVID-19 Vaccination/Masking Requirement for Employees, Students, and Visitors* ("COVID-19 Policy") attached to this certification.
2. Contractor acknowledges that the District's COVID-19 Policy may be subject to change to meet future public health standards and requirements in accordance with guidance from local and state public health authorities. Contractor shall comply with the COVID-19 Policy and any amendments in effect at the time Contractor performs the Services.
3. Contractor shall check the applicable box, fill in all applicable blanks and sign below. By so doing, Contractor certifies that the information provided is true and accurate.

COVID-19 VACCINATION AND/OR WAIVER JUSTIFICATION	
1.	<div style="display: flex; align-items: flex-start;"> <div style="width: 5%; border-bottom: 1px solid black; margin-right: 5px;"></div> <div style="flex-grow: 1;"> <p>In accordance with District's COVID-19 Policy, Contractor certifies that all employees, volunteers, and/or agents providing in-person services at District sites or facilities have been fully vaccinated against COVID-19 and will submit proof of vaccination to the District; or if they cannot receive the COVID-19 vaccine due to disability or medical or religious exemptions, or if deferring vaccination due to pregnancy, will instead submit proof of a negative COVID-19 test on a weekly basis and must at all times while on District property wear face masks that fully cover both mouths and noses.</p> </div> </div>
2.	<div style="display: flex; align-items: flex-start;"> <div style="width: 5%; border-bottom: 1px solid black; margin-right: 5px;"></div> <div style="flex-grow: 1;"> <p>Contractor certifies that its employees, volunteers, and/or agents will have NO IN-PERSON CONTACT with District students, family or staff at a District site or facility, and all services under the Agreement(s) referenced above will be provided virtually/remotely.</p> </div> </div>

CERTIFICATION

Date: _____

Proper Name of Contractor: _____

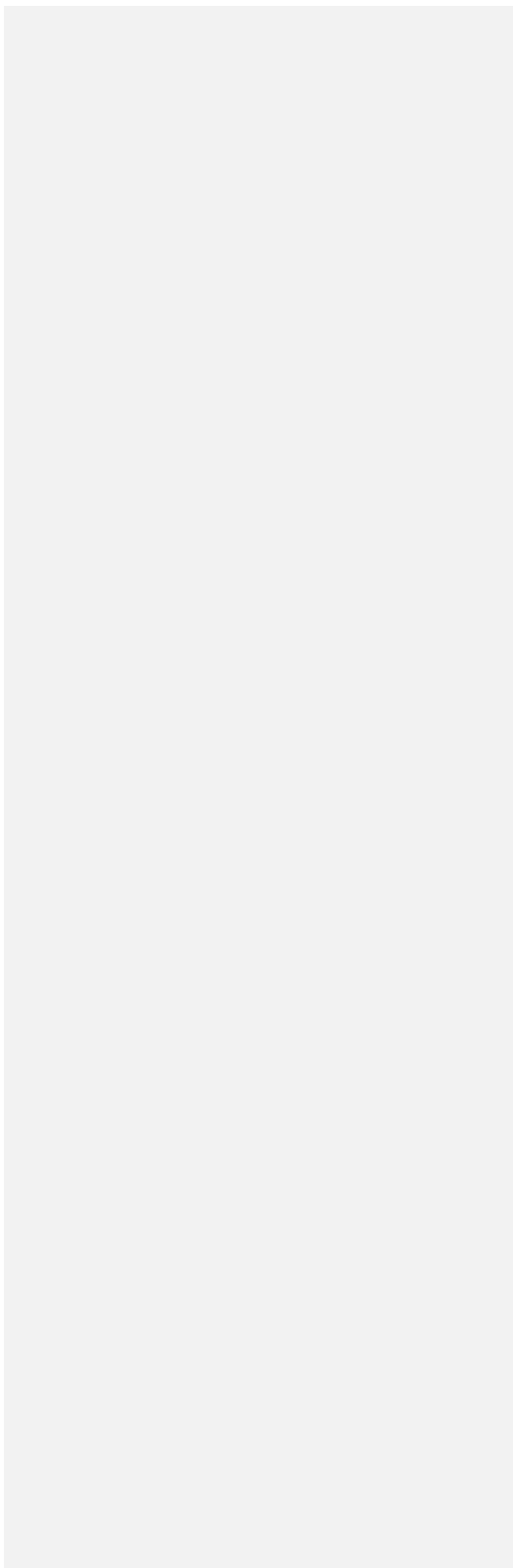
Signature: _____

Print Name: _____

Title: _____

**PERALTA COMMUNITY COLLEGE DISTRICT
Library & LRC
Issue For Bid**

**SPECIAL CONDITIONS
DOCUMENT 00 73 13 -11
March 31, 2023**



"COVID-19 Policy"

ADMINISTRATIVE PROTOCOL

COVID-19 VACCINATION/MASKING REQUIREMENT FOR EMPLOYEES, STUDENTS, AND VISITORS

These procedures apply to all new and existing Peralta Community College District (PCCD) faculty, classified employees, administrators, hourly employees (short-term temporary employees), contract employees, independent contractors and student employees (hereafter referred to as "covered individuals"). These procedures also apply to all students of PCCD.

I. Covered Individuals

All District employees are required, as a pre-condition and condition of employment, to furnish to Human Resources proof of *full* COVID-19 vaccination (as defined by the Center for Disease Control (CDC)). All other covered individuals are also required to provide the same proof of vaccination as required by employees.

A. Acceptable proof of COVID-19 vaccination consists of:

1. A dated copy of the individual's CDC COVID-19 Vaccination Record Card.
2. A dated and signed letter from the individual's licensed care giver.
3. Copy of the official Personal Digital COVID-19 Vaccine Record from the California Department of Public Health

Proof of vaccination shall be provided no later than October 7, 2021.

Covered individuals who received approved declination/exemption pursuant to section (II) below must abide by masking and weekly COVID-19 testing requirements described in section (III).

II. COVID-19 Vaccination Declination

Covered individuals are allowed to decline COVID-19 vaccination for: (a) medical, (b) disability, and (c) religious grounds. Employees may also receive a *deferral* based on pregnancy. Employees declining to show proof of COVID-19 vaccination must provide the approved PCCD COVID-19 Vaccination Declination Form to Human Resources.¹ PCCD retains the right to require documentation substantiating eligibility for declinations.

A covered individual with approved declination/exemption or deferral from vaccination shall abide by masking and weekly COVID-19 testing requirements described in section (III) below.

III. Masking and COVID-19 Testing

Covered individuals must *at all times* while on PCCD controlled property wear face masks that fully cover both mouths and noses in accordance with mandates by the State of California and/or Alameda County and the District's COVID-19 Prevention Plan.

¹ Employees receiving a deferral must provide proof of COVID-19 vaccination at the time of their return to work from maternity leave or submit a COVID-19 Declination Form and comply with the mandatory masking and testing protocols.

Also, covered individuals with approved exemptions must provide weekly proof of a negative COVID-19 Test to District Administration. Covered individuals with approved exemptions and who fail to comply with the PCCD masking and testing requirement are subject to corrective action by the District, including disciplinary action consistent with applicable employee collective bargaining agreements or student standards of conduct. District Administration will provide weekly lists to the responsible District manager of individuals who must provide proof of weekly testing.

A. Acceptable proof of negative COVID-19 testing consists of:

1. A dated copy of negative COVID-19 test results.²
- or
2. A dated and signed letter from employee's licensed care giver.

IV. Release Time to Become Vaccinated

A. PCCD will provide employees with necessary release time to travel and become vaccinated or received a vaccine booster. Compensation shall be covered by the District at the employee's regular rate of pay if vaccination occurs during the employee's regularly scheduled workday. Employees must seek prior approval and make appropriate arrangements for vaccination times with their supervisors.

V. Sick Leave for Symptoms Related to Vaccination

A. PCCD will provide employees who become vaccinated with one day (eight (8) hours) of sick leave that may be used in order to recover from any side effects of the COVID-19 vaccinations and boosters. The one (eight (8) hours) of sick leave will apply to Hourly Employees and Student Employees. This sick leave day will be in addition to any existing sick leave available to the employee, including COVID-19 Supplemental Paid Sick Leave available pursuant to SB 95.

B. For employees who have already become fully vaccinated at the time of this procedure implementation, PCCD will also provide those employees with one day (eight (8) hours) of sick leave with appropriate submission of proof of vaccination to Human Resources.³

VI. Proof of Vaccination and Medical Information

A. PCCD will not request any health or medical information other than proof of vaccination or proof of weekly negative COVID-19 tests from any covered individuals. PCCD will not

² Employees receiving a POSITIVE COVID-19 test will not be allowed to report to work on any PCCD controlled property, must follow CDC quarantine guidelines, and be followed by a Certified PCCD COVID-19 Contact Tracer.

³ Employees who have been fully vaccinated are required to continue to abide by all PCCD policies, procedures and protocols regarding COVID-19 until PCCD directs otherwise.

receive any medical information covered individuals give to any vaccination provider. Any proof of vaccination a covered individual provides to PCCD will be stored by District Administration in a manner consistent with all applicable constitutional and statutory laws and in accordance with PCCD's practice for storing medical information in a file separate from the employee's personnel file.

- B. All individuals covered by this Administrative Procedure must complete a PCCD AUTHORIZATION FOR DISCLOSURE AND USE OF MEDICAL INFORMATION Form in compliance with California's Confidentiality of Medical Information Act.

VII. Effect of Vaccination Procedure

These procedures shall be effective immediately and shall remain in effect until the District determines that these procedures are no longer necessary. These procedures may be amended or revoked at any time.

AUTHORIZATION FOR DISCLOSURE AND USE OF MEDICAL INFORMATION

Confidentiality of Medical Information Act (CMIA), Civil Code § 56, et seq.

Pursuant to California’s Confidentiality of Medical Information Act, I, _____, authorize the Peralta Community College District (“PCCD”) to receive my medical information as described in this authorization. I also authorize representatives from the PCCD to use the medical information for the purposes described in this authorization.

This authorization is limited to the following types of information:

Confirmation of COVID-19 vaccination and/or proof of negative COVID-19 testing.

The recipients of this information may use the information for the following purpose:

Participation in PCCD’s vaccination policy and to help PCCD with controlling COVID-19 infections among PCCD employees.

Expiration Date: PCCD is no longer authorized to disclose or use medical information described in this authorization after June 30, 2026.

Right to Receive Copy of This Authorization: I understand that if I sign this authorization, I have the right to receive a copy of this authorization. Upon request, PCCD will provide me with a copy of this authorization.

I authorize the disclosure and use of my medical information as described above for the purposes listed above. I understand that this authorization is voluntary and that I am signing this authorization voluntarily.

Employee Name	Signature	Date

END OF DOCUMENT

HAZARDOUS MATERIALS
PROCEDURES & REQUIREMENTS

1. Summary

This document includes information applicable to hazardous materials and hazardous waste abatement.

2. Notice of Hazardous Waste or Materials

- a. Contractor shall give notice in writing to the District, the Construction Manager, and the Architect promptly, before any of the following materials are disturbed, and in no event later than twenty-four (24) hours after first observance, of any:
 - (1) Material that Contractor believes may be a material that is hazardous waste or hazardous material, as defined in section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law;
 - (2) Other material that may present a substantial danger to persons or property exposed thereto in connection with Work at the site.
- b. Contractor's written notice shall indicate whether the hazardous waste or material was shown or indicated in the Contract Documents to be within the scope of Work, and whether the materials were brought to the site by Contractor, its Subcontractors, suppliers, or anyone else for whom Contractor is responsible. As used in this section the term "hazardous materials" shall include, without limitation, asbestos, lead, Polychlorinated biphenyl (PCB), petroleum and related hydrocarbons, and radioactive material.
- c. In response to Contractor's written notice, the District shall investigate the identified conditions.
- d. If the District determines that conditions do not involve hazardous materials or that no change in terms of Contract is justified, the District shall so notify Contractor in writing, stating reasons. If the District and Contractor cannot agree on whether conditions justify an adjustment in Contract Price or Contract Time, or on the extent of any adjustment, Contractor shall proceed with the Work as directed by the District.
- e. If after receipt of notice from the District, Contractor does not agree to resume Work based on a reasonable belief it is unsafe, or does not agree to resume Work under special conditions, then District may order such portion of Work that is in connection with such hazardous condition or such affected area to be deleted from the Work, or performed by others, or District may invoke its rights to terminate the Contract in whole or in part. District will determine entitlement to or the amount or extent of an adjustment, if any, in

Contract Price or Contract Time as a result of deleting such portion of Work, or performing the Work by others.

- f. If Contractor stops Work in connection with any hazardous condition and in any area affected thereby, Contractor shall immediately redeploy its workers, equipment, and materials, as necessary, to other portions of the Work to minimize delay and disruption.

3. Additional Warranties and Representations

- a. Contractor represents and warrants that it, its employees, and its subcontractors and their employees, shall at all times have the required levels of familiarity with the Site and the Work, training, and ability to comply fully with all applicable laws and contractual requirements for safe and expeditious performance of the Work, including whatever training is or may be required regarding the activities to be performed (including, but not limited to, all training required to address adequately the actual or potential dangers of Contract performance).
- b. Contractor represents and warrants that it, its employees, and its subcontractors and their employees, shall at all times have and maintain in good standing any and all certifications and licenses required by applicable federal, state, and other governmental and quasi-governmental requirements applicable to the Work.
- c. Contractor represents and warrants that it has studied carefully all requirements of the Specifications regarding procedures for demolition, hazardous waste abatement, or safety practices, specified in the Contract, and prior to submitting its bid, has either (a) verified to its satisfaction that the specified procedures are adequate and sufficient to achieve the results intended by the Contract Documents, or (b) by way of approved "or equal" request or request for clarification and written Addenda, secured changes to the specified procedures sufficient to achieve the results intended by the Contract Documents. Contractor accepts the risk that any specified procedure will result in a completed Project in full compliance with the Contract Documents.

4. Monitoring and Testing

- a. District reserves the right, in its sole discretion, to conduct air monitoring, earth monitoring, Work monitoring, and any other tests (in addition to testing required under the agreement or applicable law), to monitor Contract requirements of safe and statutorily compliant work methods and (where applicable) safe re-entry level air standards under state and federal law upon completion of the job, and compliance of the work with periodic and final inspection by public and quasi-public entities having jurisdiction.
- b. Contractor acknowledges that District has the right to perform, or cause to be performed, various activities and tests including, but not limited to, pre-abatement, during abatement, and post-abatement air monitoring, that District shall have no obligation to perform said activities and tests, and that a portion of said activities and tests may take place prior to the completion of

the Work by Contractor. In the event District elects to perform these activities and tests, Contractor shall afford District ample access to the Site and all areas of the Work as may be necessary for the performance of these activities and tests. Contractor will include the potential impact of these activities or tests by District in the Contract Price and the Scheduled Completion Date.

- c. Notwithstanding District's rights granted by this paragraph, Contractor may retain its own industrial hygiene consultant at Contractor's own expense and may collect samples and may perform tests including, but not limited to, pre-abatement, during abatement, and post-abatement personal air monitoring, and District reserves the right to request documentation of all such activities and tests performed by Contractor relating to the Work and Contractor shall immediately provide that documentation upon request.

5. Compliance with Laws

- a. Contractor shall perform safe, expeditious, and orderly work in accordance with the best practices and the highest standards in the hazardous waste abatement, removal, and disposal industry, the applicable law, and the Contract Documents, including, but not limited to, all responsibilities relating to the preparation and return of waste shipment records, all requirements of the law, delivering of all requisite notices, and obtaining all necessary governmental and quasi-governmental approvals.
- b. Contractor represents that it is familiar with and shall comply with all laws applicable to the Work or completed Work including, but not limited to, all federal, state, and local laws, statutes, standards, rules, regulations, and ordinances applicable to the Work relating to:
 - (1) The protection of the public health, welfare and environment;
 - (2) Storage, handling, or use of asbestos, PCB, lead, petroleum based products, radioactive material, or other hazardous materials;
 - (3) The generation, processing, treatment, storage, transport, disposal, destruction, or other management of asbestos, PCB, lead, petroleum, radioactive material, or hazardous waste materials or other waste materials of any kind; and
 - (4) The protection of environmentally sensitive areas such as wetlands and coastal areas.

6. Disposal

- a. Contractor has the sole responsibility for determining current waste storage, handling, transportation, and disposal regulations for the job Site and for each waste disposal facility. Contractor must comply fully at its sole cost and expense with these regulations and any applicable law. District may, but is not obligated to, require submittals with this information for it to review consistent with the Contract Documents.

- b. Contractor shall develop and implement a system acceptable to District to track hazardous waste from the Site to disposal, including appropriate "Hazardous Waste Manifests" on the EPA form, so that District may track the volume of waste it put in each landfill and receive from each landfill a certificate of receipt.
- c. Contractor shall provide District with the name and address of each waste disposal facility prior to any disposal, and District shall have the express right to reject any proposed disposal facility. Contractor shall not use any disposal facility to which District has objected. Contractor shall document actual disposal or destruction of waste at a designated facility by completing a disposal certificate or certificate of destruction forwarding the original to the District.

7. Permits

- a. Before performing any of the Work, and at such other times as may be required by applicable law, Contractor shall deliver all requisite notices and obtain the approval of all governmental and quasi-governmental authorities having jurisdiction over the Work. Contractor shall submit evidence satisfactory to District that it and any disposal facility:
 - (1) have obtained all required permits, approvals, and the like in a timely manner both prior to commencement of the Work and thereafter as and when required by applicable law; and
 - (2) are in compliance with all such permits, approvals and the regulations.

For example, before commencing any work in connection with the Work involving asbestos-containing materials, or PCBs, or other hazardous materials subject to regulation, Contractor agrees to provide the required notice of intent to renovate or demolish to the appropriate state or federal agency having jurisdiction, by certified mail, return receipt requested, or by some other method of transmittal for which a return receipt is obtained, and to send a copy of that notice to District. Contractor shall not conduct any Work involving asbestos-containing materials or PCBs unless Contractor has first confirmed that the appropriate agency having jurisdiction is in receipt of the required notification. All permits, licenses, and bonds that are required by governmental or quasi-governmental authorities, and all fees, deposits, tap fees, offsite easements, and asbestos and PCB disposal facilities expenses necessary for the prosecution of the Work, shall be procured and paid for by Contractor. Contractor shall give all notices and comply with the all applicable laws bearing on the conduct of the Work as drawn and specified. If Contractor observes or reasonably should have observed that Plans and Specifications and other Contract Documents are at variance therewith, it shall be responsible for promptly notifying District in writing of such fact. If Contractor performs any Work contrary to applicable laws, it shall bear all costs arising therefrom.

- b. In the case of any permits or notices held in District's name or of necessity to be made in District's name, District shall cooperate with Contractor in securing the permit or giving the notice, but the Contractor shall prepare for District review and execution upon approval, all necessary applications, notices, and other materials.

8. Indemnification

To the fullest extent permitted by law, the indemnities and limitations of liability expressed throughout the Contract Documents apply with equal force and effect to any claims or liabilities imposed or existing by virtue of the removal, abatement, and disposal of hazardous waste. This includes, but is not limited to, liabilities connected to the selection and use of a waste disposal facility, a waste transporter, personal injury, property damage, loss of use of property, damage to the environment or natural resources, or "disposal" and "release" of materials associated with the Work (as defined in 42 U.S.C. § 9601 *et seq.*).

9. Termination

District shall have an absolute right to terminate for default immediately without notice and without an opportunity to cure should Contractor knowingly or recklessly commit a material breach of the terms of the Contract Documents, or any applicable law, on any matter involving the exposure of persons or property to hazardous waste. However, if the breach of contract exposing persons or property to hazardous waste is due solely to an ordinary, unintentional, and non-reckless failure to exercise reasonable care, then the procedures for termination for cause shall apply without modification.

END OF DOCUMENT

SUMMARY OF WORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Site Access Conditions and Requirements;
- B. Special Conditions.

1.02 SUMMARY OF WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of this Contract consists of the following:

Selective demolition and construction necessary for a new academic library and learning resource center on the Laney College campus. The project is a 75,622 square foot, three (3) story concrete and steel structure, Type IIA construction and consists of Type A-3 and B occupancies. Work includes site utilities and landscaping.

1.03 CONTRACTS

- A. Perform the Work under a single, fixed-price Contract.

1.04 WORK BY OTHERS

- A. Work on the Project that will be performed and completed prior to the start of the Work of this Contract:

(1) East Bay Municipal Utility District (EBMUD) Water Line Relocation

1.05 CODES, REGULATIONS, AND STANDARDS

- A. The codes, regulations, and standards adopted by the state and federal agencies having jurisdiction shall govern minimum requirements for this Project. Where codes, regulations, and standards conflict with the Contract Documents, these conflicts shall be brought to the immediate attention of the District and the Architect.
- B. Codes, regulations, and standards shall be as published effective as of date of bid opening, unless otherwise specified or indicated.

1.06 PROJECT RECORD DOCUMENTS

- A. Contractor shall maintain on Site one set of the following record documents; Contractor shall record actual revisions to the Work:
 - (1) Contract Drawings.
 - (2) Specifications.
 - (3) Addenda.
 - (4) Change Orders and other modifications to the Contract.
 - (5) Reviewed shop drawings, product data, and samples.
 - (6) Field test records.
 - (7) Inspection certificates.
 - (8) Manufacturer's certificates.
- B. Contractor shall store Record Documents separate from documents used for construction. Provide files, racks, and secure storage for Record Documents and samples.
- C. Contractor shall record information concurrent with construction progress.
- D. Specifications: Contractor shall legibly mark and record at each product section of the Specifications the description of the actual product(s) installed, including the following:
 - (1) Manufacturer's name and product model and number.
 - (2) Product substitutions or alternates utilized.
 - (3) Changes made by Addenda and Change Orders and written directives.

1.07 EXAMINATION OF EXISTING CONDITIONS

- A. Contractor shall be held to have examined the Project Site and acquainted itself with the conditions of the Site and of the streets or roads approaching the Site.
- B. Prior to commencement of Work, Contractor shall survey the Site and existing buildings and improvements to observe existing damage and defects such as cracks, sags, broken, missing or damaged glazing, other building elements and Site improvements, and other damage.
- C. Should Contractor observe cracks, sags, and other damage to and defects of the Site and adjacent buildings, paving, and other items not indicated in the Contract Documents, Contractor shall immediately report same to the District and the Architect.

1.08 CONTRACTOR'S USE OF PREMISES

- A. If unoccupied and only with District's prior written approval, Contractor may use the building(s) at the Project Site without limitation for its operations, storage, and office facilities for the performance of the Work. If the District chooses to beneficially occupy any building(s), Contractor must obtain the District's written approval for Contractor's use of spaces and types of operations to be performed within the building(s) while so occupied. Contractor's access to the building(s) shall be limited to the areas indicated.
- B. If the space at the Project Site is not sufficient for Contractor's operations, storage, office facilities and/or parking, Contractor shall arrange and pay for any additional facilities needed by Contractor.
- C. Contractor shall not interfere with use of or access to occupied portions of the building(s) or adjacent property.
- D. Contractor shall maintain corridors, stairs, halls, and other exit-ways of building clear and free of debris and obstructions at all times.
- E. No one other than those directly involved in the demolition and construction, or specifically designated by the District or the Architect shall be permitted in the areas of work during demolition and construction activities.
- F. The Contractor shall install the construction fence and maintain that it will be locked when not in use. Keys to this fencing will be provided to the District.

1.09 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

- A. The Drawings show above-grade and below-grade structures, utility lines, and other installations that are known or believed to exist in the area of the Work. Contractor shall locate these existing installations before proceeding with excavation and other operations that could damage same; maintain them in service, where appropriate; and repair damage to them caused by the performance of the Work. Should damage occur to these existing installations, the costs of repair shall be at the Contractor's expense and made to the District's satisfaction.
- B. Contractor shall be alert to the possibility of the existence of additional structures and utilities. If Contractor encounters additional structures and utilities, Contractor will immediately report to the District for disposition of same as indicated in the General Conditions.

1.10 UTILITY SHUTDOWNS AND INTERRUPTIONS

- A. Contractor shall give the District a minimum of three (3) days written notice in advance of any need to shut off existing utility services or to effect equipment interruptions. The District will set exact time and duration for shutdown, and will assist Contractor with shutdown. Work required to re-establish utility services shall be performed by the Contractor.

- B. Contractor shall obtain District's written approval as indicated in the General Conditions in advance of deliveries of material or equipment or other activities that may conflict with District's use of the building(s) or adjacent facilities.

1.11 STRUCTURAL INTEGRITY

- A. Contractor shall be responsible for and supervise each operation and work that could affect structural integrity of various building elements, both permanent and temporary.
- B. Contractor shall include structural connections and fastenings as indicated or required for complete performance of the Work.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF DOCUMENT

SECTION 011500

DELEGATED DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: General Requirements for portions of the Work for which the engineering and system design have been delegated to the Contractor.

1.3 SYSTEM DESCRIPTION

- A. Portions of the Work may delegate the design and engineering of assemblies to the Contractor, including submitting for and obtaining related permits.
- B. Procedure:
 - 1. Drawings of the delegated design portions of work are diagrammatic. They show the following:
 - a. Design intent for profiles, shapes and forms.
 - b. Location, identification, dimension and size of components, assemblies and accessories.
 - c. Relationships between elements.
 - d. Schematic attachment details.
 - 2. Specifications of the delegated design portions of work are the performance type. They establish minimum requirements for products and materials and performance requirements for the specified assemblies.
 - 3. Drawings or specifications do not provide solutions to engineering issues. Instead, they are criteria to be used to solve the engineering problem.
 - 4. If specified criteria are not adequate to perform the required services, submit a Request for Information to the Architect.
- C. Requirements:
 - 1. Engineer, fabricate, and provide delegated design portions of the Work to meet the specified Performance Requirements; to conform to the profiles indicated; to satisfy the requirements of Authorities Having Jurisdiction; and to provide weathertight, structurally-sound assemblies.
 - 2. Accommodate the following:
 - a. Full range or manufacturing tolerances and field installation tolerances of adjacent work specified in other Sections.
 - b. Upward and downward movements.
 - c. Differential movement caused by thermal expansion, contraction and building movement.

- d. Additional in-service live loads from wind, rain, ice and window cleaning/maintenance equipment.
3. Do not deviate from profiles indicated on the Drawings without written permission from the Architect.
 - a. The decision of the Owner and Architect shall govern, in the event of a dispute regarding Contractor's proposed design and the design intent shown on the Contract Documents.
4. Employ a Professional Engineer, licensed in the State of California, to determined fastener and connection types and sizes.
 - a. Fasteners/connections shall not conflict with profiles indicated or to supporting work.
 - b. Connections to supporting structure shall not impose eccentric loading or induce twisting or warping.
 - c. Connections to the supporting structure shall accommodate potential and actual misalignment of adjacent work within tolerances specified in other Sections.
5. Submittals to Authorities Having Jurisdiction (SHJ): If required, submit shop drawings, specifications, calculations and other data for the AHJ's approval after review by Architect. Pay fees required for permit submittal.

1.4 SUBMITTALS

- A. Delegated Design Submittals: Provide submittals specified in technical sections. Submit statement, sealed and signed by the responsible Professional Engineer for each assembly engineered under its care.
- B. Indicate that products and systems comply with Performance Requirements; list codes, loads and other factors used in calculating the design solution.

1.5 QUALITY ASSURANCE

- A. Professional Engineer shall be licensed to practice in the State of California and shall have a minimum of ten years' experience providing engineering services for the kind indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide materials, parts, anchors, attachments, and accessories required to install the complete assembly Contractor engineers.

2.2 SOURCE QUALITY CONTROL

- A. Authority Having Jurisdiction (AHJ)-Required Inspections: If the AHJ requires that delegated design assemblies be fabricated in a licensed fabricator shop, which is registered with the AHJ and authorized to certify the fabrication without inspection, provide such from such a shop. Or, if the AHJ will allow fabrication to take place in an unlicensed shop, but with continuous inspection of a qualified independent testing and inspection agency, this option may also be used and paid for by the Contractor.
 1. Furnish certifications required to the AHJ.

PART 3 - EXECUTION

Not Used

END OF SECTION

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ALLOWANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-specified work.

1.2 RELATED SECTIONS

A. Document 01 10 00 (Summary of Work)

B. Document 01 29 00 (Payments and Completion)

C. Document 01 32 19 (Submittal Procedures)

1.3 ALLOWANCES

A. Contractor's costs, without overhead and profit, for products, delivery, installation, labor, insurance, payroll, taxes, bonding and equipment rental will be included in Allowance Expenditure Directive authorizing expenditure of funds from this Allowance. No overhead and profit shall be added to the Allowance Expenditure Directive.

B. Funds will be drawn from Allowance only with District approval evidenced by an Allowance Expenditure Directive.

C. At Contract closeout, funds remaining in Allowance will be credited to District by Change Order.

D. Whenever costs are more than the Allowance, the amount covered by the Allowance will be approved at cost. The Contract Price shall be adjusted by Change Order for amounts in excess of the Allowance.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF DOCUMENT

ALTERNATES AND UNIT PRICING

PART 1 – ALTERNATES

1.01 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A.** General Conditions;
- B.** Special Conditions;
- C.** Bid Form and Proposal;
- D.** Instruction to Bidders.

1.02 DESCRIPTION

The items of work indicated below propose modifications to, substitutions for, additions to and/or deletions from the various parts of the Work specified in other Sections of the Specifications. The acceptance or rejection of any of the alternates is strictly at the option of the District subject to District's acceptance of Contractor's stated prices contained in this Proposal.

1.03 GENERAL

Where an item is omitted, or scope of Work is decreased, all Work pertaining to the item whether specifically stated or not, shall be omitted and where an items is added or modified or where scope of Work is increased, all Work pertaining to that required to render same ready for use on the Project in accordance with intention of Drawings and Specifications shall be included in an agreed upon price amount.

1.04 BASE BID

The Base Bid includes all work required to construct the Project completely and in accordance with the Contract Documents.

PART 2 - UNIT PRICING

2.01 GENERAL

Contractor shall completely state all required figures based on Unit Prices listed below. Where scope of Work is decreased, all Work pertaining to the item, whether specifically stated or not, shall be omitted and where scope of Work is increased, all work pertaining to that item required to render same ready for use on the Project in accordance with intention of Drawings and Specifications shall be included in an agreed upon price amount.

END OF DOCUMENT

DOCUMENT 01 25 13
PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. Instructions to Bidders;
- B. General Conditions, including, without limitation, Substitutions For Specified Items; and
- C. Special Conditions.

1.02 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT

- A. Catalog numbers and specific brands or trade names followed by the designation "or equal" are used in conjunction with material and equipment required by the Specifications to establish the standards of quality, utility, and appearance required. Substitutions which are equal in quality, utility, and appearance to those specified may be reviewed subject to the provisions of the General Conditions.
- B. Wherever more than one manufacturer's product is specified, the first-named product is the basis for the design used in the work and the use of alternative-named manufacturers' products or substitutes may require modifications in that design. If such alternatives are proposed by Contractor and are approved by the District and/or the Architect, Contractor shall assume all costs required to make necessary revisions and modifications of the design resulting from the substitutions requested by the Contractor.
- C. When materials and equipment are specified by first manufacturer's name and product number, second manufacturer's name and "or approved equal," supporting data for the second product, if proposed by Contractor, shall be submitted in accordance with the requirements for substitutions. The District's Board has found and determined that certain item(s) shall be used on this Project based on the purpose(s) indicated pursuant to Public Contract Code section 3400(c). These findings, as well as the products and brand or trade names, have been identified in the Notice to Bidders.
- D. The Contractor will not be allowed to substitute specified items unless the request for substitution is submitted as follows:
 - (1) District must receive any notice of request for substitution of a specified item a minimum of ten (10) calendar days prior to bid opening.
 - (2) Within 35 days after the date of the Notice of Award, the Contractor shall submit data substantiating the request(s) for all substitution(s)

containing sufficient information to assess acceptability of product or system and impact on Project, including, without limitation, the requirements specified in the Special Conditions and the technical Specifications. Insufficient information shall be grounds for rejection of substitution.

- E. If the District and/or Architect, in reviewing proposed substitute materials and equipment, require revisions or corrections to be made to previously accepted Shop Drawings and supplemental supporting data to be resubmitted, Contractor shall promptly do so. If any proposed substitution is judged by the District and/or Architect to be unacceptable, the specified material or equipment shall be provided.
- F. Samples may be required. Tests required by the District and/or Architect for the determination of quality and utility shall be made at the expense of Contractor, with acceptance of the test procedure first given by the District.
- G. In reviewing the supporting data submitted for substitutions, the District and/or Architect will use for purposes of comparison all the characteristics of the specified material or equipment as they appear in the manufacturer's published data even though all the characteristics may not have been particularly mentioned in the Contract Documents. If more than two (2) submissions of supporting data are required, the cost of reviewing the additional supporting data shall be borne by Contractor, and the District will deduct the costs from the Contract Price. The Contractor shall be responsible for any re-design costs occasioned by District's acceptance and/or approval of any substitute.
- H. The Contractor shall, in the event that a substitute is less costly than that specified, credit the District with one hundred percent (100%) of the net difference between the substitute and the originally specified material. In this event, the Contractor agrees to execute a deductive Change Order to reflect that credit. In the event Contractor furnishes a material, process, or article more expensive than that specified, the difference in the cost of that material, process, or article so furnished shall be borne by Contractor.
- I. In no event shall the District be liable for any increase in Contract Price or Contract Time due to any claimed delay in the evaluation of any proposed substitute or in the acceptance or rejection of any proposed substitute.
- J. When substitutions affect DSA regulated items, a Construction Change Directive (CCD) shall be prepared by the Design Team and approved by DSA prior to Contractor fabrication and/ or installation. The CCD shall be signed by the Architect of Record, the Structural Engineer of Record (when applicable), other delegated Engineer of Record (when applicable) and DSA.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 26 00

CHANGES IN THE WORK

CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE PROVISIONS IN THE AGREEMENT, GENERAL CONDITIONS, AND SPECIAL CONDITIONS, IF USED, RELATED TO CHANGES AND/OR REQUESTS FOR CHANGES.

END OF DOCUMENT

DOCUMENT 01 29 00

**APPLICATION FOR PAYMENT AND
CONDITIONAL AND UNCONDITIONAL WAIVER AND RELEASE FORMS**

**CONTRACTOR SHALL COMPLY WITH ALL PROVISIONS IN THE GENERAL
CONDITIONS RELATED TO APPLICATIONS FOR PAYMENT AND/OR PAYMENTS.**

**CONDITIONAL WAIVER AND RELEASE
ON PROGRESS PAYMENT
(CIVIL CODE SECTION 8132)**

NOTICE: THIS DOCUMENT WAIVES THE CLAIMANT'S LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS EFFECTIVE ON RECEIPT OF PAYMENT. A PERSON SHOULD NOT RELY ON THIS DOCUMENT UNLESS SATISFIED THAT THE CLAIMANT HAS RECEIVED PAYMENT.

Name of Claimant: _____

Name of Customer: _____

Job Location: _____

Owner: _____

Through Date: _____

Conditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job through the Through Date of this document. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. This document is effective only on the claimant's receipt of payment from the financial institution on which the following check is drawn:

Maker of Check: _____

Amount of Check: \$ _____

Check Payable to: _____

Exceptions

This document does not affect any of the following:

- (1) Retentions.
- (2) Extras for which the claimant has not received payment.
- (3) The following progress payments for which the claimant has previously given a conditional waiver and release but has not received payment:

Date(s) of waiver and release: _____

Amount(s) of unpaid progress payment(s): \$ _____

**PERALTA COMMUNITY COLLEGE DISTRICT
Library & LRC
Issue For Bid**

**APPLICATION FOR PAYMENT AND
CONDITIONAL AND UNCONDITIONAL WAIVER
AND RELEASE FORMS
DOCUMENT 01 29 00-2
March 31, 2023**

- (4) Contract rights, including (A) a right based on rescission, abandonment, or breach of contract, and (B) the right to recover compensation for work not compensated by the payment.

Claimant's Signature: _____

Claimant's Title: _____

Date of Signature: _____

**UNCONDITIONAL WAIVER AND RELEASE
ON PROGRESS PAYMENT
(CIVIL CODE SECTION 8134)**

NOTICE TO CLAIMANT: THIS DOCUMENT WAIVES AND RELEASES LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL WAIVER AND RELEASE FORM.

Name of Claimant: _____

Name of Customer: _____

Job Location: _____

Owner: _____

Through Date: _____

Unconditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job through the Through Date of this document. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. The claimant has received the following progress payment: \$_____

Exceptions

This document does not affect any of the following:

- (1) Retentions.
- (2) Extras for which the claimant has not received payment.
- (3) Contract rights, including (A) a right based on rescission, abandonment, or breach of contract, and (B) the right to recover compensation for work not compensated by the payment.

Claimant's Signature: _____

Claimant's Title: _____

Date of Signature: _____

**CONDITIONAL WAIVER AND RELEASE
ON FINAL PAYMENT
(CIVIL CODE SECTION 8136)**

NOTICE: THIS DOCUMENT WAIVES THE CLAIMANT'S LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS EFFECTIVE ON RECEIPT OF PAYMENT. A PERSON SHOULD NOT RELY ON THIS DOCUMENT UNLESS SATISFIED THAT THE CLAIMANT HAS RECEIVED PAYMENT.

Name of Claimant: _____

Name of Customer: _____

Job Location: _____

Owner: _____

Conditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. This document is effective only on the claimant's receipt of payment from the financial institution on which the following check is drawn:

Maker of Check: _____

Amount of Check: \$ _____

Check Payable to: _____

Exceptions

This document does not affect any of the following: _____

Disputed claims for extras in the amount of: \$ _____

Claimant's Signature: _____

Claimant's Title: _____

Date of Signature: _____

**UNCONDITIONAL WAIVER AND RELEASE
ON FINAL PAYMENT
(CIVIL CODE SECTION 8138)**

NOTICE TO CLAIMANT: THIS DOCUMENT WAIVES AND RELEASES LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL WAIVER AND RELEASE FORM.

Name of Claimant: _____

Name of Customer: _____

Job Location: _____

Owner: _____

Unconditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for all labor and service provided, and equipment and material delivered, to the customer on this job. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. The claimant has been paid in full.

Exceptions

This document does not affect any of the following: _____

Disputed claims for extras in the amount of: \$_____

Claimant's Signature: _____

Claimant's Title: _____

Date of Signature: _____

PROJECT MEETINGS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions; and
- B. Special Conditions.
- C. Division 03- Concrete
- D. Division 04- Masonry
- E. Division 05- Metals
- F. Division 06- Wood, Plastics and Composites
- G. Division 07- Thermal and Moisture Protection
- H. Division 08- Openings
- I. Division 09- Finishes
- J. Division 10- Specialties
- K. Division 11- Equipment
- L. Division 12- Furnishings
- M. Division 13- Special Construction
- N. Division 14- Conveying Equipment
- O. Division 21- Fire Suppression
- P. Division 22- Plumbing
- Q. Division 23- Heating, Ventilating and Air Conditioning (HVAC)
- R. Division 25- Integrated Automation
- S. Division 26- Electrical
- T. Division 27- Communication

- U. Division 28- Electronic Safety and Security

1.02 PROGRESS MEETINGS:

- A. Contractor shall schedule and hold regular weekly progress meetings after a minimum of one week's prior written notice of the meeting date and time to all Invitees as indicated below.
- B. Location: Contractor's field office.
- C. The Contractor shall notify and invite the following entities ("Invitees"):
 - (1) District Representative.
 - (2) Contractor.
 - (3) Contractor's Project Manager.
 - (4) Contractor's Superintendent.
 - (5) Subcontractors, as appropriate to the agenda of the meeting.
 - (6) Suppliers, as appropriate to the agenda of the meeting.
 - (7) Construction Manager, if any.
 - (8) Architect
 - (9) Engineer(s), if any and as appropriate to the agenda of the meeting.
 - (10) Others, as appropriate to the agenda of the meeting.
- D. The District's, the Architect's, and/or an engineer's Consultants will attend at their discretion, in response to the agenda.
- E. The District representative, the Construction Manager, and/or another District Agent shall take and distribute meeting notes to attendees and other concerned parties. If exceptions are taken to anything in the meeting notes, those exceptions shall be stated in writing to the District within five (5) working days following District's distribution of the meeting notes.

1.03 PRE-INSTALLATION/PERFORMANCE MEETING(S):

- A. Contractor shall schedule a meeting, at a minimum of one (1) week, prior to the start of any activity requiring a Pre Installation/ Performance Meeting as specified in the following Divisions of Work:
 - 1. Division 03- Concrete
 - 2. Division 04- Masonry

3. Division 05- Metals
4. Division 06- Wood, Plastics and Composites
5. Division 07- Thermal and Moisture Protection
6. Division 08- Openings
7. Division 09- Finishes
8. Division 10- Specialties
9. Division 11- Equipment
10. Division 12- Furnishings
11. Division 13- Special Construction
12. Division 14- Conveying Equipment
13. Division 21- Fire Suppression
14. Division 22- Plumbing
15. Division 23- Heating, Ventilating and Air Conditioning (HVAC)
16. Division 25- Integrated Automation
17. Division 26- Electrical
18. Division 27- Communication
19. Division 28- Electronic Safety and Security

Contractor shall invite to these meetings the Owner, Construction Manager, Inspector of Record (IOR), Architect and others whose work may affect or be affected by the Work, included but not limited to the cutting and patching of Work.

- B. Contractor shall review in detail prior to this meeting, the manufacturer's requirements and specifications, applicable portions of the Contract Documents, Shop Drawings, and other submittals, and other related work. At this meeting, invitees shall review and resolve conflicts, incompatibilities, or inadequacies discovered or anticipated.
- C. Contractor shall review in detail Project conditions, schedule, requirements for performance, application, installation, and quality of completed Work, and protection of adjacent Work and property.
- D. Contractor shall review in detail means of protecting the completed Work during the remainder of the construction period.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

SCHEDULING OF WORK

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions;
- C. Summary of Work; and
- D. Submittals.

1.02 SECTION INCLUDES

- A. Scheduling of Work under this Contract shall be performed by Contractor in accordance with requirements of this Section.
 - (1) Development of schedule, cost and resource loading of the schedule, monthly payment requests, and project status reporting requirements of the Contract shall employ computerized Critical Path Method ("CPM") scheduling ("CPM Schedule").
 - (2) CPM Schedule shall be cost loaded based on Schedule of Values as approved by District.
 - (3) Submit schedules and reports as specified in the General Conditions.
- B. Upon Award of Contract, Contractor shall immediately commence development of Initial and Original CPM Schedules to ensure compliance with CPM Schedule submittal requirements.

1.03 CONSTRUCTION SCHEDULE

- A. Within ten (10) days of issuance of the Notice to Proceed, and before request for first progress payment, the Contractor shall prepare and submit to the Project Manager a construction progress schedule conforming to the Milestone Schedule below.
- B. The Construction Schedule shall be continuously updated, and an updated schedule shall be submitted with each application for progress payment. Each revised schedule shall indicate the work actually accomplished during the previous period and the schedule for completion of the remaining work.

C. Milestone Schedule:

<u>ACTIVITY DESCRIPTION</u>	<u>REQUIRED COMPLETION</u>
CONSTRUCTION STARTS	Within 30 calendar days of NTP
SUBSTANTIAL COMPLETION	Within 520 calendar days of NTP
FINAL PROJECT COMPLETION	Within 580 calendar days of NTP

1.04 QUALIFICATIONS

- A. Contractor shall employ experienced scheduling personnel qualified to use the latest version of [i.e., Primavera Project Planner]. Experience level required is set forth below. Contractor may employ such personnel directly or may employ a consultant for this purpose.
- (1) The written statement shall identify the individual who will perform CPM scheduling.
 - (2) Capability and experience shall be verified by description of construction projects on which individual has successfully applied computerized CPM.
 - (3) Required level of experience shall include at least two (2) projects of similar nature and scope with value not less than three fourths ($\frac{3}{4}$) of the Total Bid Price of this Project. The written statement shall provide contact persons for referenced projects with current telephone and address information.
- B. District reserves the right to approve or reject Contractor's scheduler or consultant at any time. District reserves the right to refuse replacing of Contractor's scheduler or consultant, if District believes replacement will negatively affect the scheduling of Work under this Contract.

1.05 GENERAL

- A. Progress Schedule shall be based on and incorporate milestone and completion dates specified in Contract Documents.
- B. Overall time of completion and time of completion for each milestone shown on Progress Schedule shall adhere to times in the Contract, unless an earlier (advanced) time of completion is requested by Contractor and agreed to by District. Any such agreement shall be formalized by a Change Order.
- (1) District is not required to accept an early completion schedule, i.e., one that shows an earlier completion date than the Contract Time.
 - (2) Contractor shall not be entitled to extra compensation in event agreement is reached on an earlier completion schedule and Contractor completes its Work, for whatever reason, beyond

completion date shown in its early completion schedule but within the Contract Time.

- (3) A schedule showing the work completed in less than the Contract Time, and that has been accepted by District, shall be considered to have Project Float. The Project Float is the time between the scheduled completion of the work and the Completion Date. Project Float is a resource available to both District and the Contractor.
- C. Ownership Project Float: Neither the District nor Contractor owns Project Float. The Project owns the Project Float. As such, liability for delay of the Completion Date rests with the party whose actions, last in time, actually cause delay to the Completion Date.
- (1) For example, if Party A uses some, but not all of the Project Float and Party B later uses remainder of the Project Float as well as additional time beyond the Project Float, Party B shall be liable for the time that represents a delay to the Completion Date.
 - (2) Party A would not be responsible for the time since it did not consume the entire Project Float and additional Project Float remained; therefore, the Completion Date was unaffected by Party A.
- D. Progress Schedule shall be the basis for evaluating job progress, payment requests, and time extension requests. Responsibility for developing Contract CPM Schedule and monitoring actual progress as compared to Progress Schedule rests with Contractor.
- E. Failure of Progress Schedule to include any element of the Work, or any inaccuracy in Progress Schedule, will not relieve Contractor from responsibility for accomplishing the Work in accordance with the Contract. District's acceptance of schedule shall be for its use in monitoring and evaluating job progress, payment requests, and time extension requests and shall not, in any manner, impose a duty of care upon District, or act to relieve Contractor of its responsibility for means and methods of construction.
- F. Software: The schedule shall be in fully operational Primavera® (latest edition) computer software format. Such software shall be compatible with Windows operating system. Contractor shall transmit contract file to District on compact disk at times requested by District.
- G. Transmit each item under the form approved by District.
- (1) Identify Project with District Contract number and name of Contractor.
 - (2) Provide space for Contractor's approval stamp and District's review stamps.
 - (3) Submittals received from sources other than Contractor will be returned to the Contractor without District's review.

1.06 INITIAL CPM SCHEDULE

- A. Initial CPM Schedule submitted for review at the pre-construction conference shall serve as Contractor's schedule for up to ninety (90) calendar days after the Notice to Proceed.
- B. Indicate detailed plan for the Work to be completed in first ninety (90) days of the Contract; details of planned mobilization of plant and equipment; sequence of early operations; procurement of materials and equipment. Show Work beyond ninety (90) calendar days in summary form.
- C. Initial CPM Schedule shall be time scaled.
- D. Initial CPM Schedule shall be cost and resource loaded. Accepted cost and resource loaded schedule will be used as basis for monthly progress payments until acceptance of the Original CPM Schedule. Use of Initial CPM Schedule for progress payments shall not exceed ninety (90) calendar days.
- E. District and Contractor shall meet to review and discuss the Initial CPM Schedule within seven (7) calendar days after it has been submitted to District.
 - (1) District's review and comment on the schedule shall be limited to Contract conformance (with sequencing, coordination, and milestone requirements).
 - (2) Contractor shall make corrections to schedule necessary to comply with Contract requirements and shall adjust schedule to incorporate any missing information requested by District. Contractor shall resubmit Initial CPM Schedule if requested by District.
- F. If, during the first ninety (90) days after Notice to Proceed, the Contractor is of the opinion that any of the Work included on its Initial CPM Schedule has been impacted, the Contractor shall submit to District a written Time Impact Evaluation ("TIE") in accordance with Article 1.12 of this Section. The TIE shall be based on the most current update of the Initial CPM Schedule.

1.07 ORIGINAL CPM SCHEDULE

- A. Submit a detailed proposed Original CPM Schedule presenting an orderly and realistic plan for completion of the Work in conformance with requirements as specified herein.
- B. Progress Schedule shall include or comply with following requirements:
 - (1) Time scaled, cost and resource (labor and major equipment) loaded CPM schedule.
 - (2) No activity on schedule shall have duration longer than fifteen (15) work days, with exception of submittal, approval, fabrication and procurement activities, unless otherwise approved by District.

- (a) Activity durations shall be total number of actual work days required to perform that activity.
- (3) The start and completion dates of all items of Work, their major components, and milestone completion dates, if any.
- (4) District furnished materials and equipment, if any, identified as separate activities.
- (5) Activities for maintaining Project Record Documents.
- (6) Dependencies (or relationships) between activities.
- (7) Processing/approval of submittals and shop drawings for all material and equipment required per the Contract. Activities that are dependent on submittal acceptance or material delivery shall not be scheduled to start earlier than expected acceptance or delivery dates.
 - (a) Include time for submittals, re-submittals and reviews by District. Coordinate with accepted schedule for submission of Shop Drawings, samples, and other submittals.
 - (b) Contractor shall be responsible for all impacts resulting from re-submittal of Shop Drawings and submittals.
- (8) Procurement of major equipment, through receipt and inspection at jobsite, identified as separate activity.
 - (a) Include time for fabrication and delivery of manufactured products for the Work.
 - (b) Show dependencies between procurement and construction.
- (9) Activity description; what Work is to be accomplished and where.
- (10) The total cost of performing each activity shall be total of labor, material, and equipment, excluding overhead and profit of Contractor. Overhead and profit of the General Contractor shall be shown as a separate activity in the schedule. Sum of cost for all activities shall equal total Contract value.
- (11) Resources required (labor and major equipment) to perform each activity.
- (12) Responsibility code for each activity corresponding to Contractor or Subcontractor responsible for performing the Work.
- (13) Identify the activities which constitute the controlling operations or critical path. No more than twenty-five (25%) of the activities shall be critical or near critical. Near critical is defined as float in the range of one (1) to (10) days.

- (14) Twenty (20) workdays for developing punch list(s), completion of punch-list items, and final clean-up for the Work or any designated portion thereof. No other activities shall be scheduled during this period.
 - (15) Interface with the work of other contractors, District, and agencies such as, but not limited to, utility companies.
 - (16) Show detailed Subcontractor Work activities. In addition, furnish copies of Subcontractor schedules upon which CPM was built.
 - (a) Also furnish for each Subcontractor, as determined by District, submitted on Subcontractor letterhead, a statement certifying that Subcontractor concurs with Contractor's Original CPM Schedule and that Subcontractor's related schedules have been incorporated, including activity duration, cost and resource loading.
 - (b) Subcontractor schedules shall be independently derived and not a copy of Contractor's schedule.
 - (c) In addition to Contractor's schedule and resource loading, obtain from electrical, mechanical, and plumbing Subcontractors, and other Subcontractors as required by District, productivity calculations common to their trades, such as units per person day, feet of pipe per day per person, feet of wiring per day per person, and similar information.
 - (d) Furnish schedule for Contractor/Subcontractor CPM schedule meetings which shall be held prior to submission of Original CPM schedule to District. District shall be permitted to attend scheduled meetings as an observer.
 - (17) Activity durations shall be in Work days.
 - (18) Submit with the schedule a list of anticipated non-Work days, such as weekends and holidays. The Progress Schedule shall exclude in its Work day calendar all non-Work days on which Contractor anticipates critical Work will not be performed.
- C. Original CPM Schedule Review Meeting: Contractor shall, within sixty (60) days from the Notice to Proceed date, meet with District to review the Original CPM Schedule submittal.
- (1) Contractor shall have its Project Manager, Project Superintendent, Project Scheduler, and key Subcontractor representatives, as required by District, in attendance. The meeting will take place over a continuous one (1) day period.

- (2) District's review will be limited to submittal's conformance to Contract requirements including, but not limited to, coordination requirements. However, review may also include:
 - (a) Clarifications of Contract Requirements.
 - (b) Directions to include activities and information missing from submittal.
 - (c) Requests to Contractor to clarify its schedule.
- (3) Within five (5) days of the Schedule Review Meeting, Contractor shall respond in writing to all questions and comments expressed by District at the Meeting.

1.08 ADJUSTMENTS TO CPM SCHEDULE

- A. Adjustments to Original CPM Schedule: Contractor shall have adjusted the Original CPM Schedule submittal to address all review comments from original CPM Schedule review meeting and resubmit network diagrams and reports for District's review.
 - (1) District, within ten (10) days from date that Contractor submitted the revised schedule, will either:
 - (a) Accept schedule and cost and resource loaded activities as submitted, or
 - (b) Advise Contractor in writing to review any part or parts of schedule which either do not meet Contract requirements or are unsatisfactory for District to monitor Project's progress, resources, and status or evaluate monthly payment request by Contractor.
 - (2) District may accept schedule with conditions that the first monthly CPM Schedule update be revised to correct deficiencies identified.
 - (3) When schedule is accepted, it shall be considered the "Original CPM Schedule" which will then be immediately updated to reflect the current status of the work.
 - (4) District reserves right to require Contractor to adjust, add to, or clarify any portion of schedule which may later be discovered to be insufficient for monitoring of Work or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.
- B. Acceptance of Contractor's schedule by District will be based solely upon schedule's compliance with Contract requirements.
 - (1) By way of Contractor assigning activity durations and proposing sequence of Work, Contractor agrees to utilize sufficient and necessary

management and other resources to perform work in accordance with the schedule.

- (2) Upon submittal of schedule update, updated schedule shall be considered "current" CPM Schedule.
 - (3) Submission of Contractor's schedule to District shall not relieve Contractor of total responsibility for scheduling, sequencing, and pursuing Work to comply with requirements of Contract Documents, including adverse effects such as delays resulting from ill-timed Work.
- C. Submittal of Original CPM Schedule, and subsequent schedule updates, shall be understood to be Contractor's representation that the Schedule meets requirements of Contract Documents and that Work shall be executed in sequence indicated on the schedule.
- D. Contractor shall distribute Original CPM Schedule to Subcontractors for review and written acceptance, which shall be noted on Subcontractors' letterheads to Contractor and transmitted to District for the record.

1.09 MONTHLY CPM SCHEDULE UPDATE SUBMITTALS

- A. Following acceptance of Contractor's Original CPM Schedule, Contractor shall monitor progress of Work and adjust schedule each month to reflect actual progress and any anticipated changes to planned activities.
- (1) Each schedule update submitted shall be complete, including all information requested for the Original CPM Schedule submittal.
 - (2) Each update shall continue to show all Work activities including those already completed. These completed activities shall accurately reflect "as built" information by indicating when activities were actually started and completed.
- B. A meeting will be held on approximately the twenty-fifth (25th) of each month to review the schedule update submittal and progress payment application.
- (1) At this meeting, at a minimum, the following items will be reviewed: Percent (%) complete of each activity; Time Impact Evaluations for Change Orders and Time Extension Request; actual and anticipated activity sequence changes; actual and anticipated duration changes; and actual and anticipated Contractor delays.
 - (2) These meetings are considered a critical component of overall monthly schedule update submittal and Contractor shall have appropriate personnel attend. At a minimum, these meetings shall be attended by Contractor's General Superintendent and Scheduler.
 - (3) Contractor shall plan on the meeting taking no less than four (4) hours.

- C. Within five (5) working days after monthly schedule update meeting, Contractor shall submit the updated CPM Schedule update.
- D. Within five (5) work days of receipt of above noted revised submittals, District will either accept or reject monthly schedule update submittal.
 - (1) If accepted, percent (%) complete shown in monthly update will be basis for Application for Payment by the Contractor. The schedule update shall be submitted as part of the Contractor's Application for Payment.
 - (2) If rejected, update shall be corrected and resubmitted by Contractor before the Application for Payment is submitted.
- E. Neither updating, changing or revising of any report, curve, schedule, or narrative submitted to District by Contractor under this Contract, nor District's review or acceptance of any such report, curve, schedule or narrative shall have the effect of amending or modifying in any way the Completion Date or milestone dates or of modifying or limiting in any way Contractor's obligations under this Contract.

1.10 SCHEDULE REVISIONS

- A. Updating the Schedule to reflect actual progress shall not be considered revisions to the Schedule. Since scheduling is a dynamic process, revisions to activity durations and sequences are expected on a monthly basis.
- B. To reflect revisions to the Schedule, the Contractor shall provide District with a written narrative with a full description and reasons for each Work activity revised. For revisions affecting the sequence of work, the Contractor shall provide a schedule diagram which compares the original sequence to the revised sequence of work. The Contractor shall provide the written narrative and schedule diagram for revisions two (2) working days in advance of the monthly schedule update meeting.
- C. Schedule revisions shall not be incorporated into any schedule update until the revisions have been reviewed by District. District may request further information and justification for schedule revisions and Contractor shall, within three (3) days, provide District with a complete written narrative response to District's request.
- D. If the Contractor's revision is still not accepted by District, and the Contractor disagrees with District's position, the Contractor has seven (7) calendar days from receipt of District's letter rejecting the revision to provide a written narrative providing full justification and explanation for the revision. The Contractor's failure to respond in writing within seven (7) calendar days of District's written rejection of a schedule revision shall be contractually interpreted as acceptance of District's position, and the Contractor waives its rights to subsequently dispute or file a claim regarding District's position.

- E. At District's discretion, the Contractor can be required to provide Subcontractor certifications of performance regarding proposed schedule revisions affecting said Subcontractors.

1.11 RECOVERY SCHEDULE

- A. If the Schedule Update shows a completion date twenty-one (21) calendar days beyond the Contract Completion Date, or individual milestone completion dates, the Contractor shall submit to District the proposed revisions to recover the lost time within seven (7) calendar days. As part of this submittal, the Contractor shall provide a written narrative for each revision made to recapture the lost time. If the revisions include sequence changes, the Contractor shall provide a schedule diagram comparing the original sequence to the revised sequence of work.
- B. The revisions shall not be incorporated into any schedule update until the revisions have been reviewed by District.
- C. If the Contractor's revisions are not accepted by District, District and the Contractor shall follow the procedures in paragraph 1.09.C, 1.09.D and 1.09.E above.
- D. At District's discretion, the Contractor can be required to provide Subcontractor certifications for revisions affecting said Subcontractors.

1.12 TIME IMPACT EVALUATION ("TIE") FOR CHANGE ORDERS, AND OTHER DELAYS

- A. When Contractor is directed to proceed with changed Work, the Contractor shall prepare and submit within fourteen (14) calendar days from the Notice to Proceed a TIE which includes both a written narrative and a schedule diagram depicting how the changed Work affects other schedule activities. The schedule diagram shall show how the Contractor proposes to incorporate the changed Work in the schedule and how it impacts the current schedule-update critical path. The Contractor is also responsible for requesting time extensions based on the TIE's impact on the critical path. The diagram must be tied to the main sequence of schedule activities to enable District to evaluate the impact of changed Work to the scheduled critical path.
- B. Contractor shall be required to comply with the requirements of Paragraph 1.09.A for all types of delays such as, but not limited to, Contractor/Subcontractor delays, adverse weather delays, strikes, procurement delays, fabrication delays, etc.
- C. Contractor shall be responsible for all costs associated with the preparation of TIEs, and the process of incorporating them into the current schedule update. The Contractor shall provide District with four (4) copies of each TIE.
- D. Once agreement has been reached on a TIE, the Contract Time will be adjusted accordingly. If agreement is not reached on a TIE, the Contract

Time may be extended in an amount District allows, and the Contractor may submit a claim for additional time claimed by contractor.

1.13 TIME EXTENSIONS

- A. The Contractor is responsible for requesting time extensions for time impacts that, in the opinion of the Contractor, impact the critical path of the current schedule update. Notice of time impacts shall be given in accord with the General Conditions.
- B. Where an event for which District is responsible impacts the projected Completion Date, the Contractor shall provide a written mitigation plan, including a schedule diagram, which explains how (e.g., increase crew size, overtime, etc.) the impact can be mitigated. The Contractor shall also include a detailed cost breakdown of the labor, equipment, and material the Contractor would expend to mitigate District-caused time impact. The Contractor shall submit its mitigation plan to District within fourteen (14) calendar days from the date of discovery of the impact. The Contractor is responsible for the cost to prepare the mitigation plan.
- C. Failure to request time, provide TIE, or provide the required mitigation plan will result in Contractor waiving its right to a time extension and cost to mitigate the delay.
- D. No time will be granted under this Contract for cumulative effect of changes.
- E. District will not be obligated to consider any time extension request unless the Contractor complies with the requirements of Contract Documents.
- F. Failure of the Contractor to perform in accordance with the current schedule update shall not be excused by submittal of time extension requests.
- G. If the Contractor does not submit a TIE within the required fourteen (14) calendar days for any issue, it is mutually agreed that the Contractor does not require a time extension for said issue.

1.14 SCHEDULE REPORTS

- A. Submit four (4) copies of the following reports with the Initial CPM Schedule, the Original CPM Schedule, and each monthly update.
- B. Required Reports:
 - (1) Two activity listing reports: one sorted by activity number and one by total Project Float. These reports shall also include each activity's early/late and actual start and finish dates, original and remaining duration, Project Float, responsibility code, and the logic relationship of activities.
 - (2) Cost report sorted by activity number including each activity's associated cost, percentage of Work accomplished, earned value- to

date, previous payments, and amount earned for current update period.

- (3) Schedule plots presenting time-scaled network diagram showing activities and their relationships with the controlling operations or critical path clearly highlighted.
- (4) Cash flow report calculated by early start, late start, and indicating actual progress. Provide an exhibit depicting this information in graphic form.
- (5) Planned versus actual resource (i.e., labor) histogram calculated by early start and late start.

C. Other Reports:

In addition to above reports, District may request, from month to month, any two of the following reports. Submit four (4) copies of all reports.

- (1) Activities by early start.
- (2) Activities by late start.
- (3) Activities grouped by Subcontractors or selected trades.
- (4) Activities with scheduled early start dates in a given time frame, such as fifteen (15) or thirty (30) day outlook.

D. Furnish District with report files on compact disks containing all schedule files for each report generated.

1.15 PROJECT STATUS REPORTING

- A. In addition to submittal requirements for CPM scheduling identified in this Section, Contractor shall provide a monthly project status report (i.e., written narrative report) to be submitted in conjunction with each CPM Schedule as specified herein. Status reporting shall be in form specified below.
- B. Contractor shall prepare monthly written narrative reports of status of Project for submission to District. Written status reports shall include:
 - (1) Status of major Project components (percent (%) complete, amount of time ahead or behind schedule) and an explanation of how Project will be brought back on schedule if delays have occurred.
 - (2) Progress made on critical activities indicated on CPM Schedule.
 - (3) Explanations for any lack of work on critical path activities planned to be performed during last month.
 - (4) Explanations for any schedule changes, including changes to logic or to activity durations.

- (5) List of critical activities scheduled to be performed next month.
- (6) Status of major material and equipment procurement.
- (7) Any delays encountered during reporting period.
- (8) Contractor shall provide printed report indicating actual versus planned resource loading for each trade and each activity. This report shall be provided on weekly and monthly basis.
 - (a) Actual resource shall be accumulated in field by Contractor, and shall be as noted on Contractor's daily reports. These reports will be basis for information provided in computer-generated monthly and weekly printed reports.
 - (b) Contractor shall explain all variances and mitigation measures.
- (9) Contractor may include any other information pertinent to status of Project. Contractor shall include additional status information requested by District at no additional cost.
- (10) Status reports, and the information contained therein, shall not be construed as claims, notice of claims, notice of delay, or requests for changes or compensation.

1.16 WEEKLY SCHEDULE REPORT

At the Weekly Progress Meeting, the Contractor shall provide and present a time-scaled three (3) week look-ahead schedule that is based and correlated by activity number to the current schedule (i.e., Initial, Original CPM, or Schedule Update).

1.17 DAILY CONSTRUCTION REPORTS

On a daily basis, Contractor shall submit a daily activity report to District for each workday, including weekends and holidays when worked. Contractor shall develop the daily construction reports on a computer-generated database capable of sorting daily Work, manpower, and man-hours by Contractor, Subcontractor, area, sub-area, and Change Order Work. Upon request of District, furnish computer disk of this data base. Obtain District's written approval of daily construction report data base format prior to implementation. Include in report:

- A. Project name and Project number.
- B. Contractor's name and address.
- C. Weather, temperature, and any unusual site conditions.
- D. Brief description and location of the day's scheduled activities and any special problems and accidents, including Work of Subcontractors. Descriptions shall be referenced to CPM scheduled activities.
- E. Worker quantities for its own Work force and for Subcontractors of any tier.

F. Equipment, other than hand tools, utilized by Contractor and Subcontractors.

1.18 PERIODIC VERIFIED REPORTS

Contractor shall complete and verify construction reports on a form prescribed by the Division of the State Architect and file reports on the first day of February, May, August, and November during the preceding quarter year; at the completion of the Contract; at the completion of the Work; at the suspension of Work for a period of more than one (1) month; whenever the services of Contractor or any of Contractor's Subcontractors are terminated for any reason; and at any time a special verified report is required by the Division of the State Architect. Refer to section 4-336 and section 4-343 of Part 1, Title 24 of the California Code of Regulations.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

SUBMITTALS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Contractor's Submittals and Schedules, Drawings and Specifications;
- B. Special Conditions.

1.02 SECTION INCLUDES:

- A. Definitions:
 - (1) Shop Drawings and Product Data are as indicated in the General Conditions and include, but are not limited to, fabrication, erection, layout and setting drawings, formwork and falsework drawings, manufacturers' standard drawings, descriptive literature, catalogues, brochures, performance and test data, wiring and control diagrams. In addition, there are other drawings and descriptive data pertaining to materials, equipment, piping, duct and conduit systems, and methods of construction as may be required to show that the materials, equipment or systems and all positions conform to the requirement of the Contract Documents, including, without limitation, the Drawings.
 - (2) "Manufactured" applies to standard units usually mass-produced; "fabricated" means specifically assembled or made out of selected materials to meet design requirements. Shop Drawings shall establish the actual detail of manufactured or fabricated items, indicated proper relation to adjoining work and amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure.
 - (3) Manufacturer's Instructions: Where any item of Work is required by the Contract Documents to be furnished, installed, or performed, at a minimum, in accordance with a specified product manufacturer's instructions, the Contractor shall procure and distribute copies of these to the District, the Architect, and all other concerned parties and shall furnish, install, or perform the work, at a minimum, in accordance with those instructions.
- B. Samples, Shop Drawings, Product Data, and other items as specified, in accordance with the following requirements:

- (1) Contractor shall submit all Shop Drawings, Product Data, and Samples to the District, the Architect, the Project Inspector, and the Construction Manager.
- (2) Contractor shall comply with all time frames herein and in the General Conditions and, in any case, shall submit required information in sufficient time to permit proper consideration and action before ordering any materials or items represented by such Shop Drawings, Product Data, and/or Samples.
- (3) Contractor shall allow sufficient time so that no delay occurs due to required lead time in ordering or delivery of any item to the Site. Contractor shall be responsible for any delay in progress of Work due to its failure to observe these requirements.
- (4) Time for completion of Work shall not be extended on account of Contractor's failure to promptly submit Shop Drawings, Product Data, and/or Samples.
- (5) Reference numbers on Shop Drawings shall have Architectural and/or Engineering Contract Drawings reference numbers for details, sections, and "cuts" shown on Shop Drawings. These reference numbers shall be in addition to any numbering system that Contractor chooses to use or has adopted as standard.
- (6) When the magnitude or complexity of submittal material prevents a complete review within the stated time frame, Contractor shall make this submittal in increments to avoid extended delays.
- (7) Contractor shall certify on submittals for review that submittals conform to Contract requirements. Also certify that Contractor-furnished equipment can be installed in allocated space. In event of any variance, Contractor shall specifically state in transmittal and on Shop Drawings, portions vary and require approval of a substitute. Submittals shall not be used as a means of requesting a substitution.
- (8) Unless specified otherwise, sampling, preparation of samples, and tests shall be in accordance with the latest standard of the American Society for Testing and Materials.
- (9) Upon demand by Architect or District, Contractor shall submit samples of materials and/or articles for tests or examinations and consideration before Contractor incorporates same in Work. Contractor shall be solely responsible for delays due to sample(s) not being submitted in time to allow for tests. Acceptance or rejection will be expressed in writing. Work shall be equal to approved samples in every respect. Samples that are of value after testing will remain the property of Contractor.

C. Submittal Schedule:

- (1) Contractor shall prepare its proposed submittal schedule that is coordinated with the its proposed construction schedule and submit both to the District within ten (10) days after the date of the Notice to Proceed. Contractor's proposed schedules shall become the Project Construction Schedule and the Project Submittal Schedule after each is approved by the District.
- (2) Contractor is responsible for all lost time should the initial submittal be rejected, marked "revise and resubmit", etc.
- (3) All Submittals shall be forwarded to the District by the date indicated on the approved Submittal Schedule, unless an earlier date is necessary to maintain the Construction Schedule, in which case those Submittals shall be forwarded to the District so as not to delay the Construction Schedule.
- (4) Contractor may be assessed \$100 a day for each day it is late in submitting a shop drawing or sample. No extensions of time will be granted to Trade Contractor or any Subcontractor because of its failure to have shop drawings and samples submitted in accordance with the Schedule.

1.03 SHOP DRAWINGS:

- A. Contractor shall submit one reproducible transparency and six (6) opaque reproductions. The District will review and return the reproducible copy and one (1) opaque reproduction to Contractor.
- B. Before commencing installation of any Work, the Contractor shall submit and receive approval of all drawings, descriptive data, and material list(s) as required to accomplish Work.
- C. Review of Shop Drawings is regarded as a service to assist Contractor and in all cases original Contract Documents shall take precedence as outlined under General Conditions.
- D. No claim for extra time or payment shall be based on work shown on Shop Drawings unless the claim is (1) noted on Contractor's transmittal letter accompanying Shop Drawings and (2) Contractor has complied with all applicable provisions of the General Conditions, including, without limitation, provisions regarding changes and payment, and all required written approvals.
- E. District shall not review Shop Drawings for quantities of materials or number of items supplied.
- F. District's and/or Architect's review of Shop Drawing will be general. District and/or Architect review does not relieve Contractor of responsibility for dimensions, accuracy, proper fitting, construction of Work, furnishing of materials, or Work required by Contract Documents and not indicated on Shop Drawings. The District's and/or Architect's review of Shop Drawings is not to be construed as approving departures from Contract Documents.

- G. Review of Shop Drawings and Schedules does not relieve Contractor from responsibility for any aspect of those Drawings or Schedules that is a violation of local, County, State, or Federal laws, rules, ordinances, or rules and regulations of commissions, boards, or other authorities or utilities having jurisdiction.
- H. Before submitting Shop Drawings for review, Contractor shall check Shop Drawings of its subcontractors for accuracy, and confirm that all Work contiguous with and having bearing on other work shown on Shop Drawings is accurately drawn and in conformance with Contract Documents.
- I. Submitted drawings and details must bear stamp of approval of Contractor:
 - (1) Stamp and signature shall clearly certify that Contractor has checked Shop Drawings for compliance with Drawings.
 - (2) If Contractor submits a Shop Drawing without an executed stamp of approval, or whenever it is evident (despite stamp) that Drawings have not been checked, the District and/or Architect will not consider them and will return them to the Contractor for revision and resubmission. In that event, it will be deemed that Contractor has not complied with this provision and Contractor shall bear risk of all delays to same extent as if it had not submitted any Shop Drawings or details.
- J. Submission of Shop Drawings (in either original submission or when resubmitted with correction) constitutes evidence that Contractor has checked all information thereon and that it accepts and is willing to perform Work as shown.
- K. Contractor shall pay for cost of any changes in construction due to improper checking and coordination. Contractor shall be responsible for all additional costs, including coordination. Contractor shall be responsible for costs incurred by itself, the District, the Architect, the Project Inspector, the Construction Manager, any other Subcontractor or contractor, etc., due to improperly checked and/or coordination of submittals.
- L. Shop Drawings must clearly delineate the following information:
 - (1) Project name and address.
 - (2) Specification number and description.
 - (3) Architect's name and project number.
 - (4) Shop Drawing title, number, date, and scale.
 - (5) Names of Contractor, Subcontractor(s) and fabricator.
 - (6) Working and erection dimensions.
 - (7) Arrangements and sectional views.

- (8) Necessary details, including complete information for making connections with other Work.
 - (9) Kinds of materials and finishes.
 - (10) Descriptive names of materials and equipment, classified item numbers, and locations at which materials or equipment are to be installed in the Work. Contractor shall use same reference identification(s) as shown on Contract Drawings.
- M. Contractor shall prepare composite drawings and installation layouts when required to solve tight field conditions.
- (1) Shop Drawings shall consist of dimensioned plans and elevations and must give complete information, particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc.
 - (2) Contractor shall coordinate these composite Shop Drawings and installation layouts in the field between itself and its Subcontractor(s) for proper relationship to the Work, the work of other trades, and the field conditions. The Contractor shall check and approve all submittal(s) before submitting them for final review.

1.04 PRODUCT DATA OR NON REPRODUCIBLE SUBMITTALS:

- A. Contractor shall submit manufacturer's printed literature in original form. Any fading type of reproduction will not be accepted. Contractor must submit a minimum of six (6) each, to the District. District shall return one (1) to the Contractor, who shall reproduce whatever additional copies it requires for distribution.
- B. Contractor shall submit six (6) copies of a complete list of all major items of mechanical, plumbing, and electrical equipment and materials in accordance with the approved Submittal Schedule, except as required earlier to comply with the approved Construction Schedule. Other items specified are to be submitted prior to commencing Work. Contractor shall submit items of like kind at one time in a neat and orderly manner. Partial lists will not be acceptable.
- C. Submittals shall include manufacturer's specifications, physical dimensions, and ratings of all equipment. Contractor shall furnish performance curves for all pumps and fans. Where printed literature describes items in addition to that item being submitted, submitted item shall be clearly marked on sheet and superfluous information shall be crossed out. If highlighting is used, Contractor shall mark all copies.
- D. Equipment submittals shall be complete and include space requirements, weight, electrical and mechanical requirements, performance data, and supplemental information that may be requested.

- E. Imported Materials Certification must be submitted at least ten (10) days before material is delivered.

1.05 SAMPLES:

- A. Contractor shall submit for approval Samples as required and within the time frame in the Contract Documents. Materials such as concrete, mortar, etc., which require on-site testing will be obtained from Project Site.
- B. Contractor shall submit four (4) samples except where greater or lesser number is specifically required by Contract Documents including, without limitation, the Specifications.
 - (1) Samples must be of sufficient size and quality to clearly illustrate functional characteristics, with integrally related parts and attachment devices.
 - (2) Samples must show full range of texture, color, and pattern.
- C. Contractor shall make all Submittals, unless it has authorized Subcontractor(s) to submit and Contractor has notified the District in writing to this effect.
- D. Samples to be shipped prepaid or hand-delivered to the District.
- E. Contractor shall mark samples to show name of Project, name of Contractor submitting, Contract number and segment of Work where representative Sample will be used, all applicable Specifications Sections and documents, Contract Drawing Number and detail, and ASTM or FS reference, if applicable.
- F. Contractor shall not deliver any material to Site prior to receipt of District's and/or Architect's completed written review and approval. Contractor shall furnish materials equal in every respect to approved Samples and execute Work in conformance therewith.
- G. District's and/or Architect's review, acceptance, and/or approval of Sample(s) will not preclude rejections of any material upon discovery of defects in same prior to final acceptance of completed Work.
- H. After a material has been approved, no change in brand or make will be permitted.
- I. Contractor shall prepare its Submittal Schedule and submit Samples of materials requiring laboratory tests to specified laboratory for testing not less than ninety (90) days before such materials are required to be used in Work.
- J. Samples which are rejected must be resubmitted promptly after notification of rejection and be marked "Resubmitted Sample" in addition to other information required.
- K. Field Samples and Mock-Ups are to be removed by Contractor at District's direction:

- (1) Size: As Specified.
- (2) Furnish catalog numbers and similar data, as requested.

1.06 REVIEW AND RESUBMISSION REQUIREMENTS:

- A. The District will arrange for review of Sample(s), Shop Drawing(s), Product Data, and other submittal(s) by appropriate reviewer and return to Contractor as provided below within twenty-one (21) days after receipt or within twenty-one (21) days after receipt of all related information necessary for such review, whichever is later.
- B. One (1) copy of product or materials data will be returned to Contractor with the review status.
- C. Samples to be incorporated into the Work will be returned to Contractor, together with a written notice designating the Sample with the appropriate review status and indicating errors discovered on review, if any. Other Samples will not be returned, but the same notice will be given with respect thereto, and that notice shall be considered a return of the Sample.
- D. Contractor shall revise and resubmit any Sample(s), Shop Drawing(s), Product Data, and other submittal(s) as required by the reviewer. Such resubmittals will be reviewed and returned in the same manner as original Sample(s), Shop Drawing(s), Product Data, and other submittal(s), within fourteen (14) days after receipt thereof or within fourteen (14) days after receipt of all related information necessary for such review. Such resubmittal shall not delay the Work.
- E. Contractor may proceed with any of the Work covered by Sample(s), Shop Drawing(s), Product Data, and other submittal(s) upon its return if designated as no exception taken, or revise as noted, provided the Contractor proceeds in accordance with the District and/or the Architect's notes and comments.
- F. Contractor shall not begin any of the work covered by a Sample(s), Shop Drawing(s), Product Data, and other submittal(s), designated as revise and resubmit or rejected, until a revision or correction thereof has been reviewed and returned to Contractor.
- G. Sample(s), Shop Drawing(s), Product Data, and other submittal(s) designated as revise and resubmit or rejected and requiring resubmittal, shall be revised or corrected and resubmitted to the District no later than fourteen (14) days or a shorter period as required to comply with the approved Construction Schedule, after its return to Contractor.
- H. Neither the review nor the lack of review of any Sample(s), Shop Drawing(s), Product Data, and other submittal(s) shall waive any of the requirements of the Contract Documents, or relieve Contractor of any obligation thereunder.
- I. District's and/or Architect's review of Shop Drawings does not relieve the Contractor of responsibility for any errors that may exist. Contractor is

responsible for the dimensions and design of adequate connections and details and for satisfactory construction of all the Work.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

SITE STANDARDS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including without limitation, Site Access, Conditions, and Regulations;
- B. Special Conditions;
- C. Drug-Free Workplace Certification;
- D. Tobacco-Free Environment Certification;
- E. Criminal Background Investigation/Fingerprinting Certification;
- F. Temporary Facilities and Controls.

1.02 REQUIREMENTS OF THE DISTRICT:

- A. Drug-Free Schools and Safety Requirements:
 - (1) All school sites and other District Facilities have been declared "Drug-Free Zones." No drugs, alcohol and/or smoking are allowed at any time in any buildings and/or grounds on District property. No students, staff, visitors, or contractors are to use drugs on these sites.
 - (2) Smoking and the use of tobacco products by all persons is prohibited on or in District property. District property includes school buildings, school grounds, school-owned vehicles and vehicles owned by others while on District property. Contractor shall post: "Non-Smoking Area" in a highly visible location in each work area, staging area, and parking area. Contractor may designate a smoking area outside of District property within the public right-of-way, provided that this area remains quiet and unobtrusive to adjacent neighbors. This smoking area is to be kept clean at all times.
 - (3) Contractor shall ensure that no alcohol, firearms, weapons, or controlled substances enter or are used at the Site. Contractor shall immediately remove from the Site and terminate the employment of any employee(s) found in violation of this provision.
- B. Language: Profanity or other unacceptable and/or loud language will not be tolerated, "Cat calls" or other derogatory language toward students, staff, volunteers, parents or public will not be allowed.

- C. Disturbing the Peace (Noise and Lighting):
- (1) Contractor shall observe the noise ordinance of the Site at all times including, without limitation, all applicable local, city, and/or state laws, ordinances, and/or regulations regarding noise and allowable noise levels.
 - (2) The use of radios, etc., shall be controlled to keep all sound at a level that cannot be heard beyond the immediate area of use. District reserves the right to prohibit the use of radios at the Site, except for mobile phones or other handheld communication radios.
 - (3) If portable lights are used after dark, all light must be located so as not to direct light into neighboring property.
- D. Traffic:
- (1) Driving on the Premises shall be limited to periods when students and public are not present. If driving or deliveries must be made during the school hours, two (2) or more ground guides shall lead the vehicle across the area of travel. In no case shall driving take place across playgrounds or other pedestrian paths during recess, lunch, and/or class period changes. The speed limit on-the Premises shall be five (5) miles per hour (maximum) or less if conditions require.
 - (2) All paths of travel for deliveries, including without limitation, material, equipment, and supply deliveries, shall be reviewed and approved by District in advance. Any damage will be repaired to the pre-damaged condition by the Contractor.
 - (3) District shall designate a construction entry to the Site. If Contractor requests, District determines it is required, and to the extent possible, District shall designate a staging area so as not to interfere with the normal functioning of school facilities. Location of gates and fencing shall be approved in advance with District and at Contractor's expense.
 - (4) Parking areas shall be reviewed and approved by District in advance. No parking is to occur under the drip line of trees or in softscape areas that could otherwise be damaged.
- E. All of the above shall be observed and complied with by the Contractor and all workers on the Site. Failure to follow these directives could result in individual(s) being suspended or removed from the work force at the discretion of the District. The same rules and regulations shall apply equally to delivery personnel, inspectors, consultants, and other visitors to the Site.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Obtaining of Permits, Licenses and Registrations and Work to Comply with All Applicable Laws and Regulations;
- B. Special Conditions; and
- C. Quality Control.

1.02 DESCRIPTION:

This section covers the general requirements for regulatory requirements pertaining to the Work and is supplementary to all other regulatory requirements mentioned or referenced elsewhere in the Contract Documents.

1.03 REQUIREMENTS OF REGULATORY AGENCIES:

- A. All statutes, ordinances, laws, rules, codes, regulations, standards, and the lawful orders of all public authorities having jurisdiction over the Work, are hereby incorporated into these Contract Documents as if repeated in full herein and are intended to be included in any reference to Code or Building Code, unless otherwise specified, including, without limitation, the references in the list below. Contractor shall make available at the Site copies of all the listed documents applicable to the Work as the District and/or Architect may request, including, without limitation, applicable portions of the California Code of Regulations ("CCR").
 - (1) California Building Standards Administrative Code, Part 1, Title 24, CCR.
 - (2) California Building Code (CBC), Part 2, Title 24, CCR; (International Building Code volumes 1-2 and California Amendments).
 - (3) California Electrical Code (CEC), Part 3, Title 24, CCR; (National Electrical Code and California Amendments).
 - (4) California Mechanical Code (CMC), Part 4, Title 24, CCR; (Uniform Mechanical Code and California Amendments).
 - (5) California Plumbing Code (CPC), Part 5, Title 24, CCR; (Uniform Plumbing Code and California Amendments).

- (6) California Fire Code (CFC), Part 9, Title 24, CCR; (International Fire Code and California Amendments).
- (7) California Green Building Standards Code (CALGreen), Part 11, Title 24, CCR.
- (8) California Referenced Standards Code, Part 12, Title 24, CCR.
- (9) State Fire Marshal Regulations, Public Safety, Title 19, CCR.
- (10) Partial List of Applicable National Fire Protection Association (NFPA) Standards:
 - (a) NFPA 13 - Automatic Sprinkler System.
 - (b) NFPA 14 - Standpipes Systems.
 - (c) NFPA 17A - Wet Chemical System
 - (d) NFPA 24 - Private Fire Mains.
 - (e) (California Amended) NFPA 72 - National Fire Alarm Codes.
 - (f) NFPA 253 - Critical Radiant Flux of Floor Covering System.
 - (g) NFPA 2001 - Clean Agent Fire Extinguishing Systems.
- (11) California Division of the State Architect interpretation of Regulations ("DSA IR"), including, without limitation:
 - (a) DSA IR A-6 — Construction Change Document Submittal and Approval Processes.
 - (b) DSA IR A-7 — Project Inspector Certification and Approval.
 - (c) DSA IR A-8 — Project Inspector and Assistant Inspector Duties and Performance.
 - (d) DSA IR A-12 — Assistant Inspector Approval.
- (12) DSA Procedures ("DSA PR")
 - (a) DSA PR 13-01 – Construction Oversight Process
- (13) DSA PR 13-02 – Project Certification Process

B. This Project shall be governed by applicable regulations, including, without limitation, the State of California's Administrative Regulations for the Division of the State Architect-Structural Safety (DSA/SS), Chapter 4, Part 1, Title 24, CCR, and the most current version on the date the bids are opened and as it pertains to school construction including, without limitation:

- (1) Test and testing laboratory per Section 4-335. District shall pay for the testing laboratory.
- (2) Special inspections per Section 4-333(c).
- (3) Deferred Approvals per section 4-317(g).
- (4) Verified reports per Sections 4-336 & 4-343(c).
- (5) Duties of the Architect & Engineers shall be per Section 4-333(a) and 4-341.
- (6) Duties of the Contractor shall be per Section 4-343.
- (7) Duties of Project Inspector shall be per Section 4-334.
- (8) Addenda and Construction Change Documents per Section 4-338.

Contractor shall keep and make available all applicable parts of the most current version of Title 24 referred to in the plans and specifications at the Site during construction.

C. Items of deferred approval shall be clearly marked on the first sheet of the Architect's and/or Engineer's approved Drawings. All items later submitted for approval shall be per Title 24 requirements to the DSA.

- (1) Contractor shall submit the following to Architect for review and endorsement:
 - (a) Product information on proposed material/system supplier.
 - (b) Drawings, specifications, and calculations prepared, signed, and stamped by an architect or engineer licensed in the State of California for that portion of the Work.
 - (c) All other requirements as may be required by DSA.
- (2) Cost of preparing and submitting documentation per DSA Deferred Approval requirements including required modifications to Drawings and Specifications, whether or not indicated in the Contract Documents, shall be borne by Contractor.
- (3) Contractor shall not begin fabrication and installation of deferred approval items without first obtaining DSA approval of Drawings and Specifications.
- (4) Schedule of Work Subject to DSA Deferred Approval: Window wall systems exceeding 10 feet in span.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF DOCUMENT

ABBREVIATIONS AND ACRONYMS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions including without limitation, Definitions;
- B. Special Conditions.

1.02 DOCUMENT INCLUDES:

- A. Abbreviations used throughout the Contract Documents.
- B. Reference to a technical society, organization, or body is by abbreviation, as follows:

1.	AA	Aluminum Association
2.	AASHTO	American Association of State Highway and Transportation Officials
3.	ABPA	Acoustical and Board Products Association
4.	ACI	American Concrete Institute
5.	AGA	American Gas Association
6.	AGC	Associated General Contractors
7.	AHC	Architectural Hardware Consultant
8.	AHRI	Air Conditioning, Heating, Refrigeration Institute
9.	AI	Asphalt Institute
10.	AIA	American Institute of Architects
11.	AISC	American Institute of Steel Construction
12.	AISI	American Iron and Steel Institute
13.	AMCA	Air Movement and Control Association
14.	ANSI	American National Standards Institute
15.	APA	APA – The Engineered Wood Association
16.	ASCE	American Society of Civil Engineers
17.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
18.	ASSE	American Society of Civil Engineers
19.	ASME	American Society of Mechanical Engineers
20.	ASTM	American Society of Testing and Materials International
21.	AWPA	American Wood Protection Association
22.	AWPI	American Wood Preservers Institute
23.	AWS	American Welding Society
24.	AWSC	American Welding Society Code
25.	AWI	Architectural Woodwork Institute
26.	AWWA	American Water Works Association

27.	BIA	The Brick Industry Association
28.	CCR	California Code of Regulations
29.	CLFMI	Chain Link Fence Manufacturers Institute
30.	CRA	California Redwood Association
31.	CRSI	Concrete Reinforcing Steel Institute
32.	CS	Commercial Standards
33.	CSI	Construction Specifications Institute
34.	CTI	Cooling Technology Institute
35.	FGIA	Fenestration and Glazing Industry Alliance
36.	FGMA	Flat Glass Manufacturers' Association
37.	FIA	Factory Insurance Association
38.	FM	Factory Mutual Global
39.	FS/FED SPEC	Federal Specification
40.	FTI	Facing Title Institute
41.	GA	Gypsum Association
42.	IAPMO	International Association of Plumbing and Mechanical Officials
43.	ICC	International Code Council
44.	IEEE	Institute of Electrical and Electronics Engineers
45.	IES	Illuminating Engineering Society
46.	MCAC	Mason Contractors Association of California
47.	MIMA	Mineral Wool Insulation Manufacturers Association
48.	MLMA	Metal Lath Manufacturers Association
49.	MS/MIL SPEC	Military Specifications
50.	NAAMM	National Association of Architectural Metal Manufacturers
51.	NBHA	National Builders Hardware Association
52.	NCMA	National Concrete Masonry Association
53.	NCSEA	National Council of Structural Engineers Associations
54.	NEC	National Electrical Code
55.	NEMA	National Electrical Manufacturers Association
56.	NIST	National Institute of Standards and Technology
57.	NSI	Natural Stone Institute
58.	NTMA	National Terrazzo and Mosaic Association, Inc.
59.	ORS	Office of Regulatory Services (California)
60.	OSHA	Occupational Safety and Health Act
61.	PCI	Precast/Prestressed Concrete Institute
62.	PCA	Portland Cement Association
63.	PCA	Painting Contractors Association
64.	PDI	Plumbing Drainage Institute
65.	PEI	Porcelain Enamel Institute, Inc.
66.	PG&E	Pacific Gas & Electric Company
67.	PS	Product Standards
68.	SDI	Steel Door Institute; Steel Deck Institute
69.	SJI	Steel Joist Institute
70.	SPC	Society for Protective Coatings
71.	TCNA	Tile Council of North America, Inc.
72.	TPI	Truss Plate Institute

73.	UBC	Uniform Building Code
74.	UL	Underwriters Laboratories Code
75.	UMC	Uniform Mechanical Code
76.	USDA	United States Department of Agriculture
77.	VI	Vermiculite Institute
78.	WCLIB	West Coast Lumber Inspection Bureau
79.	WDMA	Window and Door Manufacturers Association
80.	WEUSER	Western Electric Utilities Service Engineering Requirements
81.	WIC	Woodwork Institute of California

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DEFINITIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions including without limitation, Definitions;
- B. Special Conditions.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by association, trade, or Federal Standards, Contractor shall comply with requirements of the standard, except when more rigid requirements are specified in the Contract Documents, or are required by applicable codes.
- B. Contractor shall conform to current reference standard publication date in effect on the date of bid opening.
- C. Contractor shall obtain copies of standards unless specifically required not to by the Contract Documents.
- D. Contractor shall maintain a copy of all standards at jobsite during submittals, planning, and progress of the specific Work, until final completion, unless specifically required not to by the Contract Documents.
- E. Should specified reference standards conflict with Contract Documents, Contractor shall request clarification from the District and./or the Architect before proceeding.
- F. The contractual relationship of the parties to the Contract shall not be altered from the contractual relationship as indicated in the Contract Documents by mention or inference otherwise in any referenced document.
- G. Governing Codes shall be as shown in the Contract Documents including, without limitation, the Specifications.

END OF DOCUMENT

REFERENCES**PART 1 - GENERAL****1.01 1.01 SCHEDULE OF REFERENCES:**

The following information is intended only for the general assistance of the Contractor, and the District does not represent that all of the information is current. It is the Contractor's responsibility to verify the correct information for each of the entities listed.

AA	Aluminum Association 1525 Wilson Blvd., Suite 600 Arlington, VA 22209 www.aluminum.org	703/358-2960
AABC	Associated Air Balance Council 1518 K Street, NW, Suite 503 Washington, DC 20005 www.aabchq.com	202/737-0202
AASHTO	American Association of State Highway and Transportation Officials 555 12th St. NW - Suite 1000 Washington, DC 20004 www.transportation.org	202/624-5800
AATCC	American Association of Textile Chemists and Colorists P.O. Box 12215 One Davis Drive Research Triangle Park, NC 27709 2215 www.aatcc.org	919/549-8141
ACA	American Coatings Association 901 New York Ave., NW, Suite 300 West Washington, DC 20001 www.paint.org	202/462-6272
ACI	American Concrete Institute 38800 Country Club Dr. Farmington Hills, MI 48331-3439 www.aci-int.org	248/848-3700
ACPA	American Concrete Pipe Association 8445 Freeport Parkway, Suite 350 Irving, TX 75063-2595 www.concrete-pipe.org	972/506-7216

ADC	Air Duct Council 1901 N. Roselle Road, Suite 800 Schaumburg, IL 60195 www.flexibleduct.org	847/706-6750
AF&PA	American Forest and Paper Association 1111 Nineteenth Street, NW, Suite 800 Washington, DC 20036 www.afandpa.org	202/463-2700
AGA	American Gas Association 400 North Capitol Street, NW Washington, DC 20001 www.aga.org	202/824-7000
AGC	Associate General Contractors of America 2300 Wilson Blvd., Suite 400 Arlington, VA 22201 www.agc.org	703/548-3118
AHA	American Hardboard Association 1210 West Northwest Highway Palatine, IL 60067 http://domensino.com/AHA/default.htm	847/934-8800
AI	Asphalt Institute 2696 Research Park Drive Lexington, KY 40511-8480 www.asphaltinstitute.org	859/288-4960
AIA	The American Institute of Architects 1735 New York Ave., NW Washington, DC 20006-5292 www.aia.org	202/626-7300
AISC	American Institute of Steel Construction One East Wacker Drive Suite 700 Chicago, IL 60601-1802 www.aisc.org	312/670-2400
AISI	American Iron and Steel Institute 25 Massachusetts Ave., NW, Suite 800 Washington, DC 20001 www.steel.org	202/452-7100
AITC	American Institute of Timber Construction 7012 S. Revere Parkway Suite 140 Centennial, CO 80112 https://www.plib.org/aitc/	303/792-9559

ALI	Associated Laboratories, Inc. P.O. Box 152837 Dallas, TX 75315 www.assoc-labs.com	214/565-0593
ALSC	American Lumber Standards Committee, Inc. P.O. Box 210 Germantown, MD 20875 www.alsc.org	301/972-1700
AMCA	Air Movement and Control Association International, Inc. 30 W. University Drive Arlington Heights, IL 60004 www.amca.org	847/394-0150
AMPP (formerly SSPC)	Association for Materials Protection and Performance (merger of Society for Protective Coatings and National Association of Corrosion Engineers International) (formerly Steel Structures Painting Council) 800 Trumbull Drive Pittsburgh, PA 15205 www.sspc.org	412/281-2331 877/281-7772
ANLA	AmericanHort (merger of American Nursery & Landscape Association and OFA – The Association of Horticultural Professionals) 2130 Stella Court Columbus, OH 43215 www.americanhort.org	614/487-1117
ANSI	American National Standards Institute 1899 L Street, NW, 11th Floor Washington, DC 20036 www.ansi.org	202/293-8020
APA	APA-The Engineered Wood Association 7011 S. 19th Street Tacoma, WA 98466-5333 www.apawood.org	253/565-6600

APA	Architectural Precast Association 325 John Knox Rd, Suite L-103 Tallahassee, FL 32303 www.archprecast.org	850/205-5637
APCIA	American Property Casualty Insurance Association (merger of American Insurance Association (formerly the National Board of Fire Underwriters) with the Property Casualty Insurers Association of America) 555 12th St, NW, Suite 550 Washington DC 20004 www.apci.org	202/828-7100
AHRI	Air Conditioning and Refrigeration Institute 4100 N. Fairfax Drive, Suite 200 Arlington, VA 22203 www.lightindustries.com/ARI	703/524-8800
ARMA	Asphalt Roofing Manufacturers Association 2331 Rock Spring Road Forest Hill, MD 21050 www.asphaltroofing.org	443/640-1075
ASA	The Acoustical Society of America ASA Office Manager Suite 1NO1 2 Huntington Quadrangle Melville, NY 11747-4502 http://asa.aip.org	516/576-2360
ASCE	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191 www.asce.org	800/548-2723 703/295-6300
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers 1791 Tullie Circle, NE Atlanta, GA 30329-2305 www.ashrae.org	800/527-4723 404/636-8400
ASLA	American Society of Landscape Architects 636 Eye Street, NW Washington, DC 20001-3736 www.asla.org	202/898-2444
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016-5990 www.asme.org	800/434-2763

ASPE	American Society of Plumbing Engineers 2980 S River Rd. Des Plaines, IL 60018 http://aspe.org	847/296-0002
ASQ	American Society for Quality P.O. Box 3005 Milwaukee, WI 53201-3005 or 600 North Plankinton Avenue Milwaukee, WI 53203 http://asq.org	800/248-1946 414/272-8575
ASSE	American Society of Sanitary Engineering 901 Canterbury, Suite A Westlake, Ohio 44145 www.asse-plumbing.org	440/835-3040
ASTM	ASTM International 100 Barr Harbor Drive PO Box C700 West Conshohocken, PA, 19428-2959 www.astm.org	610/832-9500
AWCI	Association of the Wall and Ceiling Industry 513 West Broad Street, Suite 210 Falls Church, VA 22046 www.awci.org	703/538-1600
AWPA	American Wood Protection Association (formerly American Wood Preservers Institute) P.O. Box 361784 Birmingham, AL 35236-1784 www.awpa.com	205/733-4077
AWPI	American Wood Preservers Institute 2750 Prosperity Ave. Suite 550 Fairfax, VA 22031-4312 www.arcat.com	800/356-AWPI 703/204-0500
AWS	American Welding Society 8669 NW 36 Street, Suite 130 Miami, FL 33166 www.aws.org	800/443-9353 305/443-9353
AWI	Architectural Woodwork Institute 46179 Westlake Drive, Suite 120 Potomac Falls, VA 20165-5874 www.awinet.org	571/323-3636

AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235 www.awwa.org	800/926-7337 303/794-7711
BHMA	Builders Hardware Manufacturers Association 355 Lexington Avenue, 15th Floor New York, NY 10017 www.buildershardware.com	212/297-2122
BIA	The Brick Industry Association 1850 Centennial Park Drive, Suite 301 Reston, VA 20191 www.gobrick.com	703/620-0010
CGA	Compressed Gas Association 14501 George Carter Way, Suite 103 Chantilly VA 20151-2923 www.cganet.com	703/788-2700
CISCA	Ceilings & Interior Systems Construction Association 1010 Jorie Blvd, Suite 30 Oak Brook, IL 60523 www.cisca.org	630/584-1919
CISPI	Cast Iron Soil Pipe Institute 1064 Delaware Avenue SE Atlanta, GA 30316 www.cispi.org	404/622-0073
CLFMI	Chain Link Fence Manufacturers Institute 10015 Old Columbia Road, Suite B-215 Columbia, MD 21046 www.associationsites.com/main-pub.cfm?usr=clfma	410/290-6267
CPA	Composite Panel Association 19465 Deerfield Avenue, Suite 306 Leesburg, VA 20176 www.compositepanel.org	703/724-1128
CPSC	Consumer Product Safety Commission 4330 East-West Highway Bethesda, MD 20814 www.cpsc.gov	301/504-7923 800/638-2772
CRA	California Redwood Association 405 Enfrente Drive, Suite 200 Novato, CA 94949 www.calredwood.org	415/382-0662

CRI	Carpet and Rug Institute 100 S. Hamilton Street Dalton, GA 30722-2048 www.carpet-rug.org	706/278-3176
CRSI	Concrete Reinforcing Steel Institute 933 N. Plum Grove Road Schaumburg, IL 60173 4758 www.crsi.org	847/517-1200
CSI	The Construction Specifications Institute 123 North Pitt St, Suite 450 Alexandria, VA 22314 www.csinet.org	800/689-2900
CTIOA	Ceramic Tile Institute of America 12061 Jefferson Blvd. Culver City, CA 90230-6219 www.ctioa.org	310/574-7800
DHI	Door and Hardware Institute (formerly National Builders Hardware Association) 14150 Newbrook Dr. Chantilly, VA 20151 www.dhi.org	703/222-2010
DIPRA	Ductile Iron Pipe Research Association 2000 2nd Avenue, South Suite 429 Birmingham, AL 35233 www.dipra.org	205/402-8700
DOC	U.S. Department of Commerce 1401 Constitution Ave., NW Washington, DC 20230 www.commerce.gov	202/482-2000
DOT	U.S. Department of Transportation 1200 New Jersey Avenue, SE Washington, DC 20590 www.dot.gov	855/368-4200
EJMA	Expansion Joint Manufacturers Association, Inc. 25 North Broadway Tarrytown, NY 10591 www.ejma.org	914/332-0040

EPA	Environmental Protection Agency Ariel Rios Building 1200 Pennsylvania Avenue, N.W. Washington, DC 20460 www.epa.gov	202/272-0167
FCICA	Floor Covering Installation Contractors Association 7439 Millwood Drive West Bloomfield, MI 48322 www.fcica.com	248/661-5015 877/TO-FCICA
FGIA	Fenestration and Glazing Industry Alliance 1900 E Golf Rd, Suite 1250 Schaumburg, IL 60173 https://fgiaonline.org/	847/303-5664
FM Global	Factory Mutual Insurance Company Amy Daley Global Practice Leader – Education, Public Entities, Health Care FM Global 270 Central Avenue Johnston, RI 02919-4949 www.fmglobal.com	401/275-3000 401/275-3029
FS	General Services Administration (GSA) Index of Federal Specifications, Standards and Commercial Item Descriptions 470 East L'Enfant Plaza, SW, Suite 8100 Washington, DC 20407 www.gsa.gov	202/619-8925
GA	The Gypsum Association 6525 Belcrest Road, Suite 480 Hyattsville, MD 20782 www.gypsum.org	301/277-8686
HMA	Hardwood Manufacturers Association One Williamsburg Place, Suite 108 Warrendale, PA 15086 http://hmamembers.org	412/244-0440

IAPMO	International Association of Plumbing and Mechanical Officials (formerly the Western Plumbing Officials Association) 4755 E. Philadelphia St. Ontario, CA 91761 www.iapmo.org	909/472-4100
ICC	International Code Council 500 New Jersey Avenue, NW, 6th Floor Washington, DC 20001 www.iccsafe.org	888/422-7233
IEEE	Institute of Electrical and Electronics Engineers 3 Park Avenue, 17th Floor New York, NY 10016-5997 www.ieee.org	212/419-7900
IES	Illuminating Engineering Society 120 Wall Street, Floor 17 New York, NY 10005-4001 www.ies.org	212/248-5000
ITRK	Intertek Testing Services 3933 US Route 11 Cortland, NY 13045 www.intertek.com	607/753-6711
MCAA	Mechanical Contractors Association of America 1385 Piccard Drive Rockville, MD 20850 www.mcaa.org	301/869-5800
MIA	Marble Institute of America 28901 Clemens Rd, Ste 100 Cleveland, OH 44145 www.marble-institute.com	440/250-9222
MMPA (formerly WMMPA)	Moulding & Millwork Producers Association (formerly Wood Moulding & Millwork Producers Association) 507 First Street Woodland, CA 95695 www.wmmpa.com	530/661-9591 800/550-7889

MSS	Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc. 127 Park Street, NE Vienna, VA 22180-4602 http://mss-hq.org	703/281-6613
NAAMM	National Association of Architectural Metal Manufacturers 800 Roosevelt Rd. Bldg. C, Suite 312 Glen Ellyn, IL 60137 www.naamm.org	630/942-6591
NAIMA	North American Insulation Manufacturers Association P.O. Box 1906 Alexandria, VA 22313 https://insulationinstitute.org/	703/684-0084
NALP	National Association of Landscape Professionals (formerly Professional Landcare Network) 12500 Fair Lakes Circle, Suite 200 Fairfax, VA 22033 https://www.landscapeprofessionals.org/	703/736-9666
NAPA	National Asphalt Pavement Association 6406 Ivy Lane, Suite 350 Greenbelt, MD 20770-1441 www.asphaltpavement.org	888/468-6499 301/731-4748
NCSPA	National Corrugated Steel Pipe Association 14070 Proton Road, Suite 100 Dallas, TX 75244 www.ncspa.org	972/850-1907
NCMA	National Concrete Masonry Association 13750 Sunrise Valley Drive Herndon, VA 20171-4662 www.ncma.org	703/713-1900
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 www.nebb.org	301/977-3698
NECA	National Electrical Contractors Association 3 Bethesda Metro Center, Suite 1100 Bethesda, MD 20814 www.necanet.org	301/657-3110
NEMA	National Electrical Manufacturers Association 1300 North 17th Street N, Suite 900 Rosslyn, VA 22209 www.nema.org	703/841-3200

NEII	National Elevator Industry, Inc. 1677 County Route 64 P.O. Box 838 Salem, New York 12865-0838 www.neii.org	518/854-3100
NFPA	National Fire Protection Association 1 Batterymarch Park Quincy, MA USA 02169-7471 www.nfpa.org	800/344-3555 855/274-8525
NGA (formerly GANNA)	National Glass Association (merged with Glass Association of North America) 1945 Old Gallows Road Suite 750 Vienna, VA 22182 www.glass.org	866/342-5642 Ext 127
NHLA	National Hardwood Lumber Association PO Box 34518 Memphis, TN 38184 www.nhla.com	901/377-1818
NIA	National Insulation Association 12100 Sunset Hills Road, Suite 330 Reston, VA 20190 www.insulation.org	703/464-6422
NRCA	National Roofing Contractors Association 10255 W. Higgins Road, Suite 600 Rosemont, IL 60018-5607 www.nrca.net	847/299-9070
NSF	NSF International P.O. Box 130140 789 N. Dixboro Road Ann Arbor, MI 48113-0140, USA www.nsf.org	800/673-6275 734/769-8010
NTMA	National Terrazzo and Mosaic Association 209 N. Crockett Street, Suite 2 PO Box 2605 Fredericksburg, TX 78624 www.ntma.com	800/323-9736
OSHA	Occupational Safety and Health Act U.S. Department of Labor Occupational Safety & Health Administration 200 Constitution Ave., NW Washington, DC 20210 www.osha.gov	800/321-OSHA (6742)

PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077 or 500 New Jersey Ave., N.W. 7 th Floor Washington, D.C. 20001 www.cement.org	847/966-6200 202/408-9494
PCA	Painting Contractors Association (formerly Painting and Decorating Contractors of America) 2316 Millpark Drive Maryland Heights, MO 63043 https://www.pcapainted.org/	800/322-7322
PCI	Precast/Prestressed Concrete Institute 200 W. Adams St. #2100 Chicago, IL 60606 www.pci.org	312/786-0300
PDCA	Painting and Decorating Contractors of America 2316 Millpark Drive, Ste 220 Maryland Heights, MO 63043 www.pdca.com	800/332-PDCA (7322) 314/514-7322
PDI	Plumbing & Drainage Institute 800 Turnpike Street, Suite 300 North Andover, MA 01845 http://pdionline.org	978/557-0720 800/589-8956
PEI	Porcelain Enamel Institute, Inc. P.O. Box 920220 Norcross, GA 30010 www.porcelainenamel.com	770/676-9366
PG&E	Pacific Gas & Electric Company P.O. Box 997300 Sacramento, CA 95899-7300 www.pge.com	800/743-5000
PLIB	Pacific Lumber Inspection Bureau (formerly West Coast Lumber Inspection Bureau) 1010 South 336th Street, Suite 210 Federal Way, WA 98003-7394 https://www.plib.org/	253/835-3344
RFCI	Resilient Floor Covering Institute 115 Broad Street, Suite 201 La Grange GA 30240 www.rfci.com	706/882-3833

SDI	Steel Deck Institute P.O. Box 25 Fox River Grove, IL 60021 www.sdi.org	847/458-4647
SDI	Steel Door Institute 30200 Detroit Road Westlake, OH 44145 www.steeldoor.org	440/899-0010
SJI	Steel Joist Institute 234 W. Cheves Street Florence, SC 29501 http://steeljoist.org	843/407-4091
SMA	Stucco Manufacturers Association 500 East Yale Loop Irvine, CA 92614 www.stuccomfgassoc.com	949/387-7611
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 4201 Lafayette Center Drive Chantilly, VA 20151-1219 www.smacna.org	703/803-2980
SPI	SPI: The Plastics Industry Trade Association, Inc. 1425 K St. NW, Suite 500 Washington, DC 20005 www.plasticsindustry.org	202/974-5200
TCA	The Tile Council of North America 100 Clemson Research Blvd. Anderson, SC 29625 www.tcnatile.com	864/646-8453
TPI	Truss Plate Institute 2670 Crain Highway, Suite 203 Waldorf, MD 20601 www.tpinst.org	240/587-5582
TPI	Turfgrass Producers International 444 E. Roosevelt Road #346 Lombard, IL 60148 www.turfgrassod.org	800/405-8873 847/649-5555
TCIA	Tree Care Industry Association (formerly the National Arborist Association) 136 Harvey Road, Suite 101 Londonderry, NH 03053 www.tcia.org	800/733-2622

TVI	The Vermiculite Institute c/o The Schundler Company 150 Whitman Avenue Edison, NJ. 08817 www.vermiculiteinstitute.org	732/287-2244
UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, IL 60062-2096 www.ul.com	847/272-8800 877/854-3577
UNI	Uni-Bell PVC Pipe Association 2711 LBJ Freeway, Suite 1000 Dallas, TX 75234 www.uni-bell.org	972/243-3902
USDA	U.S. Department of Agriculture 1400 Independence Ave., S.W. Washington, DC 20250 www.usda.gov	202/720-2791
WA	Wallcoverings Association 401 North Michigan Avenue Suite 2200 Chicago, IL 60611 www.wallcoverings.org	312/321-5166

WCLIB	West Coast Lumber Inspection Bureau P.O. Box 23145 Portland, OR 97281 or 6980 S.W. Varns Tigard, OR 97223 www.wclib.org	503/639-0651
WCMA	Window Covering Manufacturers Association 355 Lexington Avenue 15th Floor New York, NY 10017 www.wcmanet.org	212/297-2122
WDMA	Window & Door Manufacturers Association 2001 K Street NW, 3rd Floor North Washington, D.C. 20006 www.wdma.com	202/367-1157
WCMA	Window Covering Manufacturers Association 355 Lexington Avenue 15th Floor New York, New York 10017 www.wcmanet.org	212/297-2122
WDMA	Window & Door Manufacturers Association 401 N. Michigan Avenue, Suite 2200 Chicago, IL 60611 or 2025 M Street, NW, Ste. 800 Washington, D.C. 20036-3309 www.wdma.com	312/321-6802 202/367-1157
WI	Woodwork Institute P.O. Box 980247 West Sacramento, CA 95798 www.wicnet.org	916/372-9943
WRI	Wire Reinforcement Institute 942 Main Street, Suite 300 Hartford, CT 06103 www.wirereinforcementinstitute.org	860/240-9545
WWCA	Western Wall & Ceiling Contractors Association 1910 N. Lime St. Orange, CA 92865 www.wwca.org	714/221-5520
WWPA	Western Wood Products Association (formerly Redwood Inspection Service) 1500 SW First Ave., Suite 870 Portland, OR 97201 www.wwpa.org	503/224-3930

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

SECTION 014339

COMPOSITE MOCK-UP REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. First in-place composite mock-up requirements.

1.3 RELATED SECTIONS

- A. Division 02 through 14 Sections for specific mock-up requirements.

1.4 ASSEMBLIES

- A. Extent: Refer to drawing for extent of Composite Mock-up. Contractor shall construct mockup to incorporate required conditions, including inside and outside corners, cladding and waterproofing transitions, deflection joints, fixed and operable window heads, sills, and jambs; vertical and horizontal projecting mullions; vertical and horizontal structural-sealant-glazed mullions; to represent exterior finish and waterproofing assemblies as indicated on architectural drawings for actual building, for review and approval by Architect and for water infiltration testing to be contracted separately by Owner. Contractor shall prepare mockup drawings submittal for review and approval by Architect prior to constructing mockup and after receiving approval of submittals for all products and materials to be represented in the mockup. Contractor shall coordinate with Owner's testing agency and make corrections/modifications necessary to limit water infiltration per criteria indicated in Specifications.

1.5 TESTING AGENCY

- A. General: Owner will engage a qualified independent inspecting agency to perform inspections.

1.6 GENERAL REQUIREMENTS

- A. The purpose of the composite mock-up is to allow the Architect to review the quality of assembled Work through both visual quality and physical quality through testing. Approved mock-ups shall be the standard by which remaining work will be evaluated by the Architect.
- B. Before building the composite mock-up, provide submittals to Architect for each material or product that is part of the mock-up and provide mockup drawings for review by Architect and waterproofing consultant prior to constructing mockup.

- C. Use products, materials, fabrication methods and construction methods identical to those required in the Work. Use same workers for the composite mock-up who will construct the actual work. Notify Architect that mock-up is available for review. Do not commence remaining work that is represented by mock-up until Architect has approved the composite mock-up in full.

- D. Testing: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
 - 1. Structural-Sealant Compatibility and Adhesion: Structural sealant shall be tested according to recommendations in ASTM C 1401.
 - a. Destructive Test Method A, "Hand Pull Tab (Destructive)," in ASTM C 1401, Appendix X2, shall be used.
 - 1) A minimum of two areas shall be tested.
 - 2) Repair installation areas damaged by testing.
 - 2. Structural-Sealant Glazing Inspection: After installation of aluminum-framed systems is complete, structural-sealant glazing shall be inspected and evaluated according to recommendations in ASTM C 1401.
 - 3. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. (0.03 L/s per sq. m), of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
 - 4. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform static-air-pressure difference not less than 4.18 lbf/sq. ft., and shall not evidence water penetration.
 - 5. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

- E. Correct work installed within the mock-up which is not acceptable to the Architect at no additional cost to the Owner. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

- F. Correct subsequent installations elsewhere in the facility, which are not in accordance with the approved mock-up at no additional cost to the Owner.

- G. The Architect's approval of the mock-up will not relieve the Contractor of the responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has specifically informed the Architect in writing of such deviation at the time of the review and the Architect has given written approval of the specific deviation.

- H. Prepare test and inspection reports.

- I. The approved mock-up shall not be incorporated as part of the Work.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

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SECTION 014505

QUALITY ASSURANCE: STRUCTURAL TESTING AND INSPECTION

PART 1 GENERAL

1.1 GENERAL

- A. Quality assurance is testing and inspection to assist the Owner in evaluating the Contractor's performance and quality control in the fabrication shop and field. It is not a substitute for the testing and inspection which is required as part of the Contractor's quality control program.
- B. Cost: Except as specifically noted otherwise, the testing agency for quality assurance shall be engaged and paid by the Owner.
 - 1. The Owner has negotiated inspection services based upon the assumption that all fabrication work shall be performed at one single fabrication shop. Costs associated with work being performed in additional shops will require reimbursement to the Owner.
- C. Definitions:
 - 1. See Sections 033000 and 051200.
 - 2. The term "Testing Agency" in this Specification section is defined as an independent testing and inspection service engaged by the Owner for quality assurance testing and inspection of structural construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
 - 3. The term "Geotechnical Engineer" in this Specification section is defined as an independent geotechnical engineering service engaged by the Owner for quality assurance testing and inspection of the actual soil conditions to verify compliance with the geotechnical conditions, recommendations and design values described in the Project Geotechnical Report and used as the basis of design for the most current Contract Documents.

1.2 SCOPE

- A. Testing Agency shall provide qualified personnel at the site to test and inspect materials installed by and work performed by the Contractor, for the following structural items as indicated in Part 3 of this Specification section:
 - 1. Section 031000 Concrete Formwork
 - 2. Section 032000 Concrete Reinforcement and Embedded Assemblies
 - 3. Section 033000 Cast-In-Place Concrete
 - 4. Section 051200 Structural Steel
 - 5. Section 051210 Structural Steel Additional Seismic Requirements
 - 6. Section 053000 Steel Deck
 - 7. Section 316100 Footings

1.3 TESTING AGENCY QUALIFICATIONS

- A. A Testing Agency shall be an independent agency with the experience and capability to conduct testing, inspection and sampling as indicated in accordance with ASTM E 329.
- B. Testing Agency shall be an agency approved by the local building official to perform Special Inspections and other related services as outlined in the governing project Building Code.
- C. Testing, inspection, and sampling shall be done in accordance with the applicable ASTM standards.
- D. Personnel performing visual inspection and non-destructive testing of welds shall meet the requirements of AWS D1.1 for weld inspectors and shall have current certification as an AWS Certified Welding Inspector.

1.4 TESTING AGENCY RESPONSIBILITIES

- A. Provide qualified personnel at the site to test and inspect structural construction as the work progresses using the most current Contract Documents and approved shop drawings.
- B. Provide additional testing and inspection as needed due to the following:
 - 1. Work performed contrary to Drawings and Specifications
 - 2. Work performed with improper supervision
 - 3. Work performed without prior notice
- C. Report deficiencies to Contractor, Owner, Design Professionals and Division of the State Architect (DSA) within 24 hours.
- D. Rejection: The Testing Agency has the right to reject any material at any time, when it is determined that the material or workmanship does not conform to the Contract Documents and shall immediately notify the Owner, Design Professionals, DSA and Contractor of deficiencies. Failure to detect any defective work or material shall not prevent later rejection when such a defect is discovered nor shall it obligate Design Professionals for final acceptance.
- E. Noncompliance Log: Indicate to the Contractor where remedial work must be performed and maintain a current log of work not in compliance with the Contract Documents. This noncompliance log shall be submitted to the Design Professionals and Owner on a weekly basis.
- F. Reports: Prepare daily inspection, observation, and/or test reports as required herein and provide an evaluation statement in each report stating whether or not the work conforms to requirements of Specifications and Drawings and shall specifically note deviations from them. The daily reports shall be collected and submitted for record to the Design Professionals, DSA and Owner weekly.

- G. Certification: Upon completion of work and resolution of remedial items, certify in a letter to the Design Professionals and Owner that the installation is in accordance with the requirements of the Drawings and Specifications.

1.5 CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall have sole responsibility for coordinating their work with the Testing Agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The Contractor shall cooperate fully with the Testing Agency in the performance of their work and shall provide the following:
 - 1. Information as to time and place of starting shop fabrication and field construction/erection, at least one week prior to the beginning of the work.
 - 2. The most up to date construction schedule.
 - 3. At least 24 hours advance notice of work requiring testing and inspection.
 - 4. Access to areas as required for testing and inspection.
 - 5. Site File: At least one copy of the most current Contract Documents and approved shop drawings shall be kept available in the contractor's field office. Drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job. Provide drawings for the work to be performed in the shop or field one week prior to the start of work.
 - 6. Representative material samples requested by the Testing Agency for testing, if necessary.
 - 7. Full and ample means of assistance for testing and inspection of material.
 - 8. Facilities for proper storage of material samples as required.
 - 9. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field.
- B. Immediately notify the Owner's Testing Agency and Design Professionals in writing of conditions that will adversely affect the work.
- C. Materials and installed work may require testing and retesting at any time during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

PART 2 PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL

- A. Testing Agency shall provide qualified personnel at site to test and inspect structural construction using the latest Contract Documents and approved submittals as indicated in the following sections.

3.2 CONCRETE FORMWORK

A. Quality Assurance:

1. Prior to placement, inspect reinforcement and embeds for grade, quality of material, absence of foreign matter, and for suitable storage.
2. Provide continuous inspection of reinforcement and embedded assemblies during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, mechanical splices, clearances, compliance with specified tolerances, security of supports and ties, concrete cover, and absence of foreign matter.
3. Inspect epoxy-coated reinforcement for coating damage and required applied coatings.
4. Provide continuous inspection of adhesive anchors installed in horizontal or upwardly inclined orientations and those marked (CERT) on the latest Drawings.

3.3 CONCRETE REINFORCEMENT AND EMBEDDED ITEMS

A. Quality Assurance:

1. Prior to placement, inspect reinforcement and embeds for grade, quality of material, absence of foreign matter, and for suitable storage.
2. Provide continuous inspection of reinforcement and embedded assemblies during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, mechanical splices, clearances, compliance with specified tolerances, security of supports and ties, concrete cover, and absence of foreign matter.
3. Inspect epoxy-coated reinforcement for coating damage and required applied coatings.
4. Provide continuous inspection of adhesive anchors installed in horizontal or upwardly inclined orientations and those marked (CERT) on the latest Drawings.

3.4 CAST-IN-PLACE CONCRETE

A. All testing shall be in accordance with California Building Code Section 1903A, 1910A, and 17A

B. Source Quality Assurance: The Owner's Testing Agency shall conduct concrete quality evaluations for compliance with Specifications as follows:

- a) Review and test Contractor's proposed materials.
- b) Review and test Contractor's proposed concrete mix designs.
- c) Confirm production samples at plants or stockpiles are consistent with approved mix designs. Additionally confirm the following:
 - i. Test for free water in aggregate
 - ii. Confirm supplier's documentation of compliance with ASTM standards for mix components
 - iii. Aggregates are from a single source throughout the project for exposed concrete
 - iv. The same brand of Portland Cement is from a single source
- d) Check batching and mixing operations to extent deemed necessary to assure compliance with ASTM C94

- e) Continuously inspect quality and quantity of materials used in transit mixed concrete, in batched aggregates and ready-mixed concrete at mixing plant or other location per California Building Code Section 1910A and 17A where other materials are measured.

C. Waiver of Batch Plant Inspection

- 3. Continuous batch plant inspection may be waived in accordance with California Building Code Section 1705A.3.3 if the plant complies with ASTM C94 and has been certified by an agency acceptable to DSA to comply with the requirements of the National Ready Mix Concrete Association.
- 4. When batch plant inspection is waived, the following requirements shall apply:
 - a. Approved inspector of the Owner's Testing Agency shall check the first batching at the start of work and furnish mix proportions to the licensed weighmaster.
 - b. Licensed weighmaster to positively identify materials as to quantity and certify to each load by a ticket.
 - c. Tickets shall be transmitted to the inspector of record by a truck driver with load identified thereon. The inspector will not accept the load without a load ticket identifying each truck, its load and time of receipt and approximate location of deposit in the structure and will transmit a copy of the daily record to the enforcement agency.
 - d. At the end of the project, the weighmaster shall furnish an affidavit to the enforcement agency certifying that all concrete furnished conforms in every particular to proportions established by mix designs.

D. Quality Assurance:

- 3. Monitor concrete placement as follows:
 - a. Verify use of required design mix
 - b. Record location of point of concrete discharge of each batch truck tested, cross referenced to grid lines.
 - c. Record temperature of concrete at time of placement.
 - d. Record weather conditions at time of placement, including temperature, wind speed, relative humidity, and precipitation.
 - e. Record types and amounts of admixtures added to concrete at the project site.
 - f. Record amount of water added at the site and verify that total water content does not exceed amount specified in the mix design. Addition of water at the site is subject to prior approval by the Design Professional.
 - g. Monitor consistency and uniformity of concrete.
 - h. Monitor preparation for concreting operations, placement of concrete, and subsequent curing period for conformance with Specifications for following procedures:
 - i. Concrete curing.
 - ii. Hot weather concreting operations.

- iii. Cold weather concreting operations.
4. Conduct tests of concrete as follows and in accordance with ASTM C 1077:
- a. Testing frequency: Sample sets for all tests listed below of each concrete design mix placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. Additional tests shall be performed if deemed necessary by the Owner's Testing Agency and Design Professionals. In addition, sample each truckload used for columns, regardless of other frequencies listed above.
 - b. Obtain each test sample from different batches selected on a strictly random basis before commencement of concrete placement. Record location in structure of sampled concrete.
 - c. Determine air content of normal weight concrete in accordance with either ASTM C 231 or ASTM C 138. Determine air content of lightweight concrete in accordance with ASTM C 173. Conduct one test for air content for each strength test required or for every 50 cubic yards (40 cubic meters) of fly ash concrete placed, whichever is less.
 - d. Determine unit weight of lightweight concrete in accordance with ASTM C 567.
 - e. Test water content of freshly mixed concrete on a random basis, a minimum of once per 100 cubic yards (75 cubic meters) or every 5000 square feet (500 square meters) of concrete placement, during placement in accordance with AASHTO T 318 for the following concrete types:
 - i. Hard troweled slabs exposed to view
 - ii. Slab to receive a bonded finish floor material
 - iii. Slabs with specified concrete compressive strength exceeding 6000 psi (42MPa)
 - f. Conduct slump tests in accordance with ASTM C 143.
 - g. Slump indicated in mix designs shall be achieved at point of placement. Correlation between slump at point of initial discharge from truck and point of placement must be established to determine amount of slump loss which occurs between initial discharge and point of placement. Adjustment may be necessary to achieve slump indicated in mix designs at point of placement.
 - h. Conduct slump tests for Self Consolidating Concrete (SCC) as follows
 - i. In accordance with ACI 237, where SCC is used, perform slump flow and visual stability index tests in accordance with ASTM C1611 on the first batch of SCC, and then consecutive batches until two consecutively produced batches are within specification. SCC with a visual stability index value of 2 or 3 shall be stabilized, where possible, with a viscosity modifying admixture or rejected at the discretion of the Engineer and Ready Mix

Quality Control Representative. The Ready Mix Producer shall be responsible for adjusting the mix to provide desired flow and stability. After establishing the consistency of the SCC mix, testing shall continue in accordance with the requirements of the above paragraph.

- ii. In accordance with ACI 237, where SCC is used, perform slump flow tests in accordance with ASTM C1621 using a J-ring to determine the passing ability of the SCC mix around reinforcement. If the reinforcing bars retain the coarse aggregates inside the ring, the mixture has a high potential for blocking and should be re-proportioned at the direction of the Engineer and Ready Mix Quality Control Representative.

i. Conduct strength tests of concrete as follows:

- i. Secure sample sets in accordance with ASTM C 172.
- ii. Mold cylinders in accordance with ASTM C 31 and cure under standard moisture and temperature conditions in accordance with ASTM C 31, Section 7 (a). Quantity of cylinders listed below is based on a cylinder size of 4 inch (100mm) diameter x 8 inches (200mm) long. If 6 inch (150mm) diameter by 12 inch (300mm) long cylinders are used, the total quantity of cylinders may be reduced by one with two cylinders instead of three tested at the age designated for determination of f_c .
- iii. Test cylinders in accordance with ASTM C 39. For specified concrete strength of 10,000 psi (70MPa) and above, cylinders shall be ground and not capped.
- iv. For 28 day mixes mold six cylinders. Test two cylinders at seven days and three cylinders at 28 days. The 28 day strength shall be the average of the three 28 day cylinders. One cylinder shall be retained in reserve for later testing if required.
- v. For 56 day mixes mold seven cylinders. Test one cylinder at seven days, two cylinders at 28 days, and three cylinders at 56 days. The 56 day strength shall be the average of the three 56 day cylinders. One cylinder shall be retained in reserve for later testing if required.
- vi. For 90 day mixes mold eight cylinders. Test one cylinder at seven days, one at cylinder at 28 days, two cylinders at 56 days, and three cylinders at 90 days. The 90 day strength shall be the average of the three 90 day cylinders. One cylinder shall be retained in reserve for later testing if required.
- vii. When high early strength concrete is required by Contractor, additional cylinders shall be made and tested as required at Contractor's expense.
- viii. If one cylinder in a test manifests evidence of improper sampling, molding or other damage, discard cylinder and base test results on that of remaining cylinder.

5. Evaluate concrete for conformance with Specifications as follows:

- a. Slump:
 - i. Maintain a slump moving average, comprised of the average of all batches or most recent five (5) batches tested, whichever is fewer.
- b. Strength test:
 - i. Maintain a compressive strength moving average, comprised of three (3) consecutive strength test results, for each mix design used in work.
 - ii. Strength level of concrete will be considered satisfactory provided averages of all sets of three (3) consecutive strength test results (i.e. moving average) equal or exceed specified 28-day strength, and no individual strength test result falls below specified 28-day strength by more than 500 psi (3.5MPa).
 - iii. If strength tests fail to meet minimum requirements, concrete represented by such tests shall be considered questionable and shall, if deemed appropriate by the SER, be subject to further evaluation by core testing as specified herein or other testing methods.
 - iv. Maintain a log that contains the results of all concrete strength tests. The log shall include the results of each test performed, be in electronic spreadsheet format, and updated and submitted along with concrete test data. See example log attached at the end of this Specification Section.
- c. Conduct core tests on questionable concrete in accordance with ACI 318 and ASTM C 42.
 - i. Location of cores shall be coordinated with Design Professionals so as to least impair strength of structure. Before testing cores, discard and replace any that show evidence of having been damaged subsequent to or during removal from structure or which have reinforcement present.
 - ii. Cores from structure exposed to soil or constant moisture in service (e.g. basement walls, retaining walls, slab-on-grade, piers, footings, etc.) shall be tested in a fully saturated condition. Cores for all other concrete may be tested dry. Prior to commencement of coring, verify with Design Professionals whether cores are to be tested wet or dry.
 - iii. Fill core holes with low slump concrete or mortar with a strength equal to or greater than that specified for area cored.
- d. Concrete in area represented by core test will be considered adequate if average strength of cores is equal to at least 85% of, and if no single core is less than 75% of specified strength.

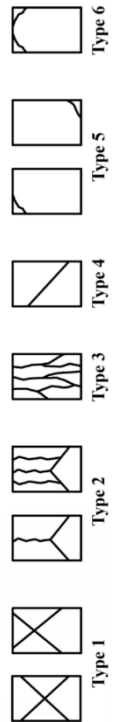
6. Floor flatness and levelness tolerance compliance testing is to be performed within 72 hours of concrete placement by Testing Agency, and prior to the removal of shores and forms.
 - A. Testing Agency to test and report flatness (F_F), levelness (F_L) prior to shoring removal. For slabs that include camber, do not test for levelness (F_L). Perform F_F/F_L testing in accordance with ASTM E 1155 requirements.

EXAMPLE CONCRETE STRENGTH SPREADSHEET LOG

DATE TESTED	AGE AT TEST (DAYS)	AVERAGE DIAMETER (IN)	AVERAGE CROSS-SECTIONAL AREA (IN ²)	BREAKING LOAD (LB)	BREAK TYPE **	AVERAGE COMPRESSIVE STRENGTH (PSI)
3/8/2106	7	4	12.56	165990	Type 1	13210
	14					
	28					
	56					

*FIELD CURING CONDITIONS: NCB=NO CURING BOX, CB=CURING BOX, I=INSULATED, CO=COOLED, HE=HEATED, CA=CAPPED, IC=ICED, O=OTHER

**BREAK TYPES (AS CLASSIFIED BY ASTM C39):



SPECIMEN I.D .	TICKET NUMBER	PLACEMENT LOCATION	MIX I.D.	CURE TYPE*
S0002	1234	First Floor Slabs and Beams	H3651	I, CA, CB

3.5 STRUCTURAL STEEL

A. Quality Assurance:

1. Shop inspection shall include alignment and straightness of members, camber, preparation for connections, dimensional checks, testing of shop bolts, witnessing of welding procedures, testing of cuts, examination and testing of completed welds, headed studs and deformed bar anchors, finishing of column ends, cleaning, painting and storage of material. All shop fabrication shall be inspected in the shop. Camber shall be verified in a minimum of 10% of all members requiring camber. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable cambers, the required percentage of tested cambers may be increased by the SER to 100% at no expense to the Owner. Where testing is required for less than 100% of locations, select test locations at random and throughout the project.
2. Field inspection shall include connections, proper tensioning of bolts, levelness, plumbness and alignment of the frame, conformance to AWS welding methods, examination of surface before welding, examination and testing of completed welds, headed studs and deformed bar anchors and field painting, including touch-up. Where testing is required for less than 100% of locations, select test locations at random and throughout the project.
3. Review the following items in the shop and field:

- a) Welding certificates, procedures, and personnel
 - b) Stud welding setup and operators; bolting procedure and crew
 - c) Bolting procedure and crew
 - d) Visually inspect seam welds of tube and pipe for evidence of cracking or lack of fusion. At each end piece of tube or pipe, inspect interior face of seam weld for evidence of cracking, lack of fusion, or less than full flashing.
 - e) Mill certifications for compliance with the Contract Documents.
4. Inspect high strength bolted construction in accordance with RCSC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts," including but not limited to:
- a) Surface preparation and bolt type conforms to plans and Specifications prior to start of bolting operations.
 - b) Proper bolt storage and handling procedures per codes and standards referenced by this Specification are being followed.
 - c) Visually inspect all bolted connections.
 - d) For all bolted connections that are indicated as snug tight, connections are properly compacted and brought to the snug tight condition progressing outward from the most rigid part.
 - e) For all bolted connections that are indicated as pretensioned or slip critical, pre-installation verification testing is performed by the inspector in cooperation with the contractor in accordance with RCSC section 9.2 and section 7.
 - f) For all bolted connections that are indicated as pretensioned or slip critical, through routine observation, as defined in RCSC 9.2.1, 9.2.3 or 9.2.4, that the pretensioning methods of RCSC 8.2.1, 8.2.3, or 8.2.4, as appropriate, are performed.
 - i. "Routine observation" is defined as observation of 10 bolts for every 100 bolts with a minimum of 2 bolts per connection.
 - g) Retest bolted connections that fail initial inspection after correction by the Fabricator or Erector.
2. Test and inspect welding and welded construction including but not limited to:
- h) Review of submittals:
 - i. Review all Welding Procedures prepared by the Contractor's Engineer or Certified Welding Engineer. Verify the accuracy of all essential variables of the Welding Procedure including but not limited to confirmation that weldability and heat induction for high restraint welds comply with AWS requirements.
 - ii. Review of welding procedures including prequalification, qualifications test, for High Restraint Welds, the welding procedure prepared by the Contractor's Engineer or Welding Consultant
 - iii. Submit for record a report indicating that the Welding Procedures have been reviewed as indicated above to the Design Professionals.

- i) Test all complete joint penetration welds for soundness by means of either radiographic or ultrasonic testing in accordance with AWS D1.1 and ASTM E164 procedures. All flaws in plate or flange material revealed during such tests shall be repaired and retested by the Contractor at the Contractor's expense.
 - j) Test all partial joint penetration welds for soundness by means of visual and magnetic particle inspection, unless other methods are specified in the Contract Documents. All flaws in plate or flange material revealed during such tests shall be repaired and retested by the Contractor at the Contractor's expense.
 - k) Testing of welds at High Restraint Welds shall be performed not less than 48 hours after the weld has been completed.
 - l) Visually inspect all fillet welds. In addition test ten percent (10%) of all fillet welds using a non-destructive method, such as dye penetrant or magnetic particle. Select test locations randomly throughout the structure, but test at least one weld in each location with 6 or more welds per connection. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable welds, the required percentage of tested welds may be increased by the SER to 100%, all at the Contractor's expense.
 - m) Inspection and Testing by the Testing Agency of High Restraint Welds:
 - i. Joint Preparation: Monitor fit up and joint preparation (bevel angle, etc.) for conformance to the submitted welding procedures including preheat and interpass temperature. Monitor base metal temperature during welding operations.
 - ii. Test Complete Joint Penetration Welds in accordance to the requirements of this Specification section, ultrasonically in accordance with AWS D1.1 procedures. On T or corner joints, pay careful attention to the heat affected zone and base metal where the weld shrinkage stresses are in the through thickness direction.
 - iii. Test Partial Joint Penetration Butt Joints in accordance with this Specification section by the magnetic particle method. At T or corner joints, in addition to the magnetic particle testing, ultrasonically scan the heat affected zone and adjacent base metal from face "C" per AWS D1.1 Table 6.7 and Annex Q7 to detect lamellar tears and shall be done with a compression wave. The Testing Agency shall submit a testing procedure that includes evaluation (acceptance criterion) procedures to the Design Professionals for review.
 - n) At High Restraint Welds: provide pre-production sample testing of heat treatment, observe fabrication, welding and heat treatment of the samples for conformance with submitted welding procedures. Establish locations of testing coupons following AWS procedures. Test coupons following AWS procedures to verify satisfactory results using the welding procedure and heat treatment.
3. Visually inspect all headed studs and deformed bar anchors for complete fusion and full 360-degree weld flash (or fillet).
- o) Check all studs with incomplete fusion, and at random five studs at each of six beams per floor, by bending to an angle of 15 degrees from its

original axis (away from any missing flash). If more than twenty percent of studs fail on one member, check all studs on member. In addition, for each member with any defective studs, test an additional member. Contractor to replace any studs that crack or break. Contractor to only straighten studs that would foul other work or have less than 1 inch (25mm) cover in bent position.

4. Cleaning & Painting:

- p) Examine shop painting to verify conformance with this Specification.
- q) Examine loading and unloading of steel to visually observe that damage does not occur during shipping and handling.

1.6 STEEL DECK

A. Quality Assurance:

1. Prior to erection of steel deck: Review all analysis and certificates of compliance. Certificates shall include verification of base metal thickness and galvanized coating as required by applicable ASTM standards.
2. Decking is subject to inspection and testing once connected in place:
 - a) Expense of removing and replacing any portion of decking for testing purposes will be borne by the Owner if connections are found to be satisfactory.
 - b) Contractor shall remove work found to be defective and provide acceptable work at no additional cost to the Owner.
3. Field inspect all steel deck after erection for the following:
 - a) Proper deck profile, type (acoustic, cellular, vented), gage and finish
 - b) Correct deck orientation, alignment, bearing and laps (if applicable)
 - c) Supplementary items including secondary supports, closures, pour stops, sumps and their connections to deck and to other members
 - d) Damage of members during transportation, storage and erection
 - e) Proper installation and erection
 - f) Proper deck to supporting member and deck to deck connections (quantity, size, spacing and quality of welds/fasteners) including inspection of deck welding
4. Field inspect headed studs (shear connectors) as follows:
 - a) At the start of each day's operations for welding headed studs, the Contractor shall first weld a minimum of two studs to demonstrate proper welding set up for that day's typical deck and support conditions. Testing Agency to observe Contractor hammer-bending the studs to an angle 15 degrees from the vertical without weld failure.
 - b) Should failure occur in the weld zone of either stud, Contractor shall adjust welding set up and repeat the test until two consecutive studs are, tested and found satisfactory before any production welding of studs may begin.

- c) Perform demonstration tests at each significant change in conditions including deck thickness, deck coating (painted to galvanized) or number of deck layers.
- d) Do not weld studs through more than one layer of steel deck, except where cellular deck is specified.
- e) Failed test studs shall be removed and replaced by production studs.
- f) During production installation, bend testing of headed studs is required where incomplete weld flash is observed, and at random locations on each floor. For production testing requirements see Section 051200.

3.7 FOOTINGS

A. Quality Assurance by Geotechnical Engineer (or Testing Agency if the same entity):

- 1. Review Contractor's proposed footing installation methods, sequences, and procedures.
- 2. Verify bearing stratum and bearing capacity of each footing; verify levelness of footing end bearing surface.
- 3. Determine final bearing elevation at each footing location.
- 4. Observe, record, and report footing as-built plan location, footing size and final elevations of bottom (where possible) and top of completed footings.
- 5. Coordinate with Testing Agency.

B. Quality Assurance by Testing Agency:

- 1. Inspection of Reinforcement: Provide continuous visual inspection of site fabrication. Record the steel reinforcement bar sizes, grade, length, and number of bars.
- 2. Inspection of Concrete and Reinforcement Placement: Provide continuous visual inspection of installation of reinforcement and concrete placement including verification of laitance removal at top of footings.
- 3. Check ready mix delivery tickets for correct concrete mix design number. Record batch to placement time. Check slump, temperature, and batch to placement time for each set
- 4. Slump Tests: ASTM C143. Make one test from each truck.
- 5. Concrete Compressive Strength Tests: Testing agency will take a minimum of one sample set of concrete cylinders per 20 cubic yards of concrete. See CAST-IN-PLACE CONCRETE section of this specification for requirements. Cure cylinders to simulate same curing conditions as concrete in footings. Reports of cylinder tests shall state footing location(s), laboratory or site curing, compression strength, type of fracture, age at testing, concrete supplier, mix specification strength, any other pertinent information, test results, and conclusions.
- 6. Additional Tests: Perform additional testing if, in the opinion of the Design Professionals, concrete of poor quality has been placed based on cylinder strengths below Specification requirements or visual defects. Tests may be compression tests on cored cylinders, ASTM C42, and load tests as outlined in ACI 318, or as directed by the Design Professionals. Complete continuous coring of footings will be required, at Contractor's expense, where verification of quality of concrete is not otherwise attainable.

END OF SECTION

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TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions;
- C. Site Standards; and
- D. Construction Waste Management and Disposal.

1.02 TEMPORARY UTILITIES:

- A. Electric Power and Lighting:
 - (1) Contractor will pay for power during the course of the Work. To the extent power is available in the building(s) or on the Site, Contractor may use the District's existing utilities by making prearranged payments to the District for the utilities used by Contractor and all Subcontractors. Contractor shall be responsible for providing temporary facilities required to deliver that power service from its existing location in the building(s) or on the Site to point of intended use.
 - (2) Contractor shall verify characteristics of power available in building(s) or on the Site. Contractor shall take all actions required to make modifications where power of higher voltage or different phases of current are required. Contractor shall be fully responsible for providing that service and shall pay all costs required therefor.
 - (3) Contractor shall furnish, wire for, install, and maintain temporary electrical lights wherever it is necessary to provide illumination for the proper performance and/or observation of the Work: a minimum of 20 foot-candles for rough work and 50 foot-candles for finish work.
 - (4) Contractor shall be responsible for maintaining existing lighting levels in the project vicinity should temporary outages or service interruptions occur.

B. Heat and Ventilation:

- (1) Contractor shall provide temporary heat to maintain environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation and curing of materials, and to protect materials and finishes from damage due to improper temperature and humidity conditions. Portable heaters shall be standard units complete with controls.
- (2) Contractor shall provide forced ventilation and dehumidification, as required, of enclosed areas for proper installation and curing of materials, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors, and gases.
- (3) Contractor shall pay the costs of installation, maintenance, operation, and removal of temporary heat and ventilation, including costs for fuel consumed, required for the performance of the Work.

C. Water:

- (1) Contractor shall pay for water used during the course of the Work. Contractor shall coordinate and pay for installation or use of water meter in compliance with local water agency requirements. To the extent water is then available in the building(s) or on the Site, Contractor may use the District's existing utilities by making prearranged payments to the District for the utilities used by Contractor and all Subcontractors. Contractor shall be responsible for providing temporary facilities required to deliver such utility service from its existing location in the building(s) on the Site, or other location approved by the local water agency, to point of intended use.
- (2) Contractor shall use backflow preventers on water lines at point of connection to District's water supply. Backflow preventers shall comply with requirements of Uniform Plumbing Code.
- (3) Contractor shall make potable water available for human consumption.

D. Sanitary Facilities:

- (1) Contractor shall provide sanitary temporary facilities in no fewer numbers than required by law and such additional facilities as may be directed by the Inspector for the use of all workers. The facilities shall be maintained in a sanitary condition at all times and shall be left at the Site until removal is directed by the Inspector or Contractor completes all other work at the Site.
- (2) Use of toilet facilities in the Work under construction shall not be permitted except by consent of the Inspector and the District.

E. Telephone Service:

- (1) Contractor shall arrange with local telephone service company for telephone service as required for the performance of the Work. Contractor shall, at a minimum, provide in its field office one line for telephone and one line for fax machine.
- (2) Contractor shall pay the costs for telephone and fax lines installation, maintenance, service, and removal.

F. Fire Protection:

- (1) Contractor shall provide and maintain fire extinguishers and other equipment for fire protection. Such equipment shall be designated for use for fire protection only and shall comply with all requirements of the California Fire, State Fire Marshall and/or its designee.
- (2) Where on-site welding and burning of steel is unavoidable, Contractor shall provide protection for adjacent surfaces.

G. Trash Removal:

- (1) Contractor shall provide trash removal on a weekly basis. Under no circumstance shall Contractor use District trash service.

H. Field Office:

- (1) If Contractor chooses to provide a field office, it shall be an acceptable construction trailer that is well-lit and ventilated. The construction trailer shall be equipped with shelves, desks, filing cabinet, chairs, and such other items of equipment needed. Trailer and equipment are the property of the Contractor and must be removed from the Site upon completion of the Work.

Final location to be reviewed and approved in writing by District.

- (2) Contractor shall provide any additional electric lighting and power required for the trailer. Contractor shall make adequate provisions for heating and cooling as required.

1.03 CONSTRUCTION AIDS:

A. Plant and Equipment:

- (1) Contractor shall furnish, operate, and maintain a complete plant for fabricating, handling, conveying, installing, and erecting materials and equipment; and for conveyances for transporting workers. Include elevators, hoists, debris chutes, and other equipment, tools, and appliances necessary for performance of the Work.
- (2) Contractor shall maintain plant and equipment in safe and efficient operating condition. Damages due to defective plant and equipment,

and uses made thereof, shall be repaired by Contractor at no expense to the District.

- B. None of the District's tools and equipment shall be used by Contractor for the performance of the Work.

1.04 BARRIERS AND ENCLOSURES:

- A. Contractor shall obtain the District's written permission for locations and types of temporary barriers and enclosures, including fire-rated materials proposed for use, prior to their installation.
- B. Contractor shall provide and maintain temporary enclosures to prevent public entry and to protect persons using other buildings and portions of the Site and/or Premises, the public, and workers. Contractor shall also protect the Work and existing facilities from the elements, and adjacent construction and improvements, persons, and trees and plants from damage and injury from demolition and construction operations.
- C. Contractor shall provide site access to existing facilities for persons using other buildings and portions of the Site, the public, and for deliveries and other services and activities.
- D. Tree and Plant Protection:
 - (1) Contractor shall preserve and protect existing trees and plants on the Premises that are not designated or required to be removed, and those adjacent to the Premises.
 - (2) Contractor shall provide barriers to a minimum height of 4'-0" around drip line of each tree and plant, around each group of trees and plants, as applicable, in the proximity of demolition and construction operations, or as denoted on the Plans.
 - (3) Contractor shall not park trucks, store materials, perform Work or cross over landscaped areas. Contractor shall not dispose of paint thinners, water from cleaning, plastering or concrete operations, or other deleterious materials in landscaped areas, storm drain systems, or sewers. Plant materials damaged as a result of the performance of the Work shall, at the option of the District and at Contractor's expense, either be replaced with new plant materials equal in size to those damaged or by payment of an amount representing the value of the damaged materials as determined by the District.
 - (4) Contractor shall remove soil that has been contaminated during the performance of the Work by oil, solvents, and other materials which could be harmful to trees and plants, and replace with good soil, at Contractor's expense.

- (5) Excavation around Trees:
- (a) Excavation within drip lines of trees shall be done only where absolutely necessary and with written permission from the District.
 - (b) Where trenching for utilities is required within drip lines, tunneling under and around roots shall be by hand digging and shall be approved by the District. Main lateral roots and taproots shall not be cut. All roots 2 inches in diameter and larger shall be tunneled under and heavily wrapped with wet burlap so as to prevent scarring or excessive drying. Smaller roots that interfere with installation of new work may be cut with prior approval by the District. Roots must first be cut with a Vermeer, or equivalent, root cutter prior to any trenching.
 - (c) Where excavation for new construction is required within drip line of trees, hand excavation shall be employed to minimize damage to root system. Roots shall be relocated in backfill areas wherever possible. If encountered immediately adjacent to location of new construction, roots shall be cut approximately 6 inches back from new construction.
 - (d) Approved excavations shall be carefully backfilled with the excavated materials approved for backfilling. Backfill shall conform to adjacent grades without dips, sunken areas, humps, or other surface irregularities. Do not use mechanical equipment to compact backfill. Tamp carefully using hand tools, refilling and tamping until Final Acceptance as necessary to offset settlement.
 - (e) Exposed roots shall not be allowed to dry out before permanent backfill is placed. Temporary earth cover shall be provided, or roots shall be wrapped with four layers of wet, untreated burlap and temporarily supported and protected from damage until permanently relocated and covered with backfill.
 - (f) Accidentally broken roots should be sawed cleanly 3 inches behind ragged end.

1.05 SECURITY:

The Contractor shall be responsible for project security for materials, tools, equipment, supplies, and completed and partially completed Work.

1.06 TEMPORARY CONTROLS:

A. Noise Control:

- (1) Contractor acknowledges that adjacent facilities may remain in operation during all or a portion of the Work period, and it shall take

all reasonable precautions to minimize noise as required by applicable laws and the Contract Documents.

- (2) Notice of proposed noisy operations, including without limitation, operation of pneumatic demolition tools, concrete saws, and other equipment, shall be submitted to the District a minimum of forty-eight (48) hours in advance of their performance.

B. Noise and Vibration:

- (1) Equipment and impact tools shall have intake and exhaust mufflers.
- (2) Contractor shall cooperate with District to minimize and/or cease the use of noisy and vibratory equipment if that equipment becomes objectionable by its longevity.

C. Dust and Dirt:

- (1) Contractor shall conduct demolition and construction operations to minimize the generation of dust and dirt, and prevent dust and dirt from interfering with the progress of the Work and from accumulating in the Work and adjacent areas including, without limitation, occupied facilities.
- (2) Contractor shall periodically water exterior demolition and construction areas to minimize the generation of dust and dirt.
- (3) Contractor shall ensure that all hauling equipment and trucks carrying loads of soil and debris shall have their loads sprayed with water or covered with tarpaulins, and as otherwise required by local and state ordinance.
- (4) Contractor shall prevent dust and dirt from accumulating on walks, roadways, parking areas, and planting, and from washing into sewer and storm drain lines.

D. Water:

Contractor shall not permit surface and subsurface water, and other liquids, to accumulate in or about the vicinity of the Premises. Should accumulation develop, Contractor shall control the water or other liquid, and suitably dispose of it by means of temporary pumps, piping, drainage lines, troughs, ditches, dams, or other methods.

E. Pollution:

- (1) No burning of refuse, debris, or other materials shall be permitted on or in the vicinity of the Premises.
- (2) Contractor shall comply with applicable regulatory requirements and anti-pollution ordinances during the conduct of the Work including, without limitation, demolition, construction, and disposal operations.

- F. Lighting:
 - (1) If portable lights are used after dark, all light must be located so as not to direct light into neighboring property.

1.07 JOB SIGN(S):

- A. General:
 - (1) Contractor shall provide and maintain a Project identification sign with the design, text, and colors designated by the District and/or the Design Professional; locate sign as approved by the District.
 - (2) Signs other than the specified Project sign and or signs required by law, for safety, or for egress, shall not be permitted, unless otherwise approved in advance by the District.
- B. Materials:
 - (1) Structure and Framing: Structurally sound, new or used wood or metal; wood shall be nominal 3/4-inch exterior grade plywood.
 - (2) Sign Surface: Minimum 3/4-inch exterior grade plywood.
 - (3) Rough Hardware: Galvanized.
 - (4) Paint: Exterior quality, of type and colors selected by the District and/or the Design Professional.
- C. Fabrication:
 - (1) Contractor shall fabricate to provide smooth, even surface for painting.
 - (2) Size: 4'-0" x 8'-0", unless otherwise indicated.
 - (3) Contractor shall paint exposed surfaces of supports, framing, and surface material with exterior grade paint: one coat of primer and one coat of finish paint.
 - (4) Text and Graphics: As indicated.

1.08 PUBLICITY RELEASES:

- A. Contractor shall not release any information, story, photograph, plan, or drawing relating information about the Project to anyone, including press and other public communications medium, including, without limitation, on website(s) without the written permission of the District.

PART 2 – PRODUCTS Not used.

PART 3 – EXECUTION Not used.

END OF DOCUMENT

SECTION 015001
TEMPORARY CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Specifications for general requirements for furnishing, installing, operating, and removing temporary project facilities and controls as required to perform and complete the Work.

1.2 REFERENCES

- A. American National Standards Institute (ANSI)
ANSI S1.4 Specification for Sound Level Meters
- B. State of California, Department of Transportation (Caltrans), Standard Specific
Section 12 Construction Area Traffic Controls Devices
Section 82 Markers and Delineators
- C. State of California, Department of Transportation (Caltrans), Traffic Manual
Chapter 5, Manual of Traffic Controls for Construction and Maintenance Work
- D. State of California (Caltrans), Standard Plans

1.3 TRAFFIC PLAN AND CONTROLS

- A. Traffic Control Plan
 - 1. Contractor shall prepare and submit a traffic control plan to illustrate extent of the Contractor's involvement in the traffic scene of the campus. The traffic control plan shall include drawings showing routes, detours, lane and/or pathway closures, traffic decking, signage, striping, barriers, warning signals and lights, and other traffic control devices and facilities required. The traffic control plan shall include explanatory narrative as required to complete the plan.
 - 2. The traffic control plan shall be submitted for approval directly to the jurisdictional authorities involved, with an informational copy furnished to the Engineer. Two copies of approved traffic control plans shall be furnished to the Engineer for record purposes.
- B. Permits: Apply for and obtain all permits from jurisdictional authorities as required to perform work in the public right-of-way, including encroachment permits and hauling permits. Two copies of issued permits shall be furnished to the Engineer for record purposes.
- C. Control Devices and Facilities
 - 1. Temporary traffic control devices and facilities shall conform with applicable requirements of the Caltrans Traffic Manual, Chapter 5, Manual of Traffic Controls for Construction and Maintenance Work Zones.
 - 2. Furnish, install, operate, maintain, and remove when no longer required, all traffic control and protective devices required for the approved traffic plan.
 - 3. Traffic control and protective devices shall include temporary directional electrical warning signs, detour signs, danger signals; temporary barricades and guard rails; crash cushions; temporary lighting, overhead warning lights, and flashing lights; temporary pavement markings, removal of permanent and temporary pavement markings; and the services of qualified flaggers.
 - 4. Maintain communication with the jurisdictional authorities regarding the Contractor's operations in maintaining and controlling traffic.
- D. Traffic Control Signs: Each change in location of traffic shall be adequately posted with signs mounted on barricades or standard posts in accordance with requirements of Caltrans

Standard Specifications Section 12. The Contractor shall make arrangements for providing temporary no parking signs.

1. "No Parking" signs and barricades shall be posted 48 hours in advance, and the jurisdictional authority shall be notified daily of all such posted "No Parking" zones.
- E. Pavement Marking: Install necessary temporary and permanent pavement marking as required in connection with the temporary street work, and remove or obliterate existing or temporary pavement markings whenever vehicle traffic is moved to a newly available pavement area or to different traffic patterns.
- F. Redirecting Traffic
1. All channelizing, shifting of traffic lanes, and barricading of traffic in connection with the Work will be subject to approval of the appropriate jurisdictional authority. Existing local standards for signing and marking of construction areas shall apply in addition to the requirements of Caltrans Standard Specifications Section 12.
 2. When required by the Contract Specifications, or indicated on the Contract Drawings, or required by responsible public agencies, the Contractor shall construct, maintain, and remove detours and detour bridges for the use of public traffic.
 3. Signage for detours shall conform with the Caltrans Traffic Manual, Chapter 5, Manual of Traffic Controls for Construction and Maintenance Work Zones.
 4. Failure or refusal of the Contractor to construct and maintain detours at the proper time shall be sufficient cause for closing down the Work until such detours are in satisfactory condition for use by public traffic.
- G. Temporary Closing to Traffic: Prior to temporary closing to traffic part of any street, sidewalk, or other access, or to changing traffic patterns from those indicated on the Contract Drawings, obtain approval from appropriate jurisdictional authority, and comply with imposed conditions, at least two weeks before such closures or changes are made. Deviations will be for an emergency condition affecting life and property only, and the Contractor shall immediately notify the Engineer and the appropriate jurisdictional authority of any such emergency changes. Copies of all approvals shall be furnished to the Engineer.
- H. Temporary Walkways: In areas where removal of existing sidewalks is necessary, access to adjacent businesses, entrances, and properties shall be maintained by temporary walkways having a width of not less than four feet and meeting ADA requirements.
- I. Intersections and Street Crossings: Intersections and street crossings shall be excavated and decked in stages as indicated. Construction shall be phased so that the required number of traffic lanes on each street will be provided at all times during these operations. Upon completion of decking installation, traffic in all directions shall be fully maintained. Trenches or open excavations shall be properly bridged where traffic lanes are to be open to traffic.
- J. Temporary Paving and Patching: Construct, maintain, and remove temporary pavement and patching required to safely and expeditiously handle vehicle and pedestrian traffic, within or adjacent to the jobsite. Temporary pavement and patching composition shall conform to the specifications of the local jurisdictional authority. Any construction, maintenance, or removal required by the Contractor's operations off site shall conform to the requirements specified herein.

1.4 CONSTRUCTION OPERATIONS UNDER TRAFFIC

- A. Definitions: Construction equipment is defined for the purposes of this Article as all types of equipment, vehicles, and tools used in connection with construction work. The term workers includes every person or firm performing work in or adjacent to public streets.
- B. Construction Equipment: When in traffic lanes, all vehicles and equipment shall be operated at normal traffic speeds. If this is not practicable, a slow moving vehicle emblem shall be displayed in accordance with the Motor Vehicle Code. Construction equipment shall not be parked in any lane intended for use by normal traffic. Equipment parked or stored at the work site shall be behind a guard rail, barrier, curb, or other protective device.

- C. One-Way Traffic: No construction equipment shall be operated in traffic lanes, except in the designated direction of travel for respective lanes.
- D. Construction Operations
 - 1. Schedule surface operations so that work is not carried on intermittently throughout the area. Excavation or construction activities shall be scheduled and pursued to completion as required to permit opening of street areas to traffic without unnecessary delays.
 - 2. No construction work involving occupancy of traffic lanes shall be performed during adverse weather conditions or adverse road conditions, and traffic shall be properly safeguarded by use of flashers and lights in addition to the signs and other markings specified herein. During these periods, no construction deliveries shall take place over a travel lane or immediately adjacent thereto.
 - 3. When traffic conditions dictate, the Contractor shall modify its work operation for such length of time as required to alleviate the hazardous traffic conditions.
- E. Equipment Travel
 - 1. No construction equipment other than that designated and used for general highway transportation shall be moved on streets during hours of darkness or periods of adverse weather conditions which reduce normal visibility.
 - 2. Any construction equipment or material required for construction operations which exceeds the maximum vehicle dimensions specified in the Motor Vehicle Code, shall be moved only in accordance with established State and local regulations. No such oversize load shall be moved over public streets without first obtaining approval of the appropriate jurisdictional authority.
- F. Crossing Traffic Lanes: Construction equipment entering the traveled way from the median shall be safeguarded by a CMS and with flaggers as required. Where traffic speeds are high, slow-moving construction equipment entering the traveled way shall be protected by a "rolling barricade" supplied by the California Highway Patrol (CHP). This operation shall be performed at off-peak hours and requires coordination between the Contractor and the CHP, with the cost being borne by the Contractor.
- G. Flaggers: When flagging is required, provide qualified flaggers and flagging in accordance with the requirements of the Caltrans Traffic Manual, Chapter 5, Manual of Traffic Controls, Section 5.07.
- H. Removal of Traffic Control Devices: All temporary signs, barricades, barrier curbs, crash cushions, drums, and cones used to safeguard traffic in connection with construction work shall be removed at the close of the work day, unless the state of the work is such that warning devices are still needed and are adapted for night closing.
- I. Storage: No material or traffic control devices shall be stored on any lane intended for traffic use.

1.5 POLLUTION ABATEMENT - GENERAL REQUIREMENTS

- A. Comply with the General Conditions, Article GC7.10. Conduct construction operations in a manner which will minimize pollution of the environment surrounding the area of the Work by all practicable means and methods. Apply specific controls as specified in the Contract Specifications and as follows:
 - 1. Waste Materials: No waste or eroded materials shall be allowed to enter natural or man-made water or sewage removal systems. Eroded materials from excavations, borrow areas, or stockpiled fill shall be contained within the Work area. The Contractor shall develop methods for control of erosion as specified in Article 1.08 herein.
 - 2. Burning: No burning of waste materials or debris will be permitted.
 - 3. Burying: No burying of waste materials and debris will be permitted within the limits of the campus property.

- B. Provide for and maintain the flow of all sewers, drains, building or inlet connections, and all water courses which may be encountered during progress of the Work. Do not allow the contents of any sewer, drain or building or inlet connection to flow into trenches or outside of the campus property unless in an approved area consistent with State and Federal regulations. Immediately remove from proximity of the work all offensive matter, using such precautions as are required by jurisdictional authorities.

1.6 DUST CONTROL

- A. Provide dust control at all times, including holidays and weekends, as required to abate dust nuisance on and about the site which is a result of construction activities. Dust control shall be by means of sprinklered water or by other approved methods, except that chemicals, oil, or similar palliative shall not be used.
- B. Quantities and equipment for dust control shall be sufficient to effectively prevent dust nuisance on and about the site; and when weather conditions warrant, sprinklering equipment shall be on hand at all times for immediate availability.
- C. The Engineer shall have authority to order dust control work whenever conditions warrant, and there shall be no additional cost to the District therefor. Dust control shall be effectively maintained whether or not the Engineer orders such work.
- D. Complaints from the public shall be reported to the Engineer and shall be acted on immediately.
- E. Where trenching operations are in progress, keep exposed earth surfaces dampened continuously. Also, keep dirt access ways and roads dampened continuously.
- F. If portions of the site are temporarily inactive or abandoned for whatever reason, provide dust control and abatement continuously during such periods of inactivity.
- G. Where dust resulting from construction activities has collected on public sidewalks and streets, hose down such sidewalks and streets to abate flying dust particles. Clean all sidewalks and streets from accumulated dirt and dust.

1.7 MUD CONTROL

- A. Take proper measures to prevent tracking of mud onto public and/or campus streets, drives, and sidewalks. Such measures shall include, but are not limited to, covering muddy areas on the site with clean, dry sand.
- B. All egress from the site shall be maintained in a dry condition, and any mud tracked onto streets, sidewalks, or drives shall be immediately removed, and the affected area shall be cleaned. The Engineer may order such work at any time the conditions warrant.
- C. Where trucks will leave a muddy site and enter paved public streets, the Contractor shall maintain a suitable truck wheel-washing facility and crew. All trucks, or other vehicles leaving the site, shall be cleaned of mud and dirt, including mud and dirt clinging to exterior body surfaces of vehicles.
- D. All trucks coming to the site or leaving the site with materials or loose debris shall be loaded in a manner which will prevent dropping of materials or debris on streets. Spillage resulting from hauling operations along or across any public traveled way shall be removed immediately.

1.8 NOISE CONTROL

- A. Requirements: Minimize noise caused by construction operations, and provide working machinery and equipment fitted with efficient noise suppression devices. Employ other noise abatement measures as necessary for protection of employees and the public. In addition, restrict working hours and schedule operations in a manner which will minimize, to the greatest extent feasible, disturbance to residents and/or students in the vicinity of the Work.

- B. Definitions
1. Daytime refers to the period from 7:00 a.m. to 5:00 p.m. local time daily except Saturdays, Sundays, and legal holidays.
 2. Nighttime refers to all other times including all day Saturday, Sunday, and legal holidays.
 3. Construction Limits are defined for the purpose of these noise control requirements as the campus property lines, construction easement boundaries, or city right-of-way lines as indicated on the Contract Drawings.
 4. Zones, Special Zones, and Special Construction Sites outside of the Construction Limits shall be as designated by the local authority having jurisdiction. Such specially designated zones shall be treated by the Contractor as if they were within the Construction Limits.
- C. Monitoring
1. Promptly inform the Engineer of any complaints received from the public regarding noise. Describe the action proposed and the schedule for implementation, and subsequently inform the Engineer of the results of the action.
 2. Monitor noise levels day and night and for each new activity or piece of equipment. Start by measuring three times a day plus once a night for three consecutive days. Monitor noise levels at least at least once a week thereafter.
- D. Measurement Procedure
1. Except where otherwise indicated, perform all noise measurements using the A-weight network and “slow” response of an instrument complying with the criteria for a Type 2 General Purpose sound level meter as described in ANSI S1.4.
 2. Measure impulsive or impact noises with an impulse sound level meter complying with the criteria of IEC 179 for impulse sound level meters. As an alternative procedure, a Type 2 General Purpose sound level meter on C-weighting and “fast” response may be used to estimate peak values of impulsive or impact noises. Transient meter indications of 125 dBC “fast” or higher will be considered as indications of impulsive noise levels of 140 dB or greater.
 3. Measure noise levels at buildings affected acoustically by the Contractor’s operations at points between three feet and six feet from the building face to minimize the effect of reflections.
 4. Measure noise levels at points on the outer boundaries of Construction Limits or Special Construction Sites for noise emanating from within.
 5. Where more than one criterion of noise limits are applicable, use the more restrictive requirement for determining compliance.
- E. Continuous Construction Noise: Prevent noise from stationary sources, parked mobile sources, or any source or combination of sources producing repetitive or long-term noise lasting more than one hour from exceeding the following limits:

1. Maximum Allowable Continuous Noise Level, dBA:

<u>Affected Residential Area</u>	<u>Daytime</u>	<u>Nighttime</u>
Single family residence	60	50
Along an arterial or in multi-family Residential areas, including hospitals	65	55
In semi-residential/commercial areas, including hotels	70	60
<u>Affected Commercial Area</u>	<u>At All Times</u>	

In semi-residential/commercial areas, including schools	65
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In commercial areas with no nighttime residency	65
--	----

Affected Industrial Areas

All locations	65
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F. Intermittent Construction Noise: Prevent noises from non-stationary mobile equipment operated by a driver or from any source of non-scheduled, intermittent, non-repetitive, short-term noises not lasting more than four hours from exceeding the following limits:

1. Maximum Allowable Intermittent Noise Level, dBA:

<u>Affected Residential Area</u>	<u>Daytime</u>	<u>Nighttime</u>
Single family residence areas	75	60
Along an arterial or in multi-family residential areas, including hospitals	75	65
In semi-residential/commercial areas, including hotels	75	70
<u>Affected Commercial Area</u>		<u>At All Times</u>
In semi-residential/commercial areas, including schools		80
In commercial areas with no nighttime residency		85
<u>Affected Industrial Area</u>		<u>At All Times</u>
All locations		90

1.9 ENCLOSED STORAGE AND SHOPS

- A. Provide all temporary storage and shop rooms that may be required at the site for safe and proper storage of tools, materials, and equipment. Construct such rooms only in locations indicated or as approved by the Engineer, and so as not to interfere with the proper installation and completion of other work.
- B. Remove such rooms within three days of receipt of notices from the Engineer that removal is necessary, and incur all expenses for such removal.
- C. Storage of gasoline or similar fuels shall conform with NFPA regulations and local fire department regulations and shall be confined within definite boundaries apart from buildings as approved by the Engineer and jurisdictional fire marshal.

1.10 PROTECTIVE BARRICADES AND SAFETY PRECAUTIONS

- A. Construct and maintain barricades, lights, shoring, warning signs, and flashing lights as required by Federal and State safety ordinances and as required to protect the Owner's property from injury or loss and as necessary to protect the public and adjacent properties from harm and damage. Provide walks around obstructions made in a public place for prosecuting the Work. Leave all protection in place and maintain until removal is authorized.
- B. Guard and protect all workers, pedestrians, vehicles, structures, fencing, landscaping and the public from excavations, construction equipment, obstructions, and other dangers with adequate railings, guard rails, k-rails, temporary walks, barricades, warning signs, directional signs, overhead protection, planking, decking, danger lights, and other suitable safeguards.

1.11 TEMPORARY FENCING

- A. Furnish, construct, maintain, and later remove temporary fencing around the project site perimeter as indicated.
- B. Except as otherwise specified herein, temporary fencing shall conform to the State Standard Drawings and Specifications Standards for permanent fences.
- C. Used materials may be employed for temporary fencing, provided such used materials are good, sound, and are suitable for the purpose intended.
- D. Fencing materials may be commercial quality, provided the dimensions and sizes of said materials are equal to, or greater than, the dimensions and sizes indicated on the Standard Drawings or specified in the Contract Specifications. Additional fencing options include the following:
 - 1. Posts may be either metal or wood.
 - 2. Galvanizing and painting of steel items will not be required.
 - 3. Treating wood with wood preservatives will not be required.
 - 4. Concrete footings for metal posts will not be required, except where portable footings are required for temporary anchorage of posts.
- E. Temporary fencing which is damaged from any cause during the progress of the Work shall be repaired or replaced by the Contractor at no additional cost to the Owner.
- F. When no longer required for the Work, temporary fencing shall be removed. Removed fencing and related materials shall become the property of the Contractor and shall be removed from the site of the Work, except as otherwise provided herein.
- G. Holes and other damages caused by the removal of temporary fences shall be properly filled to match adjacent surfaces.

1.12 SECURITY

- A. Provide for security of the Work and the site until final inspection and acceptance of the Work. Storage areas shall be suitably fenced and lighted and routinely patrolled by security guards.
- B. The Owner assumes no responsibility for protection of structures and finished work or for loss of materials and equipment from the time that Contract operations have commenced until final acceptance of the Work.
- C. If watchman service is deemed necessary by the Contractor, such protection shall be provided by the Contractor, and all costs therefor shall be paid for by the Contractor.
- D. Damaged, lost, or stolen materials and equipment, whether or not stored or already installed, shall be replaced by the Contractor with new specified materials and equipment, including reinstallation expenses where applicable, at no additional cost to the Owner.

1.13 PUBLICITY RELEASES

- A. Contractor shall not release any information, story, photograph, plan, or drawing relating information about the Project to anyone, including press and other public communications medium, including, without limitation, on website(s).

1.14 REMOVAL OF TEMPORARY FACILITIES AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials prior to final inspection.
- B. Remove underground installations to a minimum depth of two feet.

1.15 OBSTRUCTIONS

Attention is directed to Section 5-1.36D, "Non-Highway Facilities," and Section 15, "Existing Highway Facilities," of the State Standard Specifications and these Special Provisions.

The Contractor's attention is directed to the existence of certain underground facilities that may require special precautions be taken by the Contractor to protect the health, safety and welfare of workmen and of the public. These facilities include, but are not limited to: irrigation lines and peripherals; lighting electric supply system conductors or conduits; telephone and cable service lines, either directly buried or in duct or conduit and; underground water, gas, and electrical distribution systems.

The Contractor shall notify the Engineer and the appropriate regional notification center for operators of subsurface installations at least two working days, but not more than 14 calendar days, prior to performing any excavation or other work close to any underground pipeline, conduit, duct, wire or other structure. Regional notification centers include but are not limited to the following:

Notification Center
Underground Service Alert - Northern California (USA)
1(800)227-2600

It is not the intent of the plans to show the exact location of existing or relocated utilities, and the Engineer assumes no responsibility therefore. Whenever any such utilities are indicated thereon, the Contractor shall be responsible for verifying their actual location and depth in the field. The Contractor shall notify USA prior to any excavation. All costs for potholing shall be considered as included in the contract price paid for Temporary Construction Facilities and no additional compensation will be allowed therefore. The Contractor shall provide the Engineer with the results of potholing activity.

The Contractor shall backfill and replace the pavement section in place following potholing activity in a manner acceptable to the Engineer and the utility.

It is the Contractor's responsibility to coordinate any potholing work with the necessary utilities. The Contractor will not be entitled to damages or additional payment for delays, mobilization or demobilization caused by utility company's failure to appear on site at the designated date and time for potholing activity.

END OF SECTION

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions; and
- C. Temporary Facilities and Controls.

1.02 SECTION INCLUDES:

- A. Administrative and procedural requirements for the following:
 - (1) Salvaging non-hazardous construction waste.
 - (2) Recycling non-hazardous construction waste.
 - (3) Disposing of non-hazardous construction waste.

1.03 DEFINITIONS:

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.04 PERFORMANCE REQUIREMENTS:

- A. General: Develop waste management plan that results in end-of Project rates for salvage/recycling of sixty-five percent (65%) by weight (or by volume, but not a combination) of total waste generated by the Work.

1.05 SUBMITTALS:

- A. Waste Management Plan: Submit waste management plan within 30 days of date established for commencement of the Work.
- B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit copies of report. Include the following information:
 - (1) Material category.
 - (2) Generation point of waste.
 - (3) Total quantity of waste in tons or cubic yards.
 - (4) Quantity of waste salvaged, both estimated and actual in tons or cubic yards.
 - (5) Quantity of waste recycled, both estimated and actual in tons or cubic yards.
 - (6) Total quantity of waste recovered (salvaged plus recycled) in tons or cubic yards.
 - (7) Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- C. Waste Reduction Calculations: Before request for final payment, submit copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

- H. Qualification Data: For Waste Management Coordinator.
- I. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- J. Submittal procedures and quantities are specified in Document 01 33 00.

1.06 QUALITY ASSURANCE:

- A. Waste Management Coordinator Qualifications: LEED Accredited Professional by U.S. Green Building Council.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements. Review methods and procedures related to waste management including, but not limited to, the following:
 - (1) Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
 - (2) Review requirements for documenting quantities of each type of waste and its disposition.
 - (3) Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - (4) Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - (5) Review waste management requirements for each trade.

1.07 WASTE MANAGEMENT PLAN:

- A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measurement throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

- (1) Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
- (2) Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
- (3) Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
- (4) Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
- (5) Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
- (6) Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION

3.01 PLAN IMPLEMENTATION:

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - (1) Comply with Document 01 50 00 for operation, termination, and removal requirements.
- B. [Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.]
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
 - (1) Distribute waste management plan to everyone concerned within 3 days of submittal return.

- (2) Distribute waste management plan to entities when they first begin work on site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - (1) Designate and label specific areas of Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - (2) Comply with Document 01 50 00 for controlling dust and dirt, environmental protection, and noise control.

3.02 RECYCLING CONSTRUCTION WASTE:

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to the Contractor.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 - (1) Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project Site. Include list of acceptable and unacceptable materials at each container and bin.
 - (a) Inspect containers and bins for contamination and remove contaminated materials if found.
 - (2) Stockpile processed materials on site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - (3) Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - (4) Store components off the ground and protect from the weather.
 - (5) Remove recyclable waste off District property and transport to recycling receiver or processor.

- D. Packaging:
 - (1) Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - (2) Polystyrene Packaging: Separate and bag material.
 - (3) Pallets: As much as possible, require deliveries using pallets to remove pallets from Project Site. For pallets that remain on Site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - (4) Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- E. Site-Clearing Wastes: Chip brush, branches, and trees on site.
- F. Wood Materials:
 - (1) Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - (2) Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- G. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
 - (1) Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.03 DISPOSAL OF WASTE:

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project Site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - (1) Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on site.
 - (2) Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off District property and legally dispose of them.

END OF DOCUMENT

FIELD OFFICES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions; and
- C. Temporary Facilities and Controls.

1.02 SECTION INCLUDES:

- A. Requirements for Field Offices and Field Office Trailers.

1.03 SUMMARY:

- A. General: Contractor shall provide District's Field Office Trailer and contents, for District's use exclusively, during the term of the Contract.
- B. Property: Trailer, furniture, furnishings, equipment, and the like, supplied by the Contractor with the Office Trailer shall remain the property of the Contractor; District property items installed, delivered, and the like by District within the Office Trailer will remain District's property.
- C. Modifications: District reserves the right to modify the trailer or contents, or both, as may be deemed proper by District.
- D. Condition: Trailer and contents shall be clean, neat, substantially finished, in good, proper, and safe condition for use, operation, and the like; the trailer and contents shall not be required to be new.
- E. Installation Timing: Provide safe, fully furnished, functional, proper, complete, and finished trailer properly ready for entire use, within fourteen (14) calendar days of District's notification of the issuance of Notice to Proceed.

1.04 SUBMITTALS:

- A. General: Submit submittals to District in quantity, format, type, and the like, as specified herein.
- B. Office Trailer Data: One (1) copy of manufacturer's descriptive data, technical descriptions, regulatory compliance, industry standards, installation, removal, and maintenance instructions.

- C. Equipment Data: Two (2) copies of manufacturer data for each type of equipment, if directed by District.
- D. Furniture and Furnishings Data: Two (2) copies of manufacturer data for each type of equipment, if directed by District.
- E. Plans: One (1) reproducible copy of appropriately scaled plans of trailer layout. Plans shall include, but not be limited to: lighting; furniture; equipment; telephone and electrical outlets; and the like.
- F. Product Samples: One (1) complete and entire unit of each type, if directed by District.

1.05 QUALITY ASSURANCE

- A. Standards: In the event that provisions of codes, regulations, safety orders, Contract Documents, referenced manufacturer's specifications, manufacturer's instructions, industry standards, and the like, are in conflict, the more restrictive and higher quality shall govern.
- B. Installer: Installer or Installers engaged by Contractor must have a minimum of five (5) years of documented and properly authenticated successful experience of specialization in the installation of the items or systems, or both, specified herein.
- C. Manufacturer: Contractor shall obtain products from nationally and industry recognized Manufacturer with five (5) years minimum, of immediately recent, continuous, documented and properly authenticated successful experience of specialization in the manufacture of the product specified herein.
- D. State Personnel Training: Provide proper training for maintenance and operations, including emergency procedures, and the like, as directed by District.
- E. Units: Shall be sound and free of defects, and shall not include any damage or defect that will impair the safety, installation, performance, or the durability of the entire Office Trailer and appurtenant systems.

1.06 REGULATORY REQUIREMENTS

- A. General: Work shall be executed in accordance with applicable Codes, Regulations, Statutes, Enactments, Rulings, Laws, each authority having jurisdiction, and including, but not limited to, Regulatory Requirements specified herein.
- B. California Building Standards Code ("CBSC").
- C. California Code of Regulations, Title 25, Chapter 3, Sub Chapter 2, Article 3 ("CCR").
- D. Coach Insignia: Trailer shall display California Commercial Coach Insignia; such insignia shall be deemed to show that the trailer is in accordance with the Construction and Fire Safety requirements of CCR.

PART 2 – PRODUCTS

2.01 FIELD OFFICE TRAILER

- A. General: Provide entire Field Office Trailer of type, function, operation, capacity, size, complete with controls, safety devices, accessories, and the like, for proper and durable installation. Partitions, walls, ceiling, and other interior and exterior surfaces shall be appropriately finished, including, but not limited to, trim, painting, wall base, floor covering, suspended or similar ceiling, and the like; provide systems, components, units, nuts, bolts, screws, anchoring devices, fastening devices, washers, accessories, adhesives, sealants, and other items of type, grade, and class required for the particular use, not identified but required for a complete, weather-tight, appropriately operating, and finished installation.
- B. Manufacturers: General Electric Capital Modular Space; The Space Place, Inc.; or equal.
- C. Program: Provide a wheel-mounted trailer with stairs, landings, platforms, ramps, and the like, in good, proper, safe, clean, and properly finished condition; with proper heavy duty locks, and other proper and effective security at all doors, windows, and the like. Trailer shall be maintained in good, proper, safe, clean, and properly finished condition during the Contract.
- (1) Nominal Trailer Size: Four hundred eighty (480) square feet, minimum.
 - (2) Stairs, Platform: Properly finished stairs, platforms, and ramps.
 - (3) Doors: Two (2), three (3) foot wide exterior doors with locksets; finished ramp, steps, and entry platform at each exterior door.
 - (4) Keys: Submit five (5) keys for each door, window, furniture unit, and the like. There shall be no other key copies or originals available; each key shall be identified for District; and shall be labeled, or tagged or both, as directed by District.
 - (5) Lighting: Sixty-five (65) foot-candles illumination minimum at any point, at thirty (30) inches above finished floor throughout from fluorescent light source, exclusively, or as directed by District.
 - (6) Electrical Outlets: One (1) duplex outlet evenly spaced every twelve (12) linear horizontal feet of wall face, and electrical service ready for use.
 - (7) Telephones and Telephone Outlets: Two (2) telephone lines wired, connected to telephone utility service, and ready for use, and two (2) telephone instruments, each with two (2)-line capability, speed dial and hands-free feature. Locate each outlet as directed by District.
 - (8) Voicemail Messaging System or Answering Machine: One (1) unit, two (2)-line; digital.

2.02 FIELD OFFICE TRAILER ITEMS

- A. General: Provide the Field Office Trailer with the following arranged into two (2) workstations:
- (1) Desks: Two (2) desks: thirty-six (36) inches by sixty (60) inches; steel, laminated plastic top; locking, one (1) or two (2) file drawers single pedestal; steel; provide five (5) keys to District.
 - (2) Tables: Two (2) tables; thirty-six (36) inches by sixty (60) inches; twenty-nine (29) inches high; steel, laminated plastic top tables; one (1) at each desk.
 - (3) Chairs: Two (2) chairs: swivel; steel; with seat cushion and arms; one (1) at each desk.
 - (4) Waste Baskets: Two (2) waste baskets, one at each desk.
- B. Furniture and Equipment: Provide in the space located to effect efficient and logical use.
- (1) File cabinet: One (1); four (4) drawer; lateral; steel locking.
 - (2) Plan Table: One (1) plan table: thirty-six (36) inches deep by seventy-two (72) inches wide by forty-two (42) inches high; adjustable; wood or steel; with lockable plan and pencil drawers.
 - (3) Drafting Stool: One (1) drafting stool; swiveling; steel; padded; adjustable; with footrest and casters.
 - (4) Bookshelf: One (1) bookshelf: thirty-six (36) inches deep by seventy-two (72) inches wide by forty-two (42) inches high; adjustable; wood or steel; with lockable plan and pencil drawer.
 - (5) Plan Rack: One (1) wheel mounted plan rack.
 - (6) Waste Baskets: One (1) large waste basket.
 - (7) Coat/Hat Hanger: Wall mounted with minimum capacity for four (4) garments and ten (10) hats.
 - (8) Document Management System: Shall include an integrated high-volume printer, copier, and facsimile machine, including stand, base, and storage cabinet; and shall include the following features:
 - (a) Type: Laser, dry electrostatic transfer, plain paper, digital, multi-function imaging system.
 - (b) Network: Ethernet or Token Ring network ready, Plug-and-Play.
 - (c) Print, send/receive facsimile from any connected workstation.

- (d) Resolution: Six hundred (600) dots per inch by six hundred (600) dots per inch, minimum.
 - (e) Print Speed: Twenty (20) pages per minute, minimum.
 - (f) Copies: Twenty (20) copies per minute, minimum.
 - (g) Document Handler: Forty (40) sheet, minimum
 - (h) Collator: Forty (40) bin, minimum, with stapling.
 - (i) Duplexing: Capable.
 - (j) Paper Size: Capable of handling paper sizes to eleven (11) inches by seventeen (17) inches.
 - (k) Paper Cassettes: One (1) each for eight and one half (8.5) inches by eleven (11) inches, eight and one half (8.5) inches by fourteen (14) inches, and eleven (11) inches by seventeen (17) inches paper sizes; minimum two hundred fifty (250) sheets per cassette.
 - (l) Reduction/Enlargement: Capable of reduction to twenty-five percent (25%) and enlargement to two hundred percent (200%).
 - (m) Facsimile Electronic Storage: Capable of storing minimum of fifty (50) speed dial numbers, group faxing and broadcast faxing.
 - (n) Facsimile Scanning: Capable of scanning into memory a minimum of one hundred (100) pages with maximum scan time of three (3) seconds per page.
 - (o) Halftone: Sixty-four (64) levels.
 - (p) Redial: Automatic and Manual.
- (9) Maintenance: Contractor shall purchase service agreements for each unit of equipment for the duration of the project plus two (2) months, and shall maintain all equipment in proper working condition. Service agreements shall include provision for replacement of toner cartridges and other items required to effect proper unit use. Service agreements shall also provide for:
- (a) Unlimited Service Calls.
 - (b) Same Day Response.
 - (c) All parts, labor, preventative maintenance and mileage.
 - (d) All chemicals, such as toner, fixing agent, and the like.

- (e) System training and setup.
- (10) Portable Toilets: Two (2); each shall include a urinal; each unit shall be a properly enclosed chemical unit conforming to ANSI Z4.3.
 - (a) Location: As directed by District.
 - (b) Maintenance: Maintain each unit and surrounding areas in a clean, hygienic and orderly manner, at all time. Empty, clean, and sanitize each unit each day at a location and time as directed by District.
 - (c) Removal: Relocate, or remove from the site, each Portable Toilet. Upon such directive by District, the Contractor shall forthwith relocate or remove each Portable Toilet and submit the affected areas to a condition which existed prior to the installation of each Portable Toilet, within three (3) calendar days, or as directed by District in writing, at no cost to District.

2.03 UTILITY AND SERVICES

- A. Telephone Service: Contractor shall provide and interface the entire telephone service and shall properly and timely pay for telephone service for District's non-long-distance use.
- B. Electrical Service: Provide all proper connections and continuously pay for service for the duration of the Work.

2.04 FINISHES

- A. General: Manufacturer standard finish system over surfaces properly cleaned, pretreated, and prepared to obtain proper bond; all visible surfaces shall be coated.
- B. Finish: Color as selected by District from manufacturer standard palette.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General: Properly prepare area and affected items to receive the Work. Set Work accurately in location, alignment, and elevation; rigidly, securely, and firmly anchor to appropriate structure; install plumb, straight, square, level, true, without racking, rigidly anchored to proper solid blocking, substrate, and the like; provide appropriate type and quantity of reinforcements, fasteners, adhesives, self-adhesive and other tapes; lubricants, coatings, accessories, and the like, as required for a complete, structurally rigid, stable, sound, and appropriately finished installation, in accordance with manufacturer's published instructions, and as indicated. The more restrictive and higher quality requirement shall govern. Moving parts shall be properly secured, without binding, looseness, noise, and the like.

- B. Installation: Install in accordance with 25 CCR 3.2.3 and as directed by District; jack up trailer and level both ways; mount on proper concrete piers with all load off wheels; provide required tie down and accessories per Section 4368 of referenced CCR, and as directed by District.
- C. Rejected Work: Work, materials, unit, items, systems, and the like, not accepted by District shall be deemed rejected, and shall forthwith be removed and replaced with proper and new Work, materials, unit, items, systems, and the like at no cost to District.
- D. Standard: Comply with manufacturer's published instructions, or with instructions as shown or indicated; the more restrictive and higher quality requirement shall govern.
- E. Location: As directed by District.
- F. Fire Resistance: Construct and install in accordance with UL requirements.
- G. Maintenance: Contractor shall maintain trailer and adjacent areas in a safe, clean and hygienic condition throughout the duration of the Work, and as directed by District. Properly repair or replace furniture or other items, as directed by District. Properly remove unsafe, damaged, or broken furniture, or similar items, and replace with safe and proper items. Contractor shall pay cost of all services, repair, and maintenance, or replacement of each item.
- H. Janitorial Service: Provide professional janitorial services, including, but not limited to, trash, waste paper baskets, fill paper dispensers; clean and dust all furniture, files, and the like; sweep and mop resilient and similar flooring; and vacuum carpeting and similar flooring.
 - (1) Frequency: Two (2) times per week, minimum.
- I. Removal: Properly remove the Office Trailer and contents from the Site upon completion of the Contract, or as directed by District in writing. Forthwith properly patch and repair affected areas; replace damaged items with new items. Carefully and properly inventory, clean, pack, store, and protect District property; submit District property to District at a date, time and location as directed by District.

END OF DOCUMENT

SECTION 01 56 39
TEMPORARY TREE PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included:
 - 1. Fence all trees at drip line where hand excavation is required.
 - 2. Protection of trees and other plants that are scheduled to remain. Contractor shall avoid injury or damage resulting from the Contractor's operations, including:
 - a. Cutting, breaking, or skinning of roots, trunks, or branches.
 - b. Smothering or soil compaction by stockpiled materials, excavated materials, foot or vehicular traffic within the dripline.
 - c. Desiccation due to interruption of existing irrigation schedule.
 - 3. Irrigation as directed or as required to maintain the health of trees and other plants to remain, where existing irrigation of such plants is shut down for the work of this Contract.
 - 4. Restoration of existing landscape. Repair and/or replacement of trees and other plants damaged during the construction operation shall be at the Contractor's expense and to the Owner's satisfaction. Repair and/or replacement of any irrigation systems damaged or removed during the construction operation shall similarly be at the Contractor's expense and to the Owner's satisfaction.
- B. Related Work: Consult all other applicable Sections. Coordinate installation with the work of other trades and with tree removal, pruning, and tying work by Owner.

1.2 QUALITY ASSURANCE

- A. Before beginning work, Contractor shall meet with the Owner's Representative at the site to review all work procedures, access routes, storage areas, and tree protection measures.
- B. Contractor shall notify Owner's Representative when installation of protective fencing and mulch is complete and shall not proceed with site work until such installation is approved by Owner's Representative.
- C. Contractor shall keep Owner's Representative informed of the work schedule, so that Owner's Representative may be on hand to observe the work and give direction regarding tree protection during the course of the work.

1.3 SCHEDULING

- A. Coordinate work schedule with tree work by Owner so that tree removal, pruning, and tying back of branches are complete before site work begins, and so that tree branches are tied back for the minimum amount of time necessary for the protection of the tree.
- B. Install protective fencing and mulch before starting site work.

1.4 GUARANTEE

- A. If a tree to remain is destroyed, or damaged so that in the judgment of the Owner's Representative it should be replaced, it shall be removed at Contractor's expense. Except as provided below, back charges will be assessed at the rate of \$450.00 per inch of circumference at 12 inches above grade for trees with a diameter of 8 inches or less and at D.B.H. (Diameter at Breast Height) for diameters greater than 8 inches.
- B. If a shrub to remain is destroyed, or damaged so that in the judgment of the Owner's Representative it should be replaced, it shall be removed at the Contractor's expense. Back charges will be assessed at the rate of \$300.00 per shrub.

- C. If irrigated groundcover to remain is destroyed, or damaged so that in the judgment of the Owner's Representative it should be replaced, it shall be removed at the Contractor's expense.

PART 2 - PRODUCTS

2.1 TREE PROTECTION MATERIALS

- A. Barricade Fence: Plastic construction fencing ("snow fencing") constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches (2400 mm) apart. High-visibility orange color. Height to be 5'.
- B. Trunk Protection Wrap: Trunk protection wrap shall be used to provide specific protection to tree trunks and certain branches when construction activities are expected to be in close proximity. Material shall be SynTec ROADRAIN T-7 or approved equal or 2x4 wooden slats. Trunk protection wrap shall be extended in height on each trunk and on any limbs that could be damaged to protect them during construction activities to the satisfaction of the Arborist. Wrap tree trunk (and limbs, as determined by the Arborist) with geocomposite material. More than one layer may be installed to reach suitable protection from the equipment or operations designated for work in the area. Attach with banding or strong tape that will not girdle the tree during the project timeframe. No nails or other devices are to penetrate the trunk. Remove wrap promptly after construction is complete.
- C. Anti-desiccant: Manufactured for use on plants. Provide evidence that material can be used on specified trees. Do not use anti-desiccant without approval of Owner's Representative.
- D. Untreated burlap.
- E. Black plastic sheets.
- F. Wood chips.

PART 3 - EXECUTION

3.1 GENERAL

- A. Protect existing trees from damage or injury.
- B. Permit no storage, disposal, fires or stockpiling within dripline. Permit no traffic within dripline without prior approval by Owner's Representative.
- C. No materials, equipment, spoil, or waste or washout water may be deposited, stored, or parked within dripline.
- D. Prevent puddling or continuous running water within dripline.
- E. If directed to do so, install silt fences, water diversion structures, or other erosion control devices to prevent siltation or erosion within the dripline of trees to remain.
- F. Maintain fire-safe areas around trees to remain. Permit no heat sources, flames, ignition sources, or smoking near mulch or trees.
- G. Herbicides placed under paving materials shall be safe for use around trees and labeled for that use. Pesticides used on site shall be safe for use around trees and not easily transported by water.
- H. Work within dripline of trees to remain shall be as directed by Owner's Representative. Earth surface within dripline shall not be changed except as shown or specified or as directed by Owner's Representative. Trenching, grading or excavation to below depth of root zone, within dripline, shall be done by hand. Excavation within dripline below root zone may be done by means other than by hand if approved by Owner's Representative. Roots encountered that are less than 1-inch in diameter shall be cut cleanly with a sharp saw, vibrating knife, or other approved root pruning equipment. Roots shall not be pulled, jerked, or lifted. Any roots damaged during the course of the work shall be exposed to sound tissue and cut cleanly with

approved root-pruning equipment. Roots larger than 1-inch that are in the way of the new utility may be cut with the approval of the Owner's Representative in consultation with the Owner's Grounds Department. Roots larger than 1-inch that are not in the way of the utility shall be protected as noted in Item I below.

- I. Do not allow exposed roots to dry out before permanent backfill is placed. Protect exposed roots with 4 layers of wet untreated burlap and a top layer of black plastic anchored in place. Keep burlap moist until placement of backfill. Remove burlap and plastic at time of backfilling.
- J. Exercise extreme care in removing concrete or asphalt within dripline. Paving pieces shall be lifted rather than dragged. Protect surface roots immediately with 4-inch layer of chipped mulch.
- K. Where vehicles or equipment must operate or travel in unpaved landscape areas, Contractor shall place a minimum 10-inch layer of wood chips over the work area before starting work there. This mulch layer shall be replenished as necessary to maintain a ten-inch depth until operations in the area are complete. Contractor shall remove mulch upon completion of the work, unless directed otherwise. Where crane outriggers or other heavy equipment must be positioned in unpaved landscape areas, contractor shall provide additional protection against soil compaction and landscape damage. Means of providing such additional protection may include the placement of base rock and heavy timbers beneath heavy equipment. Contractor shall obtain approval of Owner's Representative for protective measures before placing or operating heavy equipment in unpaved landscape areas.
- L. Where vehicles or equipment must operate or travel over paved areas located within the dripline or over the root area of trees to remain, Contractor shall place a minimum ten (10) inch depth of mulch over the work area until operations there are complete and shall remove mulch upon completion of the work. Where crane outriggers or other heavy equipment must be positioned in paved areas located within the dripline or over the root area of trees to remain, Contractor shall provide additional protection against soil compaction and paving damage. Means of providing such additional protection may include the placement of additional mulch and steel plates beneath heavy equipment. Contractor shall obtain approval of Owner's Representative for protective measures before placing or operating heavy equipment over the root area of trees to remain.
- M. Pruning of trees and tying back of branches shall be by Owner. Contractor shall identify access and clearance requirements for operation of equipment and shall inform Owner's Representative of these requirements at the pre-work site visit specified herein. Contractor shall coordinate work schedule with tree work by Owner and shall not begin work until tree work by Owner is complete. If additional requirements for pruning, tying of branches or vegetation removal arise during the course of the work, Contractor shall inform Owner's Representative immediately.
- N. Any damage to trees due to Contractor's operations shall be reported to Owner's Representative immediately so that remedial action can be taken. Timeliness is critical to tree health.

3.2 BARRICADES

- A. Install protective fencing around trees to remain, as directed by Owner's Representative.
- B. Locate fence at dripline unless directed otherwise by Owner's Representative.
- C. Locate roots before setting posts. Prevent damage to roots.
- D. Space posts approximately 8- feet apart and securely attach fabric.
- E. Protective fencing shall be plumb, taut, and sturdy.
- F. Repair sagging or damaged protective fencing immediately. Remove protective fencing upon completion of work.

3.3 IRRIGATION

- A. As directed by Owner's Representative. The need for irrigation will be determined by the Owner's Representative based on weather and soil conditions and the length of time that existing irrigation will be interrupted by the work.
- B. Each irrigation shall wet the soil to the following depths:

<u>Area</u>	<u>Wetted Soil Depth</u>
Within dripline of tree to remain:	36 inches
Not within dripline of tree to remain:	
Shrub planting	12 inches
Groundcover planting	6 inches
Turf	6 inches

3.4 LANDSCAPE REPAIR

- A. Contractor shall repair any damage to the existing irrigation system caused by the work and replace any portion of the existing irrigation system that is removed as a result of the work.
- B. Contractor shall restore the site to existing grade except where shown or specified otherwise.
- C. Except where shown or specified otherwise, any existing lawn area disturbed by the work shall be restored to existing grade and revegetated with sod of approved species.
- D. Except where shown or specified otherwise, any existing groundcover area disturbed by the work shall be restored to existing grade and replanted with the same plants as those removed.

END OF SECTION

OWNER-FURNISHED PRODUCTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions; and
- C. Materials and Equipment.

1.02 SECTION INCLUDES

- A. Requirements for the following:
 - (1) Installing Owner-furnished materials and equipment.
 - (2) Providing necessary utilities, connections and rough-ins.

1.03 DEFINITIONS

- A. Owner: District, who is providing/furnishing materials and equipment.
- B. Installing Contactor: Contractor, who is installing the materials and equipment furnished by the Owner.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Receive, store and handle products in accordance with the manufacturer's instructions.
- B. Protect equipment items as required to prevent damage during storage and construction.

PART 2 – PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

- A. Installing Contractor's Responsibilities:
 - (1) Verify mounting and utility requirements for Owner-furnished materials and equipment items.

Provide mounting and utility rough in for all items where required.

- (a) Rough in locations, sizes, capacities, and similar type items shall be as indicated and required by product manufacturer.

B. Owner and Installing Contractor(s) Responsibilities:

- (1) Owner-Furnished/Contractor Installed ("OFICI"): Furnished by the Owner; installed by the Installing Contractor.
 - (a) General: Owner and Installing Contractor(s) will coordinate deliveries of materials and equipment to coincide with the construction schedule.
 - (b) Owner will furnish specified materials and equipment delivered to the site. Owner/vendor's representative shall be present on Site at the time of delivery to comply with the contract requirements and Specifications Section 01 43 00, Materials and Equipment, Article 1.04.
 - (c) The Owner furnishing specified materials and equipment is responsible to provide manufacturer guarantees as required by the Contract to the Installing Contractor.
 - (d) The Installing Contractor shall:
 - 1) Review, verify and accept the approved manufacturer's submittal/Shop Drawings for all materials and equipment required to be installed by the Installing Contractor and furnished by the Owner. Any discrepancies, including but not limited to possible space conflicts, should be brought to the attention of the Project Manager and/or Program Manager, if applicable.
 - 2) Coordinate timely delivery. Installing Contractor shall receive materials and equipment at Site when delivered and give written receipt at time of delivery, noting visible defects or omissions; if such declaration is not given, the Installing Contractor shall assume responsibility for such defects and omissions.
 - 3) Store materials and equipment until ready for installation and protect from loss and damage. Installing Contractor is responsible for providing adequate storage space.
 - 4) Coordinate with other bid package contractors and field measurement to ensure complete installation.
 - 5) Uncrate, assemble, and set in place.
 - 6) Provide adequate supports.

- 7) Install materials and equipment in accordance with manufacturer's recommendations, instructions, and Shop Drawings, supply labor and material required, and make mechanical, plumbing, and electrical connections required to operate equipment.
 - 8) Be certified by equipment manufacturer for installation of the specific equipment supplied by the Owner.
 - 9) This number not used.
 - 10) Provide the contract-required warranty and guarantee for all work, materials and equipment, and installation upon its completion and acceptance by the District. Guarantee includes all costs associated with the removal, shipping to and from the Site, and re-installation of any equipment found to be defective.
- C. Compatibility with Space and Service Requirements:
- (1) Equipment items shall be compatible with space limitations indicated and as shown on the Contract Documents and specified in other sections of the Specifications.
 - (2) Modifications to equipment items required to conform to space limitations specified for rough in shall not cause additional cost to the District.
- D. Manufacturer's printed descriptions, specifications, and instructions shall govern the Work unless specifically indicated or specified otherwise.

2.02 FURNISHED MATERIALS AND EQUIPMENT

- A. All furnished materials and equipment are indicated or scheduled on the Contract Documents.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install equipment items in accordance with the manufacturer's instructions.
- B. Set equipment items securely in place, rigidly or flexibly mounted in accordance with manufacturers' directions.
- C. Make electrical and mechanical connections as indicated and required.
- D. Touch-up and restore damaged or defaced finishes to the Owner's satisfaction.

3.02 CLEANING AND PROTECTION

- A. Repair or replace items not acceptable to the Architect or Owner.
- B. Upon completion of installation, clean equipment items in accordance with manufacturer's recommendations, and protect from damage until final acceptance of the Work by the Owner.

END OF DOCUMENT

SECTION 01 66 00

PRODUCT DELIVERY, STORAGE AND HANDLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Site Access, Conditions and Requirements;
- B. Special Conditions.

1.02 PRODUCTS

- A. Products are as defined in the General Conditions.
- B. Contractor shall not use and/or reuse materials and/or equipment removed from existing Premises, except as specifically permitted by the Contract Documents.
- C. Contractor shall provide interchangeable components of the same manufacturer, for similar components.

1.03 TRANSPORTATION AND HANDLING

- A. Contractor shall transport and handle Products in accordance with manufacturer's instructions.
- B. Contractor shall promptly inspect shipments to confirm that Products comply with requirements, quantities are correct, and products are undamaged.
- C. Contractor shall provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.04 STORAGE AND PROTECTION

- A. Contractor shall store and protect Products in accordance with manufacturer's instructions, with seals and labels intact and legible. Contractor shall store sensitive products in weather-tight, climate controlled enclosures.
- B. For exterior storage of fabricated Products, Contractor shall place on sloped supports, above ground.
- C. Contractor shall provide off-site storage and protection when Site does not permit on-site storage or protection.

- D. Contractor shall cover products subject to deterioration with impervious sheet covering and provide ventilation to avoid condensation.
- E. Contractor shall store loose granular materials on solid flat surfaces in a well-drained area and prevent mixing with foreign matter.
- F. Contractor shall provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- G. Contractor shall arrange storage of Products to permit access for inspection and periodically inspect to assure Products are undamaged and are maintained under specified conditions.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

FIELD ENGINEERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Site Investigation, and Soils Investigation Report;
- B. Special Conditions;
- C. Site-Visit Certification.

1.02 REQUIREMENTS INCLUDED:

- A. Contractor shall provide and pay for field engineering services by a California-registered engineer, required for the project, including, without limitations:
 - (1) Survey work required in execution of the Project.
 - (2) Civil or other professional engineering services specified, or required to execute Contractor's construction methods.

1.03 QUALIFICATIONS OF SURVEYOR OR ENGINEERS:

Contractor shall only use a qualified licensed engineer or registered land surveyor, to whom District makes no objection.

1.04 SURVEY REFERENCE POINTS:

- A. Existing basic horizontal and vertical control points for the Project are those designated on the Drawings.
- B. Contractor shall locate and protect control points prior to starting Site Work and preserve all permanent reference points during construction. In addition Contractor shall:
 - (1) Make no changes or relocation without prior written notice to District and Architect.
 - (2) Report to District and Architect when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
 - (3) Require surveyor to replace Project control points based on original survey control that may be lost or destroyed.

1.05 RECORDS:

Contractor shall maintain a complete, accurate log of all control and survey work as it progresses.

1.06 SUBMITTALS:

- A. Contractor shall submit name and address of Surveyor and Professional Engineer to District and Architect prior to its/their work on the Project.
- B. On request of District and Architect, Contractor shall submit documentation to verify accuracy of field engineering work, at no additional cost to the District.
- C. Contractor shall submit a certificate signed by registered engineer or surveyor certifying that elevations and locations of improvements are in conformance or nonconformance with Contract Documents.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION

3.01 COMPLIANCE WITH LAWS:

Contractor is responsible for meeting all applicable codes, OSHA, safety and shoring requirements.

3.02 NONCONFORMING WORK:

Contractor is responsible for any re-surveying required by correction of nonconforming work.

END OF DOCUMENT

CUTTING AND PATCHING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Inspector, Inspections, and Tests, Integration of Work, Nonconforming Work, and Correction of Work, and Uncovering Work;
- B. Special Conditions;
- C. Hazardous Materials Procedures and Requirements;
- D. Hazardous Materials Certification;
- E. Lead-Based Paint Certification;
- F. Imported Materials Certification.

1.02 CUTTING AND PATCHING:

- A. Contractor shall be responsible for all cutting, fitting, and patching, including associated excavation and backfill, required to complete the Work or to:
 - (1) Make several parts fit together properly.
 - (2) Uncover portions of Work to provide for installation of ill-timed Work.
 - (3) Remove and replace defective Work.
 - (4) Remove and replace Work not conforming to requirements of Contract Documents.
 - (5) Remove Samples of installed Work as specified for testing.
 - (6) Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.
 - (7) Attaching new materials to existing remodeling areas – including painting (or other finishes) to match existing conditions.
- B. In addition to Contract requirements, upon written instructions from the District, Contractor shall uncover Work to provide for observations of covered Work in accordance with the Contract Documents; remove samples of

installed materials for testing as directed by District; and remove Work to provide for alteration of existing Work.

- C. Contractor shall not cut or alter Work, or any part of it, in such a way that endangers or compromises the integrity of the Work, the Project, or work of others.

1.03 SUBMITTALS:

- A. Prior to any cutting or alterations that may affect the structural safety of Project, or work of others, and well in advance of executing such cutting or alterations, Contractor shall submit written notice to District pursuant to the applicable notice provisions of the Contract Documents, requesting consent to proceed with the cutting or alteration, including the following:
 - (1) The work of the District or other trades.
 - (2) Structural value or integrity of any element of Project.
 - (3) Integrity or effectiveness of weather-exposed or weather-resistant elements or systems.
 - (4) Efficiency, operational life, maintenance or safety of operational elements.
 - (5) Visual qualities of sight-exposed elements.
- B. Contractor's Request shall also include:
 - (1) Identification of Project.
 - (2) Description of affected Work.
 - (3) Necessity for cutting, alteration, or excavations.
 - (4) Affects of Work on District, other trades, or structural or weatherproof integrity of Project.
 - (5) Description of proposed Work:
 - (a) Scope of cutting, patching, alteration, or excavation.
 - (b) Trades that will execute Work.
 - (c) Products proposed to be used.
 - (d) Extent of refinishing to be done.
 - (6) Alternates to cutting and patching.
 - (7) Cost proposal, when applicable.

- (8) The scheduled date the Contractor intends to perform the Work and the duration of time to complete the Work.
- (9) Written permission of District or other District contractor(s) whose work will be affected.

1.04 QUALITY ASSURANCE:

- A. Contractor shall ensure that cutting, fitting, and patching shall achieve security, strength, weather protection, appearance for aesthetic match, efficiency, operational life, maintenance, safety of operational elements, and the continuity of existing fire ratings.
- B. Contractor shall ensure that cutting, fitting, and patching shall successfully duplicate undisturbed adjacent profiles, materials, textures, finishes, colors, and that materials shall match existing construction. Where there is dispute as to whether duplication is successful or has been achieved to a reasonable degree, the District's decision shall be final.

1.05 PAYMENT FOR COSTS:

- A. Cost caused by ill-timed or defective Work or Work not conforming to Contract Documents, including costs for additional services of the District, its consultants, including but not limited to the Construction Manager, the Architect, the Project Inspector(s), Engineers, and Agents, will be paid by Contractor and/or deducted from the Contract by the District.
- B. District shall only pay for cost of Work if it is part of the original Contract Price or if a change has been made to the contract in compliance with the provisions of the General Conditions. Cost of Work performed upon instructions from the District, other than defective or nonconforming Work, will be paid by District on approval of written Change Order. Contractor shall provide written cost proposals prior to proceeding with cutting and patching.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Contractor shall provide for replacement and restoration of Work removed. Contractor shall comply with the Contract Documents and with the Industry Standard(s), for the type of Work, and the Specification requirements for each specific product involved. If not specified, Contractor shall first recommend a product of a manufacturer or appropriate trade association for approval by the District.
- B. Materials to be cut and patched include those damaged by the performance of the Work.

PART 3 – EXECUTION

3.01 INSPECTION:

- A. Contractor shall inspect existing conditions of the Site and the Work, including elements subject to movement or damage during cutting and patching, excavating and backfilling. After uncovering Work, Contractor shall inspect conditions affecting installation of new products.
- B. Contractor shall report unsatisfactory or questionable conditions in writing to District as indicated in the General Conditions and shall proceed with Work as indicated in the General Conditions by District.

3.02 PREPARATION:

- A. Contractor shall provide shoring, bracing and supports as required to maintain structural integrity for all portions of the Project, including all requirements of the Project.
- B. Contractor shall provide devices and methods to protect other portions of Project from damage.
- C. Contractor shall, provide all necessary protection from weather and extremes of temperature and humidity for the Project, including without limitation, any work that may be exposed by cutting and patching Work. Contractor shall keep excavations free from water.

3.03 ERECTION, INSTALLATION AND APPLICATION:

- A. With respect to performance, Contractor shall:
 - (1) Execute fitting and adjustment of products to provide finished installation to comply with and match specified tolerances and finishes.
 - (2) Execute cutting and demolition by methods that will prevent damage to other Work, and provide proper surfaces to receive installation of repairs and new Work.
 - (3) Execute cutting, demolition excavating, and backfilling by methods that will prevent damage to other Work and damage from settlement.
- B. Contractor shall employ original installer or fabricator to perform cutting and patching for:
 - (1) Weather-exposed surfaces and moisture-resistant elements such as roofing, sheet metal, sealants, waterproofing, and other trades.
 - (2) Sight-exposed finished surfaces.
- C. Contractor shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances,

and finishes as shown or specified in the Contract Documents including, without limitation, the Drawings and Specifications.

- D. Contractor shall fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. Contractor shall conform to all Code requirements for penetrations or the Drawings and Specifications, whichever calls for a higher quality or more thorough requirement. Contractor shall maintain integrity of both rated and non-rated fire walls, ceilings, floors, etc.
- E. Contractor shall restore Work which has been cut or removed. Contractor shall install new products to provide completed Work in accordance with requirements of the Contract Documents and as required to match surrounding areas and surfaces.
- F. Contractor shall refinish all continuous surfaces to nearest intersection as necessary to match the existing finish to any new finish.

END OF DOCUMENT

SECTION 017419

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 1. Salvaging nonhazardous construction and demolition waste.
 2. Recycling nonhazardous construction and demolition waste.
 3. Disposing of nonhazardous construction and demolition waste.

1.2 DEFINITIONS

- A. **Alternative daily cover:** Cover material other than earthen material placed on the surface of the active face of a municipal solid waste landfill at the end of each operating day to control vectors, fires, odors, blowing litter, and scavenging.
- B. **Construction Waste:** Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- C. **Demolition Waste:** Building and site improvement materials resulting from demolition or selective demolition operations
- D. **Disposal:** Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- E. **Extended Producer Responsibility:** Closed-loop program, aka product take-back, are measures undertaken by a producer to accept its own and sometimes other manufacturers' products as post-consumer waste at the end of the product's useful life to recover and recycle the materials for use in new products of the same type.
- F. **Material Stream:** A material flow coming from a jobsite into markets for building materials including a specific material category that is diverted in a specific way or a mixture of several material categories that are diverted in a specific way.
- G. **On site Waste Diversion:** On site reuse including crushing asphalt, concrete, and masonry for infill or aggregate.
- H. **Recycle:** Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- I. **Salvage:** Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- J. **Salvage and Reuse:** Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of at least 50% by weight (minimum allowable) of total waste generated by the work with a minimum of two separate diverted material streams (1 LEED pt). For a total 2 LEED points, divert 75% by weight and three separate diverted material streams (2 points). Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.4 ACTION SUBMITTALS

- A. Construction and Demolition Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed. Plan should meet the requirements outlined below in Section 1.7.

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
 - 1. Material category.
 - 2. Total quantity of waste in tons.
 - 3. Quantity of waste salvaged, in tons.
 - 4. Quantity of waste recycled, in tons.
 - 5. Quantity of waste diverted on site, in tons.
 - 6. Total quantity of waste diverted (salvaged, recycled, and on site diversion) in tons.
 - 7. Total quantity of waste diverted salvaged, recycled, and on site diversion) as a percentage of total waste.
 - 8. Location and name of facilities, organizations or landfills receiving waste.
 - 9. For commingled materials, provide the annual reporting rate for that facility. To count toward the corresponding credit (MR Credit Construction and Demolition Waste Management), commingled recycling facilities must be able to provide diversion rates either specific to the project, or an average diversion rate for the facility that is regulated by the local or state authority. The average recycling rate for the facility must exclude alternative daily cover (ADC).
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Record of Extended Producer Responsibility Program: Indicate receipt and acceptance of materials from the manufacturer participating in the program.
- E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

- G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- H. LEED Submittal:
 - 1. LEED Credit Form for Prerequisite MR 2 and Credit MR 5: Construction & Demolition Waste Management – the General Contractor shall populate the LEED Online form identifying total waste material, quantities diverted and means by which it is diverted, number of material streams diverted, hauler or facility, and waste-recycling statements showing that the requirements for the credit have been met.
 - 2. Construction Calculator: Complete the Construction Calculator, signed by General Contractor tabulating total waste material, quantities diverted and number of material streams diverted, and statement that requirements for the credit have been met.
 - 3. Waste Hauling Tickets and Recycling Receipts showing the total waste material, quantities diverted, number of material streams diverted, and the hauler or facility.
- I. Qualification Data: For waste management coordinator.

1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED-Accredited Professional, certified by the USGBC, as waste management coordinator. Waste management coordinator may also serve as LEED coordinator.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. The Plan must include the following information and directives:
 - 1. Must be customized for each project.
 - 2. Must include an overall project waste diversion goal and identify at least five materials (both structural and nonstructural) targeted for diversion from landfills or incineration.
 - 3. Must account for all materials, including land-clearing debris, materials to be used for alternative daily cover (ADC), and other materials not contributing to diversion but not included in the diverted waste total.
 - 4. Must include the strategy for the safe removal and disposal of hazardous materials. Hazardous materials must be tracked separately and not be included in the project's total waste.

- B. Waste Identification: Indicate anticipated types and quantities of site-clearing, demolition and construction waste generated by the Work. Identify at least two kinds of materials that will be diverted from landfills or incineration. Include estimated quantities and assumptions for estimates. Specify the means and methods of diversion for each of the selected material streams.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work. Include on site reuse such as crushing asphalt, concrete, and masonry for infill or aggregate.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 5. Extended Producer Responsibility: Include list of manufacturers that may accept materials as part of a take-back program.
 - 6. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 7. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 4. Store components off the ground and protect from the weather.
 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.3 RECYCLING CONSTRUCTION WASTE – BEST PRACTICES

- A. Packaging:
 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Commingled Waste Recycling:
 1. If utilizing commingled waste strategy, the General Contractor shall select a facility that meets ONE of the following:
 - a. Facility has an average diversion rate and is regulated by the local or state authority and must exclude alternative daily cover (ADC). This system must be a closed system; shipping waste to another municipality to manage, thus burdening another system, does not count as diverting the waste.

- b. The waste-sorting facility shall provide a waste diversion percentage specific to the project's waste based on measurement of each component waste material. Visual inspection is not an acceptable method of evaluation for documenting this percentage.

C. Source Separated Waste Recycling:

1. If utilizing a source separation waste strategy, the Construction Waste Management Plan shall include a list of anticipated types and quantities of waste materials generated from the Project site and proposed siting locations (including map) for waste/recycling containers. The plan shall identify materials to be recycled, re-used or salvaged. It shall include efforts at source reduction, material handling procedures and collection of weight and hauling destination information.
2. Source Reduction: List processes that minimize waste such as working with suppliers to take back or buy back substandard, rejected or unused items and to deliver supplies using returnable pallets and containers. Also include procedures to minimize breakage, mishandling, contamination, and other factors that reduce job site waste.
3. Material Handling Procedures: List means by which source separated waste materials will be protected from contamination, and the means for recycling them consistent with requirements for acceptance by designated facilities
4. Implement recycling program that includes separate collection of waste materials of following types as applicable to Project:
 - a. Asphalt.
 - b. Land clearing debris.
 - c. Soil.
 - d. Trees and shrubs.
 - e. Concrete and concrete blocks.
 - f. Brick and masonry materials.
 - g. Wood.
 - h. Cardboard and paper packaging materials.
 - i. Plastics.
 - j. Ferrous metal.
 - k. Non-ferrous metals (e.g. copper, aluminum, etc.).
 - l. Glass.
 - m. Food and beverage containers.
 - n. Electrical fixtures and wires.
 - o. Other (where applicable)

- D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION

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ALTERATION PROJECT PROCEDURES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Integration of Work, Purchase of Materials and Equipment, Uncovering of Work and Non-conforming Work and Correction of Work and Trenches;
- B. Special Conditions.

PART 2 - PRODUCTS

2.01 PRODUCTS FOR PATCHING AND EXTENDING WORK:

- A. New Materials: As specified in the Contract Documents including, without limitation, in the Specifications, Contractor shall match existing products, conditions, and work for patching and extending work.
- B. Type and Quality of Existing Products: Contractor shall determine by inspection, by testing products where necessary, by referring to existing conditions and to the Work as a standard.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Contractor shall verify that demolition is complete and that areas are ready for installation of new Work.
- B. By beginning restoration Work, Contractor acknowledges and accepts the existing conditions.

3.02 PREPARATION:

- A. Contractor shall cut, move, or remove items as necessary for access to alterations and renovation Work. Contractor shall replace and restore these at completion.
- B. Contractor shall remove unsuitable material not as salvage unless otherwise indicated in the Contract Documents. Unsuitable material may include, without limitation, rotted wood, corroded metals, and deteriorated masonry and concrete. Contractor shall replace materials as specified for finished Work.

- C. Contractor shall remove debris and abandoned items from all areas of the Site and from concealed spaces.
- D. Contractor shall prepare surface and remove surface finishes to provide for proper installation of new Work and finishes.
- E. Contractor shall close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity. Contractor shall insulate ductwork and piping to prevent condensation in exposed areas. Contractor shall insulate building cavities for thermal and/or acoustical protection, as detailed.

3.03 INSTALLATION:

- A. Contractor shall coordinate Work of all alternations and renovations to expedite completion and to accommodate District occupancy.
- B. Designated Areas and Finishes: Contractor shall complete all installations in all respects, including operational, mechanical work and electrical work.
- C. Contractor shall remove, cut, and patch Work in a manner to minimize damage and to provide a means of restoring Products and finishes to original or specified condition.
- D. Contractor shall refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat and square or straight transition to adjacent finishes.
- E. Contractor shall install products as specified in the Contract Documents, including without limitation, the Specifications.

3.04 TRANSITIONS:

- A. Where new Work abuts or aligns with existing, Contractor shall perform a smooth and even transition. Patched Work must match existing adjacent work in texture and appearance.
- B. When finished surfaces are cut so that a smooth transition with new Work is not possible, Contractor shall terminate existing surface along a straight line at a natural line of division and make a recommendation for resolution to the District and the Architect for review and approval.

3.05 ADJUSTMENTS:

- A. Where removal of partitions or walls results in adjacent spaces becoming one, Contractor shall rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- B. Where a change of plane of 1/4 inch or more occurs, Contractor shall submit a recommendation for providing a smooth transition to the District and the Architect for review and approval.

- C. Contractor shall trim and seal existing wood doors and shall trim and paint metal doors as necessary to clear new floor finish and refinish trim as required.
- D. Contractor shall fit Work at penetrations of surfaces.

3.06 REPAIR OF DAMAGED SURFACES:

- A. Contractor shall patch or replace portions of existing surfaces, which are damaged, lifted, discolored, or showing other imperfections, in the area where the Work is performed.
- B. Contractor shall repair substrate prior to patching finish.

3.07 CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS:

- A. Cultivated or planted areas and other surface improvements which are damaged by actions of the Contractor shall be restored by Contractor to their original condition or better, where indicated.
- B. Contractor shall protect and replace, if damaged, all existing guard posts, barricades, and fences.
- C. Contractor shall give special attention to avoid damaging or killing trees, bushes and/or shrubs on the Premises and/or identified in the Contract Documents, including without limitation, the Drawings.

3.08 FINISHES:

- A. Contractor shall finish surfaces as specified in the Contract Documents, including without limitations, the provisions of all Divisions of the Specifications.
- B. Contractor shall finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, Contractor shall refinish entire surface to nearest intersections.

3.09 CLEANING:

- A. Contractor shall continually clean the Site and the Premises as indicated in the Contract Documents, including without limitation, the provisions in the General Conditions and the Specifications regarding cleaning.

END OF DOCUMENT

CONTRACT CLOSEOUT AND FINAL CLEANING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Completion of Work;
- B. Special Conditions;
- C. Temporary Facilities and Controls.

1.02 CLOSEOUT PROCEDURES

Contractor shall comply with all closeout provisions as indicated in the General Conditions.

1.03 FINAL CLEANING

- A. Contractor shall execute final cleaning prior to final inspection.
- B. Contractor shall clean interior and exterior glass and all surfaces exposed to view; remove temporary labels, tape, stains, and foreign substances, polish transparent and glossy surfaces, wax and polish new vinyl floor surfaces, vacuum carpeted and soft surfaces.
- C. Contractor shall clean equipment and fixtures to a sanitary condition.
- D. Contractor shall replace filters of operating equipment.
- E. Contractor shall clean debris from roofs, gutters, down spouts, and drainage systems.
- F. Contractor shall clean Site, sweep paved areas, and rake clean landscaped surfaces.
- G. Contractor shall remove waste and surplus materials, rubbish, and construction facilities from the Site and surrounding areas.

1.04 ADJUSTING

Contractor shall adjust operating products and equipment to ensure smooth and unhindered operation.

1.05 RECORD DOCUMENTS AND SHOP DRAWINGS

- A. Contractor shall legibly mark each item to record actual construction, including:
 - (1) Measured depths of foundation in relation to finish floor datum.
 - (2) Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permit surface improvements.
 - (3) Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - (4) Field changes of dimension and detail.
 - (5) Details not on original Contract Drawings
 - (6) Changes made by modification(s).
 - (7) References to related Shop Drawings and modifications.
- B. Contractor will provide one set of Record Drawings to District.
- C. Contractor shall submit all required documents to District and/or Architect prior to or with its final Application for Payment.

1.06 INSTRUCTION OF DISTRICT PERSONNEL

- A. Before final inspection, at agreed upon times, Contractor shall instruct District's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. For equipment requiring seasonal operation, Contractor shall perform instructions for other seasons within six months or by the change of season.
- C. Contractor shall use operation and maintenance manuals as basis for instruction. Contractor shall review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. Contractor shall prepare and insert additional data in Operation and Maintenance Manual when the need for such data becomes apparent during instruction.
- E. Contractor shall review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

1.07 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Contractor shall provide products, spare parts, maintenance, and extra materials in quantities specified in the Specifications and in Manufacturer's recommendations.

- B. Contractor shall provide District with all required Operation and Maintenance Data at one time. Partial or piecemeal submissions of Operation and Maintenance Data will not be accepted.

PART 2 – PRODUCTS Not used.

PART 3 – EXECUTION Not used.

END OF DOCUMENT

OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Completion of the Work;
- B. Special Conditions.

1.02 QUALITY ASSURANCE:

Contractor shall prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.03 FORMAT:

- A. Contractor shall prepare data in the form of an instructional manual entitled "OPERATIONS AND MAINTENANCE MANUAL & INSTRUCTIONS" ("Manual").
- B. Binders: Contractor shall use commercial quality, 8-1/2 by 11 inch, three-side rings, with durable plastic covers; two inch maximum ring size. When multiple binders are used, Contractor shall correlate data into related consistent groupings.
- C. Cover: Contractor shall identify each binder with typed or printed title "OPERATION AND MAINTENANCE MANUAL & INSTRUCTIONS"; and shall list title of Project and identify subject matter of contents.
- D. Contractor shall arrange content by systems process flow under section numbers and sequence of Table of Contents of the Contract Documents.
- E. Contractor shall provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- F. Text: The content shall include Manufacturer's printed data, or typewritten data on 24 pound paper.
- G. Drawings: Contractor shall provide with reinforced punched binder tab and shall bind in with text; folding larger drawings to size of text pages.

1.04 CONTENTS, EACH VOLUME:

- A. Table of Contents: Contractor shall provide title of Project; names, addresses, and telephone numbers of the Architect, any engineers, subconsultants,

Subcontractor(s), and Contractor with name of responsible parties; and schedule of products and systems, indexed to content of the volume.

- B. For Each Product or System: Contractor shall list names, addresses, and telephone numbers of Subcontractor(s) and suppliers, including local source of supplies and replacement parts.
- C. Product Data: Contractor shall mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- D. Drawings: Contractor shall supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Contractor shall not use Project Record Documents as maintenance drawings.
- E. Text: The Contractor shall include any and all information as required to supplement product data. Contractor shall provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- F. Warranties and Bonds: Contractor shall bind in one copy of each.

1.05 MANUAL FOR MATERIALS AND FINISHES:

- A. Building Products, Applied Materials, and Finishes: Contractor shall include product data, with catalog number, size, composition, and color and texture designations. Contractor shall provide information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Contractor shall include Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture Protection and Weather Exposed Products: Contractor shall include product data listing applicable reference standards, chemical composition, and details of installation. Contractor shall provide recommendations for inspections, maintenance, and repair.
- D. Additional Requirements: Contractor shall include all additional requirements as specified in the Specifications.
- E. Contractor shall provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS:

- A. Each Item of Equipment and Each System: Contractor shall include description of unit or system, and component parts and identify function, normal operating characteristics, and limiting conditions. Contractor shall

include performance curves, with engineering data and tests, and complete nomenclature, and commercial number of replaceable parts.

- B. Panelboard Circuit Directories: Contractor shall provide electrical service characteristics, controls, and communications.
- C. Contractor shall include color coded wiring diagrams as installed.
- D. Operating Procedures: Contractor shall include start-up, break-in, and routine normal operating instructions and sequences. Contractor shall include regulation, control, stopping, shut-down, and emergency instructions. Contractor shall include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Contractor shall include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Contractor shall provide servicing and lubrication schedule, and list of lubricants required.
- G. Contractor shall include manufacturer's printed operation and maintenance instructions.
- H. Contractor shall include sequence of operation by controls manufacturer.
- I. Contractor shall provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Contractor shall provide control diagrams by controls manufacturer as installed.
- K. Contractor shall provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- L. Contractor shall provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Contractor shall provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- N. Additional Requirements: Contractor shall include all additional requirements as specified in Specification(s).
- O. Contractor shall provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.07 SUBMITTAL:

- A. Contractor shall submit to the District for review two (2) copies of preliminary draft or proposed formats and outlines of the contents of the Manual within thirty (30) days of Contractor's start of Work.

- B. For equipment, or component parts of equipment put into service during construction and to be operated by District, Contractor shall submit draft content for that portion of the Manual within ten (10) days after acceptance of that equipment or component.
- C. Contractor shall submit two (2) copies of a complete Manual in final form prior to final Application for Payment. Copy will be returned with Architect/Engineer comments. Contractor must revise the content of the Manual as required by District prior to District's approval of Contractor's final Application for Payment.
- D. Contractor must submit two (2) copies of revised Manual in final form within ten (10) days after final inspection.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF DOCUMENT

WARRANTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Warranty/Guarantee Information;
- B. Special Conditions.

1.02 FORMAT

- A. Binders: Contractor shall use commercial quality, 8-1/2 by 11 inch, three-side rings, with durable plastic covers; two inch maximum ring size.
- B. Cover: Contractor shall identify each binder with typed or printed title "WARRANTIES" and shall list title of Project.
- C. Table of Contents: Contractor shall provide title of Project; name, address, and telephone number of Contractor and equipment supplier; and name of responsible principal. Contractor shall identify each item with the number and title of the specific Specification, document, provision, or section in which the name of the product or work item is specified.
- D. Contractor shall separate each warranty with index tab sheets keyed to the Table of Contents listing, providing full information and using separate typed sheets as necessary. Contractor shall list each applicable and/or responsible Subcontractor(s), supplier(s), and/or manufacturer(s), with name, address, and telephone number of each responsible principal(s).

1.03 PREPARATION:

- A. Contractor shall obtain warranties, executed in duplicate by each applicable and/or responsible subcontractor(s), supplier(s), and manufacturer(s), within ten (10) days after completion of the applicable item or work. Except for items put into use with District's permission, Contractor shall leave date of beginning of time of warranty blank until the date of completion is determined.
- B. Contractor shall verify that documents are in proper form, contain full information, and are notarized, when required.
- C. Contractor shall co-execute submittals when required.
- D. Contractor shall retain warranties until time specified for submittal.

1.04 TIME OF SUBMITTALS:

- A. For equipment or component parts of equipment put into service during construction with District's permission, Contractor shall submit a draft warranty for that equipment or component within ten (10) days after acceptance of that equipment or component.
- B. Contractor shall submit for District approval all warranties and related documents within ten (10) days after date of completion. Contractor must revise the warranties as required by the District prior to District's approval of Contractor's final Application for Payment.
- C. For items of work delayed beyond date of completion, Contractor shall provide an updated submittal within ten (10) days after acceptance, listing the date of acceptance as start of warranty period.

PART 2 - PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF DOCUMENT

RECORD DOCUMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Documents on Work;
- B. Special Conditions.

PART 2 - RECORD DRAWINGS

2.01 GENERAL:

- A. As indicated in the Contract Documents, the District will provide Contractor with one set of reproducible, full size original Contract Drawings (mylars).
- B. Contractor shall maintain at each Project Site one set of marked-up plans and shall transfer all changes and information to those marked-up plans, as often as required in the Contract Documents, but in no case less than once each month. Contractor shall submit to the Project Inspector one set of reproducible vellums of the Project Record Drawings ("As-Builts") showing all changes incorporated into the Work since the preceding monthly submittal. The As-Builts shall be available at the Project Site. The Contractor shall submit reproducible vellums at the conclusion of the Project following review of the blueline prints.
- C. Label and date each Record Drawing "RECORD DOCUMENT" in legibly printed letters.
- D. All deviations in construction, including but not limited to pipe and conduit locations and deviations caused by without limitation Change Orders, Construction Claim Directives, RFI's, and Addenda, shall be accurately and legibly recorded by Contractor.
- E. Locations and changes shall be done by Contractor in a neat and legible manner and, where applicable, indicated by drawing a "cloud" around the changed or additional information.

2.02 RECORD DRAWING INFORMATION:

- A. Contractor shall record the following information:
 - (1) Locations of Work buried under or outside each building, including, without limitation, all utilities, plumbing and electrical lines, and conduits.

- (2) Actual numbering of each electrical circuit to match panel schedule.
- (3) Locations of significant Work concealed inside each building whose general locations are changed from those shown on the Contract Drawings.
- (4) Locations of all items, not necessarily concealed, which vary from the Contract Documents.
- (5) Installed location of all cathodic protection anodes.
- (6) Deviations from the sizes, locations, and other features of installations shown in the Contract Documents.
- (7) Locations of underground work, points of connection with existing utilities, changes in direction, valves, manholes, catch basins, capped stubouts, invert elevations, etc.
- (8) Sufficient information to locate Work concealed in each building with reasonable ease and accuracy.

In some instances, this information may be recorded by dimension. In other instances, it may be recorded in relation to the spaces in the building near which it was installed.

- B. Contractor shall provide additional drawings as necessary for clarification.
- C. Contractor shall provide reproducible record drawings, made from final Shop Drawings marked "No Exceptions Taken" or "Approved as Noted."
- D. After review and approval of the marked-up specifications by the Project Inspector, Contractor shall provide electronic copies of the drawings (in PDF format) with one file with all of the sheets and one set of individual sheet files at the conclusion of the Project.

PART 3 - RECORD SPECIFICATIONS

3.01 GENERAL:

- A. Contractor shall mark each section legibly to record manufacturer, trade name, catalog number, and supplier of each Product and item of equipment actually installed.
- B. After review and approval of the marked-up specifications by the Project Inspector, Contractor shall provide one electronic copy of the specifications (in PDF format) at the conclusion of the Project.

PART 4 - MAINTENANCE OF RECORD DOCUMENTS

4.01 GENERAL

- A. Contractor shall store Record Documents apart from documents used for construction as follows:

PERALTA COMMUNITY COLLEGE DISTRICT
Library & LRC
Issue For Bid

RECORD DOCUMENTS
DOCUMENT 01 78 39-2
March 31, 2023

- (1) Provide files and racks for storage of Record Documents.
- (2) Maintain Record Documents in a clean, dry, legible condition and in good order.

B. Contractor shall not use Record Documents for construction purposes.

PART 5 – PRODUCTS Not Used.

END OF DOCUMENT

SECTION 01 81 13

SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to achieve the targeted LEED Silver certification under the LEED for New Construction and Major Renovations (LEED-NC) version 4 (v4) as administered by the U.S. Green Building Council (USGBC) and the Green Building Certification Institute (GBCI).
1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on design goals and other aspects of Project that are not part of the Work of the Contract.
 3. A copy of the LEED Project Scorecard is attached at the end of this Section for information.
- B. Administrative Requirements:
1. Comply with LEED requirements and requirements specified in other Sections.
 - a. Refer any discrepancy to the Architect for clarification.
 - b. Coordinate the Work specified in This Section and the requirements applicable and effecting Work in other Sections.
 2. LEED Coordinator: Engage a LEED-Accredited Professional knowledgeable of certification to coordinate LEED requirements. The LEED Coordinator must have documented LEED experience on at least two building projects with a similar scope of work. The experience must include construction activities. LEED coordinator may also serve as waste management coordinator in Section 01 74 19. LEED coordinator shall attend all LEED certification meetings and shall be available as needed in the field for LEED-related site walks and inspections and to answer questions that may arise and as otherwise requested.
 3. Respond to questions and requests from Owner's Representative and the USGBC regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the project's LEED certification application. Document responses as informational submittals.
 4. It is the Contractor's responsibility to meet all the requirements of the California Green Building Code for the project scope of work under its contract. LEED Consultant will assist the University's Representative when Green Building Code compliance is not clearly evident. Request for assistance must be made in writing to the University Representative and LEED Consultant.
- C. Related Requirements:
1. Section 011000 "Summary" for general Division 01 requirements.
 2. Section 017419 "Construction Waste Management and Disposal."

3. Section 018119 "Indoor Air Quality Procedures."

1.2 DEFINITIONS

- A. EA: Energy and Atmosphere.
- B. ID: Innovation in Design.
- C. IEQ: Indoor Environmental Quality.
- D. LEED: Leadership in Energy & Environmental Design.
- E. MR: Materials and Resources.
- F. RP: Regional Priority.
- G. SS: Sustainable Sites.
- H. WE: Water Efficiency.
- I. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- J. Bio-based Materials: Materials that meet the Sustainable Agriculture Network's Sustainable Agriculture Standard. Bio-based raw materials shall be tested using ASTM D 6866 and be legally harvested, as defined by the exporting and receiving country.
- K. CDPH Standard Method v1.2: California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v. 1.2–2017, for the emissions testing and requirements of products and materials.
- L. Environmental Product Declaration (EPD): An independently verified report based on life-cycle assessment studies that have been conducted according to a set of common rules for each product category and peer-reviewed.
 - 1. Product-Specific Declaration: A product with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
 - 2. Industry-Wide (Generic) EPD: A product with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator. EPD must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - 3. Product-Specific Type III EPD: A product with a third-party certification, including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator. EPD must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
- M. Extended Producer Responsibility (EPR): Measures undertaken by the maker of a product to accept its own and sometimes other manufacturers' products as postconsumer waste at the end of the products' useful life.
- N. Health Product Declaration Open Standard (HPD): A standard format for reporting product content and associated health information for building products and materials.

- O. Regionally Extracted, Harvested, or Recovered Materials: Materials that are extracted, harvested, or recovered and manufactured within a radius of 100 miles from the Project site. Manufacturing refers to the final assembly of components into the building product that is installed at the Project site.
- P. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
 - 1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
 - 2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.
- Q. Additional definitions are listed in "Glossary of Terms" in the USGBC Reference Guide.

1.3 MEETINGS

- A. Contractor shall schedule and conduct LEED Certification coordination meetings. At the Owner Representative's discretion, the LEED Certification meetings may be combined with other Project meetings. Meeting attendees shall include:
 - 1. Contractor's Project Manager
 - 2. Contractor's LEED Coordinator
 - 3. All other attendees designated by the Owner
 - 4. Sub-Contractor Representatives as appropriate to stage of work
- B. Meetings shall be held every four to six weeks.
- C. LEED Certification goals and issues shall be discussed at the following meetings:
 - 1. Pre-construction Kick-off
 - 2. Project Progress Meetings

1.4 SUBMITTALS

- A. LEED submittals are to be submitted in electronic format, and are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- B. Project Materials Cost Data: Deliver the necessary material and cost data required for credit calculations on the LEED Materials Buyout Form. Include total cost and shop labor for project materials and itemized costs of specific materials being tracked for LEED credits. Material costs exclude site labor, overhead, profit and construction equipment. Include Divisions 03-10 and 12, if applicable to the Project scope of work (the total materials cost is exclusive of specialties: Conveying Systems and Mechanical and Electrical components).
- C. LEED Action Plans: Within 30 days of Notice to Proceed submit the following action plans to the Owner's Representative:
 - 1. Prerequisite SS 1, Construction Activity Pollution Prevention: Erosion and Sedimentation work plan.

2. Prerequisite MR 2 and Credit MR 5, Construction and Demolition Waste Management: Construction Waste Management Plan complying with Section 017419 "Construction Waste Management".
 3. Credit EQ 2, Low-Emitting Materials: Low Emitting Materials Tracking Sheet indicating all adhesives, sealants, paints, coatings, composite wood, flooring, insulation, wall and ceiling products anticipated to be used on the project.
- D. LEED Progress Reports: On a monthly basis, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
1. Prerequisite SS 1, Construction Activity Pollution Prevention: Progress photographs or inspection reports taken during construction showing implemented Construction Pollution Prevention measures.
 2. Prerequisite MR 2 and Credit MR 5, Construction and Demolition Waste Management: Waste reduction progress reports complying with Section 01 74 19 Construction Waste Management and Disposal.
 3. Credit MR 2, Building Product Disclosure and Optimization – Environmental Product Declarations: EPD reports for all compliant products that have been purchased or installed.
 4. Credit MR 3, Building product disclosure and optimization – sourcing of raw materials: Summary of product data and materials costs collected, including:
 - a. Extended producer responsibility.
 - b. Bio-based materials.
 - c. Certified wood products.
 - d. Materials reuse.
 - e. Recycled content
 5. Credit MR 4, Building Product Disclosure and Optimization – Material Ingredients: Manufacturer Inventory Reports, Health Product Declarations (HPDs), Cradle2Cradle Certificates, Declare Labels, or equivalent for all compliant products that have been purchased or installed.
 6. Credit EQ 2, Low-Emitting Materials: Low Emitting Materials Tracking Sheet indicating progress towards targeted LEED Low-Emitting Materials Credit options.
- E. LEED Documentation Submittals:
1. Prerequisite SS 1, Construction Activity Pollution Prevention:
 - a. A minimum of 18 date-stamped photos which show the implemented measures and any corrective actions taken OR monthly inspection reports.
 2. Prerequisite MR 2 and Credit MR 5: Comply with Section 017419 "Construction Waste Management and Disposal."
 3. Credit MR 2 – Building Product Disclosure and Optimization – Environmental Product Declarations, Option 1, Environmental Product Declarations (EPD's):
 - a. Manufacturers Life Cycle Analysis conforming to ISO 14044, Industry-wide (generic) EPD with third-party Type III certification, or Product-specific Type III EPD.
 - b. Complete LEED Material Buy-Out Form.
 - c. Complete USGBC's BDC MRc BPDO Calculator.
 4. Credit MR 3, Building Product Disclosure and Optimization – Sourcing of Raw Materials:

- a. Recycled Content: Cutsheet, product literature or letter from manufacturer that clearly indicates the percentage by weight of post-consumer and pre-consumer (post-industrial) recycled content.
 - b. Biobased Material: Cutsheet, product literature or letter from manufacturer that clearly indicates the percentage by weight that is biobased material.
 - c. FSC Certified Wood: For all wood products designated in this specification as “FSC certified,” submit document of compliance with FSC standards as follows:
 - d. Demonstrate that products are FSC certified by providing vendor invoices. Invoices will contain the vendor’s Chain-of-Custody (COC) number and identify each FSC certified product on a line-item basis. A “vendor” is defined as the company that furnishes wood products to project contractors and/or subcontractors for onsite installation. FSC-certified products qualify for credit only when purchased from a vendor with an FSC chain-of-custody certificate that is current at the time of sale. The status of a COC certification can be verified at info.fsc.org. Invoices must contain:
 - 1) The vendor’s Chain-of-Custody (COC) number
 - 2) Separately itemize each FSC certified product on a line-item basis, clearly identifying the wood product manufacturer and type.
 - 3) Identify the entity being invoiced and indicate that the delivery is intended for the LEED project
 - 4) FSC designation for each product as either FSC 100%, FSC Mix, or FSC Mix [NN%].

If FSC wood products are modified by an architectural woodworker or millworker, the woodworker must have an FSC COC number which must appear on the project invoice. The woodworker must also install this custom wood. The woodworker must also provide a document, separate from the project invoice, detailing FSC-certified wood materials used and total cost of wood materials used. (The woodworker does not need to provide itemized material cost calculations but must maintain calculation records for auditing purposes by the FSC certifying body). The contract cost may include assembly labor but must exclude on-site labor
 - e. Material Reuse: Cutsheet, product literature or letter from manufacturer that clearly indicates that a material is salvaged, refurbished, or reused.
 - f. Extended Producer Responsibility: Cutsheet, product literature or letter from manufacturer that clearly indicates that the manufacturer participates in an extended producer responsibility program.
 - g. Local/ Regional Material: For any materials contributing to MRc3 that are manufactured and extracted within 100 miles of the project site, submit cutsheet, product literature or letter from manufacturer indicating the location of harvest, processing and manufacturer and proximity from the project site.
 - h. Material cost.
 - i. Complete LEED Material Buy-Out Form.
 - j. Complete USGBC’s BDC MRc BPDO Calculator.
5. Credit MR 4, Building product disclosure and optimization – material ingredients.
- a. Summary of product data collected for all materials purchased or installed that demonstrate their chemical inventory.
6. Credit IEQ 2, Low Emitting Materials: Product data indicating VOC content and emissions testing documents showing compliance with requirements for low-emitting materials, for the following:
- a. Adhesives, Sealants, Paints, Coatings, Flooring, Ceilings, Walls, Thermal, and Acoustic Insulation:

- 1) Submit manufacturers VOC Emissions Evaluation verification in accordance with California Department of Public Health (CDPH) Standard Method v1.2–2017 or equivalent verification method.
- b. Adhesives, Sealants, Paints and Coatings:
- 1) Submit product MSDS, SDS or other documentation confirming the VOC emission information for on-site wet applied products.
 - 2) Submit volume of all products used in Liters or Gallons.
- c. Flooring, Ceiling, Wall Panel, and Insulation products:
- 1) Submit manufacturers General Emissions Evaluation verification in accordance with California Department of Public Health (CDPH) Standard Method v1.2–2017 or equivalent verification method.
 - 2) Submit quantities of products used in surface area or square feet.
- d. Composite Wood Products:
- 1) Submit CARB Executive Order for the specific manufacturing location of the composite wood product confirming No Added Formaldehyde (NAF) resins or Ultra Low Emitting Formaldehyde (ULEF) resins. In addition, provide a statement from the manufacturer that reads "The XX product is a HWPW-CC/-VC/PB/MDF manufactured in our XX location which is authorized under CARB EO #XX."manufacturers' verification or documentation confirming low formaldehyde emissions in accordance with California Air Resources Board ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde (NAF) resins. CARB executive order letters can be found here:
<https://ww2.arb.ca.gov/resources/documents/nafulef-executive-orders>
 - 2) For structural composite wood products, provide manufacturers verification or documentation confirming that the product is made with moisture resistant adhesives meeting ASTM 2559, have no surface treatments with added urea-formaldehyde resins or coatings, and is certified according to one of the following industry standards:
 - a) Plywood: compliant with Voluntary Product Standard – Structural Plywood (PS 1-09) or Voluntary Product Standard – Performance Standard for Wood-Based Structural-Use Panels (PS 2-10)
 - b) Oriented Strand Board: specified with the Exposure 1 or Exterior bond classification in accordance with Voluntary Product Standard – Performance Standard for Wood-Based Structural-Use Panels (PS 2-10)
 - c) Structural Composite Lumber: compliant in accordance with Standard Specification for Evaluation of Structural Composite Lumber Products (ASTM D 5456-13)
 - d) Glued laminated timber: compliant in accordance with Structural Glued Laminated Timber (ANSI A190.1-2012)
 - e) I-joists: compliant in accordance with Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists (ASTM D 5055-13)
 - f) Cross-laminated timber: compliant in accordance with Standard for Performance-Rated Cross-Laminated Timber (PRG 320-15)
 - g) Finger-jointed lumber: labeled "Heat Resistant Adhesive (HRA)" in accordance with the American Softwood Lumber Standard (DOC PS-20 2015)

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

2.2 BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION

- A. MR 2, Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Option 1. Provide at least 20 permanently installed products (sourced from at least 5 different manufacturers) which meet one of the disclosure criteria:
 - 1. Product-Specific Declaration: Valued as one product.
 - 2. Industry-Wide (Generic) EPD: Valued as one product.
 - 3. Product-Specific Type III EPD: Valued as one product.
 - 4. Product-Specific Type III EPD with external verification and critical review: Valued as one and one-half product.
- B. MR 3, Building Product Disclosure and Optimization, Sourcing of Raw Materials. Provide products that meet at least one of the responsible extraction criteria below for at least 20%, by cost, of the total value of permanently installed building products in the project:
 - 1. Extended producer responsibility program.
 - 2. Bio-based materials.
 - 3. Recycled content.
 - 4. Certified Wood: Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
 - a. Rough carpentry.
 - b. Miscellaneous carpentry.
 - c. Heavy timber construction.
 - d. Wood decking.
 - e. Metal-plate-connected wood trusses.
 - f. Structural glued-laminated timber.
 - g. Finish carpentry.
 - h. Architectural woodwork.
 - i. Wood paneling.
 - j. Wood veneer wall covering.
 - k. Wood flooring.
 - l. Wood lockers.
 - m. Wood cabinets.
 - n. Furniture

- C. MR 4, Building Product Disclosure and Optimization, Material Ingredients: Option 1, Material Ingredient Reporting.
1. Use at least 20 different permanently installed products from at least 5 different manufacturers that use any of the following programs to demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm), which meet one of the following disclosure criteria:
 - a. Manufacturer Inventory.
 - b. Health Product Declarations (HPDs).
 - c. Cradle to Cradle (C2C) certifications.
 - d. Declare product labels.
 - e. Product Lens Certificate
 - f. ANSI/BIFMA e3 Furniture Sustainability Standard. Must comply with BIFMA v2014 credit 7.5.1.3 or BIFMA v2012 credit 7.4.1.3 for 3 points and 99% disclosure.

2.3 LOW-EMITTING MATERIALS

- A. IEQc2, Low-Emitting Materials, VOC Emissions Evaluation: Products must demonstrate they have been tested and determined compliant in accordance with California Department of Public Health, (CDHP), Standard Method v1.2-2017, using the applicable exposure scenario. Manufacturer’s documentation demonstrating compliance must state the range of total VOCs (tVOC) after 14 days measured as specified in the CDPH Standard Method v1.2 as follows:
1. 0.5mg/m³ or less,
 2. between 0.5 and 5.0 mg/m³ or,
 3. 0.50 mg/m³ or more.
- B. IEQc2, Low-Emitting Materials, Paints and Coatings – VOC Content Evaluation: For field applications that are inside the weatherproofing system, use paints and coatings that comply with the limits for VOC content when calculated according to the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.

Product Type:	Allowable VOC Content (g/L):
Bond Breaker	350
Clear wood finishes - Varnish	275
Clear wood finishes – Sanding Sealer	275
Clear wood finishes - Lacquer	275
Colorant – Architectural Coatings, excluding IM coatings	50
Colorant – Solvent Based IM	600
Colorant - Waterborne IM	50
Concrete – Curing compounds	100
Concrete – Curing compounds for roadways & bridges	350
Concrete surface retarder	50
Driveway Sealer	50
Dry-fog coatings	50
Faux finishing coatings - Clear topcoat	100
Faux finishing coatings – Decorative Coatings	350
Faux finishing coatings - Glazes	350
Faux finishing coatings - Japan	350

Faux finishing coatings – Trowel applied coatings	50
Fire-proof coatings	150
Flats	50
Floor coatings	50
Form release compounds	100
Graphic arts (sign) coatings	150
Industrial maintenance coatings	100
Industrial maintenance coatings – High temperature IM coatings	420
Industrial maintenance coatings – Non-sacrificial anti-graffiti coatings	100
Industrial maintenance coatings – Zinc rich IM primers	100
Magnesite cement coatings	450
Mastic coatings	100
Metallic pigmented coatings	150
Multi-color coatings	250
Non-flat coatings	50
Pre-treatment wash primers	420
Primers, sealers and undercoaters	100
Reactive penetrating sealers	350
Recycled coatings	250
Roof coatings	50
Roof coatings, aluminum	100
Roof primers, bituminous	350
Rust preventative coatings	100
Stone consolidant	450
Sacrificial anti-graffiti coatings	50
Shellac- Clear	730
Shellac – Pigmented	550
Specialty primers	100
Stains	100
Stains, interior	250
Swimming pool coatings – repair	340
Swimming pool coatings – other	340
Traffic Coatings	100
Waterproofing sealers	100
Waterproofing concrete/masonry sealers	100
Wood preservatives	350
Low solids coatings	120

- C. IEQc2, Low-Emitting Materials, Paints and Coatings – VOC Emissions Evaluation: For field applications that are inside the weatherproofing system, 75 percent of paints and coatings shall comply with the VOC Emissions Evaluation. Acceptable third party verified labels confirming CDPH compliance include but are not limited to:
1. Greenguard Gold
 2. MAS Certified Green
 3. Intertek ETL Environmental VOC+
- D. IEQc2, Low-Emitting Materials, Adhesives and Sealants – VOC Content Evaluation: For field applications [that are inside the weatherproofing system], use adhesives and sealants that comply with the limits for VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, requirements in effect on October 6, 2017:

Architectural Applications:	Allowable VOC Content (g/L):
Indoor carpet adhesives	50
Carpet pad adhesives	50
Outdoor carpet adhesives	150
Wood flooring adhesives	100
Rubber floor adhesives	60
Subfloor adhesives	50
Ceramic tile adhesives	65
VCT and asphalt tile adhesives	50
Dry wall and panel adhesives	50
Cove base adhesives	50
Multipurpose construction adhesives	70
Structural glazing adhesives	100
Single ply roof membrane adhesives	250
Specialty Applications:	
PVC welding	510
CPVC welding	490
ABS welding	325
Plastic cement welding	250
Adhesive primer for plastic	550
Computer diskette manufacturing	350
Contact adhesive	80
Special purpose contact adhesive	250
Tire retread	100
Adhesive primer for traffic marking tape	150
Structural wood member adhesive	140
Sheet applied rubber lining operations specialty	250
Top and Trim adhesive	250
Substrate Specific Applications:	
Metal to metal substrate specific adhesives	30
Plastic foam substrate specific adhesives	50
Porous material (except wood) substrate specific adhesives	50
Wood substrate specific adhesives	30
Fiberglass substrate specific adhesives	80
Sealants:	
Architectural sealant	250
Marine deck sealant	760
Nonmember roof sealant	300
Roadway sealant	250
Single-ply roof membrane sealant	450
Other sealant	420
Sealant Primers:	
Architectural non-porous sealant primer	250
Architectural porous sealant primer	775
Modified bituminous sealant primer	500
Marine deck sealant primer	760
Other sealant primer	750
Other	
Other adhesives, adhesive bonding primers, adhesive primers or any other primers	250

- E. IEQc2, Low-Emitting Materials, Adhesives and Sealants – VOC Emissions Evaluation: For field applications that are inside the weatherproofing system, 75 percent of adhesives and sealants shall comply with the VOC Emissions Evaluation. Acceptable third party verified labels confirming CDPH compliance include but are not limited to:
1. Greenguard Gold
 2. MAS Certified Green
 3. Intertek ETL Environmental VOC+
- F. IEQc2, Low-Emitting Materials, Flooring – VOC Emissions Evaluation: 90 percent of floorings shall comply with the VOC Emissions Evaluation. Acceptable third party verified labels confirming CDPH compliance include but are not limited to:
1. FloorScore
 2. CRI Green Label Plus
 3. Greenguard Gold
 4. SCS Indoor Advantage Gold
 5. MAS Certified Green
 6. Intertek ETL Environmental VOC+
 7. NSF/ ANSI 332
- G. IEQc2, Low-Emitting Materials, Composite Wood – Formaldehyde Emissions Evaluation: All interior grade plywood, composite hardwood, and agrifiber products that are architecturally rated shall meet EPA TSCA Title VI or California Air Resources Board (CARB) ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde (NAF).

All structural composite wood products shall be made with moisture resistant adhesives meeting ASTM 2559, have no surface treatments with added urea-formaldehyde resins or coatings, and is certified according to one of the following industry standards:

1. Plywood: compliant with Voluntary Product Standard – Structural Plywood (PS 1-09) or Voluntary Product Standard – Performance Standard for Wood-Based Structural-Use Panels (PS 2-10)
2. Oriented Strand Board: specified with the Exposure 1 or Exterior bond classification in accordance with Voluntary Product Standard – Performance Standard for Wood-Based Structural-Use Panels (PS 2-10)
3. Structural Composite Lumber: compliant in accordance with Standard Specification for Evaluation of Structural Composite Lumber Products (ASTM D 5456-13)
4. Glued laminated timber: compliant in accordance with Structural Glued Laminated Timber (ANSI A190.1-2012)
5. I-joists: compliant in accordance with Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists (ASTM D 5055-13)
6. Cross-laminated timber: compliant in accordance with Standard for Performance-Rated Cross-Laminated Timber (PRG 320-15)

7. Finger-jointed lumber: labeled “Heat Resistant Adhesive (HRA)” in accordance with the American Softwood Lumber Standard (DOC PS-20 2015)
- H. IEQc2, Low-Emitting Materials, Ceilings – VOC Emissions Evaluation: 90% of ceilings, by cost or surface area, comply with the requirements of the VOC Emissions Evaluation. Acceptable third party verified labels confirming CDPH compliance include but are not limited to:
 1. Greenguard Gold
 2. SCS Indoor Advantage Gold
- I. IEQc2, Low-Emitting Materials, Walls Panels – VOC Emissions Evaluation: 75% of all wall panels, by cost or surface area, shall comply with the requirements of the VOC Emissions Evaluation. Wall panel product category included all finish wall treatments (wall coverings, wall paneling, wall, tile), surface wall structures such as gypsum or plaster, cubicle/ curtain/ partition walls, doors, frames, windows and window treatments. Acceptable third party verified labels confirming CDPH compliance include but are not limited to:
 1. Greenguard Gold
 2. SCS Indoor Advantage Gold
- J. IEQc2, Low-Emitting Materials, Insulation – VOC Emissions Evaluation: 75% of all insulation shall comply with the requirements of the VOC Emissions Evaluation. The insulation material category includes all thermal and acoustic boards, batts, rolls, blankets, sound attention, foamed-in place, loose-fill, blown and sprayed insulation. Acceptable third party verified labels confirming CDPH compliance include but are not limited to:
 1. Greenguard Gold
 2. SCS Indoor Advantage Gold

PART 3 - EXECUTION

3.1 NON-SMOKING SITE/ BUILDING

- A. IEQc3 Indoor Air Quality Management: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes. Install appropriate signage to communicate this to all parties on-site during construction.

3.2 CONSTRUCTION WASTE MANAGEMENT

- A. Prerequisite MR 2 and Credit MR 5: Comply with Section 017419 Construction Waste Management.

3.3 CONSTRUCTION INDOOR AIR QUALITY PROCEDURES

- A. Credit IEQ 3, Construction Indoor Air Quality Management Plan: Comply with Section 018119 Indoor Air Quality (IAQ) Procedures.

3.4 LEED MATERIAL INFORMATION TRACKING

- A. For LEED credits: MR 2, MR 3, and MR 4, track LEED material and cost information using the USGBC’s BDC Material Tracker.
- B. For LEED credits: MR 2, MR 3, MR 4, and IEQc2 use the LEED Material Buyout Form. The Project LEED Consultant will deliver electronic copies of this form.

3.5 ATTACHMENTS (IN APPENDIX AT END OF PROJECT MANUAL)

- A. Appendix A.1: LEED Scorecard.
- B. Appendix A.2: LEED Specification Matrix

END OF SECTION

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SECTION 018115
CALGREEN REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

- A. Work Included: Sustainable Design Requirements, complete, as shown and specified. This Section includes requirements in accordance with the 2019 California Green Building Standards Code (CALGreen). Project shall comply with CALGreen Mandatory Requirements.
- B. Work Specified Elsewhere:
 - 1. Construction Waste Management: Section 017419.
 - 2. Technical Specifications throughout the Project Manual: contain CALGreen Requirements.
 - 3. Green Building Checklist included in drawing set.

1.2 SUBSTITUTIONS

- A. To substitute products that affect CALGreen, propose products that offer equivalent or increased environmental sensitivity and meet the intent of the Contract Documents. Substitutions that may affect CALGreen compliance shall be clearly identified.
- B. Guidelines: Only one substitution for a CALGreen product will be considered. If the substitution is rejected, provide the specified product. Submit the following for review by Owner:
 - 1. Product data, including manufacturer, website, and phone number.
 - 2. Copy of VOC testing data
 - 3. Description of the differences between the proposed substitution and the specified product related to CALGreen requirements. Explain the environmental advantages of the proposed product as compared to the specified product.
 - 4. The Contractor is responsible for re-submittals of calculations, documentation of products, or material substitutions that affect CALGreen. Do not submit products for substitution that do not meet these requirements.
 - 5. Identify product substitution by Specification and CALGreen credit(s).
 - 6. State effect of substitution on construction schedule and changes required in other work of products.

1.3 SUBMITTALS

- A. General: Additional CALGreen submittals are specified in the technical specification sections.
- B. CALGreen Actions Plans: Within seven days of Notice to Proceed, submit Action Plans indicating how the following will be met:

1. 5.504.3 Covering of duct openings and protection of mechanical equipment during construction, Construction indoor air quality management plan.
- C. CALGreen Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with CALGreen action plans for the following:
1. 5.504.3 Covering of duct openings and protection of mechanical equipment during construction. Construction Indoor Air Quality Management (IAQ) plan: During Construction.
- D. CALGreen Documentation Submittals:
1. 5.504.3 Covering of duct openings and protection of mechanical equipment during construction:
 - a. Provide a copy of the project's Indoor Air Quality (IAQ) Management Plan.
 2. 5.504.4.1 Adhesives, Sealants, Caulks: Product Data and material safety data sheets (MSDS) for adhesives and sealants used on the project, indicating VOC content of each product used.
 - a. Provide a listing of each adhesive, sealant and sealant primer product used on the project. Include the manufacture's name, product name, specific VOC data (in g/L less water) for each product, and the corresponding allowable VOC from the referenced standard.
 - b. Provide a listing of each aerosol adhesive product used on the project. Include the manufacture's name, product name, specific VOC data (in g/L less water) for each product, and the corresponding allowable VOC from the referenced standard.
 3. 5.504.4.3 Paints and Coatings: Product data and material safety data sheets (MSDS) for paints and coatings used on the interior of the building indicating VOC content of each product used.
 - a. Provide a listing of each indoor paint and coating used on the project. Include the manufacture's name, product name, specific VOC data (in g/L less water) for each product, and the corresponding allowable VOC from the referenced standard.
 - b. Provide a listing of each aerosol paint and coating used on the project. Include the manufacture's name, product name, specific VOC data (in g/L less water) for each product, and the corresponding allowable VOC from the referenced standard.
 4. 5.504.4.4 Carpet Systems: Product data shall state one of the following:
 - a. Carpet and Rug Institute's Green Label Plus Program
 - b. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health Standard method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers, Version 1.1,

- February 2010 (also known as CDPH Standard Method V1.1 or Specification 01350).
- c. NSF/ANSI 140 at the Gold level of higher;
 - d. Scientific Certifications Systems Sustainable Choice; or
 - e. Compliant with the Collaborative for High Performance School California (2014 CA-CHPS) Criteria listed in the CHPS High Performance Product Database.
 - a) 5.504.4.4.1 Carpet cushion. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program.
 - b) 5.504.4.4.2 Carpet adhesive. All carpet adhesive shall meet the requirements of Table 5.504.4.1.
5. 5.504.4.5: Composite wood products. Product data for hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.). Those materials not exempted under the ATCM must meet the specified emission limits, as shown in Table 5.504.4.5.
- a. 5.504.4.5.3 Documentation. Verification of compliance with this section shall be provided as requested by the enforcing agency. Documentation shall include at least one of the following.
 - 1) Product certifications and specifications
 - 2) Chain of custody certifications
 - 3) Product labeled and invoiced as meeting the Composite Wood Products regulation (see CCR, Title 17, Section 93120, et seq.)
 - 4) Exterior grade products marked as meeting the PS-1 or PS-2 standards of the Engineered Wood Association, the Australian AS/NZS 2269 or European 636 3S standards.
 - 5) Other methods acceptable to the enforcing agency
6. 5.504.4.6 Product data for resilient flooring, showing compliance with at least one of the following:
- a. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program;
 - b. Compliant with the VOC-emission limits and testing requirements specified in the California Dept. of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010;
 - c. Compliant with the Collaborative for High Performance Schools California (2014 CA-CHPS) Criteria and listed in the CHPS High Performance Product DataBase; or
 - d. Products certified under UL GREENGUARD Gold (formerly Greenguard Children's & Schools Program).
7. 5.504.5.3 Filters: Product data for filters used in the building. In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media for outside and return air that provides at least a Minimum Efficiency Reporting Value (MERV) of 13. MERV 13 filters shall be installed prior to occupancy, and recommendations for maintenance with filters of the same value shall be included in the operation and maintenance manual.

1.4 QUALITY ASSURANCE

- A. Contractor's CALGreen Representative: Contractor's CALGreen Representative shall oversee the environmental goals for the project, shall instruct workers concerning these goals, and shall be present on site when Work is in progress.
- B. CALGreen Meetings: Schedule and conduct CALGreen meetings on a regular basis, but not less than twice a month. Meeting attendees shall include at least the following: Architect, Contractor's Project Manager, Contractor's CALGreen Representative, and Sub-Contractor Representatives as appropriate to stage of Work. Discuss CALGreen Certification at Pre-bid, Pre-construction, and regular job site meetings. Discuss CALGreen Certification goals and challenges at the following meetings:
 - 1. Preconstruction Meetings
 - 2. Progress Meetings
 - 3. Subcontractor Meetings
 - 4. Monthly CALGreen Meetings
- C. CALGreen Training Program: Provide environmental training for workers performing Work on the Project site. Training shall include the following:
 - 1. Overview of environmental issues related to the building industry.
 - 2. CALGreen Building System: Requirements for this project.
- D. Regulatory Requirements: Comply with applicable requirements of laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from authorities having jurisdiction.

PART 2 – PRODUCTS

2.1 POLLUTANT CONTROL

- A. 5.504.4.1 Adhesives, Sealants, Caulks:
 - 1. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable or SCAQMD Rule 1168 VOC limits, as shown in Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride, methylene chloride, perchloroethylene and trichloroethylene), except for aerosol products as specified in Subsection 2, below.
 - 2. Aerosol adhesives and smaller unit sizes of adhesives and sealant or caulking compounds (in units of product, less packaging, which do not weigh more than one pound and do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of California Code of Regulations, Title 17, commencing with Section 94507.

- B. 5.504.4.3 Paints and Coatings: Architectural paints and coatings shall comply with VOC limits in Table 1 of ARB Architectural Coatings Suggested Control Measure, as shown in Table 5.504.4.3 unless more stringent local limits apply. The VOC content limit for coatings that do not meet the definitions for the specialty coatings categories listed in Table 5.504.4.3 shall be determined by classifying the coating as a Flat, Nonflat or Nonflat-High Gloss coating, based on its gloss, as defined in Subsections 4.21, 4.36 and 4.37 of the 2007 California Air Resources Board Suggested Control Measure, and the corresponding Flat, Nonflat or Nonflat-High Gloss VOC limit in Table 5.504.4.3 shall apply.
1. 5.504.4.3.1 Aerosol paints and coatings. Aerosol paints and coatings shall meet the Product-Weighted MIR Limits for ROC in Section 94522(a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Sections 94522(c)(2) and (d)(2) of California Code of Regulations Title 17, commencing with Section 94520; and in areas under the jurisdiction of the Bay Area Air Quality Management District additionally comply with the percent VOC by weight of product limits of Regulation 8 Rule 49.
 2. 5.504.4.3.2 Verification. Verification of compliance with this section shall be provided at the request of the enforcing agency. Documentation may include, but is not limited to, the following:
 - a. Manufacturer's product specification.
 - b. Field verification of on-site product containers.
- C. Carpet Systems: All carpet installed in the building interior shall meet at least one of the testing and product requirements:
1. Carpet and Rug Institute's Green Label Plus Program
 2. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health Standard method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers, Version 1.1, February 2010 (also known as CDPH Standard Method V1.1 or Specification 01350).
 3. NSF/ANSI 140 at the Gold level or higher;
 4. Scientific Certifications Systems Sustainable Choice; or
 5. Compliant with the Collaborative for High Performance School California (2014 CA-CHPS) Criteria listed in the CHPS High Performance Product Database.
 - a. 5.5.4.4.4.1 Carpet Cushion. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program.
 - b. 5.504.4.4.2 Carpet Adhesive. All carpet adhesive shall meet the requirements of Table 5.504.4.1.
- D. 5.504.4.5 Composite wood products. Hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.). Those materials not exempted under the ATCM must meet the specified emission limits, as shown in Table 5.504.4.5.
1. 5.504.4.5.3 Documentation. Verification of compliance with this section shall be provided as requested by the enforcing agency. Documentation shall include at least one of the following:
 - a. Product certifications and specifications
 - b. Chain of custody certifications

- c. Product labeled and invoiced as meeting the Composite Wood Products regulation (see CCR, Title 17, Section 93120, et seq.)
 - d. Exterior grade products marked as meeting the PS-1 or PS-2 standards of the Engineered Wood Association, the Australian AS/NZS 2269 or European 636 3S standards.
 - e. Other methods acceptable to the enforcing agency
- D. 5.504.4.6 Resilient Flooring. For 80 percent of floor area receiving resilient flooring, installed resilient flooring shall meet at least one of the following:
- 1. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program;
 - 2. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010;
 - 3. Compliant with the Collaborative for High Performance Schools California 2014 (CA-CHPS) Criteria and listed in the CHPS High Performance Product DataBase; or
 - 4. Products certified under UL GREENGUARD Gold (formerly Greenguard Children's & Schools Program).
 - 5. 5.504.4.6.1 Verification of compliance. Documentation shall be provided verifying that resilient flooring materials meet the pollutant emissions limits.
- E. 5.504.5.3 Filters: In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media for outside and return air that provides at least a Minimum Efficiency Reporting Value (MERV) of 13. MERV 13 filters shall be installed prior to occupancy, and recommendations for maintenance with filters of the same value shall be included in the operation and maintenance manual.
- 1. Exception: Existing mechanical equipment.
 - 2. Labeling. Installed filters shall be clearly labeled by the manufacturer indicating the MERV rating.
- F. 5.507.4 Acoustical control. Employ building assemblies and components with Sound Transmission Class (STC) values determined in accordance with ASTM E 90 and ASTM E 413, or Outdoor-Indoor Sound Transmission Class (OITC) determined in accordance with ASTM E 1332, using either the prescriptive or performance method in Section 5.507.4.1 or 5.507.4.2.
- 1. Exception: Buildings with few or no occupants or where occupants are not likely to be affected by exterior noise, as determined by the enforcement authority, such as factories, stadiums, storage, enclosed parking structures and utility buildings.
 - 2. Exception (DSA-SS): For public schools and community colleges, the requirements of this section and all subsections apply only to new construction.
 - 3. 5.507.4.1 Exterior noise transmission, prescriptive method. Wall and roof-ceiling assemblies exposed to the noise source making up the building or addition envelope or altered envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 in the following locations:
 - a. Within the 65 CNEL noise contour of an airport.
 - 1) Exceptions:
 - a) Ldn or CNEL for military airports shall be determined by the facility Air Installation Compatible Land Use Zone (AICUZ) plan.

- b) Ldn or CNEL for other airports and heliports for which a land use plan has not been developed shall be determined the local general plan.
 - b. Within the 65 CNEL or Ldn noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway source as determined by the Noise Element of the General Plan.
 - c. 5.507.4.1.1 Noise exposure where noise contours are not readily available. Buildings exposed to a noise level of 65 dB Leq-1-1hr during any hour of operation shall have building, addition or alteration exterior wall and roof-ceiling assemblies exposed to the noise source meeting a composite STC rating of at least 45 (or OITC 35), with exterior windows of a minimum STC of 40 (or OITC of 30).
- 4. 5.507.4.2 Performance method. For building located as defined in Section 5.507.4.1 or 5.507.4.1.1, wall and roof-ceiling assemblies exposed to the noise source making up the building or addition envelope or altered envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level (Leq-1Hr) or 50 dBA in occupied areas during any hour of operation.
 - a. 5.507.4.2.1 Site features: Exterior features such as sound walls or earth berms may be utilized as appropriate to the building, addition or alteration project to mitigate sound migration to the interior.
 - b. 5.507.4.2.2 Documentation of compliance. An acoustical analysis documenting complying interior sound levels shall be prepared by personnel approved by the Architect or Engineer of Record.
- 5. 5.507.4.3 Interior sound transmission. Wall and floor-ceiling assemblies separating tenant spaces and tenant spaces and public places shall have an STC of at least 40.
- G. 5.508.1.1 Chlorofluorocarbons (CFCs). Install HVAC, refrigeration and fire suppression equipment that does not contain CFCs.
- H. 5.508.1.2 Halons. Install HVAC, refrigeration and fire suppression equipment that do not contain Halons.

PART 3 – EXECUTION

3.1 FIELD EXECUTION OF CALGREEN REQUIREMENTS

- A. The Contractor is responsible for ensuring proper field execution of all CALGreen credits, and submittal requirements; communication with sub-contractors of all requirements; and submission of all documentation in a timely manner.
- B. Contractor shall notify Owner and Architect immediately of failure to meet any stated CALGreen pre-requisite or credit requirement.

3.2 PROTECTION

- A. Protect stored on-site and installed absorptive materials from moisture damage. Where absorptive materials not intended for wet applications are exposed to moisture, immediately remove from site and dispose of properly.
- B. Protect installed materials using methods that do not support growth of molds and mildews.

1. Immediately remove from site and properly dispose of materials showing signs of mold and signs of mildew, including materials with moisture stains.

END OF SECTION

SECTION 018119

INDOOR AIR QUALITY (IAQ) PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing protection of indoor air quality (IAQ), absorbent materials, and mechanical system from contamination during demolition and building flush out along with baseline indoor air quality testing prior to Owner occupancy.

1.2 REFERENCES

- A. ASHRAE Standard 52.2-Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 1999.
- B. SMACNA (OCC) - IAQ Guideline for Occupied Buildings under Construction; 2nd Edition, 2007, ANSI/SMACNA 008-2008 (Chapter 3).
- C. EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air.

1.3 DEFINITIONS

- A. Absorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.4 SUBMITTALS

- A. See Section 01 81 13 for LEED Certification Requirements.
 - 1. Credit IEQ 3 Construction Indoor Air Quality Management Plan: An IAQ plan based upon SMACNA IAQ Guidelines. The plan shall describe in detail measures specific to this project to be taken during construction to promote adequate indoor air quality upon completion.
 - a. HVAC Protection: Describe steps to protect ductwork and HVAC equipment from dust and water damage.
 - b. Source Control: Identify sources of VOCs and appropriate measures to mitigate their impacts.
 - c. Pathway Interruption: Manipulate air paths to reduce contaminants of finished spaces.
 - d. Housekeeping: Describe cleaning and dust control procedures.
 - e. Scheduling: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.

- f. Prohibit the use of tobacco products during construction inside the building and within 25 feet of building entrances.
 2. Quality Assurance and IAQ Monitoring: Describe steps to ensure compliance by Contractor and subcontractors.
 3. Photograph Documentation - six photographs of the 5 SMACNA measures taken throughout construction and on submitted on a monthly basis. Identify date and SMACNA measure featured in each photograph.
- B. Credit IEQ 4 Indoor Air Quality Assessment: An IAQ plan based upon ASHRAE Standard 62.1-2004. The plan describes in detail measures specific to this project to be taken before occupancy to promote adequate indoor air quality upon completion.
 1. Indoor Air Quality Flush-Out:
 - a. Narrative describing the Project's specific flush-out procedures.
 2. Indoor Air Quality Testing
 - a. Narrative describing IAQ testing process.
- C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to absorption of odors and vapors, and indicate air handling zone, sequence of application and curing times.
- D. LEED Online Documentation: Complete LEED Credit Forms on LEED Online for Credit IEQ 3 and Credit IEQ 4 and provide supporting documentation including IAQ Management Plan for during construction and post-occupancy, photo documentation of required construction practices, calculations and logs to support building flush-out or reports confirming indoor air quality testing methods and results.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Credit IEQ 2 Low-Emitting Materials: See Section 018113 Sustainable Design Requirements for specific requirements – emissions testing requirements and VOC limits.
- B. Air Filters: MERV 8, minimum, when tested in accordance with ASHRAE 52.2, 1992.

PART 3 - EXECUTION

3.1 CREDIT IEQ 3: CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN

- A. Refer to SMACNA IAQ Guideline for Occupied Buildings under Construction for avoiding unnecessary contamination due to construction procedures.
- B. Building HVAC system and supply air ductwork may be used for ventilation during construction:
 1. Begin construction ventilation when building is substantially enclosed.
 2. Operate HVAC system with 100 percent outside air and with 1.5 air changes per hour, minimum.
 3. Ensure that air filters are correctly installed prior to starting use; replace filters when they lose efficiency.
 4. Do not use return air ductwork for ventilation unless absolutely necessary.

5. Where return air ducts shall be used for ventilation, install MERV 8 filters at return inlets, sealed to ducts; replace filters when they lose efficiency.
- C. Prevent the absorption of moisture and humidity by adsorptive materials by:
1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
 3. Provide sufficient ventilation for drying within reasonable time frame.
- D. HVAC Protection:
1. Protect air handling and distribution equipment, and air supply and return ducting during demolition.
 2. Adequately cover and protect exposed air inlets and outlets, openings, grilles, ducts, plenums, as required to prevent water, moisture, and other contaminant intrusion.
 3. Apply protection immediately after installation of equipment and ducting.
 4. Do not store construction materials or waste in mechanical or electrical rooms.
 5. Prior to using return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
 6. Inspect duct intakes, return air grilles, and terminal units for dust.
 7. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
 8. Clean tops of doors and frames.
 9. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
 10. Clean return air plenums of air handling units.
 11. Remove air intake filters only after cleaning is complete.
 12. Do not perform dust or dirt-producing work after starting use of return air ducts without intake filters on return air ducts.
- E. Pathway Interruption:
1. Provide solid physical barriers to isolate areas of construction. Securely attach and seal at floor and structure above.
 2. Openings within the designated work area shall be sealed.
 3. Adequate exhaust ventilation equipment shall be installed to maintain a negative pressure differential between the work area and adjacent areas of the building.
 4. Ventilation units shall be exhausted to the outside of the building.
- F. Source Control:
1. Limit construction traffic and motor idling in the vicinity of air intake louvers when the HVAC systems are activated. Restrict motor vehicles to the loading dock area, well removed from air intakes and operable windows, preventing emissions from being drawn into the building.

2. Use electric or natural gas alternatives for gasoline and diesel equipment where possible and practical.
3. Cycle equipment off when not being used or needed.
4. Avoid the use of materials and products with high VOC and/or particulate levels. Use products and installation methods with low VOCs such as paints, sealers, sealants, filler materials, insulation, adhesives, caulking and cleaners. Comply with the requirements in other specification Sections.
5. Keep containers of wet products closed as much as possible. Cover and seal waste materials, which can release odor or dust.
6. Protect materials, especially absorbent materials such as insulated ductwork, against moisture during delivery to and storage at the job site. Store materials inside the structure in a dry and clean environment pending installation. Building materials shall be kept dry to avoid the introduction of moisture into the building interior.
7. Avoid the use of moisture-damaged materials. Any porous materials that have been wetted shall be dried thoroughly before installation. Any porous materials that have been damaged remained wet longer than 48 hours, or show signs of visible mold shall be discarded.
8. Ensure that the construction process will not result in moisture intrusion.
9. Avoid tracking pollutants into work areas. Once the framing and mechanical system installation starts, access to the building interior shall be controlled to minimize the tracking in of contaminants. Material deliveries and construction waste removal shall be routed via the most direct route to the building exterior of the building rather than through the space.
10. Provide rough track-off grates or matting at the entryway to remove moisture and containments from entering the building.
11. Prevent the ingress of rodents and pests.
12. Prohibit the use of tobacco products during construction inside the building and within 25 feet of building entrances.

G. Housekeeping:

1. Provide temporary ventilation during demolition to minimize accumulation of dust fumes, vapors, or gases in the building.
2. Suppress dust with wetting agents or sweeping compounds.
3. Clean-up dust using a wet rag or damp mop.
4. Increase the cleaning frequency when dust build-up is noted.
5. Remove spills or excess applications of solvent-containing products as soon as possible.
6. Remove accumulated water and keep work areas as dry as possible.
7. Store volatile liquid containers closed when the container is inside of the building and not in use.
8. Keep volatile liquid containers closed when the container is inside of the building and not in use.
9. HEPA vacuuming and duct cleaning.
10. Use nontoxic cleaning materials and procedures.

H. Scheduling:

1. Comply with the scheduling requirements of Article, "Sequence of Finish Installation" of this Section.
2. To avoid potential contamination of porous or absorbent materials such as ceiling tiles, install furnishings after interior finishes (drywall, paint, and floor finishing) have cured.
3. Phased Completion: Implement IAQ control measures in each tenant area until construction in that area is complete. Do not allow contaminants from an area under construction to enter the HVAC ductwork systems or to migrate to completed areas.
4. Filters: Install new MERV 8 filters at the central fan system, immediately prior to the first phase of building occupancy. Install new MERV 8 filters at fan systems serving limited areas immediately prior to occupancy for each respective area.

3.2 CREDIT IEQ 4: INDOOR AIR QUALITY ASSESSMENT

A. Prior to flush-out or air testing, the building shall have interior finishes installed including, but not limited to, millwork, doors, paint, carpet, acoustic tiles and movable furnishings (e.g. workstations, partitions), and major VOC punch-list items must be finished.

B. Option 1, Path 1: Flush-out, Before Occupancy

1. After construction ends, prior to occupancy and with interior finishes and furniture installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. (sq. m) of floor area while maintaining an internal temperature of at least 60 degrees F (16 degrees C) and a relative humidity no higher than 60 percent. Indicate operating procedure for each HVAC system and piece of equipment and the operating duration required for flush-out.
 - a. Follow the manufacturer operating procedures for each HVAC system and piece of equipment and the operating duration required for flush out.

C. Option 1, Path 2: Flush-out, During Occupancy

1. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. (sq. m) of floor area to the space.
 - a. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. (1.52 L/s per sq. m) of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater.
 - b. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy.
 - c. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. (4 300 000 L/sq. m) of outside air has been delivered to the space.
 - d. Follow the manufacturer operating procedures for each HVAC system and piece of equipment and the operating duration required for flush out.

D. Option 2: Air Testing:

1. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's Compendium of Methods, or ISO Methods, as detailed in the USGBC's "Reference Guide for Building Design and Construction," version 4 (v4).

2. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
 - a. Formaldehyde: 27 ppb.
 - b. Particulates (PM10): 50 micrograms/cu. m.
 - c. Ozone: 0.075 ppm.
 - d. Total Volatile Organic Compounds (TVOCs): 500 micrograms/cu. m.
 - e. Target Chemicals listed in CDPH Standard Method v1.1, Table 4, except formaldehyde: CHPH Standard Method v1.1, Allowable Concentrations, Table 4-1.
 - f. Formaldehyde: 27 ppb.
 - g. Carbon Monoxide (CO): 9 ppm and no greater than 2 ppm above outdoor levels.

* NOTE: The target volatile organic compounds are from CDPH Standard Method v1.1, Table 4-1. The Maximum concentration limits for these target compounds are the full CREL adopted by Cal/EPA OEHHA in effect on June 2014 (<http://oehha.ca.gov/air/allrels.html>)

3. Measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
4. Prior to testing, the building shall have interior finishes installed including, but not limited to, millwork, doors, paint, carpet, acoustic tiles and movable furnishings (e.g. workstations, partitions), and major VOC punch-list items must be finished.
5. Test at least one location per ventilation system for each occupied space type. There must be a minimum of one test per floor. The locations selected for testing must represent the worst-case zones where the highest concentrations of contaminants of concern are likely to occur.
6. For offices, retail, schools, hospitality, and multifamily residential projects, test areas no larger than 5,000 square feet. For warehouses or large open spaces in other building types (e.g., ballrooms in hospitality, gymnasiums in schools), a limit of 50,000 square feet may be used. If there is evidence that the air in the space is well mixed and sources of contaminants of concern are uniform, project teams may test a single location in that space.
7. Determine whether the project includes spaces (e.g., offices, school classrooms, or multifamily residential units) that are identical in their construction, finishes, configuration, square footage, and HVAC systems. Project teams may sample identical spaces by testing one in seven. If the sampled space fails the test, all seven must be tested. For buildings with a large number of identical spaces (more than 21 spaces in a sample group), test a minimum of three spaces in the sample group."
8. For each sampling point where the maximum concentration limits are exceeded, take corrective action and retest for the noncompliant contaminants at the same sampling points. Repeat until all requirements are met.

3.3 SEQUENCE OF FINISH INSTALLATION

- A. Sequence of Finish Installation: Project schedule shall address construction scheduling/sequencing requirements and procedures necessary to optimize Indoor Air Quality (IAQ) levels for the completed Project.
1. Scheduling Contractor's Project Schedule for finish applications should allow for: Dissipation of high emissions from finishes that off-gas perceptible quantities of deleterious material during curing Separation of off-gassing effects from the installation of adsorptive materials that would act as a "sink" for storage and subsequent release of these unwanted substances into building spaces and mechanical systems after project occupancy.
 2. When Contractor's "Project Schedule" requires less than optimal sequencing of finish installation, related to IAQ, provide supplemental filtered "fresh air" ventilation of work areas during construction and restrict / control the use of permanent building mechanical systems prior to Owner's acceptance of building to prevent contamination of systems by construction wastes and other deleterious substances.
 3. Type 1: Materials and finishes which have a potential for short-term levels of off-gassing from chemicals inherent in their manufacturing process, or which are applied in a form requiring vehicles or carriers for spreading which release a high level of particulate matter in the process of installation and/or curing. Type 1 Finishes include, but are not limited to the following:
 - a. Adhesives, sealants, and glazing compounds, specifically those with petrochemical vehicles or carriers.
 - b. Wood preservatives, finishes, and paint.
 - c. Control and/or expansion joint fillers.
 - d. All hard finishes requiring adhesive installation.
 - e. Gypsum board and associated finish processes.
 - f. Sealants and associated filler materials.
 4. Type 2: Finishes: Materials and finishes which are woven, fibrous, or porous in nature and tend to adsorb chemicals off-gassed by Type 1 finishes or may be adversely affected by particulates. These materials become "sinks" for deleterious substances, which may be released much later, or collectors of contaminants that may promote subsequent bacterial growth. Type 2 Finishes include, but are not limited to the following:
 - a. Carpet and padding.
 - b. Fabric wallcovering.
 - c. Insulation exposed to the airstream.
 - d. Acoustic ceiling materials.
 - e. Fabric covered acoustic wall panels.
 - f. Upholstered furnishings.
 - g. Materials that can be categorized as both Type 1 and Type 2 materials shall be considered to be Type 1 materials.

- B. Optimal Order of Installation: Apply Type 1 interior finishes throughout the entire controlled air zone of each enclosed building or building segment and allow such finishes to completely cure according to intervals and times stated in respective finish manufacturer's printed instructions before commencing installation of any Type 2 materials in the same area.
 - 1. Do not store any Type 2 materials in areas where installation or curing of Type 1 materials is in progress.

END OF SECTION

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SECTION 019100
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Section 18113 – LEED Requirements
- B. Section 18115 – CalGreen Requirements
- C. Section 22000 - Plumbing
- D. Section 230000 - HVAC Equipment and Controls
- E. Section 230593 – Testing, Adjusting and Balancing
- F. Section 25000 - Building Automation Systems
- G. Section 260000 – Electrical Equipment and Controls
- H. Section 260800 - Testing
- I. Section 265700 - Lighting Control System
- J. Section 328400 - Irrigation
- K. In the event of conflict between this Specification and any other Specification(s) regarding system commissioning, the more stringent Specification shall govern.

1.2 DESCRIPTION

- A. This section includes administrative and procedural requirements with a detailed description of the Commissioning process. Commissioning requirements are found in Part 6, Section 120.8 of the 2019 Title 24 Nonresidential Compliance Manual. Commissioning is also defined in the US Green Building Council (USGBC) LEED Reference Guide for Green Building Design and Construction, v4.1 The USGBC rating system, Leadership in Energy and Environmental Design (LEED), defines these commissioning procedures as Fundamental Commissioning and Enhanced Commissioning.
- B. This section supplements other Division 01 Commissioning Sections and applies to equipment listed in Section 1.4 SYSTEMS TO BE COMMISSIONED.
- C. Irrigation commissioning requirements are defined in the CALGreen Section 5.410.2.

- D. Reference to Commissioning activities within this section specifically refers to requirements associated with the Commissioning processes of the 2019 Title 24, LEED v4, and CALGreen and is not intended to replace other commissioning activities that may be contracted.
- E. Commissioning requirements outlined in this Section shall be assigned, as required, to the Owner (or owner's representative), architect, mechanical, electrical, and plumbing engineers, landscape designers, project managers, construction managers, General Contractor, and all subcontractors responsible for equipment to be commissioned.
- F. Commissioning is intended to achieve the following objectives:
 1. Verify the Owner's Project Requirements (OPR) are developed and incorporated into the design and construction documents.
 2. Verify the Basis of Design (BOD) reflects the OPR and is integrated in the design and construction documents.
 3. Verify the submittals for equipment and systems subject to commissioning meet the requirements defined in the BOD, specifications, and construction documents.
 4. Verify the applicable equipment and systems are installed according to the manufacturer's recommendations and that they receive adequate operational checkout by installing contractors. Operational checkout is documented by the Installation Verification and Startup Checklists that are developed by the Contractors/Vendors and reviewed by the Commissioning Authority.
 5. Verify and document that performance of equipment and systems is proper for the application and meet the Owner's operational requirements. Performance of commissionable equipment is generally achieved through the successful completion of the Functional Performance Tests.
 6. Verify the Operations and Maintenance (O&M) Manuals are complete.
 7. Verify that the Owners' operating personnel are trained in accordance with the specifications.

1.3 DEFINITIONS

- A. Owner's Project Requirements (OPR): A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, and supporting information.
- B. Basis of Design (BOD): A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of proposed systems that support the design process.
- C. Commissioning (Cx) Plan: The Commissioning Plan (Cx Plan) is the roadmap for all activities related to commissioning. Commissioning begins during early design and continues through construction and into the post-occupancy period; therefore this document is intended to provide requirements for both design and construction teams. A preliminary Cx Plan is developed during the early design phase and updated by the CxA as needed throughout the project.
- D. Commissioning Coordinator (CxC): This position is provided through the General Contractor or Owner. Responsibilities include being the point person to coordinate and interface with the Commissioning Authority and subcontractors.
- E. Components, Equipment, Subsystems, and Systems: Where these terms are used together or separately, they shall mean "as-built" components, equipment, subsystems, and systems that are part of the building subject to Commissioning.

- F. Commissioning Authority (CxA): An entity identified by the Owner that plans, schedules, and coordinates the Commissioning Team to implement the Commissioning Process.
- G. Submittal: Documentation that is provided by a contractor for the purpose of confirming equipment and functional operations identified in the Contract Documents.
- H. Installation Verification and Startup Checklists: A written set of checks and tests that document the equipment's readiness, to be completed prior to the equipment's Functional Performance Tests.
- I. Test Adjust Balance (TAB): TAB work is to be completed after all Startup Checklists are reviewed and accepted and prior to Functional Performance Tests. CxA reviews the final TAB report for consistency and compliance with design requirements.
- J. Functional Performance Test (FPT): A documented test of the dynamic functioning and operation of equipment and systems with the goal of verifying that the OPR and BOD are met. Functional Performance Testing generally begins with verification of component calibration and proceeds through verification of equipment operations and systems integration.
 - 1. Test procedures are developed and results documented by the Commissioning Authority.
 - 2. Test procedures are executed by the Contractor.
 - 3. Testing occurs once all system components are installed, energized, programmed, balanced, and otherwise ready for operation under part- and full-load conditions. Testing includes each course of action in the Sequence of Operation, including startup, shutdown, capacity modulation, emergency and failure modes, alarms, and interlocks to other equipment.
 - 4. Successful FPTs are predictable and repeatable.

1.4 SYSTEMS TO BE COMMISSIONED

- A. The following systems shall be commissioned:
 - 1. Heating, Ventilation, Air Conditioning systems (including air handling systems, VAV boxes, exhaust systems, ventilation systems, fan coil units, environmental refrigerated water systems, environmental heating hot water systems as applicable)
 - 2. Building Automation System (BAS)
 - 3. Domestic Hot Water Systems
 - 4. Lighting and Lighting Controls
 - 5. Electrical Distribution
 - 6. Irrigation System

1.5 OWNER OR OWNER'S REPRESENTATIVE (OR) RESPONSIBILITIES

- A. Update Owner's Project Requirements (OPR) as operational goals are modified during design.
- B. Provide the OPR documentation to the CxA, design team, and Contractor for information and use.
- C. Schedule operation and maintenance personnel and assign them to participate in Commissioning team activities.
- D. Schedule operation and maintenance personnel and assign them to participate in the training activities on their respective systems.

- E. Assists the CxA in directing the project team, as needed

1.6 ARCHITECTS RESPONSIBILITIES

- A. May be requested to assist the owner with the development of the OPR.
- B. Respond to design review comments provided by CxA to clarify questions and discrepancies found during the Commissioning Design Review.
- C. Responsible for coordination and management of submittal documentation. Architect ensures that Commissioning Agent receives submittals for review and coordinates team responses.

1.7 MECHANICAL, ELECTRICAL, PLUMBING (MEP) ENGINEERS AND LANDSCAPE DESIGNER RESPONSIBILITIES

- A. Design engineer shall provide system control diagrams and Sequences of Operations (SoO) in the contract documents. If for some minor systems one is not provided, the design engineer must approve the SoO developed by the controls contractor.
- B. Design Team shall develop and update the BOD, based on changes to the OPR or design.
- C. Design Team shall respond to design review comments provided by CxA to clarify questions and discrepancies found during the Commissioning Design Review.
- D. Review and approve equipment submittals.
- E. Communicate and provide clarification to CxA and contractors as to the operational intent for proper and efficient equipment functioning and integration of systems within the building.
- F. Assist with resolution and clarification of equipment and systems' Sequence of Operations during design and construction.

1.8 GENERAL CONTRACTOR (GC) RESPONSIBILITIES

- A. Include the GC and Sub Contractor cost for commissioning in the total contract price.
- B. Provide a competent person in the role of MEP Commissioning Coordinator (CxC).
- C. Incorporate commissioning activities into the master construction schedule.
- D. Coordinate owner training with subcontractors and commissioning agent.
- E. Attend Post Occupancy review with CxA approximately 10 months after building turnover.
- F. Assist in resolving any warranty issues raised during the Post Occupancy Review.

1.9 COMMISSIONING COORDINATOR (CxC) RESPONSIBILITIES

- A. Provides the point of contact for the Commissioning Authority and subcontractors in the organization, scheduling, coordination, management, and facilitation of the commissioning process.
- B. Responsible for tracking all submittal documentation from subcontractors with the goal of assuring timely processing to and from the CxA.
- C. Delegate commissioning tasks to subcontractors.
- D. Assist in the problem solving of commissioning related issues, to assure the successful completion of Commissioning activities.
- E. Notify the CxA when modifications to Contract Documents occur.
- F. Ensure subs provide submittals necessary to document and verify equipment is started up and in operational condition to meet the OPR and all Commissioning requirements.
- G. Provide Training Agenda to CxA covering topics necessary to impart information to the building users, maintenance staff, and Owner.
- H. Provide and document training to building users, maintenance staff, and Owner.

1.10 MEP AND IRRIGATION SUBCONTRACTORS

- A. Each Subcontractor shall assign a representative with expertise and authority to act on its behalf and shall schedule him or her to participate in and perform Commissioning process activities.
- B. Include the cost for commissioning in the contract bid price.
- C. Provide competent personnel to execute commissioning tasks.
- D. Coordinate with GC on scheduling of commissioning tasks and potential conflicts.
- E. Attend Commissioning team meetings held on as needed basis.
- F. Submit equipment submittals and other required documentation for all equipment subject to Commissioning for review by CxA.
- G. Ensure submittals are provided as necessary to document and verify equipment is started up and in operational condition to meet the OPR and all Cx requirements.
- H. Furnish a copy of all construction documents, addenda, change orders, submittals, and shop drawings related to commissionable equipment to the CxA.
- I. Coordinate with equipment vendors for proper documentation and procedures.
- J. Provide Manufacturers' manuals and other supporting documentation described in other sections necessary for the CxA to develop Functional Performance Testing and compile the Systems Manual for Owner.

- K. Provide a copy of all Certificate of Installation (CRCI), Certificate of Acceptance (NRCA), and Certificate of Verification (NRCV) forms to CxA as applicable and required by Title 24 for the CxA to review and approve
- L. Review, comment, and ultimately accept Functional Performance Test procedures provided by the CxA.
- M. Execute Functional Performance Testing.
- N. Evaluate performance deficiencies identified in the Commissioning Issues Log and in collaboration with the entity responsible for system and equipment installation, and follow on to recommend corrective action.
- O. Provide Training Plan to CxA covering topics necessary to impart information to the building users, maintenance staff, and Owner.
- P. Provide and document training to the Owner's personnel, which may include building users, maintenance staff, and Owner.
- Q. Provide documentation necessary to fulfill the Title 24 requirements for the Systems Manual.
- R. Ensure seasonal or deferred functional testing are executed and witnessed by the CxA, according to the specifications.
- S. Ensure any known deficiencies and deficiencies identified in the commissioning issues log are corrected. Make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing and/or modifications to the original design documents.
- T. Reference Division specific Commissioning Specification for any additional responsibilities.

1.11 CONTROLS SUBCONTRACTORS (CC) RESPONSIBILITIES

- A. Submit equipment submittals and other required documentation for review by CxA.
- B. Attend Commissioning team meetings
- C. Furnish a copy of all construction documents, addenda, change orders, submittals, and shop drawings related to commissioned equipment to the CxA.
- D. Provide list of all schedules, set points, and alarms.
- E. Provide control drawings and Sequence of Operations.
- F. Provide Point-to-Point checks and calibration of all sensors prior to FPTs.
- G. Review, comment, and ultimately accept Functional Performance Test procedures provided by the CxA.
- H. Provide a person capable of performing Functional Performance Test scripts and proper system operation.
- I. Execute Functional Performance Testing under the observation of the CxA.

- J. Evaluate performance deficiencies identified in the Commissioning Issues Log and in collaboration with the entity responsible for system and equipment installation, and then follow on to recommend corrective actions.
- K. Provide Training Plan to CxA covering topics necessary to impart information to the building users, maintenance staff, and Owner.
- L. Provide and document training to the Owner's personnel, which may include building users, maintenance staff, and Owner.
- M. Participate in seasonal or deferred functional testing as needed and according to the specifications.
- N. Provide point trends and assistance with remote access to building automation system.
- O. Reference Division specific Commissioning Specification for any additional responsibilities.

1.12 TAB SUBCONTRACTORS RESPONSIBILITIES

- A. Submit the outline of the TAB plan and approach to the CxA and the BAS contractor when other submittals and contractor documentation is being processed. A full description of the procedures and equipment to be verified, along with the design values, shall be provided.
- B. Coordinate with the commissioning team in the weeks prior to balancing.
- C. Complete air and water balancing, per AABC or NEBB requirements and project specifications.
- D. Identify and report on issues discovered in the field while balancing.
- E. Provide a field copy to CxA prior to functional testing.
- F. Demonstrate TAB results to CxA during Functional Performance Tests.
- G. Coordinate with MEP Coordinator and CxA for resolution of issues.
- H. Provide final TAB reports to CxA and Owner.

1.13 EQUIPMENT VENDOR RESPONSIBILITIES

- A. Provide documentation on furnished equipment, including complete submittals, equipment data, installation manuals, O&M manuals, Control diagrams, Field wiring diagrams, start-up procedures, test results and warranties.

1.14 CxA'S RESPONSIBILITIES DURING CONSTRUCTION

- A. Report results, findings, observations, and recommendations directly to the Owner, in addition to communicating with the Cx Team.
- B. Organize and lead the Commissioning Team.

- C. Provide Commissioning Plan.
- D. Organize and lead Commissioning Team meetings.
- E. Review design documents required for verification of system performance such as control diagrams, Sequence of Operation, single line diagrams, equipment schedules, and specifications.
- F. Review Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews, or as determined by the Owner's Representative or GC.
- G. Review contractor provided documents required for verification of system performance, such as Sequence of Operations, single line diagrams, manufacturers' Installation and Operations Manuals, and Installation Verification and Startup Checklists. Each document will be reviewed, approved, and stamped 'approved' prior to submitting to the CxA. Comments are based on adherence to construction documents and manufacturer's requirements.
- H. Review and comment on controls contractor's submittal, actual point-to-point checks, calibration of sensors, dampers, and control actuators.
- I. Review proposed TAB plan and completed reports.
- J. With necessary input and review from installing contractor, write the Functional Performance Tests to be completed by the installing contractor and witnessed by CxA. Additional support may be required of Design Engineers.
- K. Verify the execution of Commissioning process activities using random sampling when appropriate. The sampling rate may vary from 10 to 100 percent. When test results do not meet the requirements, the CxA will report the failure in the Commissioning Issues Log.
- L. Prepare and maintain the Commissioning Issues Log.
- M. Compile test data, inspection reports, and certificates; include them in the Systems Manual and Commissioning Report.
- N. Analyze any functional performance trend logs and monitoring data to verify performance.
- O. Issue final Commissioning Report to Owner.

1.15 COORDINATION

- A. The Commissioning Team includes:
 1. Owner or owner's representative (OR)
 2. Commissioning Authority (CxA)
 3. Architect and Design Engineers (A/E Team)
 4. Design Reviewer (DR); for this project the CxA will be DR
 5. Project Manager (PM) / Construction Manager (CM)
 6. General Contractor (GC)
 7. Commissioning Coordinator (CxC)
 8. Subcontractors (Subs)
 9. Building operator (Operator {includes facilities maintenance representative})

- B. Items listed below require coordination among members of the Commissioning Team. Details regarding these items are provided elsewhere in this Section and discipline specific sections. The activities listed below shall be successfully completed prior to Substantial Completion. Seasonal Tests deemed to be required shall not be a reason to delay Substantial Completion.
1. GC shall submit equipment submittals for equipment listed in Section 1.4.
 2. Contractor Documentation for equipment subject to commissioning. GC to submit to CxA for review within 30 days of equipment submittal being approved. Documents are evaluated for conformance to the OPR, BOD, and contract documents and to their operational functionality. Included are:
 - a. Manufacturer's Installation and Operations Manuals
 - b. Control Diagrams (and/or P&IDs)
 - c. Single line diagrams
 - d. Sequence of Operations
 - e. Installation Verification and Startup Checklists
 - f. TAB Plan
 3. Equipment Startup (to be performed by the GC and appropriate SUB's)
 - a. Develop and utilize Installation Verification and Startup Checklists.
 - b. Coordinate equipment startup with manufacturers' and/or vendor testing, and other required testing.
 - c. Notify CxA 10 days prior to Startup.
 - d. Provide completed Installation Verification and Startup Checklists 10 days prior to scheduled Test Adjust Balance work.
 4. GC shall submit all Point-to-Point check and calibration of all sensors, actuators, dampers, and automatic valves for review by CxA, prior to the start of Test Adjust Balance. Provide completed checklists 10 days prior to TAB.
 5. Title 24 Acceptance Tests.
 - a. GC shall complete all required NRCI, NRCA, and NRCV forms, as outlined in the construction documents.
 - b. GC shall submit completed NRCI, NRCA, and NRCV to CxA 10 days prior to scheduled Functional Performance Testing.
 6. Test Adjust Balance (TAB): TAB work shall begin by the appropriate contractor after completion of and acceptance of completed Installation Verification and Startup Checklists by the CxA. Notify CxA 10 days prior to Test Adjust and Balance. Submit TAB report to the CxA within 5 days of completion.
 7. Functional Performance Testing (FPT): CxA is to develop FPT, then witness and document testing. Completion of Installation Verification and Startup Checklists and TAB reports by Subs and acceptance by the CxA are required prior to scheduling Functional Performance Tests. Coordinate FPT schedule with CxA and CxC.
 8. Operations and Maintenance Manuals (O&M): General Contractor shall collect and review O&M documentation and verify it complies with Contract Documentation. GC shall then submit final O&M Manuals for review by CxA at least 10 days prior to training.
 9. As-Built Drawings: GC shall provide "redline" or as-built drawings for review by CxA in advance of training activities.
 10. Training of building users and operations personnel: GC shall submit training plan to CxA for review and acceptance at least 10 days prior to scheduling training. GC and appropriate SUB's shall provide training to building users and operations personnel at the level necessary to impart the operational knowledge relevant to each group. O&M and as-built documentation is recommended to be included in training of maintenance personnel.

1.16 COMMISSIONING PLAN

- A. The Commissioning Plan (Cx Plan) is a document issued by the CxA to the Commissioning Team in the design phase. The Cx Plan will be updated at various milestones throughout the project. If

a conflict exists between the Commissioning Plan and the Specifications, and Contract Documents; the contractor shall ask for clarification on which document takes precedence.

- B. The Cx Plan begins during the design phase of the project. Updates are made throughout the design and construction phase of the project, as necessary.
- C. Cx Plan establishes process guidelines to ensure that the OPR and BOD are met.
- D. Cx Plan includes a commissioning schedule from design through construction and into occupancy.
- E. The Commissioning Plan provides guidance in the execution of the Commissioning process. The Commissioning Plan outlines the specific submittals, reviews, inspections and tests that shall be performed as part of the Commissioning process and assigns roles and responsibilities among the Commissioning Team.
- F. Cx Plan shall include the following:
 - 1. General project information
 - 2. Commissioning goals
 - 3. Systems to be commissioned
 - 4. Roles and responsibilities of the members of the Cx Team
 - 5. Cx Team directory
 - 6. Schedule of Cx activities
 - 7. Plan to test systems and components
- G. The Cx Plan shall be issued during early design and implemented throughout the design and construction phases. This document will be updated as needed and then used as a basis for the Commissioning Kick-off Meeting during construction.
- H. The Cx Plan shall be integrated with the GC's overall project schedule.
- I. The Cx plan will be approved by the Owner Representative, an approved plan will be submitted in 1 hard copy and 1 electronic copy to the Owner Representative.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Contractor shall provide all testing equipment, tools, and instruments required by the Commissioning Process except data logging equipment. If needed, data logging equipment is provided by the CxA.
- B. Submit to CxA a list of test equipment, serial numbers, and calibration certificates expected to be used in the testing process. Calibration certificates shall be dated within 12 months of when equipment is expected to be used or as more restrictive specifications may state in the Contract Documents.
- C. Contractor shall be responsible for disposable materials, e.g. chart/graph paper, recording media, etc. Contractor shall be responsible for all temporary materials, e.g. extension cords, jumper wires, portable sensors, etc.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Construction Commissioning Kick-off Meeting: A Commissioning meeting led by the CxA, shall be held within sixty (60) working days after the Notice to Proceed. Attendance is mandatory for the Construction Commissioning Team. The Cx Plan shall be presented at this meeting.
- B. Controls Integration Meeting: The CxA, CxC, Engineer of Record, CC, and OR (or Owner's designated Facility Representative) may conduct controls integration meeting(s) in coordination with team members as appropriate, including the controls programmer for the project. The meetings shall occur after the software and database drawings are issued for initial review, but prior to the development of the database and code for any piece of equipment.
- C. Other Meetings: The CxA shall schedule other meetings, generally in conjunction with regularly scheduled site meetings. Meetings shall cover coordination, deficiency resolution, and planning issues.

3.2 COMMISSIONING SUBMITTALS

- A. General Requirements
 1. Allow clear space on each submittal for review stamp.
 2. Identify Tag Numbers from construction drawings and or specifications on all submittals.
 3. Commissioning submittal requests shall be integrated into the normal submittal process and protocol of the construction team.
 4. The CxA shall review and comment on submittals related to the equipment to be commissioned for conformance to the Contract Documents as it relates to the Commissioning process, to the functionality of the equipment, and as to the adequacy for developing test procedures.
 5. CxA will stamp and provide comments on all submittals.
 6. If submittals are incomplete at issuance and require multiple reviews, the Contractor will be billed for additional review time and materials at current billing rates of the CxA.
- B. Equipment Submittals: Specific equipment submittals outlined in the specifications shall be provided to the CxA for review and comment.
 1. Manufacturer's standard drawings shall be modified to remove information which is not applicable and shall be supplemented to provide additional information where necessary.
 2. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other standard descriptive data shall:
 - a. Have each copy clearly marked to identify pertinent materials, products, models, finishes, etc.
 - b. Clearly show intended options and delete (or strike) options not provided.
 - c. Show dimensions, access points, and clearances required.
 - d. Show performance characteristics and capacities.
 - e. Show wiring diagrams and controls, and show necessary rough-in requirements for utility services and connections, where applicable.
 - f. Include ID Tag numbers as designated on contract drawings.
- C. The following contractor-provided documents are required within 30 days of the approved Equipment Submittal.
 1. System Control Diagram (P&ID)s, Documents and Sequence of Operations (SoO). Contractor provides Control Drawings (or Piping and Instrumentation Diagrams {P&IDs})

- and narrative description of all control sequences for each component, equipment and system.
- a. A list of all control points, including analog inputs, analog outputs, digital inputs, and digital outputs. Include the values of all parameters for each system point.
 - b. Provide information (narrative, control drawings, P&IDs) describing the operational modes for all equipment and systems, including startup, shutdown, capacity modulation, emergency and failure modes, alarm scenarios, occupied and unoccupied modes, and interlocks to other equipment.
 - c. Provide SoO and Control diagrams in the same submittal.
2. Single Line Diagram: Single line drawings identifying equipment and its interconnected relationship to other equipment.
 - a. Provide a single line diagram showing equipment and its relationship to other equipment and systems. This diagram informs the reader of equipment connectivity. Include clear indication of interlocks, safeties, and dependencies.
 - b. Diagrams showing all control points, sensor locations, point names, actuators, and controllers, where necessary.
 - c. Logic diagrams showing the logic flow of the system.
 3. Manufacturer's Installation and Operations Manuals (IOM).
 - a. Provide one copy of the manufacturer's IOM for each unique type of equipment. This manual shall be consistent with the specified approved model. Highlight or cross out sections to illustrate the options and control strategies that are being used for this project. Identify ID Tags on the cover page of each IOM, consistent with design drawings.
 4. Installation Verification and Startup Checklists – Contractor developed checklists designed to verify equipment installation procedures.
 - a. The contractor shall prepare Installation Verification and Startup Checklists as a submittal for each piece of equipment listed in Section 1.4 and submit it for review by the CxA within 30 days of receiving approved equipment submittals (and at least 30 days prior to scheduled startup). The CxA will review these Checklists and may request that additional items be added.
 - b. Installation Verification and Startup Checklists are primarily static inspections and functional procedures to prepare the equipment or system for initial operation (e.g., verification of installation requirements, fan belt tension, labels affixed, gages in place, torque values, sensor calibration, etc.).
 - c. Other startup record forms normally used should also be filled out and submitted at the same time as Installation Verification and Startup Checklists. All documentation should be submitted to the CxA upon completion.
 - d. Manufacturer's recommended checklists shall be part of each contractor's developed Checklist.
 - e. Provide checklists for all components, equipment, sub-systems, and systems.
 - f. Each item shall have a different entry line with space provided for technician's signoff and comments.
 - g. Separate checklists shall be prepared for each piece of equipment for each mode of operation, as appropriate.
 - h. Indicate whether the individual verification line item was installed, configured, and calibrated successfully, as defined in the checklist.
 - i. Provide space for all necessary parties to sign off and date the checklist.
 - j. The approved Installation Verification and Startup Checklists are completed by the Contractor and verified by the Commissioning Authority through site visits, inspections, and/or review of the completed Checklists.
 - k. This list of procedures does not constitute a recommendation of the full installation and startup procedures or release the installer from following all factory recommendations, the specifications, applicable codes and good practice.
 5. Test Adjust Balance (TAB).

- a. Submit a sample TAB Report form for each component, piece of equipment, sub-system, and system requiring testing, adjusting, and balancing; including all interfaces, interlocks, etc.
- b. Sample TAB report is developed with project specific procedures and equipment and includes all required testing, adjusting, and balancing identified elsewhere in contract documents.
- c. Provide a detailed description of the Test Adjust Balance procedures and processes.

3.3 SITE INSPECTIONS

- A. Relevant subcontractors shall accompany the Commissioning Authority on up to 2 construction site visits prior to Functional Performance Testing.
- B. The Contractor shall correct deficiencies found during site visits within 7 days of receiving a corrective action report (Commissioning Issues Logs). A Contractor's written response shall be provided with an explanation describing the corrective measure.

3.4 STARTUP PROCEDURES

- A. Undertake a full startup checkout of each piece of equipment. The startup testing shall be successfully completed prior to formal Functional Performance Testing of that system.
- B. Each piece of equipment receives a full checkout by the Contractor. No sampling strategies are used.
- C. Execution of Installation Verification and Startup Checklists
 - 1. A minimum of 10 days prior to startup, the Subs and/or vendors schedule startup with the CxC and CxA. The startup and initial checkout are directed and executed by the Subcontractor or vendor. The CxA, A/E, and OR may observe the procedures for some or all of the primary equipment.
 - 2. To document the process of startup, the site technician performing the task initials and dates each line item in the Installation Verification, Startup Checklists, and any manufacturer field startup sheets, as they are completed. Only individuals having direct knowledge of a line item being completed shall check or initial the forms. Each form is to be dated and signed by the person responsible for the Startup.
 - 3. The Subs and/or vendors submit a signed copy of the completed checklists to the CxA for review.
 - 4. Installation Verification and Startup Checklists may contain tasks for multiple subcontractors. The primary subcontractor for any particular commissioned equipment is responsible for coordinating sign-off by others.
 - 5. The subcontractors shall submit the completed documentation to the CxA at least 10 days prior to any TAB or FPT is scheduled.
 - 6. Provide all manufacturers recommended maintenance to equipment until Final Completion.
 - 7. Reference Division specific Commissioning Specification for any additional Installation Verification and Startup requirements.

3.5 TEST ADJUST AND BALANCE REQUIREMENTS

- A. Test Adjust Balance (TAB) work is to start after all Installation Verification and Startup Checklists are completed and accepted by CxA. Exceptions may be made if approved by CxA in advance of scheduled TAB.
- B. Notify CxA 10 days prior to scheduled TAB work.
- C. Submit working copy of TAB report to CxA for review as soon as completed.
- D. Submit final TAB Report 10 days prior to FPTs.
- E. Acceptance of TAB report is based on specified deviation from design values. Deviation of $\pm 10\%$ from design value will be used absent of specified values from design engineers.
- F. A sample set of readings will be taken during Functional Performance Tests to verify final TAB Report. Discrepancies of values greater than $\pm 10\%$ (unless specified elsewhere) for 10% of the sample will be cause to have the TAB Report rejected by CxA.
- G. Reference Division specific Commissioning Specification for additional Installation Verification and Start-up requirements.

3.6 CALIFORNIA TITLE 24 ENERGY STANDARDS ACCEPTANCE TESTING

- A. Acceptance requirements ensure that equipment, controls and systems operate as required by the 2019 California Nonresidential Energy Standards. The activities specified in these requirements have three aspects:
 - 1. Visual inspection of the equipment and installation
 - 2. Review of the certification requirements
 - 3. Functional tests of the systems and controls
- B. Complete and submit a copy of all required NRCI, NRCA, and NRCV forms, as outlined in the construction documents.
- C. A list of Acceptance Tests is found in Appendix A of 2013 Nonresidential Compliance Manual.
- D. The Building Department may require that Certificates of Acceptance are completed and submitted prior to signing off on the final Certificate of Occupancy.
- E. Notify CxA 14 days prior to executing Acceptance Tests.
- F. Acceptance Testing shall be reviewed and approved by CxA.

3.7 FUNCTIONAL PERFORMANCE TESTING REQUIREMENTS

- A. Reference Division specific Commissioning Specifications for any additional Functional Performance Testing Requirements.
- B. Complete the following prior to Functional Performance Testing:
 - 1. Coordinate with the Commissioning Authority to be present during Functional Performance Testing.

2. A minimum of 14-day notice to the CxA is required prior to scheduling the Functional Performance Testing.
 3. Review by CxA of the Installation Verification and Startup Checklists, Title 24 Acceptance Tests, and TAB Report.
 4. Correction of deficiencies identified during Installation Verification and Startup Checklists. Deficits shall be identified through Commissioning Issues Logs provided by CxA.
 5. Provide CxA with access to the record documents. Finalize and make corrections to Record Documents as noted by the CxA prior to Functional Performance Testing.
 6. List of any changes to equipment, SoO, and final schedules and setpoints.
 7. Review and execute the FPTs in advance of the CxA witnessing the tests. Report any inconsistencies of expected results to the CxC and CxA.
- C. Use only the certified testing equipment provided in the list given to the CxA, as stated in Section 2.1.
- D. Perform Functional Performance Testing under the observation of the Commissioning Authority who shall record the results of the Functional Performance Test procedures.
- E. Perform all specified tests according to approved testing procedures and the following Control Signal Manipulation requirements:
1. Verify and test performance using actual conditions whenever possible.
 2. Simulate conditions by imposing an artificial load when it is not practical to test under actual conditions and when written approval for simulated conditions is received from Commissioning Authority. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After test, return settings to normal operating conditions.
 3. Alter setpoints when simulating conditions is not practical and when written approval to do so is received from Commissioning Authority. After tests, return all setpoints back to normal operating conditions.
- F. Deficiencies found during testing shall be recorded on the FPT form and communicated in the Issues Log.
- G. Deficiencies found during testing shall be corrected by the Contractor within 7 days of receiving an Issues Log from the CxA. Deficiencies shall be retested without cost to the owner until accepted by the Commissioning Authority. Where there is a dispute over a deficiency, the Engineer of Record shall be the final authority.
- H. Resolution of minor deficits during Functional Performance Testing may be permissible as determined by the CxA at the point when/where the defect is found.
- I. Deficiencies found during Functional Performance Testing due to inadequate startup are subject to additional services. Contractor will pay CxA on a time and materials basis for retesting.
- J. Problem Solving: The CxA may recommend solutions to problems found, however the burden of responsibility to solve, correct, and retest problems is with the contractor.
- K. The Commissioning Authority shall review and recommend Functional Performance Testing results for approval.
- L. All testing, retesting, and acceptance of Functional Performance Testing shall be completed prior to Substantial Completion. Seasonal Testing may occur after Substantial Completion, where necessary.

3.8 PERFORMANCE TRENDS

- A. Prior to functional testing, the Controls Contractor (CC) shall set up trends on the BAS and Facilities Data Historian (FDH) as specified in the FPTs and/or contract documents. The shall download and submit trend data to the GC, who shall forward it to the CxA for review. The data must be electronic and in spreadsheet or database format.
- B. Remote access, when possible, shall be established prior to functional testing and the CxA shall be given access.
- C. Trends may also be required for review by the CxA during the Post Occupancy Review period.
- D. Trending Requirements
 1. All trended points and alarms need to be mapped into the Facilities Data Historian (FDH). Controls Contractor shall coordinate FDH alarm and trending requirements with the Owner.
 2. Submit trends for all points listed in Functional Performance Tests. Equipment should be trended during a period similar to design conditions.
 3. Trend data must be saved in CSV (Comma delimited) (*.csv) format.
 4. All data is to be within the specified trend period for any particular submittal period.
 5. Status or Change of Value (COV) data may be saved with other COV data in a single file, but not with Time Series data.
 6. Time Series data may be saved with other Time Series data in a single file, but not with COV data.
 7. Provide continuous number of specified days of data, 24 hours a day, with time intervals as specified in Functional Performance Tests

3.9 OPERATIONS & MAINTENANCE AND CLOSE OUT DOCUMENTATION

- A. The CxC shall compile all close out documents required by the contract documents, including O&M manuals, equipment warranties, contractor guarantees, and as-builts and verify compliance with the contract documents.
- B. CxC shall forward a complete set of documents to the EOR and Owner for review and approval.
- C. Contractor shall make corrections to the O&M documents within 7 days of receipt of EOR review comments.
- D. The final approved O&M documents shall then be forwarded to the CxA for review in accordance with the contract document requirements. Follow the normal submittal procedure for this submittal.

3.10 SYSTEMS OPERATION TRAINING

- A. Training of the appropriate maintenance staff for each equipment type or system shall be documented for inclusion in the commissioning report.
- B. Training shall include procedures to operate and maintain the building in a cost-effective and energy efficient manner.
- C. Provide a written Training Plan for the targeted audience for review by CxA. Training Plan is to be submitted prior to the completion of Functional Performance Testing.

- D. Submit Training Plan, including a training agenda, proposed schedule with date and length of training, targeted audience, and qualifications of trainer. Send proposed Training Plan to the Owner and CxA for review 2 weeks prior to training. CxA shall review its content and adequacy.
- E. Coordinate training schedule with the CxC.
- F. The O&M manuals shall be available as reference material for the training sessions.
- G. Separate training will be required for building users and owner's maintenance staff.
- H. Instruct Owner's operating personnel in proper starting sequences, operation, shutdown, and maintenance procedures, including normal and emergency procedures. Review the SoO documentation.
- I. Training will include a field demonstration of each piece of equipment.
- J. Submit a written record of the session, complete with an attendance list (Training Log) to the CxA. The Training Log is to be signed by all attendees. The Training Plan and Training Log are included in the Commissioning Report.
- K. In addition to these general requirements, specific training requirements for commissioned equipment may be specified in other Divisions.

3.11 COMMISSIONING REPORT

- A. General: The Final Report shall be in accordance with 01 78 39 – Master Specification – Requirements for Contractor Turnover Packages. The hardcopy shall be typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by commissioned systems. Content shall be organized by equipment tag numbers and or system name.
- B. The report shall meet Title 24 and LEED v4 requirements.
- C. The report shall include a certification sheet in front of binder signed and shall be sealed by the Commissioning Authority (one per system binder).
- D. For validated systems, an extra copy of all Automation System documentation shall be provided to owner.
- E. The report shall include all relevant system and equipment commissioning data in each system TOP section.
- F. The hardcopy shall be scanned into a .pdf format and delivered to the Owner Representative.

3.12 SYSTEM MANUAL

- A. At the completion of the construction phase commissioning activities, CxA to provide a Systems Manual to the owner for use in operating the building, with Contractor participation.
- B. The Systems Manual is assembled during the construction phase and available during the contractors' training.

- C. This manual is in addition to construction record drawings and Operations and Maintenance Manuals.
- D. Systems Manual shall document the general aspects of the building operations, including:
 - 1. Site information, including facility description, history and current requirements
 - 2. Site contact information
 - 3. Instruction for basic operations and maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, and a site events log
 - 4. Site equipment inventory and maintenance notes
 - 5. Copy of all special inspection verifications required by enforcing agency or the Standards
 - 6. Owner's Project Requirements
 - 7. Basis of Design
 - 8. System Narrative
 - 9. Single Line Diagrams
 - 10. Test Adjust Balance Report
 - 11. Schedule for Maintenance
 - 12. Schedule for Retesting / Recommissioning
 - 13. Calibration Schedule
 - 14. Blank Functional Performance Tests

3.13 PROJECT CLOSEOUT

- A. The Commissioning process shall be completed when the systems operate according to the Owner's Project Requirements, Basis of Design, and the Contract Documents, as determined by the CxA.
- B. The Commissioning process may continue past Substantial Completion of the Project, until all non-compliance issues have been resolved. Any remaining deficits are reported to the Owner in the Final Commissioning Report.

3.14 POST OCCUPANCY REVIEW

- A. Approximately 10 months after Substantial Completion (or 10 months after the start of the contractor's warranty), the CxA shall provide a building operations review of the commissioned systems.
- B. The CxA will be available to discuss outstanding Issues Log items and other conditions inconsistent with the functional expectations of the building operations by the Owner's representatives, building users, and maintenance personal.
- C. The CxA will assist in drafting a plan to remedy outstanding and present issues presented at this review meeting.
- D. A summary report of the Post Occupancy Review will be provided to the Owner.

3.15 COST OF RETESTING

- A. Additional costs incurred by the CxA for retesting systems which used unapproved Startup procedures or completed inadequately during startup may be charged to the Contractor.

- B. Where disputes occur, the Owner shall make the final determination.
- C. Retesting shall not be considered a reason for a claim of delay or for a time extension by the contractor.

3.16 DEFERRED TESTING

- A. Equipment requiring seasonal testing to properly assure equipment operations, as determined by the CxA, shall require the Contractor to perform Functional Performance Testing at a later time. At no time shall the testing extend beyond the warranty period.
- B. Unforeseen Deferred Tests: Checks or tests not completed due to the required occupancy condition, or other conditions may be delayed upon approval of the Owner.
- C. Post Occupancy Review: CxA may require contractor to perform additional testing when results from the Post Occupancy Review suggest components, systems, or system's integration is failing during the warranty period.

END OF SECTION

SECTION 024000
DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Specifications for the demolition and removal of pavement sections, retaining wall, concrete flatwork, underground pipes, including backfilling of resultant excavations and depressions within limits of project, as indicated. Abandoned underground pipes at the limits shall be capped with concrete and/or pipe fittings as determined by the Engineer.
- B. Extent of demolition work shall be as follows:
 - o Concrete flatwork, asphalt pavement, including base and any concrete which may be encountered
 - o Concrete stairways, retaining walls, including footings and any concrete which may be encountered
 - o Fences, gates, including foundation which may be encountered
- C. Restoration of existing structures and facilities to remain in place which are damaged by demolition and removal operations.

1.2 RELATED SECTIONS

- A. Section 015001 - Temporary Facilities and Controls
- B. Section 015639 – Temporary Tree Protection

1.3 REFERENCES

- A. American National Standards Institute (ANSI)
ANSI A10.6 - Safety Requirements for Demolition Operations
- B. California Code of Regulations (CCR)
CCR Title 8, Chapter 4, Subchapter 4 – Construction Safety Orders
CCR Title 24, Part 2, California Building Code, Chapter 33, Section 3303, Protection of Pedestrians during Construction or Demolition

1.4 PERMITS

- A. Obtain all special permits and licenses and give all notices required for performance and completion of the demolition and removal work, hauling, and disposal of debris.

1.5 SUBMITTALS

A. Demolition Plan

- 1. Submit a comprehensive demolition plan, describing the proposed sequence, methods, and equipment for demolition, removal, and disposal of structure(s); include salvage if required. Do not proceed with demolition until the designated approval authority has approved the demolition plan.

B. Permits

- 1. Submit copies of demolition, hauling, and debris disposal permits and notices for record purposes. Include description of proposed haul routes.

1.6 SITE CONDITIONS

- A. Erect and maintain temporary bracing, shoring, lights, barricades, signs, and other measures as necessary to protect the public, workers, and adjoining property from damage from demolition work, all in accordance with applicable codes and regulations.
- B. Open depressions and excavations occurring as part of this work shall be barricaded and posted with warning lights when accessible through adjacent property or through public access. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
- C. Protect utilities, pavements, and facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by demolition operations.
- D. Protection of Utilities: Protect active sewer, water, gas, electric, and other utilities; and drainage and irrigation lines indicated or, when not indicated, found or otherwise made known to the Contractor before or during demolition work.
- E. Maintain existing utilities and protect from damage as necessary to satisfy the requirements of jurisdictional utility companies and related codes and regulations.
- F. Make arrangements with affected utility companies and Owners to provide the information and services necessary to coordinate and complete the Work.
- G. Do not disconnect or shut down any part of the existing utilities and services, except by permission of authorities having jurisdiction. Submit schedule of estimated shut-down time in order to obtain such permission, and notify all interested parties, utilities, and municipal and county authorities, as required.
- H. Utilities to be removed shall not be removed until shut-down time can be kept to a minimum. Do not remove an existing utility line or service until the replacement line, crossover, or capping is ready to be performed.
- I. Notify the Engineer and utility owners 72 hours before performing any excavation work. Notify affected utilities by calling Underground Service Alert (USA) at 1-800-227-2600. Contact utility owners not covered by USA, by calling the affected utility owners directly.
- J. Protect active underground utilities from damage. If underground utilities are damaged in any way, notify the Engineer and affected utilities immediately for corrective action.
- K. Noise and Dust Abatement: Comply with requirements specified in Section 01 50 00 - Temporary Facilities and Controls. In addition, provide continuous noise and dust abatement as required to prevent disturbance and nuisance to the public and workers and to the occupants of adjacent premises and surrounding areas. Dampen or cover areas affected by demolition operations as necessary to prevent dust nuisance.
- L. The Contract Drawings and related documents may not represent all surface conditions at the site and adjoining areas. The known surface conditions are as indicated, and shall be compared with actual conditions before commencement of work.
- M. Existing utilities and drainage systems below grade are located from existing documents and from surface facilities such as manholes, valve boxes, area drains, and other such surface fixtures.
- N. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under construction, notify the Engineer in writing, requesting instructions on their disposition. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the work until written instructions are received from the Engineer.
- O. Thicknesses of existing pavements and base rock are unknown. Remove pavement and base rock of whatever thickness as required.

PART 2 - PRODUCTS

2.1 MATERIALS, EQUIPMENT, AND FACILITIES

- A. Furnish all materials, tools, equipment, devices, appurtenances, facilities, and services as required for performing the demolition and removal work.

PART 3 - EXECUTION

3.1 PRESERVATION OF REFERENCE MARKERS

- A. Record the locations and designation of survey markers and monuments prior to their removal. Provide three reference points for each survey marker and monument removed, established by a licensed civil engineer or land surveyor currently registered in the State of California.
- B. Store removed markers and monuments during demolition work, and replace them upon completion of the work. Re-establish survey markers and monuments in conformance with the recorded reference points. Forward to the Engineer a letter verifying re-establishment of survey markers and monuments, signed by a licensed civil engineer or land surveyor currently registered in the State of California.

3.2 DEMOLITION

- A. Perform demolition in accordance with the approved Demolition Plan.
- B. Operational procedures shall be in accordance with the approved Demolition Plan.
- C. Demolish concrete and masonry in small sections. Perform demolition with small tools as much as possible. Blasting will not be permitted.
- D. Cap and plug pipe and other conduits abandoned due to demolition, with approved type caps and plugs as required by the utility owners.
- E. Backfill and compact depressions caused by excavations, demolition, and removal in accordance with the requirements of Section 31 20 00 - Earth Moving.

3.3 RESTORATION OF EXISTING STRUCTURES AND FACILITIES

- A. All damage to existing structures and facilities, including utilities, which are to remain in place, shall be repaired to a condition equal to that existing prior to the beginning of demolition and removal operations. The cost of repairing existing structures and facilities damaged by the Contractor's operations shall be at the Contractor's expense.

3.4 CLEANUP

- A. Provide a clean and orderly site. Restore surrounding area to match existing.

END OF SECTION

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SECTION 031000

CONCRETE FORMWORK

PART 1 GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation for formwork and related accessories required to complete all cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Section 013300
Quality Control	Section 014500
Quality Assurance: Structural Testing and Inspection	Section 014505
Concrete Reinforcement and Embedded Assemblies	Section 032000
Cast-In-Place Concrete	Section 033000
Architectural Concrete	Section 033300
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

- A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
 2. ACI 301 – Specifications for Structural Concrete.
 3. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
 4. ACI 347 – Guide to Formwork for Concrete.
- C. Definitions:
1. See Section 033000.

1.5 CONTRACTOR QUALIFICATIONS

- A. The work of this section shall be performed by a company specializing in the type of concrete formwork required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workers thoroughly experienced in the necessary crafts.
- B. Contractor's testing agency Services: Required as specified in Division 1, and herein.
- C. Materials and installed work may require testing and retesting at any time during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

- (1) Submittal Schedule
- (2) Shop Drawings
- (3) Shoring Calculations
- (4) Product Data
- (5) Samples
- (6) Compatibility Certification
- (7) Hazardous Materials Notification
- (8) LEED Submittals

- 1. Submittal Schedule: See Section 013300.
- 2. Shop Drawings:

- a) Submit for action: Formwork shop drawings sealed and signed by a Professional/Structural Engineer licensed in California. Shop drawings shall clearly indicate but not be limited to the following:
 - 1. Size, type and quality of form materials including conditions at tops and ends of walls. (If wood is used, indicate species.)
 - 2. Form construction indicating structural stability and jointing including special form joints or reveals required by Contract Documents
 - 3. Location and pattern of form tie placement, and other items that affect the appearance of concrete that will remain exposed to view.
 - 4. Form finish clearly indicating proper locations and full coordination with concrete finishes required by Contract Documents.
 - 5. Layout, procedures, and sequencing of shoring that correlates with the information contained in the shoring calculations described below.

6. Locations and dimensions of openings in structural members including floor slab, shear walls, columns. See SUBMITTALS Section of Specification 033000.
 7. Location of proposed construction joints in walls and slabs. See SUBMITTALS Section of Specification 033000.
3. Shoring Calculations: Submit for record. Calculations sealed and signed by a Professional/Structural Engineer licensed in California. Calculations shall clearly address but not be limited to the following:
 - a) Description of construction loads assumed including concrete, formwork, and construction live load in accordance with ACI 347.
 - b) The total construction load imposed on shoring.
 4. Product Data: Submit for action copies of manufacturers' product data and installation instructions for proprietary materials used in exposed concrete work, including form liners, release agents, manufactured form systems, ties, and accessories.
 5. Samples: At request of Architect, submit for record samples of form ties and spreaders.
 6. Compatibility Certification: Submit for record a written statement certifying that form release agent used is compatible with subsequent architectural finish materials applied to concrete surfaces. Submit along with manufacturer's data.
 7. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.
 8. LEED Submittals
- B. Submittal Process: See Section 013300.
 - C. SER Submittal Review: See Section 033000.
 - D. Substitution Request: See Section 012513.
 - E. Request for Information (RFI): See Section 033000.

1.7 FORMWORK DESIGN

- A. Design of Formwork, Shoring, and its removal is the Contractor's responsibility.
- B. Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads per SEI/ASCE 37-14 that might be applied, until such loads can be supported by the concrete structure.
- C. Design Requirements:
 1. Forms shall be designed for fabrication and erection in accordance with Design Professionals' requirements and recommendations of ACI 301, 318 and 347, and California Building Code, Section 19A.
 2. Design formwork in a manner such that the total construction load does not at any time exceed the total design load of new or existing construction and accounts for concrete age and relative strength at time of loading.

3. Design formwork for loads and lateral pressures outlined in Section 2.2, ACI 347, and wind and seismic loads as specified by SEI/ASCE 37-14 unless otherwise controlled by local building code.
4. Design formwork to include loads imposed during construction, including weight of construction equipment, concrete mix, height of concrete drop, rate of filling of formwork, vibrator frequency, ambient temperature, foundation pressures, lateral stability, temporary imbalance or discontinuity of building components, and other factors pertinent to safety of structure during construction.
5. The use of flowing concrete (8" (200mm) to 10" (250mm) slump) requires a review of the formwork design based on the rate of placement and setting time of the mix. Unless shown to be sufficient otherwise, formwork design shall conform to the requirements of ACI 237.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with General Conditions and Division 1, including the following:
 1. Store forms and form materials clear of ground and protect from damage.

1.9 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

- A. See Section 014505.

1.10 QUALITY CONTROL BY CONTRACTOR

- A. See Section 033000.

1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

- A. See Section 033000.

1.12 PERMITS AND WARRANTY

- A. Permits: See Sections 007213 and 033000.
- B. Warranty: See Sections 017836 and 033000. Failures include but are not limited to the following:
 1. Discoloration of concrete scheduled to remain exposed to view.
 2. Damage of concrete finishes caused by forms.
 3. Damage of concrete caused by form stripping.
 4. Non-compliance with form finishes required for designated architectural finishes.
 5. Non-compatibility of form release agent with subsequent architectural finish materials applied to concrete surfaces.
 6. Excessive and/or noticeable bowing in placed concrete members caused by deflection of formwork during concrete placement.

PART 2 - PRODUCTS

2.1 FORMWORK REQUIREMENTS

- A. General Requirements:

Laney Library & LRC
Issue for Bid
Thornton Tomasetti

Section 031000 – Page 4
CONCRETE FORMWORK
March 31, 2023

1. Product information presented in Section 033300 governs except for the following conditions:
 - a) Concrete that is only exposed to view of maintenance workers in the final condition
 - b) Concrete not exposed to any view in the final condition.
2. Formwork shall meet construction safety regulations for California.
3. Forms shall be removable without impact, shock or damage to concrete surfaces, the structure and adjacent materials.
4. Forms shall be tight-fitting, designed and fabricated for required finishes and to withstand concrete weight and maintain tolerances as specified in ACI 117 for the following designations: (See architectural drawings for locations).
 - a) Class A – For surfaces prominently exposed to public view where appearance is of special importance.
 - b) Class B – Coarse-textured concrete-formed surfaces intended to receive plaster, stucco or wainscoting.
 - c) Class C – General Standard for permanently exposed surfaces where other finishes are not specified.
 - d) Class D - Minimum quality surface where roughness is not objectionable, usually applied where surfaces will be concealed.
5. Furnish forms in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings, using form materials with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.
6. Butt Joints: Shall be solid and complete with backup material to prevent leakage of cement paste.

B. Form Finishes for Exposed Surfaces:

1. Type: Straight, smooth, free of cement paste leaks at butt-joints, surface imperfections and other irregularities detrimental to appearance of finished concrete, fully coordinated with requirements for required finish material.
2. Form exposed areas of columns and, balcony fascias to achieve true alignment and level soffit of concrete edges. All such areas must be sharp, straight and true to line and level. Slab edges must have adequate shoring to prevent any visible amount of sag and sufficient bracing to prevent any lateral movement during construction.

2.2 FORM MATERIALS

- A. General: Plywood, fiberglass, metal, metal-framed plywood faced, or other acceptable panel-type materials.
 1. Provide materials with sufficient strength to prevent warping.
- B. Plywood: Of species and grade suitable for intended use, sound undamaged sheets with clean true edges, minimum 5/8" (16mm) thick, complying with U.S. Product Standard PS-1.
 - 1.

1. Other Acceptable Sheet Materials: 14 gauge (2.0mm) sheet steel or fibrous glass reinforced resin.
- C. Lumber: Construction grade or better consistent with calculation requirements, without loose knots or other defects.
1. Use only where entire width can be covered with one board 11-1/4" (285mm) or less in width.
- D. Forms for Cylindrical Columns and Supports: Metal, glass-fiber reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications.
1. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.
- E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to support weight of placed concrete without deformation.
- F. Chamfer for Form Corners:
1. Types: Chamfer strips of wood, metal, PVC or rubber fabricated to produce smooth form lines and tight edge joints, 3/4" (20mm) size, maximum possible lengths.
 2. Required for all exposed corners of walls and column forms.
- G. Form Ties:
1. Type: Factory-fabricated metal, adjustable length, designed to prevent form deflection and to prevent spalling concrete upon removal.
 2. Ties used for architecturally exposed concrete shall be galvanized.
 3. Ties shall not leave metal closer than 1-1/2" (40mm) to exposed surface.
 4. When removed, ties shall not leave holes larger than 1" (25mm) diameter in concrete surface.
 5. Removable Ties: Use type with tapered cones, 1" (25mm) outside diameter, for concrete walls which will remain exposed to view and scheduled for architectural finishes.
 6. Snap-Off Ties: Use for concrete walls below grade and walls which will not remain exposed to view and are not scheduled for architectural finishes.
 7. Wire Ties: Not acceptable.
- H. Nails, Spikes, Lag Bolts, Thru-Bolts, Anchorages:
1. Type: Of size, strength and quality to meet the required quality of formwork.
- I. Form Release Agent:
1. Type: Commercial formulation form release agent of non-emulsifiable type which will not bond with, stain, or adversely affect concrete surfaces. Form release agent shall not impair subsequent treatment of concrete surfaces requiring bond or adhesion, or impede the wetting of surfaces to be cured with water or curing compounds. Form release agent shall be compatible with subsequent architectural finish materials applied to concrete surfaces. Apply in compliance with manufacturers' instructions.

2. Form release agent shall meet, at a minimum, all federal and state requirements for volatile organic compounds (VOC's).
 3. For Steel Forms: Non-staining rust-preventative type.
- J. Reglets: Provide sheet metal reglets formed of same type and gauge as flashing metal, unless indicated otherwise on Drawings. Where resilient or elastomeric sheet flashing, or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gauge (0.55mm) galvanized sheet metal. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
- K. Carton Forms: Product of a manufacturer regularly engaged in commercial production of carton forms for the purpose of providing void space below foundation elements as protection from subgrade movement.
1. Acceptable Manufacturer: SureVoid Product, Inc. or equal.
 2. Carton forms shall be capable of supporting required dead load of wet concrete plus normal construction loads until applied loads can be supported by concrete structure, while maintaining full void depth as indicated on drawings.
 3. Carton forms shall be manufactured with corrugated material with a moisture resistant exterior, an interior fabrication of a uniform, cellular configuration composed of non-wax impregnated components, and shall be biodegradable.
 4. Depth: As indicated on drawings.
 5. Profile: Rectangular in cross-section.
 6. Strength capable of supporting a minimum working load of 600 psf (30kPa) in dry condition, Submit for record Independent Testing Laboratory Reports verifying strength.
 7. Protective hardboard cover sheets must be placed over void forms at slabs, walls, and grade beams wider than 12" (300mm) to distribute working loads, bridge small gaps, and protect void material from puncture and other damage during concrete placement. The minimum thickness of the hardboard cover sheets shall be 1/8" (3mm).
- L. Void Retainer Unit: Precast concrete units with 28-day compressive strength ($f'c$) not less than 2,500 psi (17MPa), reinforced with 6x6-W1.4xW1.4 WWR., with the following minimum dimensions for individual units, unless otherwise noted on drawings: Thickness = 1 5/8" (40mm), Length = 3'-0" (900mm), Height not less than carton/void height plus 6" (150mm). Do not substitute trapezoidal carton forms for carton forms specified to receive void retainer units.
1. Acceptable option to above precast concrete units for void retention: "SureRetainer" as manufactured by SureVoid Products, Inc or equal. Depth and installation as recommended by manufacturer to ensure soil retention for specified carton form depth. Submit size and installation instructions for approval prior to use.
- M. Coordinate with materials as specified in Section 032000 Concrete Reinforcement and Embedded Assemblies.

PART 3 EXECUTION

3.1 FORMWORK

A. General:

1. Execution information presented in Section 03 33 00 governs except for the following conditions:
 - a) Concrete that is only exposed to view of maintenance workers in the final condition
 - b) Concrete not exposed to any view in the final condition.
2. Inspect areas to receive formwork.
3. Construct forms to sizes, shapes, lines, and dimensions shown on Contract Documents, and to obtain accurate alignment, location, grades, level and plumb work in finished structures.
4. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins, and to maintain alignment.
5. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, drips, bevels, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in the Work.
6. Comply with shop drawings, ACI 301, 318, 347 and Contract Documents.
7. Maintain formwork and finished work construction tolerances complying with ACI 301 and 117.
8. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.
9. Erect forms for easy removal without hammering or prying against concrete surfaces.
10. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
11. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
12. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
13. Chamfer exposed corners and edges as indicated on the architectural drawings, using wood, metal, PVC or rubber chamfer strips fabricated to produce smooth lines and tight edge joints.
14. Design, erect, support, brace and maintain formwork and shoring to support loads until such loads can be safely supported by the concrete structure.
15. Where specifically shown on the Contract Documents as monolithic, curbs and similar members in connection with slabs shall be formed so that they can be poured integrally with slabs.

B. Concrete Accessories and Embedded Items:

1. Install into forms concrete accessories, sleeves, inserts, anchor bolts, anchorage devices and other miscellaneous embedded items furnished by other trades or that are required for other work that is attached to or supported by cast-in-place concrete.

- a) Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached.
2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
 3. Install dovetail anchor slots in concrete structures as indicated on drawings or required by other trades.
 4. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces.
 5. Coordinate with CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES Section in Specification 032000.
 6. Install accessories and embedded items straight, level, plumb and secure in place to prevent displacement by concrete placement.
- C. Temporary Openings:
1. Locate temporary openings in forms at inconspicuous locations.
 2. For clean-outs and inspection before concrete placement, locate temporary openings where interior area of formwork would otherwise be inaccessible.
 3. For cleaning and inspections, locate openings at bottom of forms to allow flushing water to drain.
 4. Securely brace temporary openings and set tightly in forms to prevent loss of concrete.
 5. Close temporary openings with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be noticeable on exposed concrete surfaces.
- D. Provisions for Other Trades: Coordinate and provide openings in concrete formwork to accommodate work of other trades.
1. Determine size and location of openings, recesses, chases, offsets, openings, depressions, and curbs from information provided by trades requiring such items.
 2. Accurately place and securely support items built into forms.
- E. Cleaning:
1. Normal Conditions:
 - a) Thoroughly clean forms and adjacent surfaces to receive concrete.
 - b) Remove chips, wood, sawdust, dirt, standing water or other debris just before placing concrete.
 - c) Flush with water or use compressed air to remove remaining foreign matter.
 - d) Verify that water and debris can drain from forms through clean-out ports.
 2. During Cold Weather:
 - a) Remove ice and snow from within forms.
 - b) Do not use de-icing salts.
 - c) Do not use water to clean out completed forms, unless formwork and concrete construction will proceed within heated enclosure.
 - d) Use compressed air or other means to remove foreign matter.

F. Form Release Agents

1. Before placing reinforcing steel and miscellaneous embedded items, coat contact surfaces of forms with an approved non-residual, low VOC form release agent in accordance with manufacturer's published instructions.
2. Do not allow release agent to accumulate in forms or come into contact with reinforcement or concrete against which fresh concrete will be placed.
 - a) Coat steel forms with nonstaining, rust-preventative material.
3. Remove form release agent and residue from reinforcement or surfaces not requiring form coating.

G. Before Placing Concrete:

1. Inspect and check completed formwork, shoring and bracing to ensure that work is in accordance with formwork requirements of this section and Contract Documents, and that supports, fastenings, wedges, ties, and parts are secure.
 - a) Make necessary corrections or adjustment to formwork to meet tolerance requirements.
2. Retighten forms and bracing before concrete placement to prevent mortar leaks and maintain proper alignment.
3. Notify Testing Agency sufficiently in advance of placement of concrete to allow inspection of completed and cleaned forms.

H. During Concrete Placement:

1. Maintain a check on formwork to ensure that forms, shoring, ties and other parts of formwork have not been disturbed by concrete placement methods or equipment.
2. Use positive means of adjustment as required for formwork settlement during concrete placing operations.

I. Camber:

1. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.
2. Camber bottom forms where indicated on the drawings. Whenever forms are cambered, screeded levels for establishing top of concrete must be cambered to the same amount and to the same profiles such that scheduled depth of member is not reduced by lifting of forms. Check camber and adjust forms before initial set as required to maintain camber.

J. Surface Defects:

1. Install forms that will not impair the texture of the concrete and are compatible with the specified finish type.

K. Formwork Loads on Grade

1. Where loads from formwork bear on grade, provide suitable load-spreading devices for adequate support and to minimize settlement. In no event shall frozen ground or soft ground be utilized directly as the supporting medium.
- L. Footings and Grade Beams:
 1. Provide forms for footings and grade beams if soil or other conditions are such that earth trench forms are unsuitable.
 2. When trench forms are used, provide an additional 1" (25mm) of concrete on each side of the minimum design profiles and dimensions indicated.
- M. For slabs at grade, secure edge forms in such a manner as to not move under weight of construction loads, construction and finishing equipment, or workers.

3.2 REMOVING FORMS

- A. Formwork not supporting the weight of concrete, such as sides of walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 12 hours after placing concrete, provided concrete is sufficiently hard to avoid damage by form-removal operations, and provided curing and protection operations are maintained after removal of formwork.
- B. Formwork supporting the weight of concrete, such as soffits, slabs, and other structural elements, may not be removed until concrete has attained at least [75%] of design compressive strength. If stripping occurs before [3] days, 100% strength must be achieved.
- C. Remove formwork progressively using methods to prevent shock loads or unbalanced loads from being imposed on structure. Comply with ACI 347.
- D. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.
- E. Whenever formwork is removed during the curing period, the exposed concrete shall be cured per requirements of Section 033000.
- F. All wood formwork, including that used in void spaces, pockets and other similar places shall be removed.
- G. Form tie holes shall be filled as per approved samples submitted to the Design Professionals.
- H. The Contractor shall assume responsibility for all damage due to removal of the forms.

3.3 RE-USING FORMS

- A. Before forms can be re-used, surfaces that will be in contact with freshly poured concrete must be thoroughly cleaned, damaged areas repaired, and projecting nails withdrawn.
 1. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable.
 2. Apply new form release agent on re-used forms.

- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets.
- C. Forms for exposed concrete may be reused only if the surfaces have not absorbed moisture and have not splintered, warped, discolored, stained, rusted or peeled, subject to acceptance by the Design Professionals. The Design Professionals reserve the right to require the Contractor to remove and reconstruct such formwork as will produce subsequent areas that are acceptable. Do not use "patched" forms for exposed concrete surfaces, unless approved by the Design Professionals.

3.4 CORRECTIVE MEASURES

- A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION 031000

SECTION 032000

CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES

PART 1 GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation for reinforcing steel, accessories, embedments and miscellaneous anchorage accessories, joint fillers, and waterstops for cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Section 013300
Quality Control	Section 014505
Quality Assurance: Structural Testing and Inspection	Section 014500
Concrete Formwork	Section 031000
Cast-In-Place Concrete	Section 033000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

- A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
 2. ACI 301 – Specifications for Structural Concrete.
 3. ACI 315 – Details and Detailing of Concrete Reinforcement.
 4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
 5. ACI 355.2 – Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
 6. ACI 355.4 – Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary
 7. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.

8. AWS D1.1 – Structural Welding Code-Steel.
9. AWS D1.4 – Structural Welding Code-Reinforcing Steel.
10. CRD C 572 – Specification for Polyvinylchloride Waterstops.
11. Concrete Reinforcing Steel Institute "Manual of Standard Practice"
12. ASTM D3963 Fabrication and Jobsite Handling of epoxy Coated Steel Reinforcing Bars.

C. Definitions:

1. See Section 033000.

1.5 CONTRACTOR QUALIFICATIONS

- A. The work of this section shall be performed by a fabricator specializing in the type of reinforcement fabrication required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.
1. Welders shall be qualified in accordance with applicable AWS Code within 12 months before starting the work.
 - a) Make qualification records available to the Design Professionals upon request.
- B. Manufacturers shall specialize in manufacturing the types of concrete accessories required for cast-in-place concrete work, with a minimum of 10 years of documented successful experience and shall have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty for each type of accessory.

1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

- (1) Submittal Schedule
- (2) Shop Drawings
- (3) Product Data
- (4) Mill Reports
- (5) Reinforcement Strain Test
- (6) Hazardous Materials Notification
- (7) LEED Submittals

1. Submittal Schedule: See Section 033000.
2. Shop Drawings: Submit for action shop drawings that shall clearly indicate, but not be limited to:

- a) All details, dimensions and information required for fabrication and placement of concrete reinforcement in accordance with Contract Documents, prepared in accordance with ACI 315 recommendations.
 - b) Elevations, plans, sections, and dimensions of concrete work with required reinforcement clearances.
 - c) Ledges, brackets, openings, sleeves, anchor rods, embedments, prefabricated bent-in dowel keyway systems, electrical conduit and items of other trades including interference with reinforcing materials.
 - d) Sizes, grade designations, spacing, locations, and quantities of wire fabric, reinforcement bars, temperature and shrinkage reinforcement dowels.
 - i. Do not use dimensions scaled from Contract Drawings to determine bar lengths.
 - ii. Hooks and bends not specifically dimensioned shall be detailed per ACI 318.
 - e) Bending and cutting schedules, assembly diagrams, splicing and connection requirements, details, and laps.
 - f) Each type of supporting and spacing devices, including miscellaneous accessories.
 - g) Construction joint type, details, and locations. Contractor shall coordinate construction joint type, details, and locations with concrete pour schedule. Submittal shall include details for each type of construction joint in accordance with Contract Documents.
 - h) Locations and dimensions of openings in structural members including floor slab, shear walls, columns and beams. See SUBMITTALS Section of Specification 033000.
 - i) Concrete accessories and embedded items. See SUBMITTALS Section of Specification 033000.
3. Product Data: Submit for action for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and I.C.C reports, where applicable, for products of each manufacturer specified in this section.
4. Mill Reports: Submit for record.
5. Reinforcement Strain Test: For Grade 75 reinforcement, submit for record certification that steel has a yield strength of no less than 75 ksi as measured by both ASTM A615 and ACI 318 Section 3.5.3.2 procedures.
6. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.
7. LEED SUBMITTALS
- a) Building Product Disclosure and Optimization: Environmental Product Declarations Option 1 Environmental Product Declaration (EPD)
 - i. Submit product data or other published information verifying that this product has an EPD. Submit in accordance with Section 018113, LEED Submittals – MRc2 - Building Product Disclosure and Optimization – Environmental Product Declarations.

- ii. Include information on USGBC's v4.1 Building Product Disclosure and Optimization Calculator.
- b) Building Product Disclosure and Optimization: Sourcing of Raw Materials Option 2 Leadership Extraction Practices
 - i. Recycled content:
 - (1) Submit product data or other published information indicating total weight of product to be provided for the Project, percent of post-consumer recycled material by weight and percent of post-industrial recycled material by weight. Include material costs (excluding costs of installation).
 - (2) Include information on USGBC's v4.1 Building Product Disclosure and Optimization Calculator.

- B. Submittal Process: See Section 013300.
- C. SER Submittal Review: See Section 033000.
- D. Substitution Request: See Section 012513.
- E. Request for Information (RFI): See Section 033000.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with General Conditions and Division , including the following:
 - 1. Deliver reinforcing steel to Project site bundled, tagged and marked.
 - a) Use weatherproof tags indicating bar sizes, lengths and other information corresponding to markings shown on placement diagrams.
 - 2. Deliver welded wire fabric in sheets. Do not deliver in rolls.
 - 3. During construction period, properly store reinforcing steel and accessories to assure uniformity throughout the Project.
 - 4. Deliver and store welding electrodes in accordance with AWS D1.4.
 - 5. Immediately remove from site materials not complying with Contract Documents or determined to be damaged.
 - 6. Store reinforcing steel above ground so that it remains clean.
 - a) Maintain steel surfaces free from materials and coatings that might impair bond.
 - b) Keep covered.
 - c) Protect against corrosion or deterioration of any kind.

1.8 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

- A. See Section 014505

1.9 QUALITY CONTROL BY CONTRACTOR

- A. See Section 033000.

1.10 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

- A. See Section 033000.

1.11 PERMITS AND WARRANTY

- A. Permits: See Sections 007213 and 033000.
- B. Warranty: See Sections 017836 and 033000. Failures include but are not limited to the following:
 - 1. Bars with kinks or bends not indicated on Drawings or on approved shop drawings.
 - 2. Bars damaged due to bending, straightening or cutting.
 - 3. Bars heated for bending.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

- A. Verify lines, levels, and dimensions before proceeding with work of this section.
- B. Reinforcing Steel:
 - 1. Type: Deformed billet steel bars, ASTM A 615, Grade 60 or 75 as indicated on Drawings.
 - 2. Size: As indicated on structural Drawings.
 - 3. Where indicated on Drawings, reinforcing steel shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.
 - a) Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
 - 4. Epoxy-Coated: ASTM A 775 where indicated on Drawings.
 - 5. Weldable reinforcement: ASTM A 706 where indicated on Drawings.
- C. Shear Walls:
 - 1. All reinforcing in shear walls shall comply with ASTM A706. Reinforcing not conforming to the low-alloy steel requirements of A706 shall comply with the following requirements:
 - a) Reinforcing shall be limited to ASTM A615, Grade 60 bars.
 - b) The actual yield stress, based on mill tests, shall not exceed the minimum specified yield stress, F_y , by more than 18,000 psi. Retests shall not exceed this value by more than 3000 psi.
 - c) The ratio of actual tensile strength to the actual yield strength is not less than 1.25.
- D. Welded Wire Reinforcement:

1. Type: steel wire, deformed, ASTM A1064.
2. Size: As indicated on structural Drawings.
3. Where indicated on Drawings, welded wire reinforcement shall be hot-dipped galvanized after fabrication in accordance with ASTM A 1060, , with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.
 - a) Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
4. Plain Steel Welded Wire Reinforcement: ASTM A 1064.
5. Deformed Steel Welded Wire Reinforcement: ASTM A 1064.
6. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A.

E. Reinforcement Coating Repair Materials:

1. Apply repair coating in accordance with the manufacturer's written procedures.
2. Galvanized Repair Coating: Zinc-based solder, paint containing zinc dust or sprayed zinc complying with ASTM A780.
3. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/ A 775M.
 - a) The maximum amount of repaired damaged areas shall not exceed 2% of the surface area in each linear foot of each bar. If more than 2% of the surface area in each linear foot of bar is damaged, bar shall be replaced.

2.2 ACCESSORIES

A. Tie Wire:

1. Type: Minimum 16 gauge (1.5mm) annealed steel wire, ASTM A 510 and ASTM A 853.
2. Wire Bar Type: Comply with CRSI.

B. Mechanical Splicing Systems:

1. Mechanical tension and compression splicing systems shall be used where indicated on Drawings or at contractor's option. Only Type 2 mechanical splices are permitted for elements that are part of the seismic force resisting system (SFRS).
2. Splices shall be installed in accordance with manufacturer's requirements.
3. Acceptable Products:
 - a) Bartec Couplers by Dextra (ICC ESR-1705)
 - b) Lenton Interlok LK Couplers by Erico (IAPMO ER-129)
 - c) Lenton FormSaver Couplers by Erico (IAPMO ER-129)
 - d) Lenton Standard and Transition Couplers A2/A12 by Erico (IAPMO ER-129)
 - e) Taper-Lock Couplers by Dayton Superior (IAPMO ER-319)
 - f) 500/510 Series by Headed Reinforcement Corp (ICC ESR-2764)

4. Mechanical and welded tensile mechanical splicing systems shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength (Type 1) except where indicated as Type 2 (100% of specified tensile strength).
5. Mechanical compression splices shall be such that the compression stress is transmitted by end bearing held in concentric contact.

C. Headed Bars:

1. For bar sizes #11 (ø36) or smaller where specifically detailed on Drawings, mechanical bar terminators shall be used.
2. Headed bars shall meet the requirements of ASTM A970, Class HA.
3. Acceptable Products:
 - a) Headed Bars by Dextra (ICC ESR-1705)
 - b) Lenton Terminator by Erico (IAPMO ER-188)
 - c) Taper Threaded Grip-Twist by Bar-Splice (IAPMO ER-796)
 - d) ButtonHead by BarSplice (IAPMO ER-331)
 - e) Taper-Lock End Anchor Disc by Dayton Superior (IAPMO ER-245)
 - f) 550 and 670 Series by Headed Reinforcement Corp (IAPMO ER-177)

D. Weldable Bar Couplers:

1. Acceptable Products:
 - a) Lenton Weldable Couplers by Erico (IAPMO ER-129)
 - b) DBDI Weldable Coupler by Dayton Superior (IAPMO ER-319)

E. Slip Dowel Bar/Plate Systems for Slab on Grade Joints

1. Acceptable Products:
 - a) Speed Dowel or Speed Plate by Sika Corporation
 - b) QuicDowel or QuicPlate by BoMetals, Inc.
 - c) Diamond Dowel System by PNA Construction Technologies

F. Supports for Reinforcement:

1. Types: Bolsters, chairs, spacers, clips, chair bars, and other devices for properly placing, spacing, supporting, and fastening the reinforcement, plastic, plastic protected steel, or epoxy coated to match supported reinforcement.
2. For Contact with Forms: Use types with not less than 3/32" (2.5mm) of plastic between metal and concrete surface.
 - a) Plastic tips shall extend not less than 1/2" (12mm) on metal legs.
3. Individual and continuous slab bolsters and chairs shall be of type to suit various conditions encountered and must be capable of supporting 300 pound (1.5kN) load without damage or permanent distortion.
4. Unless otherwise indicated on Drawings, bottom reinforcing bars in footings shall be supported by precast concrete bricks or individual high chairs with welded sand plates on bottom.
5. For Slabs on Grade: Use supports with sand plates or horizontal runners where base material will not support chair legs.

- G. Deformed Bar Anchors:
1. Type: Automatic end welded, ASTM A 496 quality.
 2. Size and Grade: As indicated on structural Drawings by Nelson Stud Welding.
- H. Anchor rods and dowels:
1. Types and Sizes: Provide sizes and types of anchor rods and dowels as indicated on the Drawings. Each type of anchor shall be manufactured of structural quality steel, designed for cast-in-place concrete applications and be of sizes as indicated on Drawings, complete with washers, nuts, plates and miscellaneous accessories required to meet Contract Document requirements.
 2. Adhesive Anchors for anchor rods and dowels in existing concrete: See Anchorage Accessories.
- I. Prefabricated Bent-In Dowel Keyway Systems and Dowel Bar Replacements:
1. Type, Size and Grade as indicated on Drawings.
 2. Dowels shall be installed in accordance with manufacturer's requirements
 3. Acceptable Products:
 - a) Lenton Form Savers by Erico (IAPMO ER-129)
 - b) DBDI Splice System by Dayton Superior (IAPMO ER-319)
 - c) 300 Series by Headed Reinforcement Corp (ICC ESR-2764)

2.3 ANCHORAGE ACCESSORIES

- A. General: Miscellaneous anchorage accessories for anchoring structural, architectural, electrical, and mechanical items to poured concrete shall include but not be limited to the following:
1. Concrete Anchors: Headed or bent studs ASTM A 108/Grade 1015 through 1020, minimum yield strength of 50,000 psi (345MPa), minimum tensile strength of 60,000 psi (415MPa).
 2. Anchor Rods: ASTM F1554, Grade as noted on Drawings.
 3. Inserts and Coil Rods: Yield strength 65,000 psi (450MPa), ASTM B 633, manufactured by Acrow-Richmond Limited or Dayton Superior
 4. Welding Electrodes: AWS 5.5, Series E70.
 5. Welded Deformed Bar Anchors: Welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division or equal.
- B. Dovetail Anchor Slots:
1. Type: Formed 22 gauge (0.85mm) galvanized steel
 2. Acceptable Manufacturers:
 - a) Heckmann Building Products
 - b) Hohmann and Barnard,
 - c) BoMetals, Inc..
 3. Location of Use: Continuous installation of anchor slots, full height of masonry walls, where masonry walls abut poured concrete walls.

4. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.
5. Finish: Hot-dip galvanized or zinc-plated steel.
6. Stainless steel anchors are acceptable.

2.4 JOINT FILLERS

A. Permanent Compressible Joint Filler:

1. Acceptable Product: W. R. Meadows: "Ceramar" closed-cell expansion joint filler, ultraviolet stable, minimal moisture absorption, non-impregnated, nonstaining and nonbleeding, inert and compatible with cold-applied sealants, or equal.
2. Location of Use: Slabs and curbs as indicated on Drawings or required.
3. Thickness: As indicated on Drawings or required.

B. Temporary Compressible Joint Filler:

1. Type: White molded polystyrene beadboard.
2. Location of Use:
 - a) In slabs, curbs, and walls which must be removed prior to joint sealant installation.
 - b) Vertically to isolate walls from columns or other walls.

C. Semi Rigid Joint Filler:

1. Acceptable Product: Euclid Chemical Company "Euco 700" or "Euco QWIKjoint 200"
2. Acceptable Product: Sika Corporation "Sikadur 51 SL"
3. Acceptable Product: W.R. Meadows Sealtight "Rezi-Weld Flex"

D. Noncompressible Joint Filler:

1. Acceptable Product: Dow Chemical's "STYROFOAM 40" rigid closed-cell extruded polystyrene board, square edges, 40 psi (275kPa) compressive strength, ASTM C 578, Type IV, or equal.
2. Thickness: As indicated on Drawings.
3. Location of Use: As indicated on Drawings or required.

E. Asphalt-Impregnated Joint Filler:

1. Acceptable Product: W.R. Meadows Asphalt Expansion Joint Filler, preformed, ASTM D 994, or equal.
2. Thickness: 1/2" (12mm) maximum, as indicated on Drawings or required.
3. Location of Use: Sidewalks at foundation walls and as indicated on Drawings or required.

F. Asphalt-impregnated fiberboard expansion joint filler for interior work:

1. Type: ASTM D1751.

- G. Self-expanding cork board expansion joint filler for exterior work:
 - 1. Type: ASTM D1752.
- H. Construction Joints:
 - 1. Type: Tongue and groove type profile of galvanized steel, with knock-out holes at 6" (150mm) on center to receive dowelling, complete with anchorage.

2.5 WATERSTOPS

- A. Preformed Swellable Waterproofing Strips especially formulated for concrete cold joints at footings, walls, or slabs.
 - 1. Acceptable Products:
 - a) Volclay Waterstop RX by CETCO Building Materials Group
 - b) Adcor ES by GCP Applied Technologies
 - c) Hydrotite by Sika
 - 2. Size: 3/4" (20mm) by 3/8" (10mm) strips minimum, 25 ft. (7.5m) long, and weighing at least 0.165 lbs/ft (0.245kg/m).
 - 3. Location of Use: Concrete cold joints at footings, walls and slab joints.
 - 4. Comply with manufacturer product application and installation instructions.
- B. Polyvinyl Chloride Waterstops:
 - 1. Type: PVC Waterstops for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections and directional changes. U.S. Corp of Engineers Specification CRD C 572.
 - 2. Acceptable Products:
 - a) PVC Waterstops" by BoMetals
 - b) Greenstreak by Sika
 - c) Sealtight PVC Waterstops by W.R. Meadows

2.6 LEED REQUIREMENTS

- A. Building Product Disclosure and Optimization: Sourcing of Raw Materials, Recycled Content:
 - 1. Rebar to have 80% recycled content by weight of total product.
 - 2. Rebar to be from North American Steel.
- B. Building Product Disclosure and Optimization: Environmental Product Declarations:
 - 1. Preference should be given to materials/products that meet the requirements for the LEED credit MRc2, Environmental Product Declarations.

PART 3 – EXECUTION

3.1 FABRICATION

A. Reinforcing Steel Fabrication:

1. Fabricate in accordance with approved shop Drawings, ACI 315 and Contract Documents.
2. Heating of Reinforcement: Will be permitted only with specific prior approval of the SER.
3. Welding: Comply with ANSI/AWS D1.4; use E9018 electrodes or approved electrodes.
4. Tolerances: Comply with ACI 117.
5. Unacceptable Materials: Reinforcement with any of following defects will not be permitted in Work.
 - a) Bar lengths, depths, and bends exceeding ACI fabrication tolerances.
 - b) Bends or kinks not indicated on Drawings or final shop drawings.
 - c) Bars with reduced cross-section due to excessive rusting or other cause.

B. Welded Wire Reinforcement:

1. Type: As fabricated in accordance with CRSI, unless otherwise noted.

C. Templates:

1. Required for all footing and column dowels, and where required for proper alignment of reinforcing.

D. Assemblies:

1. Fabricate and assemble structural steel items in shop in conformance with AISC and AWS D1.1. Shearing, flame cutting, and chipping shall be done carefully and accurately. Cut, drill, or punch holes at right angles to the surface of the metal. Do not make or enlarge holes by burning. Holes shall be clean-cut without torn or ragged edges.
2. Welding of deformed bar anchors and headed stud anchors shall be installed by full-fusion process equivalent to TRW Nelson Stud Welding Division or KSM Welding Services Division, Omark Industries or Tru-Weld Stud Welding, Medina, OH.
3. Welding of reinforcement shall be done in accordance with AWS requirements. Welding shall be performed subject to the observance and testing by Testing Agency.
4. Galvanizing where required, shall be applied after fabrication and prior to casting concrete.
5. Welding of crossing bars (tack welding) for assembly of reinforcement is not permitted without use of weldable reinforcement and express written consent of SER.

3.2 INSTALLATION OF REINFORCEMENT

A. General:

1. Perform the work of this section in accordance with approved shop drawings, ACI 318 and CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as specified.
2. Before placing reinforcement steel, inspect forms for proper fitting and compliance with allowable tolerances.
3. Reinforcement shall be free of form coatings, sealers, powdered and scaled rust, loose mill scale, earth, ice, and other materials which will reduce or destroy bond with concrete.
4. Do not place concrete until the completed reinforcement steel work has been observed and accepted by Owner's Testing Laboratory.
5. Reinforcement steel is not permitted to be "floated into position".
6. Bend bars cold.
 - a) Do not heat or flame cut bars.
 - b) No field bending of bars partially embedded in concrete is permitted, unless specifically approved by the SER and tested by Testing Agency for cracks.
7. Weld only as indicated.
 - a) Perform welding per ANSI/AWS D12.1 and/or ANSI/AWS D1.4.
 - b) See structural Drawings for additional requirements.
8. Tag reinforcement steel for easy identification.

B. Placement of Reinforcement Bars:

1. Comply with approved shop drawings, ACI 318 and Contract Documents.
2. Accurately position, support and secure reinforcement in a manner to prevent displacement before and during placement of concrete.
 - a) Place reinforcement bars within tolerances specified in ACI 117.
 - b) Locate and support reinforcement by metal chairs, runners, bolsters, spacers, hangers and other accessories for fastening reinforcing bars and welded wire reinforcement in place.
3. If bars are displaced beyond specified tolerance when relocating the bars to avoid interference with other reinforcement or embedded items, immediately notify the Design Professionals for approval prior to concrete placement.
4. Avoid cutting or puncturing vapor retarder during reinforcement placement.
 - a) Repair damages before placing concrete.
5. Concrete Coverage: Maintain concrete cover around reinforcement as indicated on Drawings.
6. Bar Supports: Use type specified in this section.
7. Tie Wires: After cutting, turn tie wires to the inside of section and bend so that concrete placement will not force ends to be exposed at face of concrete.

C. Placement of Wire Reinforcement:

1. Install in lengths as long as practicable.

2. Support in position adequately to prevent bending of reinforcement between supports before and during placement of concrete.
 3. Overlap the wire reinforcement 6" (150mm) or one panel width + 2" (50mm), whichever is larger.
 - a) Securely tie together with wire.
 4. Offset laps of adjoining widths to prevent continuous laps in either direction.
 5. Locate wire fabric in the top third of slabs, unless noted otherwise on structural Drawings.
- D. At Construction Joints:
1. Reinforcement bars and wire reinforcement shall be continuous through construction joints, unless otherwise indicated on Drawings. See Drawings for scheduled lap splices.
- E. At Expansion Joints:
1. Reinforcing bars and wire fabric shall NOT be continuous through expansion joints, unless otherwise indicated on Drawings.
- F. Splicing:
1. Unless otherwise indicated on Drawings provide lap splices for bar sizes #11 ($\phi 36$) and smaller by lapping ends, placing bars in contact, and tying tightly with wire in accordance with requirements of ACI 318 for lap lengths indicated on Drawings.
 2. At all #14 ($\phi 43$) and #18 ($\phi 57$) bars and where mechanical splices are specifically indicated on Drawings, comply with requirements specified in this Specification section under "Mechanical Splicing Systems".
 3. Do not splice reinforcement except as indicated on structural Drawings.
 4. Tension couplers may be used and installed per manufacturer's specifications where indicated on Drawings or as approved by Engineer.
- G. Dowels in Existing Concrete:
1. Install dowels and dowel adhesive in accordance with manufacturer's recommendations.
 2. Minimum embedment length shall be 12 bar diameters, unless noted otherwise.

3.3 INSTALLATION OF POST-INSTALLED ADHESIVE ANCHORS

- A. General:
1. Post-installed adhesive anchors shall be installed in accordance with the Manufacturer's Printed Installation Instructions (MPII).
 2. The adhesive anchors shall be supplied as an entire system. The contractor shall provide all equipment required to install the adhesive anchor in accordance with the MPII.

3. Anchors shall be installed in holes drilled with a rotary impact hammer drill with carbide bit. Contractor shall obtain prior written approval from SER before using rock drilling or core drilling installation methods.
4. Anchor holes shall be thoroughly cleaned and dry prior to adhesive injection, in accordance with the MPII. Anchors to be installed in the adhesive shall be clean, oil-free, and free of loose rust, paint, or other coatings.
5. Concrete shall have a minimum compressive strength of 2500 psi (17MPa).
6. Concrete at time of adhesive anchor installation shall have a minimum of 21 days.
7. Concrete temperature at the time of adhesive anchor installation shall be at least equal to manufacture's requirements, or 50° F (10°C) if no requirement exists.
8. Support the anchor and protect it from disturbance or loading for the full cure time stated by the manufacturer at that base material temperature.
9. Unless specified otherwise in the contract documents, anchors shall be installed perpendicular to the concrete surface. Anchors displaced or disturbed prior to the adhesive cure time shall be considered damaged and reported to the SER (see Observations and Corrections section of 033000).
10. Locate, by non-destructive means, and avoid all existing reinforcement prior to installation of anchors. If existing reinforcement layout prohibits the installation of anchors as indicated in the drawings the contractor shall immediately notify the Design Professionals.
11. Reinforcement bars or all-threaded bars shall not be bent after being adhesively embedded in hardened, sound concrete, unless written approval is given by the SER.
12. All personnel installing anchors shall be trained by the manufacturer on proper installation techniques. Submit for record certificate from training documentation from the manufacturer for each installer on this Project
13. Installation of adhesive anchors horizontally or upwardly inclined and anchors that are designated with a (CERT) after the anchor call-out, shall be performed by personnel certified by the ACI/CRSI Adhesive Anchor Installer Certification program. Submit for record certificate from ACI-CRSI Adhesive Anchor Installation Certification Program for each certified installer on this Project.

3.4 INSTALLATION OF ACCESSORIES AND EMBEDDED ITEMS

- A. Install concrete accessories in accordance with manufacturer's published instructions and Contract Documents.
 1. Set and secure embedments, including embedded plates, bearing plates, and anchor rods, per approved setting drawings and in such a manner to prevent movement during placement of concrete and to allow removal of formwork without damage.
 2. Tolerances: Anchor rod and other embedded items placement tolerances shall comply with AISC 303, "Code of Standard Practice", Section 7.5.
 3. Inspect locations to receive concrete accessories.
 4. Immediately notify the Design Professionals in writing of conditions that will adversely affect the Work or fail to meet Contract Document requirements.
 5. Do not place concrete until reinforcement, accessories and other built-in items have been inspected and accepted by Testing Agency.
- B. Construction and Contraction (Control) Joints:

1. Construction and contraction (control) joints indicated on Drawings are mandatory and must not be omitted.
 - a) Provide construction joints in accordance with ACI 318.
 - b) Roughen surface at construction joints as indicated on the drawings.
 - c) Where specifically indicated on drawings, provide 1-1/2" (40mm) deep key type construction joints at end of each placement for slabs, beams, walls and footings.
 - i. Bevel forms for easy removal.
 2. Provide waterstops in construction joints as indicated on the Contract Documents in sizes to suit joint.
 3. Install waterstops to form continuous diaphragm in each joint.
 4. Support and protect exposed waterstops during progress of Work.
 5. Field-fabricate joints in waterstops according to manufacturer's printed instructions.
- C. Coordinate the installation of pipes, bolts, hangers, anchors, flashing and other embedded items with the work of other trades.

3.5 CORRECTIVE MEASURES

- A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION 032000

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation required to complete all concrete work as shown on Drawings, as specified herein, and as required by the job conditions. This Specification is not intended to address the particular requirements of Architectural Concrete.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Section 013300
Quality Control	Section 014500
Quality Assurance: Structural Testing and Inspection	Section 014505
Sustainable Design Requirements	Section 018113
Concrete Formwork	Section 031000
Concrete Reinforcement and Embedded Assemblies	Section 032000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

- A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
 - 1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials except as modified by more stringent requirements in the Project Specifications and/or Drawings.
 - 2. ACI 301 – Specifications for Structural Concrete.
 - 3. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
 - 4. American Concrete Institute “Manual of Concrete Practice”, various committee reports as referenced herein.
 - 5. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
 - 6. AASHTO T318 – Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

C. Definitions:

1. The term “Contract Documents” in this Specification is defined as the design Drawings and the specifications.
2. The term “SER” in this Specification is defined as the Structural Engineer of Record for the structure in its final condition.
3. The term “Design Professionals” in this Specification is defined as the Owner’s Architect and SER.
4. The term “Contractor” in this Specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Concrete Contractor and their sub-contractors.
5. The term “Testing Agency” in this Specification is defined as an independent testing and inspection service engaged by the Owner for quality assurance testing and inspection of structural construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
6. The terms “for record” and “submit for record” in this Specification are defined as Contractor submittals that do not require a response from the Design Professionals.
7. The term “Working Days” in this Specification is defined as Monday through Friday, excluding federal or state holidays.
8. The term “Delegated Design” in this Specification is defined as a scope of work that meets performance and design criteria established in the Contract Documents and is to be completed by the Contractor’s licensed engineer.

1.5 CONTRACTOR QUALIFICATIONS

- A. The work of this section shall be performed by a company specializing in the type of concrete work required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.
- B. Contractor’s testing agency services: Required as specified in Division 1, and herein.

1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of structural drawings for shop drawings is not permitted. Building Information Models for contractor’s use may be provided as mutually agreed upon by Design Professionals.
 1. Submittal Schedule
 2. Mix Designs
 3. Concrete Travel Times to the Project Site
 4. Hot Weather Procedures
 5. Product Data
 6. Concrete Joint Locations
 7. Comprehensive Layout Drawings
 8. Preconstruction Survey
 9. Survey of Flat Plate or Flat Slab Concrete Floors during construction

10. FF/FL Testing
11. Structural Repairs
12. Patching Defective Concrete Finishes
13. Conduit and Pipes Embedded in Concrete
14. Hazardous Materials Notification
15. LEED Submittals

1. Submittal Schedule: See Section 013300.
2. Mix Designs: Submit for action concrete mix designs for each type and strength of concrete required for this Project at least thirty (30) days before placing concrete.
 - a) Mix designs shall be prepared or reviewed by an approved independent testing agency retained by the Contractor in accordance with requirements of ACI 301 and ACI 318, sealed and signed by a Professional Engineer licensed in the state where the project is located, and shall be coordinated with design requirements and Contract Documents.
 - b) Before submitting to Testing Agency, submit complete mix design data for each separate mix to be used on the Project in a single submittal.
 - c) Provide a completed "Concrete Mix Design Submittal Form" (attached to the end of this Specification Section) for each proposed concrete mix.
 - d) Mix materials shall be from the same production facility that will be used for this Project.
 - e) Mix Design data shall include but not be limited to the following:
 - i. Locations on the Project where each mix design is to be used corresponding to Structural General Notes on the Drawings.
 - ii. Design Compressive Strength: As indicated on the Drawings.
 - iii. Proportions: ACI 301 and ACI 318.
 - iv. Gradation and quality of each type of ingredient including fresh (wet) unit weight, aggregates sieve analysis.
 - v. Water/cementitious material ratio.
 - vi. Evaluation and classification fly ash in accordance with ASTM D 5759.
 - vii. Report of chemical analysis of fly ash in accordance with ASTM C 618.
 - viii. Classification of slag cement in accordance with ASTM C 989.
 - ix. Slump: ASTM C 143.
 - x. Certification and test results of the total water soluble chloride ion content of the design mix - AASHTO T260 or ASTM C 1218 at age between 28 and 42 days.
 - xi. Air content of freshly mixed concrete by the pressure method, ASTM C 231, or the volumetric method, ASTM C 173.
 - xii. Density of Concrete: ASTM C 138.
 - xiii. Design strength at 28, 56 or 90 days, as indicated on Contract Documents: ASTM C 39.
- 1) Document strength based on basis of previous field experience or trial mixtures per ACI 301. Proportioning by water-cement ratio alone, with no test results per the trial mixtures procedure is not permitted.

- 2) Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength. Test records to support proposed mixtures shall be no more than 24 months old and use current cement aggregate sources. Test records to establish standard deviation may be older if necessary to have the required number of samples.
- 3) If early concrete strengths are required, Contractor shall submit trial mixture results as required.
 - xiv. Manufacturer's product data for each type of admixture.
 - xv. Manufacturer's certification that all admixtures used are compatible with each other.
 - xvi. All information indicating compliance with Contract Documents including method of placement and method of curing.
 - xvii. Normalweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.
 - xviii. Certification from a qualified testing agency indicating absence of potential for deleterious expansion of concrete due to alkali reactivity of the aggregate as determined by testing per ASTM C1260 in accordance with ASTM C 33. If potential for deleterious expansion exists, expansion reduction and mitigation measures per the guidelines of ASTM C1778 or US Army COE CRD-C662 shall be submitted for review by the SER.
3. Concrete Travel Times to the Project Site: Submit for record.
4. Hot Weather Procedures: Submit for record written procedures for placement of concrete in hot weather conditions. Hot weather is as defined in the Concrete Placement section of this Specification.
5. Product Data: Submit for action product data clearly marked to indicate locations to be used and all technical information which specifies full compliance with this section and Contract Documents, including published application instructions, product characteristics, compatibility, and limitations for each of the following:
 - a) Bonding agents.
 - b) Curing compound and liquid sealer densifier. Submit for record to Design Professionals a written statement guaranteeing that the compound will not leave discoloration on concrete to be left exposed, or affect the bond for paint or other applied finishes. Include provision in written statement that in the event of failure of applied finishes to bond to membrane cured concrete, to remove the curing compound and leave suitable surfaces for bonding such finishes.
 - c) Absorptive covers and moisture retaining covers.
 - d) Vapor Retarder: See Division 7, Thermal and Moisture Protection.
 - e) Self-leveling concrete topping.
 - f) Grout: Submittal of grout by manufacturers not listed herein must be accompanied by independent certification of ASTM C 1107 compliance without modification of standard methods.
 - g) Other products proposed by Contractor.
6. Concrete Joint Locations: Submit for action plans indicating locations and details of construction joints, contraction joints, waterstops, sleeves, embedments, etc. that interact with the joints. Contractor to coordinate joint location with

reinforcement shop drawings. Reinforcement shop drawings shall indicate additional reinforcement bars where required at construction joints.

- a) Joint locations for concrete slabs to receive a terrazzo or similar finish subject to reflective cracking must be coordinated with layout of finish drawings.
7. Comprehensive Layout Drawings: Submit for action comprehensive layout drawings (a single drawing per area/element):
 - a) Drawings shall show openings in structural members, including floor slab, shear walls, columns and beams.
 - b) Drawings shall consolidate the work of all trades and shall be coordinated by the Contractor.
 - c) Drawings shall show concrete accessories and embedded items, including fabrication details of items to be placed (exclusive of reinforcement).
 - d) Submit with or prior to reinforcement and formwork submittals for same element/area.
 8. Preconstruction Survey: Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals.
 9. Survey of Flat Plate or Flat Slab Concrete Floors during construction: Submit for record. Survey requirements are described on Drawings. Based on survey results, SER may propose adjustments to formwork and camber.
 10. FF/FL Testing: Submit for record. Testing Agency to test and report flatness (F_F), levelness (F_L) prior to shoring removal. For slabs that include camber, do not test for levelness (F_L). Perform F_F/F_L testing in accordance with ASTM E 1155 requirements.
 11. Structural Repairs: Submit for action procedures, intended locations, and product information. Alterations to design shall be sealed and signed by a Professional/Structural Engineer licensed in the state where the project is located.
 12. Patching Defective Concrete Finishes: Submit for action procedures, intended locations, and product information.
 13. Conduit and Pipes Embedded in Concrete: Submit for action layout of embedded conduit and pipes.
 14. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.
 15. LEED Submittals
 - a) Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - i. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - ii. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

- iii. IEQc2 - Low-Emitting Materials – Interior Wet Applied Products: For paints, coatings, adhesives and sealants applied on site or used for laminating off-site, include product data indicating the VOC content (g/L) and testing certificates or third party certification demonstrating compliance with California Department of Public Health (CDPH) v1.2-2017 emissions testing.

A. Submittal Process

1. Submittal of shop drawings and other submittals by the Contractor shall constitute Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each drawing with other Drawings and other trades. The Contractor shall place their shop drawing stamp on all submittals confirming the above.
2. Shop drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable Drawings used in the development of the shop drawings shall be referenced on each shop drawing to facilitate checking.
3. The Contractor shall submit to the Design Professionals one (1) electronic copy for shop drawing review. The naming convention of each drawing must follow the submittal numbering system and include the submittal number, Specification number, revision number and drawing number in the prefix of the drawing name.
4. The Contractor shall allow at least ten (10) working days between receipt and release by the SER for the review of shop drawings and submittals.
5. All modifications or revisions to submittals and shop drawings must be clouded, with an appropriate revision number clearly indicated. The following shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been approved by the Design Professionals:
 - a) Failure to specifically cloud modifications
 - b) Unapproved revisions to previous submittals
 - c) Unapproved departure from Contract Documents
6. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal. Do not include new content not previously reviewed.
7. Resubmittals Compensation: The Contractor shall compensate the Design Professionals for submittals that must be reviewed more than twice due to Contractors' errors. The Contractor shall compensate the Design Professionals at standard billing rates plus out-of-pocket expenses incurred at cost + 10%.
8. The Contractor shall deliver to the Design Professionals at the completion of the job two (2) copies of the electronic version of the final as-built shop drawings on a CD-ROM or other media acceptable to the Design Professionals.

B. SER Submittal Review

1. The Design Professionals' review and approval of shop drawings and other submittals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:

- a) Conforming to the Contract Documents.
 - b) Coordination with other trades.
 - c) Responsibility for all required detailing and proper fitting of construction work.
 - d) The necessity of furnishing material and workmanship required by Drawings and Specifications which may not be indicated on the shop drawings.
 - e) Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.
2. TYPE 1 – Structural Submittal Review Stamp: For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require one of the following actions:
- a) APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
 - b) APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.
 - c) REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
 - d) NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
3. TYPE 2 – Delegated Design Review Stamp: For submittals for building elements which are not designed by the SER but are delegated design items, or for items that do not form part of the completed structural system but impose loads on the structure, or for construction items or activities which have an effect on the final structure. The responses on the stamp used by the SER require one of the following actions:
- a) NO EXCEPTIONS indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
 - b) EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication,

manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.

- c) REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

C. Substitution Request

- 1. See Section 012513.

D. Request for Information (RFI)

- 1. RFIs shall be submitted by the Contractor. RFIs submitted by other entities will be returned with no response.
- 2. Limit RFI to one subject.
- 3. Submit RFI immediately upon discovery of the need for interpretation or clarification of the Contract Documents. Submit RFI within timeframe so as not to delay the Construction Schedule while allowing the full response time described below.
- 4. The response time for answering an RFI depends on the category in which it is assigned.

- a) Upon receipt by the SER, each RFI will be assigned to one of the following categories:

- i. No cost clarification
- ii. Shown in Contract Documents
- iii. Change to be issued in future document revision
- iv. Previously answered
- v. Information needs to be provided by others
- vi. Request for corrective field work
- vii. Request for substitution

- b) RFIs in the first five categories listed above will be turned around by the SER on average of five (5) working days.

- c) RFIs in the last two categories listed above will be immediately rejected and must be submitted as submittals or requests for substitution.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with General Conditions and Division 1.

B. Storage:

- 1. Store materials in accordance with ACI 304R.
- 2. Store cement in weather-tight buildings, bins or silos that will exclude moisture and contaminants.
- 3. Store admixtures to avoid contamination, evaporation, damage, and in accordance with manufacturer's temperature and other recommendations.

4. Keep packaged material in original containers with seals unbroken and labels intact until time of use.

C. Handling:

1. Handle fine and coarse aggregates as separate ingredients.
2. Arrange aggregate stockpiles to avoid excessive segregation, and prevent contamination with other materials or with other sizes of like aggregates.
3. Do not use frozen or partially frozen aggregates.
4. Allow sand to drain until it has reached relatively uniform moisture content before use.
5. Protect liquid admixtures from freezing and temperature changes that would adversely affect characteristics, and in accordance with manufacturer's recommendations.

1.8 PRE-CONCRETE CONFERENCE

- A. At least 30 working days prior to the start of concrete construction, the Contractor shall hold a meeting to review the proposed concrete mix designs and to determine the procedures for producing proper concrete construction. The Contractor shall notify the Design Professionals of the meeting and require responsible representatives of every party who is concerned with the concrete Work to attend the conference, including but not limited to the following:
 1. Contractor's superintendent.
 2. Testing Agency representative responsible for field quality control.
 3. Concrete subcontractor.
 4. Ready-mix concrete producer.
 5. Admixture manufacturer(s).
 6. Architect.
 7. Structural Engineer.
- B. Minutes of the meeting shall be recorded and distributed by the Contractor to all parties concerned within five working days of the meeting. One copy of the minutes shall also be furnished to the following:
 1. Design Professionals.
 2. Owner's Representative.
- C. The minutes shall include a statement by the concrete contractor and admixture manufacturer(s) indicating that the proposed mix design and placing, finishing, and curing techniques can produce the concrete properties and quality required by these Specifications.

1.9 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

- A. See Section 014505.

1.10 QUALITY CONTROL BY CONTRACTOR

- A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.

- B. The Owner's general review during construction and activities of the Testing Agency are undertaken to inform the Owner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.
- C. The Contractor shall immediately notify the Design Professionals of any deficiencies in the work which are departures from the Contract Documents. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Owner, the Contractor shall correct the deficiency at no cost to the Owner. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in the OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS section of this Specification.
- D. Where SCC is used, the Ready Mix Producer shall have a Quality Control Representative on site during placements until mix consistency and stability is established.

1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONAL

- A. Observations: The Design Professionals will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.
- B. Corrections by Design Professionals: See Part 3 - CORRECTIVE MEASURES section of this Specification.

1.12 PERMITS AND WARRANTY

- A. Permits: See Section 00 72 13. In addition, the Contractor shall apply for, procure, renew, maintain, and pay for all permits required by City, State, or other governing authorities, necessary to execute work under this Contract. Contractor shall furnish copies of all permits to the Owner and Design Professionals.
- B. Warranty: See Section 01 78 36. In addition, comply with General Conditions, agreeing to repair or replace specified materials or work that has failed within the warranty period. Failures include but are not limited to the following:
 - 1. Oily, waxy or loose residue which may interfere with the bonding or discoloration of various applied Architectural finish materials.
 - 2. Discoloration of concrete surfaces scheduled to remain exposed as a finish.
 - 3. Areas which show surface failure or defects.
 - 4. Areas which puddle water.
 - 5. Areas which are not properly prepared to receive Architectural finish materials. If necessary, the Contractor, at his own expense, shall have the Testing Agency perform appropriate tests for bond and discoloration.
 - 6. Patches that become crazed, cracked or sound hollow when tapped.
 - 7. Self-leveling concrete topping that has cracked, spalled and/or not performed in accordance with manufacturer's design criteria.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Products including but not limited to bonding agents, sealers, epoxy, and methyl methacrylate shall meet the volatile organic compounds (VOC) requirements of CALGreen Section 5.504.4.

2.2 CONCRETE MATERIALS AND PRODUCTION

- A. Portland Cement:
 - 1. ASTM C150, Type I or Type II
 - 2. ASTM C150, Type III, High-early Strength Portland Cement may be used subject to review and approval of the SER. The specified 28-day concrete compressive strength shall occur within 7 days for concrete using Type III Portland Cement.
 - 3. ASTM C150, Type V or Type II/V
 - 4. Provide the same brand of Portland Cement from a single source throughout the project, as required to meet Design Professionals' requirements.
 - 5. Provide Portland Cement that is uniform in color for concrete exposed in final condition.

- B. Aggregates for normal weight Concrete:
 - 1. ASTM C 33
 - 2. Fine Aggregate: Natural sand, or sand prepared from stone or gravel, clean, hard, durable, uncoated and free from silt, loam and clay.
 - 3. The acceptability of aggregates for the work will depend on proof that their potential alkali reactivity is not deleterious to the concrete.
 - 4. Do not use fine or coarse aggregates that contain substances that cause spalling.
 - 5. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed the following:
 - Size no. 57 (25mm max) for footings and grade beams
 - Size no. 67 (20mm max) for all other locations
 - Size no. 467 or 457 for non-reinforced concrete at locations noted on Drawings.
 - 6. Contractor shall furnish concrete with maximum 3/8" (10mm) aggregate at no additional cost to the Owner if areas of high reinforcement density require it for placement and consolidation.

- C. Aggregates for Lightweight Concrete:
 - 1. ASTM C 330: Except aggregates prepared by processing natural materials, such as pumice, scoria, or tuff.
 - 2. Classification of Aggregates: As required to meet Design Professional's requirements.
 - 3. Aggregate shall contain the minimum absorbed moisture content recommended by the manufacturer for the project prior to batching.
 - 4. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed 3/4" (20mm).

D. Water: ASTM C 1602. Clean, and free from injurious amounts of oil, acids, alkali, salts, organic material, or other deleterious materials.

E. Supplementary Cementitious Material

1. Fly Ash:

- a) ASTM C 618, Class F.
- b) Shall only be used as part of an approved mix design.
- c) Slag Cement
- d) ASTM C 989.
- e) Shall not be used unless part of an approved mix design.

2. Silica Fume (Microsilica):

- a) ASTM C 1240
- b) Acceptable Products:
 - i. Force 10,000 D by GCP Applied Technologies, Inc.
 - ii. Eucon MSA by Euclid Chemical Company
 - iii. MasterLife SF 100 by BASF Corporation
 - iv. Sikacrete 950 DP by Sika Corporation

3. Metakaolin:

- a) ASTM C 618, Class N
- b) Acceptable Products:
 - i. MetaMax by BASF Kaolin, part of BASF Corporation
 - ii. HRMK 100 by GCP Applied Technologies, Inc.
 - iii. Sikacrete M-100 by Sika Corporation

4. For concrete subject to Exposure Class F3 conditions as defined in ACI 318, limit the maximum content of supplementary cementitious materials to values shown in ACI 318.

5. The exact percentages used shall be based on successful test placement on site. Resubmit mix design if percentages change based on test placement.

6. The fly ash or natural pozzolan supplier shall have an effective quality control program in place to guard against contamination of the fly ash and assure compliance with Specifications.

7. Fly ash and slag cement used shall be from one source throughout the project. Substitution of sources will be acceptable only if testing of concrete mixes containing the substituted material show similar test results and if the color of concrete produced with the substituted material matches the color of previously poured concrete to the satisfaction of the Architect.

F. Ready Mixed Concrete:

1. Shall be batch-mixed and transported in accordance with ASTM C 94.

2.3 CONCRETE MIX DESIGN

A. Concrete Strength:

1. Shall be as indicated on the Structural Drawings

B. Concrete Density (Unit Weight):

1. Shall be as indicated on the Structural Drawings

C. Air Entrainment

1. For concrete exposed to freeze/thaw cycles and/or deicing chemicals (ACI 318 Exposure Classes F1, F2, F3), and concrete intended to be watertight, provide entrained air content of $6\% \pm 1.5\%$, unless specified otherwise. This includes, but is not limited to, concrete at the following locations:
 - a) Concrete at the exterior of the structure with at least one surface exposed to weather, such as exterior face of grade beams, foundation walls, exterior walls and parapets, exposed columns and edge beams.
 - b) Floor framing and ramps in parking garages.
 - c) Loading docks.
 - d) Balconies and terraces with no waterproofing membrane.
2. For concrete with a specified compressive strength (f'_c) greater than 5000 psi (35MPa), required air content may be reduced to $5\% \pm 1.5\%$.
3. Entrained air content noted above shall occur at point of delivery.
4. No entrained air content is required for foundations with no surface exposed to weather.
5. All interior steel trowel finished, normalweight slabs shall have a maximum air content of 3%.

D. Water-Cementitious Materials Ratio (w/cm) for Normalweight Concrete

1. Concrete used in slabs at grade shall have a maximum w/cm ratio of 0.45.
2. All concrete exposed to brackish water, seawater or spray from these sources (Exposure Class F3) shall have a maximum w/cm of 0.40 and a minimum $f'_c=4500$ psi.
3. Absent the above conditions, all concrete with required strength of 4000 psi (28MPa) or higher shall have a maximum w/cm of 0.50.
4. The water-cementitious materials ratio shall not exceed values indicated, including any water added to meet specified slump in accordance with the requirements of ASTM C 94.
5. Weight of fly ash and other pozzolanic materials shall be included with the weight of cementitious materials used to determine the water-cementitious materials ratio.

E. Slump

1. Concrete design mixes shall be proportioned to meet the following slump limitations. Slump should be measured as described in the Testing Agency responsibilities:

- a) Concrete with high range or mid-range water-reducing admixture: Concrete slump prior to addition of high range water-reducing admixture shall not exceed 3" +/- 1" (75mm) for normalweight concrete. After addition of water-reducing admixture, the concrete shall have a maximum slump of 9" +/- 1" (225mm) unless otherwise approved by the SER.
 - b) Concrete without a water-reducing admixture: Slump shall not exceed 4" +/- 1".
2. Where concrete is placed on metal deck, consider consolidation of concrete between deck and hat channels over acoustic insulation when designing concrete mixture design for workability and slump.

F. Chloride Ion Content

- 1. The total water-soluble chloride ion content of the mix including all constituents shall not exceed the limits defined in ACI 318 unless corrosion inhibiting admixtures are added to the mixture to offset the additional chloride.
- 2. If the specified level of water-soluble chloride ion content cannot be maintained, appropriate level of corrosion inhibiting admixture shall be added to the mix in accordance with the manufacturer's recommendation to offset the excess amount of chloride at no additional cost to the Owner.

2.4 ADMIXTURES

A. General:

- 1. Admixtures specified below can be used only when established in the mix design with Design Professionals' prior written approval.
- 2. Each admixture approved by Design Professionals shall be used in strict compliance with manufacturer's published instructions.
- 3. Concrete supplier shall certify all admixtures to be compatible with each other. (See Submittals Section in Part 1)

B. Air Entraining Admixture:

- 1. ASTM C 260
- 2. Acceptable Products:
 - a) MasterAir Series by BASF Corporation
 - b) Darex Series or Daravair Series by GCP Applied Technologies, Inc.
 - c) EUCON AEA -92 or EUCON Air Series by Euclid Chemical Company
 - d) AIR Series or AEA-14 by Sika Corporation

C. Water-Reducing Admixture:

- 1. ASTM C 494, Type A
- 2. Acceptable Products:
 - a) MasterPozzoloth Series by BASF Corporation
 - b) EUCON NW or EUCON WR 91 by Euclid Chemical Company
 - c) WRDA Series, Zyla Series or Mira Series by GCP Applied Technologies, Inc.

d) Plastocrete Series by Sika Corporation

D. Retarding Admixture:

1. ASTM C 494, Type B
2. Acceptable Products:
 - a) MasterSet R Series or MasterSet DELVO Series by BASF Corporation
 - b) EUCON RETARDER 100 by Euclid Chemical Company
 - c) Daratard 17 by GCP Applied Technologies, Inc.
 - d) Plastiment Series by Sika Corporation

E. Non Corrosive Accelerating Admixture:

1. ASTM C 494, Type C
2. Acceptable Products:
 - a) MasterSet FP 20 or MasterSet NC 534 by BASF Corporation
 - b) ACCELGUARD 80, ACCELGUARD NCA or ACCELGUARD 90 by Euclid Chemical Company
 - c) Daraset™ Series, Polarset, or DCI by GCP Applied Technologies, Inc.
 - d) Sikaset Series or Rapid-1 by Sika Corporation

F. Water-Reducing and Retarding Admixture:

1. ASTM C 494, Type D
2. Acceptable Products:
 - a) MasterSet R Series or MasterSet DELVO Series by BASF Corporation
 - b) EUCON RETARDER 75 or EUCON DS by Euclid Chemical Company
 - c) Daratard 17 or Recovery Series by GCP Applied Technologies, Inc.
 - d) Plastiment Series by Sika Corporation

G. Water-Reducing and Accelerating Admixture:

1. ASTM C 494, Type E
2. Acceptable Products:
 - a) MasterSet FP 20 by BASF Corporation
 - b) ACCELGUARD 80 or ACCELGUARD 90 by Euclid Chemical Company
 - c) Libricon NCA by GCP Applied Technologies, Inc.
 - d) Sikaset NC by Sika Corporation

H. Mid-Range Water-Reducing Admixture:

1. ASTM C 494, Type A
2. Acceptable Products:
 - a) MasterPolyheed Series by BASF Corporation
 - b) Daracem or Mira by GCP Applied Technologies, Inc.
 - c) Sikaplast Series or Sikament Series by Sika Corporation
 - d) Eucon MR or Eucon MRX by Euclid Chemical Company

- I. High-Range Water-Reducing Admixture:
1. ASTM C 494, Type F
 2. Acceptable Products:
 - a) MasterGlenium Series by BASF Corporation
 - b) EUCON 37 or PLASTOL SERIES by Euclid Chemical Company
 - c) Daracem or ADVA Series by GCP Applied Technologies, Inc.
 - d) Viscocrete Series or Sikament Series by Sika Corporation
- J. High-Range Water-Reducing Admixture for production of Control Flow Concrete:
1. ASTM C494 Type A and F and ASTM C1017 Type I
 2. Acceptable Product:
 - a) CONCERA SA8080 by GCP Applied Technologies, Inc, or equal.
- K. High-Range Water-Reducing and Retarding Admixture:
1. ASTM C 494, Type G
 2. Acceptable Products:
 - a) EUCON 537 by Euclid Chemical Company
 - b) Daracem Series or Adva Series by GCP Applied Technologies, Inc.
- L. Workability Retaining Admixture:
1. ASTM C494, Type S
 2. Acceptable Products:
 - a) MasterSure Z-60 by BASF Corporation
 - b) Visco Flow-2020 by Sika Corporation
- M. Permeability-Reducing Admixture:
1. ASTM C494, Type S
 2. Shall be a Portland cement based crystalline capillary waterproofing admixture that reacts in concrete to form non-soluble crystalline hydration products in the capillary pores of concrete,
 3. Acceptable Products:
 - a) MasterLife 300D by BASF Corporation
 - b) Eucon Vandex AM-10 by Euclid Chemical Company
 - c) Admix C-Series by Xypex
- N. Viscosity Modifying Admixture (VMA):
1. ASTM C 494, Type S
 2. Acceptable Products:
 - a) MasterMatrix VMA Series by BASF Corporation
 - b) V-MAR3 by GCP Applied Technologies, Inc.

- c) EUCON ABS or EUCON WO or VISCTROL by Euclid Chemical Company
- d) Sika Stabilizer-4R by Sika Corporation

O. Corrosion Inhibiting Admixtures:

- 1. Calcium Nitrite Based: ASTM C 1582 and ASTM C 494, Type C, 30% + 2% solution

- a) Acceptable Products:

- i. DCI or DCI-Sby GCP Applied Technologies, Inc.
- ii. MasterLife CI 30 by BASF Corporation
- iii. EUCON CIA by Euclid Chemical Company
- iv. Sika-CNI by Sika Corporation

- 2. Amine Carboxylate Based: ASTM C 1582, which includes ASTM C-494 amine carboxylate

- a) Acceptable Product:

- i. MCI 2005, MCI 2005 NS, MCI 2006 or MCI 2006 NS by Cortec Corporation, or equal.

- 3. Amino Alcohol Based:

- a) Acceptable Product:

- i. FerroGard 901 by Sika Corporation
- ii. MasterLife CI 222 by BASF Corporation

P. Shrinkage Reducing/Compensating Admixtures:

- 1. ASTM C 494, Type S

- 2. Acceptable Products:

- a) Eclipse Floor 200 or Eclipse 4500 (for use with air-entrained concrete) by GCP Applied Technologies, Inc.
- b) Conex or EUCON SRA Floor or EUCON SRA-XT (for use with air-entrained concrete) by Euclid Chemical Company
- c) MasterLife SRA Series or MasterLife CRA 007 by BASF Corporation
- d) SikaControl 75 by Sika Corporation
- e) PREVent-C by PremierCPG

Q. Alkali-Silica Reaction Inhibiting Admixture:

- 1. ASTM C 494, Type S

- 2. Shall contain a nominal lithium nitrate content of 30 percent.

- 3. Dosage to be determined in accordance with US Army COE CRD-C662

- 4. Acceptable Products:

- a) MasterLife ASR 30 by BASF Corporation

- b) Eucon Integral ARC by Euclid Chemical Company
- c) RASIR by GCP Applied Technologies

R. Porosity Inhibiting Admixture:

- 1. ASTM C494, Type S
- 2. Sodium silicate free
- 3. Manufacturer must be able to provide a flooring adhesion guarantee and life of the concrete vapor transmission warranty. In order to obtain warranty, product must be installed in compliance with the manufacturer's published data sheet including but not limited to proper on-site representation, mix design review, concrete testing and installation of vapor retarder for slabs on ground.
- 4. Acceptable Products:
 - a) Barrier One by Concrete Moisture Solutions, Inc, or equal.

S. Carbon Dioxide (CO₂) Mineralization:

- 1. Where called for on the drawings or when approved by the SER, provide concrete that has undergone carbonization treatment with carbon dioxide (CO₂) during mixing, such that CO₂ is chemically mineralized into the concrete.
- 2. CO₂ injected into the mix must be post-industrial CO₂ sourced from a nearby emitter. Provide concrete producer's certificate outlining quantity, location and supplier of CO₂.
- 3. Acceptable Product:
 - a) Carbon Cure by CarbonCure Technologies, or equal.

2.5 FIBER REINFORCEMENT

A. General:

- 1. Fiber reinforcement specified below can be used only with Design Professional's prior written approval.
- 2. See Drawings for location of Fibers.
- 3. Where macro synthetic fiber reinforcement is proposed as a substitution request to replace welded wire reinforcement, Contractor shall demonstrate that proposed material and dosage rate provides equivalent performance to the welded wire reinforcement indicated on Drawings.
- 4. Fiber reinforcement shall not replace reinforcing bars shown on Drawings.

B. Synthetic Fibrillated or Monofilament Micro Fibers (low volume synthetic used for reduction of plastic shrinkage cracking)

- 1. ASTM C 1116, Type III polyolefin fibers engineered and designed for use in making fiber-reinforced concrete.
- 2. Acceptable Products:
 - a) SINTA F38, SINTA M2219 by GCP Applied Technologies, Inc.
 - b) PSI Fiberstrand by Euclid Chemical Company
 - c) Fibermesh 150-e3 or 300-e3 by Sika Corporation
 - d) MasterFiber F Series or MasterFiber M Series by BASF Corporation

C. Synthetic Macro Fibers (high volume synthetics used for reduction of plastic and drying shrinkage cracking)

1. ASTM C 1116, Type III polyolefin fibers engineered and designed for use in making fiber-reinforced concrete.
2. The fibers shall provide a minimum equivalent flexural residual strength (f_{e3}) of 150 psi (1.0 MPa), unless otherwise noted on the drawings, when tested in accordance with ASTM C1609.
3. When synthetic macro fibers are used as a replacement for welded wire reinforcement in composite slabs, contractor shall submit documentation that the fibers are Underwriters Laboratories (UL) certified for the fire ratings as indicated on the drawings. Provide dosage of fibers as required to meet the fire resistance rating but not less than 4 pounds per cubic yard (2.4 kg/m³).
4. Acceptable Products:
 - a) Strux 90/40 by GCP Applied Technologies, Inc.
 - b) Tuf-Strand SF by Euclid Chemical Company
 - c) Fibermesh 650-e3 by Sika Corporation
 - d) MasterFiber MAC 100 by BASF Corporation

D. Synthetic Hybrid Fibers

1. ASTM C1116, Type III polyolefin fibers engineered and designed for use in making fiber-reinforced concrete.
2. The fibers shall provide a minimum equivalent flexural residual strength (f_{e3}) of 150 psi (1.0MPa), unless otherwise noted on the drawings, when tested in accordance with ASTM C1609.
3. When synthetic macro fibers are used as a replacement for welded wire reinforcement in composite slabs, contractor shall submit documentation that the fibers are Underwriters Laboratories (UL) certified for the fire ratings as indicated on the drawings but not less than 4 pounds per cubic yard (2.4 kg/m³).
4. Acceptable Products:
 - a) MasterFiber MAC 360 FF by BASF Corporation
 - b) Novomesh 950 by Sika Corporation

E. Carbon Steel Fibers (smooth or deformed)

1. ASTM C1116, Type I containing steel fibers designed for use in making fiber reinforced concrete meeting the criteria of ASTM A820, Type I, II or V
2. The fibers shall provide a minimum equivalent flexural residual strength (f_{e3}) of 200 psi (1.4 MPa), unless otherwise noted on the drawings, when tested in accordance with ASTM C1609.
3. When steel fibers are used as a replacement for welded wire reinforcement in composite slabs, contractor shall submit documentation that the fibers are Underwriters Laboratories (UL) certified for the fire ratings as indicated on the drawings but not less than 25 pounds per cubic yard (14.8 kg/m³).
4. Acceptable Products:
 - a) Dramix 3D, 4D, 5D by Bakaert Corporation
 - b) CAR-25-CDM by Fibercon International Inc.
 - c) Novocon CHE7560H by Sika Corporation
 - d) PSI Steel Fiber 6560 by Euclid Chemical Company]

- e) CFS 100-2 or CFS-150-5 by Concrete Fiber Solutions
- f) Helix Micro Rebar by Helixsteel

2.6 ADHESIVES

- A. Epoxy Bonding Agent for bonding hardened concrete to hardened concrete (existing concrete damp or dry, at least 28 days old, no surface water):
 - 1. ASTM C 881 Type IV, Grade 1, 2 or 3, Class B or C as appropriate for field temperature conditions.
 - 2. Acceptable Products:
 - a) Acceptable Product: Dural 452 Series by Euclid Chemical Company
 - b) Rezi-Weld 1000 by W. R. Meadows
 - c) Sure Bond J58 by Dayton Superior

- B. Epoxy Bonding Agent for bonding freshly mixed concrete to hardened concrete (existing concrete damp or dry, less than 28 days old, no surface water):
 - 1. ASTM C 881, Type V, Grade 1, 2, or 3, Class B or C as appropriate for field temperature conditions.
 - 2. Acceptable Products:
 - a) Dural 452 Gel or 452 MV by Euclid Chemical Company
 - b) Sikadur 32 Hi-Mod by Sika Corporation
 - c) Rezi-Weld 1000 by W. R. Meadows
 - d) Sure Bond J58 by Dayton Superior

- C. Anti-Corrosive Epoxy Modified Cementitious Bonding Compound and Corrosion Protection of Reinforcement (bonding agent for existing concrete saturated surface dry, no surface water):

This adhesive shall be a water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time).

- 1. Acceptable Products:
 - a) DURALPREP AC by Euclid Chemical Company
 - b) ARMATEC 110 EpoCem by Sika Corporation
 - c) MasterEmaco P124 by BASF Corporation
 - d) Perma Prime 3C by Dayton Superior

2.7 CURING COMPOUNDS AND SEALERS

- A. Interaction with finishes:
 - 1. See architectural Drawings for finish material applied over concrete.
 - 2. Use only curing and sealer compounds that are compatible with finish, waterproofing or roofing material.

- B. Curing and Sealing Compound (VOC Compliant, 350 g/l) :

1. ASTM C1315, Type I, Class A and/or ASTM C 309, Type 1, Class A or B
2. Water based acrylic, clear, 25% solids curing and sealing compound.
3. Acceptable Products:
 - a) Super Diamond Clear VOX by Euclid Chemical Company
 - b) Cure & Seal 1315 J22WB by Dayton Superior
 - c) VOCOMP-25 by W. R. Meadows
 - d) Dress & Seal WB 30 or Lumiseal WB by Laticrete International, Inc.
 - e) MasterKure CC 1315WB by BASF Corporation (if yellowing is acceptable).

C. Curing Compound-Dissipating/Strippable (VOC Compliant, 350 g/l):

1. ASTM C 309, Type I, Class A or B
2. Water based resin, clear curing compound that begins to dissipate when exposed to UV light and traffic.
3. Acceptable Products:
 - a) Kurez DR VOX by Euclid Chemical Company
 - b) Clear Resin Cure J11W by Dayton Superior
 - c) 1100 by W. R. Meadows

D. Surface Applied Vapor Emission Mitigation

1. Shall conform to state and federal VOC regulations with zero VOC content.
2. Shall provide a 15 year warranty against flooring failure due to negative-side moisture vapor migration of moisture-born alkalinity.
3. Acceptable Products:
 - a) CS2000 by Creteseal, or equal.

E. Liquid Densifier/Sealer:

1. The liquid densifier compound shall be a silicate based compound that penetrates and chemically hardens concrete surfaces.
2. Acceptable Products:
 - a) Euco Diamond Hard by Euclid Chemical Company
 - b) Acceptable Product: Dayton Superior "Densifier J13"
 - c) MasterKure HD 200WB by BASF Corporation
 - d) Liqui-Hard by W. R. Meadows

F. Evaporation Retarder:

1. Acceptable Products:
 - a) MasterKure ER50 by BASF Corporation
 - b) Eucobar by Euclid Chemical Company
 - c) Sika Film by Sika Corporation

2.8 DRY SHAKE HARDENERS

- A. Mineral Aggregate Hardener:
1. The specified mineral aggregate hardener shall be a factory-blended mixture of specially processed graded non-metallic aggregate.
 2. Acceptable Products:
 - a) Euclid Chemical Company, "Surflex" to be used with "Kurez DR VOX"
 - b) MasterTop 100 to be used with "MasterKure CC 200WB by BASF Corporation
 - c) Quartzplate FF to be used with Dress & Seal WB 30 by Laticrete International, Inc.
- B. Non-Oxidizing Metallic Hardener:
1. The specified non-oxidizing metallic floor hardener shall be a mixture of specially processed non-rusting aggregates.
 2. Acceptable Products:
 - a) Euclid Chemical Company, "Diamond-Plate" to be used with "Kurez DR VOX"
 - b) MasterTop 210COR to be used with "MasterKure CC 200WB by BASF Corporation
 - c) Emeryplate FF to be used with Lumiseal WB by Laticrete International, Inc.

2.9 MISCELLANEOUS CONCRETE AND CONCRETE RELATED PRODUCTS

- A. Cementitious Non-Shrink Grout:
1. Provide pre-packaged high-precision, non-shrink, non-metallic grout.
 2. See General Notes for grout minimum compressive strength.
 3. ASTM C 1107
 4. Acceptable Products:
 - a) MasterFlow 928 by BASF Corporation
 - b) Dry Pack Grout or HI-FLOW GROUT by Euclid Chemical Company
 - c) Five Star Grout by Five Star Products
 - d) Sikagrout 328 by Sika Corporation
 - e) Duragrout by Laticrete International, Inc.
- B. Self-Leveling Concrete Topping - Underlayment for Interior Applications:
1. Use self-leveling underlayment concrete formulated to level concrete floors without shrinking, cracking or spalling, and capable of being placed from feathered edge to 1" (25mm) thickness without aggregate in one pour. If greater than 1" (25mm) thickness is required, aggregate shall be extended with aggregate in accordance with manufacturer's requirements. Appropriate primer shall be utilized for all underlayment applications.
 2. Acceptable Products:

- a) K-15 by Ardex
- b) Flo-Top or Super Flo-Top by Euclid Chemical Company
- c) Sika Level Series by Sika Corporation

C. Moisture-Retaining Covers:

- 1. ASTM C171
- 2. A naturally colored, non-woven polypropylene fabric with a non-perforated reflective polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention.
- 3. Acceptable Products:
 - a) Hydracure S-16 by PNA Construction Technologies, Inc.
 - b) Transguard 4000 by Amorlon a Division of Reef Industries, Inc.
 - c) UltraCure NCF by Sika Corporation
 - d) Top Cure by Transshield

D. Expanded Polystyrene (EPS) used as Fill - Geofoam

- 1. Material: Rigid, closed cell polystyrene blocks formed by expansion of polystyrene beads by steam.
- 2. Comply with the requirements of ASTM D 6817
- 3. Unless noted otherwise on the drawings, provide the following types of EPS:
 - a) Fill between a lower slab and a raised slab area: EPS12 -2.2 psi (15 kPa) compressive resistance minimum at 1% deformation, 10 psi (70 kPa) flexural strength minimum
 - b) Fill below exterior floor slabs or slabs with truck loading: EPS19 - 5.8 psi (40 kPa) compressive resistance minimum at 1% deformation, 30 psi (200 kPa) flexural strength minimum
- 4. Thickness as indicated on Drawings.
- 5. Execution: Conform to manufacturer's instructions regarding preparation, installation and protection
- 6. Gripper plates shall be used as needed to restrain EPS from moving laterally in multi-layer applications
- 7. Contractor shall sequence soil or concrete topping placement to avoid EPS block shift or flotation.
- 8. Submit the following for review:
 - a) Manufacturer's product literature including physical properties in compliance with ASTM D 6817 and type specified
 - b) 10 year physical property warranty
 - c) Proposed plan layout of fill blocks showing gaps between blocks where required for stabilizing and/or load bearing reinforced concrete ribs as shown on drawings, in details or in notes.
- 9. Submit the following for record:
 - a) Summary of test compliance with specified performance characteristics and physical properties
 - b) Product Certificates showing evidence of third party quality control

10. Acceptable Manufacturers:
 - a) ACH Foam Technologies
 - b) Atlas EPS
 - c) Universal Construction Foam

E. Vapor Retarder: See Division 7, Thermal and Moisture Protection

1. Minimum 15-mil thick polyolefin membrane
2. Manufactured with prime virgin resins
3. Water Vapor Retarder: ASTM E 1745, meets or exceeds Class A
4. Water Vapor Transmission Rate: ASTM E 96, 0.008 gr./ft²/hr. (0.086 gr./m²/hr) or lower
5. Permeance Rating: ASTM E 96, 0.03 Perms or lower for new material and after conditioning tests in accordance with applicable sections of ASTM E 154
6. Puncture Resistance: ASTM E 1745, minimum 2200 grams
7. Tensile Strength: ASTM E 1745, minimum 45.0 lbs./in (8.0 kg/cm).
8. Acceptable products:
 - a) Floprufe 120 by GCP Applied Technologies, Inc.
 - b) Perminator by W. R. Meadows
 - c) Stego Wrap by Stego Industry LLC
 - d) Raven Vapor Block 15 by Raven Industries
 - e) Husky Yellow Guard 15 Mil by Poly-America]

F. Non-Slip Aggregate:

1. Abrasive crushed and graded aggregate, high in aluminum oxide aggregate which is unaffected by moisture or cleaning compounds.
2. Acceptable Products:
 - a) Non-Slip Aggregate by Euclid Chemical Company
 - b) Emery Non-Slip by Dayton Superior
 - c) A-H Emery Emerundum by Anti-Hydro International, Inc.

2.10 CONCRETE REPAIR MATERIALS

A. Polymer-Modified Repair Mortar

1. The following patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Design Professionals is required.
2. Acceptable Products-Horizontal Surfaces:
 - a) Tammspatch II or Tamms Thin Patch by Euclid Chemical Company
 - b) Sikatop 122 Plus by Sika Corporation
 - c) Meadow-Patch T1 or T2 or Meadow-Crete GPS by W. R. Meadows
 - d) Duracrete by Laticrete International, Inc.
3. Acceptable Products-Vertical and Overhead Surfaces:
 - a) MasterEmaco N400 by BASF Corporation

- b) Verticoat, Vertacoat Supreme or Dualtop Gel by Euclid Chemical Company
 - c) SikaTop 123 Plus by Sika Corporation
 - d) Meadow-Crete GPS by W. R. Meadows

- B. Crack Repair:
 - a) Euco Qwikstitch or Dural 50 LM by Euclid Chemical Company
 - b) MasterSeal 630 by BASF Corporation
 - c) T78 Methyl Methacrylate Crack Sealer by Transpo Industries, Inc.

- C. High Strength Flowing Repair Concrete:
 - 1. For forming and placing large volume repairs, provide shrinkage compensated repair concrete with integral corrosion inhibitor.
 - 2. Minimum compressive strength 8000 psi (56MPa) @ 28-days
 - 3. Acceptable Products:
 - a) Eucocrete by Euclid Chemical Company
 - b) MasterEmaco S 466 CI by BASF Corporation
 - c) Meadow-Crete FNP by W. R. Meadows

- D. Epoxy Injection:
 - 1. ASTM C881
 - 2. Acceptable Products:
 - a) MasterInject 1380 by BASF Corporation
 - b) Dural Injection Gel by Euclid Chemical Company
 - c) Sikadur 35 LV LPL by Sika Corporation
 - d) Rezi-Weld LV State by W. R. Meadows

- E. Pressure-Injected Foam Resin:
 - 1. Acceptable Products:
 - a) De Neef Sealform PRe by GCP Applied Technologies
 - b) Crack-Pac Flex-H2O by Simpson Strong-Tie
 - c) SikaFix HH LV by Sika Corporation

- F. Semi Rigid Joint Filler:
 - 1. Acceptable Products:
 - a) MasterSeal CR 190 by BASF Corporation
 - b) Euco 700 or Qwikjoint UVR by Euclid Chemical Company
 - c) MM-80 by Metzger/McGuire
 - d) Rezi-Weld Flex by W. R. Meadows

- G. Methyl Methacrylate (MMA)
 - 1. Acceptable Products:

- a) MasterSeal 630 by BASF Corporation
- b) Transpo Industries, Inc. "T-78 Methyl Methacrylate Polymer Crack Healer/Sealer"
- c) MMA #884 by Epoxy Systems

H. Sealant:

- 1. Silicone or Polyurethane Sealant (as selected based on project requirements such as loading, traffic, bond, coatings, etc.).
- 2. Joint to be routed and cleaned per manufacturer's written directions.
- 3. Acceptable Products:
 - a) MasterSeal Sealants by BASF Corporation
 - b) Sikaflex-1C SL and Loadflex 524 EZ by Sika Corporation
 - c) Pourthane NS by W. R. Meadows
 - d) Eucolastic 1NS by Euclid Chemical Company

2.11 LEED REQUIREMENTS

- A. Products specified under this section must have a Type III Product Specific EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section must be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 01 81 13 Sustainable Design Requirements. In addition, all paints and coatings must be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

PART 3 EXECUTION

3.1 TOLERANCES

- A. Work shall conform to all requirements of ACI 117 except as modified by more stringent requirements in the Project Specifications and/or Drawings.

3.2 PREPARATION

- A. Subgrade:
 - 1. Dampen subgrades not covered with membrane by sprinkling immediately before placing concrete.
 - a) Omit when subgrade is already damp.
 - 2. Do not place on water-saturated subgrade unless placing can be done without damage to subgrade (surface is stable) and loading the subgrade does not drive free water to the surface.
 - 3. Do not place concrete on frozen ground.

B. Forms:

1. Coordinate with Section 031000 Concrete Formwork.

C. Concrete Accessories:

1. Coordinate with Section 031000 Concrete Formwork.

D. Dewatering:

1. Remove water from concrete formwork.
2. Divert any flowing water to sump and remove by pumping.
3. Refer to Division 1 for additional dewatering requirements.

E. Vapor Retarder Placement: See Division 7, Thermal and Moisture Protection.

1. Vapor retarder installation shall be in accordance with manufacturer's instructions and ASTM E 1643.
2. Place vapor retarder under slabs at grade in position with longest dimension parallel with direction of pour.
3. Joints: Lap 6" (150mm) minimum and seal with manufacturer's recommended mastic or pressure-sensitive tape.
4. Prevent damage to moisture barrier.
5. If moisture barrier is damaged, place a piece of moisture barrier over damaged area (6" (150mm) larger all around) and tape in place with type of tape recommended by moisture barrier manufacturer.
6. Seal laps and intersections of walls with compatible trowel mastic or pressure-sensitive sealing tape.
7. Seal around pipes and other penetrations with compatible trowel mastic.
8. The vapor barrier installation must be approved prior to concrete placement.

3.3 JOINTS IN CONCRETE

A. Locate construction and contraction joints as indicated on Drawings and on approved joint location submittal.

1. Do not use contraction joints in framed floors or composite slabs.
2. Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Design Professionals.
3. Coordinate location of construction and contraction joints with locations of joints in finish materials where they exist.

- a) Construction and contraction joints in slabs or slab on grade with terrazzo finish must be reviewed and approved by the Design Professionals.

4. Maximum joint spacing is as indicated on Drawings.

B. Construction Joints:

1. Construction joints shall be located within the central third of the span. Any concrete spilling over or through the bulkhead shall be removed at the

completion of the pour. All surfaces of the concrete shall have reinforcing extending through the joint.

2. Horizontal Joints: Horizontal construction joints other than those shown on the Drawings will not be permitted unless approved by the Architect.
3. Joint Preparation: Forms shall be removed in time to permit roughening of construction joints of structural members by chipping and wire brushing to remove all loose and foreign material and roughen as indicated on the Drawings. The existing concrete at joints shall either be (a) dampened to the point that the surface is saturated, but all standing water has been removed, promptly followed by placement and vibration of fresh concrete, or (b) not required to be dampened, with one of the specified bonding compounds applied as appropriate for the joint condition, following manufacturer recommendations, with placement and vibration of fresh concrete to follow while the epoxy bonding agent is still tacky. Joints without epoxy bonding agent require fresh concrete with slump 7 inches (180mm) or greater at horizontal joints, and fresh concrete confined to maintain pressure against the joint at vertical joints. Where such conditions are not present, or where applying water to dampen the surface is impractical, use epoxy bonding agent suitable for dry surfaces

C. Isolation Joints:

1. Interrupt structural continuity resulting from bond, reinforcement or keyway at points of contact between slabs at grade and vertical surfaces, such as column pedestals, foundation walls and other locations, as indicated.

D. Joint Fillers: Coordinate with Section 032000 Concrete Reinforcement and Embedded Assemblies and Division 7 requirements.

3.4 MIXING

A. Measurement of Materials: Conforming to ASTM C 94.

B. Mixing: All concrete shall be ready-mixed conforming to ASTM C 94 except as follows:

1. Provide concrete materials, proportions and properties as herein specified in lieu of ASTM C 94.
2. Water, beyond that required by the mix design, shall not be added at the Project site. Addition of water at the Project site shall be made only in the presence of the Testing Agency.
3. Furnish delivery ticket with each load of concrete delivered to the site to the Contractor conforming to the requirements of ASTM C 94.

C. High range water reducing agents (superplasticizer), if added at the batch plant, may be added again at the Project site.

1. If superplasticizers are added at the batch plant, the concrete mix design must account for the delivery time, workability, finishability, and setting time required on the jobsite for proper placing and finishing procedures.
2. If the superplasticizer is redosed at the jobsite in air entrained concrete, air content must be checked after mixing.

D. Discharge of the concrete shall be completed within 1-1/2 hours , after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the

aggregates. If the 1-1/2 hour limit cannot be achieved due to project location or other project specific conditions, hydration control measures to extend the proper workability up to 4 hours maximum can be proposed for approval by the SER. The increased time period along with redosing of the high range water reducer and/or use of hydration controlling/workability retaining admixtures should be agreed upon at the pre-concrete conference.

3.5 CONCRETE PLACEMENT

A. Prior to Concrete Placement:

1. Mechanical vibrators are required and must be available for placing concrete.
2. Remove debris from space to be occupied with concrete.
3. Notify Design Professionals, DSA and Testing Agency 48 hours prior to starting concrete placement.
4. Approved mix designs must be maintained on file in Contractor's Field Office.
5. Reinforcement and accessories shall be in proper locations, clean, free of loose scale, dirt or other foreign coatings that may reduce bond to concrete, and in accordance with Section 032000 and Drawings.
6. Fog spray forms, reinforcing steel, and subgrade just before pouring concrete.
7. Do not place concrete having a slump outside of allowable slump range.
8. Place concrete before initial set has occurred, but in no event after it has been discharged from the mixer more than 30 minutes. All concrete shall be placed upon clean, damp surfaces, free from puddled water, or upon properly consolidated fills or upon Controlled Low-Strength Material with a strength between 50 and 1200 psi. Placement upon soft mud or dry earth is not permitted.
9. Unless adequate protection is provided, concrete shall not be placed during rain.
10. Rain water shall not be allowed to increase mixing water or to damage the surface finish.
11. At surfaces left exposed to view, do not use equipment in placing and finishing concrete that contain aluminum in the finishing edges that come in contact with the concrete surface.
12. Keep subgrade moisture uniform without puddles or dry areas.
13. Place vapor retarder directly below slabs at grade as specified in Contract Documents.

B. For Conduits and Pipes Embedded in Concrete:

1. For concrete slab, wall, beam or column, conform to requirements of ACI 318. For variations from these requirements, submit a written request for Design Professionals' review and response.
2. Conduits and pipes shall not be embedded in concrete slabs on steel deck without approval of Design Professional.
3. Provide sleeves for pipes passing vertically through concrete.
4. Do not embed aluminum materials.
5. Do not cut, bend or displace the reinforcement to facilitate placement of embedded pipes and conduits.

C. Pumping: Pumping shall be done in strict accordance with ACI 304.2R.

D. Placing Concrete in Forms:

1. Clean and prepare forms as specified in Section 031000/Concrete Formwork.

2. Place concrete continuously without interruption between predetermined construction and contraction joints in walls.
3. Deposit concrete in forms in horizontal layers no deeper than 24" (600mm) and in a manner to avoid inclined construction joints.
4. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.
 - a) Use equipment and procedures for consolidation of concrete in accordance with ACI 309R.
6. Do not use vibrators to move fresh concrete laterally inside forms from discharge point; shift discharge point as needed.
7. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine.
8. Place vibrators to rapidly penetrate placed layer and at least 6" (150mm) into preceding layer.
9. Do not insert vibrators into lower layers of concrete that have begun to set.
10. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

E. Placing Concrete Slabs:

1. Place concrete continuously without interruption between predetermined construction and contraction joints in floors.
 - a) Place slabs at grade by the long strip cast method. Refer to ACI 302.1R for recommended methods of placement.
2. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
3. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
4. Bring slab surfaces to correct level with a straightedge and strike off.
 - a) Use highway straight edges, bullfloats or darbies to smooth surface free of humps or hollows.
 - b) Do not disturb slab surfaces prior to beginning finishing operations.
5. Maintain reinforcing in proper position on chairs during concrete placement.
6. Do not place materials on slabs or impose loads during period of setting.

F. Placing Concrete on Steel Decks

1. Exercise care during concrete placement on steel decks to prevent concentrated loads or high pile-ups of concrete and to avoid impacts caused by dumping or dropping of concrete on steel decks.
2. Do not use buggies on unprotected areas of deck. If buggies are used to place concrete, furnish and install planked runways to protect deck from damage.
3. Place and consolidate concrete at profiled steel decks to consolidate concrete between flutes and hat channels occurring over acoustic insulation.

G. Placing Concrete at Construction Joints:

1. To secure full bond at construction joints, surfaces to receive concrete in a subsequent placement shall be left in a roughened state or intentionally roughened by raking while plastic or brushing and chipping immediately after removal.
2. Before new concrete is placed in contact, surfaces of hardened concrete already placed shall be thoroughly cleaned of foreign materials and laitance.
3. At hardened concrete at joints where no bonding agents are used, dampen concrete to achieve a saturated surface dry condition. Leave no standing water. Place and vibrate concrete (slump 7 inches (180mm) or greater) against horizontal joints. Place and vibrate flowing concrete (slump 8 to 10 inches (200 to 250mm)) while maintaining pressure against vertical joints by confinement.
4. At hardened concrete with joints not meeting conditions required for no bonding agents, apply appropriate specified bonding agent for conditions present including age and moisture per manufacturer's specifications. Place new concrete while the bonding agent is still tacky.

H. Floor Topping Slabs:

1. Place concrete topping slab to required lines and levels.
2. Minimum topping slab thickness is 2" (50mm).
3. Place dividers, edge strips and other items to be cast in place.
4. At all topping slabs, remove deleterious material before placing topping slab.
5. All topping slabs shall be bonded unless noted as unbonded on the drawings.
6. Bonded topping slabs should be placed directly against a properly prepared base slab. Proper preparation of the base slab consists of cleaning and removal of all deleterious material roughening the surface to a concrete surface profile of CSP5 or CSP6 and overnight prewetting of the newly cleaned, exposed surface with no standing water present. The surface abrasion method should not cause micro cracking of the top of the base slab.
7. Immediately before placing the bonded topping slab, scrub an even, 1/16" to 1/8" layer of portland cement/sand/water bonding grout over the entire surface to receive the topping slab. Do not allow the bonding grout to dry to a whitish appearance before the topping slab is placed.
8. Where topping slab is noted on Drawings as unbonded the topping should be placed on bond breaker consisting of two sheets of plastic film.
9. Topping mix shall have a maximum water/cement ratio of 0.45.
10. Topping mix shall have a maximum shrinkage of 0.04% at 28 days. If the topping slab is to be exposed and polished, the maximum shrinkage shall be 0.02%.
11. The topping mix shall contain a minimum of 4 lbs. per cubic yard (2.4 kg/m³) of macro synthetic fibers. The fibers shall provide a minimum equivalent flexural residual strength (f_{e3}) of 150 psi (1.0 MPa) measured in accordance with ASTM C1609 unless a higher dosage is noted on the plans.
12. The topping slab shall be moist cured for a minimum of 36 hours after placement.
13. Bonded topping slabs shall have contraction joints located to match any joints in the base slab. All topping slabs shall be jointed to eliminate restraint conditions such as re-entrant corners and to isolate the slab from columns, walls, etc. and to limit the maximum distance between joints to 15 feet (4570mm).

I. Hot-Weather Placement:

1. Hot weather is defined as air temperature which exceeds 90°F (32°C) or any combination of high temperature, low humidity and/or high wind velocity which causes a rate of evaporation in excess of 0.2 pounds per square feet per hour (1.0 kg/m² per hour) as determined by ACI 305R.
2. When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with ACI 305R and as specified in this section.
3. Cool ingredients before mixing to maintain concrete temperature at time of placement below 95°F (35°C).
4. Mixing water may be chilled, or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
5. Use of liquid nitrogen to cool concrete is Contractor's option.
6. When concrete placement will occur late in the day and reinforcing steel will be heated by the sun, cover reinforcing steel with water-soaked burlap so that steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
7. When concrete operations must be performed in direct sun, wind, high temperatures, low relative humidity, or other adverse placing conditions, the specified evaporation retarder shall be applied one or more times during the finishing operation to prevent plastic cracking.

3.6 MASS CONCRETE

- A. General: The requirements of this part of the specification are in addition to all other applicable requirements of this specification.
- B. Definition: Mass Concrete elements are those footings and mats that have a smallest dimension (mat thickness for example) greater than or equal to [4] feet (1220mm), and other elements where indicated on the drawings.
- C. Required Submittals:
 1. Submit mix design for mass concrete elements in conformance with requirements of ACI 301, Section 8 and ACI 211.1-Appendix 5. Mix designs shall be proportioned to achieve specified compressive strength at 56 days or 90 days for foundations and lower level columns of tall buildings per approval by the SER.
 2. Submit calorimeter test results for all mass concrete mix designs.
 3. Submit proposed methods of temperature control, including cementitious material content control in mix design to reduce heat-generating potential of concrete, precooling of ingredients to lower concrete temperature as placed, and methods to protect mass concrete elements from excessive temperature differentials.
 4. Submit analysis of anticipated thermal developments within mass concrete elements with the proposed mix design for these elements. Results of the analysis shall address the maximum differential temperature and the maximum temperature during curing.
 5. Submit proposed number and locations of temperature monitoring devices to record temperature development between the interior and the exterior of mass concrete elements. At a minimum, one temperature sensor shall be placed at the center of mass of placement and one temperature sensor at a depth of 2" from center of nearest exterior surface.

D. Products:

1. Use ASTM C 150 Type II cement.
2. Use of ASTM C 150 Type III cement is prohibited.
3. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed Size no. 57 (25mm max).
4. Use ASTM C 494, Type D water reducing and retarding admixture (minimum retardation is 3 hours).
5. Use fly ash, ground granulated blast furnace slag, crushed or liquid nitrogen ice as needed to maintain required concrete temperatures.

E. Placement:

1. Place Mass Concrete in accordance with the requirements of ACI 301 and ACI 207.1R and as specified herein.
2. Temperature Controls:
 - a) The temperature of concrete when deposited at the point of placement shall not exceed 70°F (21°C), or be less than 35°F (2°C).
 - b) The maximum temperature after placement (during curing) shall not exceed 160°F (71°C).
 - c) The maximum allowable temperature differential between the interior and the exterior of the mass concrete element is 35°F (19°C).
 - d) The drop in concrete surface temperature during, and at the conclusion of the specified curing period, shall not exceed 20°F (11°C) in any 24 hour period.
3. Consolidation: Place concrete in layers not more than 18 inches (450mm) thick. Extend vibrator heads into the previously placed layer of plastic concrete.

F. Field Monitoring:

1. The contractor shall provide temperature monitoring devices, such as plastic-sheathed thermocouples with an appropriate logger, to record temperature development between the interior and the exterior of the mass concrete element. The contractor shall submit readings taken from the temperature monitoring devices at intervals not exceeding six hours. Readings shall be taken from the time that concrete is placed and continue until the maximum temperature location is cooled within 35°F of the average air temperature.
2. If monitoring indicates that the maximum temperature, maximum temperature differential or the maximum drop in surface temperature, as indicated in the Required Submittals section of this Specification have been exceeded, the contractor shall take immediate action to retard further growth in the maximum and/or differential temperature.
3. The contractor shall submit proposed revisions to the approved mass concrete placement procedures to achieve the maximum temperature differential and maximum absolute temperature limits on any remaining mass concrete placements for Design Professional's review.

3.7 CONCRETE FINISHES

A. General:

1. Comply with recommendations for concrete finishing established by ACI 302.1R and ACI 304R.

2. Comply with dimensional tolerance limitations given by ACI 117.
 3. For shored floor or slab at grade construction: Floor flatness/floor levelness tolerance compliance testing is to be performed prior to the removal of shores and forms but not later than 72 hours of concrete placement by Testing Agency.
 4. See architectural Drawings for locations of the various finishes listed below.
 5. Comply with the specified overall SOF_F and SOF_L values listed below:
 - a) The specified overall area shall be each individual floor.
 - b) F_F/F_L shall be measured in accordance with ASTM E 1155.
 - c) The specified minimum local values of MLF_F/MLF_L shall be 3/5 of the SOF_F/SOF_L values listed below.
 - d) If an individual test section measures less than either of the specified minimum local MLF_F/MLF_L numbers, that section may be rejected and remedial measures may be required as specified in CONCRETE SURFACE REPAIRS.
 - e) If the composite value of the test surface measures less than either of the specified overall SOF_F/SOF_L numbers, then the entire slab may be rejected and remedial measures may be required.
 - f) F_L numbers shall only apply to supported slabs if the tested with all of the original shoring in place, prior to shoring removal/reshoring.
 - g) F_L numbers shall not apply to unshored slabs or shored slabs with camber.
- B. Finish for monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile and other bonded applied cementitious finish flooring material, as indicated on architectural Drawings:
1. Scratch Finish.
 - a) Finish surface to overall value of $SOF_F=20$ and $SOF_L=15$.
 - b) Slope surfaces uniformly to drains where required.
 - c) After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- C. Finish for monolithic slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, sand-bed terrazzo as indicated on architectural Drawings:
1. Float Finish.
 - a) After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating.
 - b) Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both.
 - c) Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
 - d) Finish surfaces to overall value of $SOF_F=20$ and $SOF_L=15$.
 - e) Cut down high spots and fill low spots.
 - f) Uniformly slope surfaces to drains.
 - g) Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

- D. Finishes for Pedestrian Sidewalks and Ramps, Exterior Platforms, Steps, as indicated on architectural Drawings:
1. Sidewalks and Curbs: Light-to-medium broom finish applied with fiber-bristle broom perpendicular to direction of main traffic route immediately after float finishing.
 2. Ramps: Scored finish as applied perpendicular to direction of main traffic route immediately after float finishing.
 3. Finish surface to overall value of $SOF_F=20$ and $SOF_L=15$.
 4. Texture shall be approved by the Design Professionals from sample panels.
- E. Finish for interior floor slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, paint or another thin film-finish coating system, as indicated on architectural Drawings:
1. Trowel Finish.
 - a) After floating, begin first trowel-finish operation using a power-driven trowel.
 - b) Begin final troweling when surface produces a ringing sound as trowel is moved over surface.
 - c) The final hand-troweling operation shall result in a smooth surface, free of trowel marks, uniform in texture and appearance.
 - d) Grind smooth any surface defects that would telegraph through applied floor covering system.
 2. Finish surface to overall value of $SOF_F=25$ and $SOF_L=20$.
 3. Floor Slopes: Where drains occur, slope floor slabs uniformly to drains, maintaining scheduled slab thickness.
 4. Floor Edges at Expansion Joints: Tool edges minimum 3/8" (10mm).
 5. Defects: Remove defects of sufficient magnitude to show through floor covering by grinding.
 6. Floor Hardener: Use only where scheduled and in accordance with manufacturer's published instructions.
 7. Dry Cement: Shall not be used during finishing.
- F. Finish for thin set ceramic tile or thin set epoxy terrazzo, as indicated on architectural Drawings:
1. Trowel and Fine Broom Finish:
 - a) Apply a trowel finish as specified.
 - b) Immediately follow by slightly scarifying the surface with a fine broom.
 2. Finish surface to overall value of $SOF_F=35$ and $SOF_L=25$.
- G. Finishes for Parking Garage Deck, Ramps, Loading Docks:
1. Highway straight edge immediately after screeding concrete.
 2. Finish surface to overall values of $SOF_F=20$ and $SOF_L=15$.
 3. For Slabs Not Receiving Deck Coating: Medium broom finish with ridges not to exceed 1/8" (3mm) in height. Texture shall be as approved by the Design Professionals from sample panels.

4. For Slabs Scheduled to Receive Deck Coating: Smooth floated finish which must be verified with coating manufacturer before finishing the slab.
 - a) Coordinate with deck coating specified in Division 7.
 5. Auto Ramps: Rough texture applied perpendicular to direction of traffic. Texture shall be as approved by the Design Professionals from sample panels.
- H. Finishes Equipment and Housekeeping Pads
1. Coordinate finish surface to meet equipment manufacturer requirements, if any, for flatness and levelness.
- I. Tolerances at Slab Discontinuities
1. Within 2 ft (600mm) of slab boundaries, construction joints, isolation joints, block-outs, penetrations or other similar discontinuities, where required for travel paths, installation of finishes and partitions, or any other requirements indicated in the Contract Documents, the following equivalent straightedge tolerances shall apply:
 - a) Specified local $MLF_F = 12$, use $\frac{1}{4}$ " (6mm) over 4 ft (1200mm), no offset greater than $\frac{1}{16}$ " (2mm)
 - b) Specified local $MLF_F = 15$, use $\frac{1}{8}$ " (3mm) over 4 ft (1200mm), no offset greater than $\frac{1}{32}$ " (0.8mm)
- J. Dry Shake Finish:
1. Non-slip aggregate where indicated on Drawings.
 2. Non-oxidizing metallic hardener on loading docks at a rate of 1.5 lbs. per sq. ft. (7.3 kg/m²) and in other locations so noted on the Drawings.
 3. Mineral aggregate hardener at a rate of 1.2 lbs. per sq. ft. (5.8 kg/m²) where noted on the Drawings.
 4. Final finish type, method and tolerance as applicable by location and use.
 5. Dry shake finish will be applied only where scheduled and in accordance with the manufacturer's published instructions and the methods and procedures agreed upon at the pre-installation conference.
- K. Rough Formed Finish:
1. Acceptable for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated.
 2. Concrete surface shall have texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding $\frac{1}{4}$ " (6mm) in height rubbed down or chipped off.
- L. Smooth Formed Finish:
1. Required for formed concrete surfaces exposed to view, or scheduled to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp proofing, veneer plaster, painting, or other similar system, as indicated on architectural Drawings:

2. Surface is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
3. Repair and patch tie holes and defects. Remove fins and other projections completely.

M. Smooth Rubbed Finish:

1. "Smooth Rubbed" finish shall consist of a finish free of fins, joint marks smoothed off, blemishes removed and surfaces left smooth and unmarred.
2. Provide smooth rubbed finish to scheduled concrete surfaces, as indicated on architectural Drawings, which have received smooth form finish treatment not later than one day after form removal.
3. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced.
 - a) Do not apply cement grout other than that created by the rubbing process.

N. Grout-Cleaned Finish:

1. Provide grout-cleaned finish on scheduled concrete surfaces, as indicated on architectural Drawings, that have received smooth-formed finish treatment.
2. Combine one part Portland Cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint.
3. Blend standard Portland Cement and white Portland Cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
4. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes.
5. Remove excess grout by scraping and rubbing with clean burlap.
6. Keep surface damp by fog spray for at least 36 hours after rubbing.

O. Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 CURING AND PROTECTION

A. Normal Conditions:

1. Protect concrete from premature drying, excessive hot temperature, and damage.
2. Concrete shall be kept continuously moist and above 50°F (10°C) for seven days (ASTM C 150 Type I cement) or for 10 days (ASTM C 150 Type II cement). High early strength concrete usage shall be maintained over 50°F (10°C) for three days.

3. Concrete and concrete patching materials shall be cured according to manufacturers published recommendations.
4. Begin curing as soon as free water has disappeared from concrete surface and finishing has been completed.
5. Curing Methods: Cure concrete by curing compound, moist curing, moisture-retaining cover curing, or by combining these methods, as specified. Under extreme hot/dry or windy/dry conditions, moist curing and/or moisture-retaining cover curing should be used.
 - a) Curing compound is an acceptable form of curing if all of the following requirements are met:
 - i. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). In accordance with all manufacturer's instructions.
 - ii. Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions.
 - iii. Recoat areas subjected to heavy rainfall within 3 hours after initial application.
 - iv. Maintain continuity of coating and repair damage during curing period.
 - v. Use curing and sealing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
 - vi. Floors to receive covering shall be cleaned thoroughly using a power scrubber and industrial strength detergent. Hand-brooming and sweeping is not sufficient.
 - vii. Strippable curing compound may be used in lieu of a moist curing method when approved by the Design Professionals.
 - b) Provide moist curing by the following methods:
 - i. Keep concrete surface continuously wet by covering with water.
 - ii. Use continuous water-fog spray.
 - iii. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4" (100mm) lap over adjacent absorptive covers.
 - c) Provide moisture-retaining cover curing as follows:
 - i. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" (75mm) and sealed by waterproof tape or adhesive.
 - (1) Immediately repair any holes or tears during curing period using cover material and waterproof tape
6. Cure slabs at grade, concrete toppings, concrete pour strips, supported slabs, walls and columns, not subject to conditions of hot weather concreting, in accordance with ACI 308.

7. Cure surfaces exposed to brackish water, etc., such as loading dock slabs and ramps in accordance with ACI 308 recommendations for moist curing.
 8. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by leaving forms in place for the full curing period (equivalent to moist curing).
 - a) If forms are removed prior to completion of full curing period, continue curing by methods specified above for Unformed Surfaces, as applicable.
- B. Hot-Weather Protection:
1. When concrete is placed under conditions of hot weather concreting, provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations with an evaporation retarder.
 - a) Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
 2. Hot weather curing is required if hot weather conditions occur within a 24-hour period after completion of concrete placement.
- C. Floor surfaces, wherever indicated by weather conditions, shall be sprinkled during the interval between finishing operation and the start of curing to positively ensure against the possibility of surface drying.

3.9 CONCRETE REPAIRS

- A. Perform patching and repairs in accordance with ACI 301.
- B. Contractor shall submit patching and repair methods and materials for review by Design Professionals.
- C. When complete, all patches and repairs shall match color and texture of adjoining surfaces.
- D. At surfaces that are exposed to view, prepare test areas at inconspicuous locations for review by Design Professionals to verify repair color and texture match before proceeding with repair.
- E. Apply all patching and repair materials in accordance with manufacturer's specifications.
- F. Repairing Cracks In Formed and Unformed Surfaces:
 1. Contractor shall notify Design Professionals of all cracks wider than 0.02" (0.50mm) and all cracks wider than 0.01" (0.25mm) that occur in a group of at least three cracks within twelve inches (300mm), in concrete. If Design Professionals deem repairs necessary, Contractor shall be responsible for repairing all such cracks per Design Professionals recommendation at no expense to the Owner. Repairs will generally require one or more of the following: Epoxy Injection, Semi-Rigid Epoxy, Pressure Injected Foam Resin,

Methyl Methacrylate and/or Sealant with joint routed and cleaned. See Concrete Repair Materials section of this Specification for acceptable products

G. Repairing Formed Surfaces

1. Immediately after stripping forms, patch all honeycombing, defective joints, voids, etc. before the concrete is thoroughly dry.
2. Remove all burrs, fins, and ridges before the concrete is thoroughly dry.
3. Remove stains from rust, grease and oils, from release agents, etc.
4. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of the Design Professionals.
 - a) Surface defects, include color and texture irregularities, cracks as defined above, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - b) Chip away defective areas, honeycomb, rock pockets, voids over 1/4" (6mm) in any dimension and holes left by tie rods and bolts, down to solid concrete but in no case to a depth less than 1" (25mm) and saw-cut edges to prevent feather edging of fill material.
5. Repair concealed formed surfaces, where possible, containing defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
6. Clean out form tie holes and fill with dry pack mortar or precast cone plugs secured in place with bonding agent.
7. If honeycombing exposes reinforcement, chip to provide clear space at least 3/4" (20mm) wide all around steel to allow proper bond.

H. Repairing Unformed Surfaces:

1. High and Low areas in concrete surfaces which are in excess of specified tolerances shall be leveled or ground-smooth.
 - a) Correct high areas by grinding after concrete has cured at least 14 days.
 - b) Correct low areas by applying leveling material. Finish leveling material as specified in this section.
2. Repair surfaces containing defects that affect durability of concrete.
 - a) Surface defects include crazing, cracks as defined above, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
3. Repair defective areas, except random cracks and single holes not exceeding 1" (25mm) in diameter, by cutting out and replacing with fresh concrete.
 - a) Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4" (20mm) clearance all around.

- I. Filling In: Fill in holes and openings left in concrete for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.

3.10 EVALUATION AND ACCEPTANCE OF CONCRETE

3.11 CORRECTIVE MEASURES

- A. Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and placement of reinforcement steel; placement of inserts and other embedded items; and the structural adequacy of all formwork.

- B. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents either developing corrective actions or reviewing corrective actions developed by others, the Contractor is responsible for paying for additional work performed by the Design Professionals at their standard firm-wide billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

[Balance of page blank; see form on next page]

CONCRETE MIX DESIGN SUBMITTAL FORM

Project: _____
 City: _____
 General Contractor: _____
 Concrete Contractor: _____
 Concrete Strength: _____
 Use/Location on Job: _____
 Supplier's Mix Designation: _____

Design Mix Information (Please check one): *Refer to ACI 301 for requirements of data used to substantiate strength calculations.*

Field Experience (Based on Standard Deviation Analysis): _____
 Trial Mixture Test Data: _____

Design Characteristics:

Density: _____ Pcf (kg/m3)
 Strength: _____ Psi (MPa) (28 day)
 Air: _____ % (specified)

Materials:	Type/Source	Specific Gravity	Weight (lb)	Absolute Vol. (cu. ft.) (cu. m)
Cement:				
Fly ash:				
Slag (GGBFS)				
Microsilica:				
Coarse Aggregate:				
Fine Aggregate:				
Water:				
Air:				
Other:				
TOTAL:				27.0 cu. ft. (1.0 m3)
Water/Cementitious Material Ratio (lbs. (kg) water / lbs. (kg) cementitious material) =				%

Admixtures:	Manufacturer	ASTM	Dosage (oz/cwt)
Water Reducer:			
Air Entraining Agent:			

High Range Water Reducer			
Non-corrosive Accelerator:			
Other:			

Slump before HRWR: _____ Inches (mm)
 Slump after HRWR: _____ Inches (mm)

Standard Deviation Analysis (from experience records):

No. of Test Cylinders
 Evaluated: _____
 Standard Deviation: _____

Required Average Strength f_{cr}

Average Strength by Tests

Equation Used (ACI Chapter 5)

(Refer to ACI 318 for increased deviation factor when less than 30 tests are available)

TRIAL MIXTURE TEST DATA

Compressive Strength:	Age (days)	Mix #1	Mix #2	Mix #3
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	Average	psi (MPa)	psi (MPa)	psi (MPa)
<i>Required Average Strength f_{cr}</i>				
<i>Average Strength by Tests</i>				
<i>Equation Used (ACI Chapter 5)</i>				

REQUIRED ATTACHMENTS

***Please
check***

Coarse Aggregate Gradation Report	
Fine Aggregate Gradation Report	
Fly Ash (or other Supplementary Cementitious Material) Certification	

Concrete Compressive Strength Data or Trial Mixture Test Data
 Admixture Compatibility certification letters
 Chloride Ion Content Certification
 Alkali Aggregate Reactivity Certification
 Shrinkage Test Reports

SUBMITTED BY:

Name: _____
 Address: _____

 Phone no.: _____
 Main Plant Location: _____
 Miles from Project: _____
 Secondary Plant Location: _____
 Miles from Project: _____

 Date: _____

 Certification by Concrete
 Supplier: _____
 Signature: _____

 Print Name: _____

 PE License Number
 and Expiration Date
 (print or stamp) _____

Structural Substitution Request Form – to be completed by Contractor

Project:		Substitution Request #
Date:		
Requesting Contractor:		Pages Attached (including this form)

1. Description of Requested Substitution:

2. Related Drawings and Specification Sections:

3. Rationale or Benefit Anticipated:

END OF SECTION 033000

SECTION 033300

ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Architectural concrete, complete, as shown and specified. Work includes, but is not limited to, formed Architectural Concrete Walls and Stair A.
- B. Work Specified Elsewhere:
 - 1. Concrete Polishing: Section 033543.
 - 2. Water and Graffiti Repellents: Section 071900.
- C. Other Applicable Sections: Work of this Section is governed by applicable provisions of the following Sections:
 - 1. Concrete Formwork: Section 031000.
 - 2. Concrete Reinforcing: Section 032000.
 - 3. Cast-in-Place Concrete: Section 033000.

1.2 REFERENCES

- A. General: Comply with the applicable provisions of the referenced standards except as modified by governing codes and the Contract Documents. Where a recommendation occurs in the referenced standards, it shall be considered mandatory. In the event of conflict, the more stringent standard or requirement shall govern.
 - 1. American Concrete Institute (ACI):
 - a. ACI 347 "Guide to Formwork for Concrete."
 - b. ACI 303R "Guide to Cast-In-Place Architectural Concrete Practice."
 - c. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials"

1.3 SUBMITTALS

- A. Product Data: Submit for Architect's action. Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating specified requirements.
 - 1. Provide product with an Environmental Product Declaration (EPD).
- B. Shop Drawings: Submit for Architect's action. Submit shop drawings for the fabrication and installation of the Work. Prepare details at not less than 3 in. = 1 ft. scale.
 - 1. Reinforcement: Submit as specified under other applicable concrete Sections.

2. Formwork: Show type, design, and materials. Architectural drawings detail all tie locations, reveals, and construction joints. Any deviations from these drawings to be submitted as drawings to Architect for review and approval. Show locations of formwork joints, construction joints, form ties, and rustication strips.
- C. Sequence of Pours: Submit for Architect's action. Per the "Scheduling" article, submit a diagram, showing the order in which pours will occur. Provide a sequence of all concrete pours for review by Architect.
- D. Samples: Submit for Architect's action. Furnish sufficient samples to establish full range of colors and textures for materials exposed in the finished Work. Label samples to indicate product and location in the Work. Samples will be reviewed for appearance only. Compliance with other requirements is the responsibility of the Contractor.
1. Concrete: Each sample to be 12-inch by 12-inch by 1-1/2-inch-thick, with bent rebar handle for carrying; each type and finish for preliminary review. Provide three different samples of color variations to match Architect's sample. Final review by mock-up.
 2. Tie Hole Sealant: provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- E. Quality Assurance/Quality Control Submittals: Submit for Architect's information.
1. Certificates:
 - a. Document Review: Submit a written statement signed by the Contractor and the Applicator stating that the Contract Documents, shop drawings and product data have been reviewed with qualified manufacturer representatives. The statement shall certify that selected materials are proper, compatible with contiguous materials and adequate for the application shown.
 - b. Mock-Up Documentation: Provide written information as a submittal prior to field review of the mock-up indicating the location, products and materials used, dates scheduled for observation, and any other information pertinent to the construction of the Mock-up. Corrections, if any, shall also be submitted in writing along with any field reports that have been generated.
 - c. Installer's Qualifications
 - d. Certificates for admixtures, concrete mix design, and concrete trial mixes, and as specified under other applicable concrete Sections.
- F. LEED Submittals:
1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.4 QUALITY ASSURANCE

- A. Qualified Contractor: shall have 5 years' experience in the installation of specified materials on comparable projects.
- B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.
- C. Visual Mock-Up(s): After selection of submitted sample by Architect, provide visual mock-ups. Prior to commencement of final work, construct mock-up of portion of Work shown at Project site. Include specified finishes, rustication strips, construction joints, form tie hole treatment, and similar items in mock-up. No patching is permitted. Use the visual mock-up as a standard for finishes, appearance, quality, and workmanship.
 - 1. Formed Finish: Exposed concrete with rock pockets, mortar paste leakage, voids, discoloration, sanding, or deviations from specified surface will be considered defective. Replace defective work at no additional cost to Owner.
 - 2. Finish Selection Mock-ups: Allow for minimum of five. Mock-up shall be exposed on both sides. Mockups shall be preserved without damage or discoloration throughout the duration of construction. The approved finish selection mock-up shall be stored on the construction site. Contractor shall reinforce and brace wall mockups as required. Contractor shall reinforce beam to column intersection mockup as shown on drawings, and brace as required.
 - a. Provide two 8 ft. by 8 ft. walls. Provide formtie holes as shown in the Mock-up Drawings. On ½ of each mock-up provide the following Graffiti Resistant Coatings, per Section 071900. Coordinate extents of mock-up for each Graffiti Resistant coating with Architect and Owner's Representative.
 - 1) Show Anti-Graffiti Coating only.
 - 2) Show Water-Repellent Coating with Anti-Graffiti Coating only covering bottom 4 ft. of mock-up.
 - b. Provide one beam to column intersection.
 - c. Provide an additional two mock-ups, if required by the Architect and Owner's Representative.
- D. Pre-Installation Meetings: Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include the Owner, Owner's Representative, Architect, Architect's consultants, Contractor, and subcontractors whose work is relevant to this Specification Section.

1.5 PROJECT / SITE CONDITIONS

- A. Weather Conditions: As specified under other applicable concrete Sections. Concrete pours shall not be performed if rain is forecasted within 24 hours.

1.6 SCHEDULING

- A. General: Coordinate with other trades for installation of items to be embedded in concrete.

- B. Sequence of Pours: Contractor shall pour less-obvious areas first, to establish methods for pouring concrete to match approved mock-ups. Contractor shall start at Column Line 2 or 4.5.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. PS EPD: Products specified under this section shall have a Type III Product Specific EPD.

2.2 CONCRETE TYPES

- A. Provide Architectural Concrete, unless noted otherwise.

2.3 MATERIALS

- A. General: As specified under applicable Sections, except as follows:
 - 1. Formwork: Provide forms for a continuous, straight, smooth finish. Forms shall not have been re-used from a previous project.
 - a. Plywood-Formed Finish: PS1, Exterior Grade, Douglas Fir, not less than 3/4-inch-thick.
 - 1) High Density Overlay (HDO)
 - b. Upon formwork removal, no patching, stoning or other repair is permitted.
 - 2. Form Edges: Factory seal with aluminized polyurethane sealer to prevent moisture penetration.
 - 3. Rustication and Reveal Strips: Birch, Select and Btr Grade per NHLA; mill straight to profiles shown.
- B. Form Ties:
 - 1. Ties: Dywidag Systems International (630-739-1100). Provide threadbars 5/8 in. in diameter in 3/4 in. PVC sleeves, or equal
 - 2. Sealant: Provide silicone sealant, per Section 079200 "Joint Sealants." Sealant to be semi-recessed, as shown.
- C. Bar chairs resting on formwork for architecturally exposed concrete surfaces shall be plastic, color to match color of specific concrete mix as closely as possible. Dayton Superior Aztec E-Z Chair or equal.
- D. Tie wire in architecturally exposed concrete shall be stainless steel or poly-coated type, installed to not puncture or mar coating.

2.4 MIXES

- A. General: Provide lightweight mix as specified under other applicable concrete Sections.

PART 3 - EXECUTION

3.1 FORMWORK

- A. General: As specified under other applicable concrete Sections except as follows:
1. Panel Size: Provide panel layout, as shown on Architectural Drawings.
 2. Formwork Tolerances: Conform to the more stringent of tolerances specified in Section 031000 "Concrete Formwork" and the following:
 - a. Irregularities: Maximum offset between butt joints of adjacent individual or ganged form shall be 1/32 in.
 - b. Cross Section Dimensions: -1/8 in. and + 1/4 in at beams and columns.
 - c. Surface Class: 1/8 in. in 10 ft.
 3. Form Panel Back-Up: Back formwork panels with second layer of 3/4-inch thick exterior grade plywood; stagger panel joints, and screw fasten face panel through back-up panel. Exposed fastener heads or ends on formwork are not permitted.
 4. Make provisions in formwork for removal of debris from formed surfaces. Locate temporary openings in inconspicuous locations at bottom of forms. Close ports with tight-fitting panels, flush with inside face of forms.
 5. Rustication and Reveal Strips: Nail to form where shown. Use finishing nails only.
 6. Form Joints: Lap and seal joints, gaps, and apertures in forms to withstand full hydraulic pressure and remain watertight and flush.
 7. Form Ties: Locate as shown. Accurately place and align.
 8. Corners: Form outside exposed horizontal and vertical corners square with eased corners, unless otherwise shown. Eased corners shall have a maximum 1/8 in. radius.

3.2 CONCRETE

- A. General: Mix, convey, place consolidate, cure, and protect concrete as specified under other applicable concrete Sections, except as follows:
1. Consolidation: Do not spade concrete at finish surfaces. Do not permit vibrator heads to come within 1-1/2 inches of form face.
 2. Construction Joints: Not permitted except at inside corners, and where specifically shown in the Architectural Drawings, and/or at panel joints that have been reviewed and accepted by the Architect.

3.3 FORM TIE HOLES

- A. General: As specified under other applicable concrete Sections and as follows.
1. Exposed Tie Rod Holes: To be reviewed and selected in the mockup, from the following:
 - a. Install plugs with adhesive per plug manufacturer's recommendations.
 - b. Install semi-recessed grout as shown on Drawings.

3.4 FINISHES

A. General: As specified under other applicable concrete Sections, except as follows:

1. Plywood-Formed Finishes: Provide smooth finish upon form removal with no patching, stoning, or other form of repair, except washing, permitted.

3.5 CLEANING

A. General: Clean finished surfaces with mild detergents and brushes. Rinse off cleaning solutions with clear water.

3.6 PROTECTION

A. General: Protect outside horizontal and vertical corners with full-length wood guards. Place immediately after stripping. Remove when hazards of damage from construction operations are no longer present.

END OF SECTION

SECTION 033543

POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Polished concrete finishing.
2. Concrete for polished concrete, including concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 033000 "Cast-in-Place Concrete."

B. Related Requirements:

1. Section 018115 "CALGreen Requirements."
2. Section 033000 "Cast-in-Place Concrete" for topping slab.
3. Section 033300 "Architectural Concrete."

1.3 DEFINITIONS

- A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place concrete subcontractor.
 - e. Polished concrete finishing Subcontractor.

2. Review curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. CALGreen Submittals: Refer to Section 018115 "CALGreen Requirements."
- C. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.
- D. Samples for Initial Selection: For each type of product requiring color selection.
- E. Samples for Verification: For each type of exposed color.
- F. LEED Submittals:
 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. IEQc2 - Low-Emitting Materials – Interior Wet Applied Products: For paints, coatings, adhesives and sealants applied on site or used for laminating off-site, include product data indicating the VOC content (g/L) and testing certificates or third party certification demonstrating compliance with California Department of Public Health (CDPH) v1.2-2017 emissions testing.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each of the following, signed by manufacturers:
 1. Repair materials.
 2. Liquid floor treatments.

1.7 QUALITY ASSURANCE

- A. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches minimum, to demonstrate the expected range of finish, color, and appearance variations.
 1. Locate panels as indicated or, if not indicated, as directed by Architect.
 2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 3. Demolish and remove field sample panels when directed.
- B. Mockups: Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of

workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Demonstrate curing, finishing, and protecting of polished concrete.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PERFORMANCE REQUIREMENTS

- A. Performance Requirements
 1. Slip Resistance, Wet Dynamic Coefficient of Friction (DCoF): Wet DCoF of installed flooring and paving shall be as follows, when measured in accordance with NFSI/ANSI B101.3.
 - a. Level Surfaces: Not less than 0.42.

2.3 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 1. Hardening / Sealing Agent:
 - a. Advanced Floor Products, Inc. "Retro-Plate 99", or equal.

PART 3 - EXECUTION

3.1 POLISHING

- A. Polish: Match design reference sample.
- B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 - 1. Machine grind floor surfaces to receive polished finishes level and smooth.
 - 2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 - 3. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
 - 4. Control and dispose of waste products produced by grinding and polishing operations.
 - 5. Neutralize and clean polished floor surfaces.
- C. Scoring: Score decorative jointing in concrete surfaces 1/16 inch deep with diamond blades to match pattern indicated. Rinse until water is clear.
 - 1. Joint Width: 3/8 inch.

END OF SECTION

SECTION 034800
PRECAST CONCRETE SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Fabrication of Precast Concrete Furnishings.
 - 2. Placement of Precast Concrete Furnishings.
- B. For Site Concrete Water Repellants, see Section 070921.
- C. For Site Concrete, see Section 321316.
- D. For Site Concrete Sealants, see Section 321373.
- E. For Site Furnishings, see Section 323000.
- F. For Sustainable Design Requirements, see Section 018113.

1.2 DEFINITIONS

- A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of Owner’s representative in writing.

1.3 REFERENCES

- A. ASTM — American Society for Testing and Materials:
 - 1. A 185/A185M — Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement. Most current edition.
 - 2. A 615/A615M — Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. Most current edition.
 - 3. C 33 — Specification for Concrete Aggregates. Most current edition.
 - 4. C 140 — Method of Sampling and Testing Concrete Masonry Units. Most current edition.
 - 5. C 150 — Specification for Portland Cement. Most current edition.
 - 6. C 330 — Specification for Lightweight Aggregates for Structural Concrete. Most current edition.
 - 7. C 979 — Specification for Pigments for Integrally Colored Concrete. Most current edition.
 - 8. C 1116 — Specification for Fiber-Reinforced Concrete and Shotcrete. Most current edition.
 - 9. D 2000 — Classification System for Rubber Products in Automotive Applications. Most current edition.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Color admixtures.

2. Micro-reinforcement.
 3. Form material for exposed surfaces.
- B. Samples:
1. Samples for each type of finish indicated on exposed surfaces of precast architectural concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected per specified size.
 2. Six-inch × six-inch finish and color sample of exposed surfaces of planter wall unit.
 3. 3' long × 1.5' tall x 2' wide three-sided unit of precast planter wall. Unit sample shall include accepted finish, color, faceted side, edges and one faceted top transition.
 4. Three-inch length of grout.
 5. Three-inch length of sealant.
- C. Proof of Work Experience:
1. Precast Manufacturer: Submit project lists, including reference names, phone numbers and project dates.
- D. Certificates of Conformance or Compliance: Submit proofs of conformance or compliance for the following:
1. Glass Fibers: Submit evidence that glass composition and Portland cement matrix have been designed for GFR applications.
- E. Styrofoam Field Sample:
- F. Shop Drawings:
1. Detail fabrication and installation of precast architectural concrete units. Indicate member locations, plans, elevations, dimensions, shapes, cross sections, limits of each finish, edge radii and types of reinforcement, including special reinforcement.
 - a. Indicate locations and extent and treatment of dry joints if two-stage casting is proposed.
 - b. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, inserts, connections, and joints, including accessories.
 - c. Indicate locations and details of anchorage devices to be embedded in other construction.
 - d. Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation.
- G. Field Samples:
1. Full scale Styrofoam field sample of each site furnishing element. Upon review of Styrofoam mock-ups, adjust form, if required, to achieve acceptable form.
 2. Full scale Precast field sample: Construct one full size segment of planter wall.
 - a. Include specified joints and three sloped tops of planter wall.
 - b. Construct as many samples as necessary to achieve an accepted sample.
 - c. Samples which are partially constructed or finished incorrectly will be rejected.
 - d. Remove rejected samples immediately from the site.
 - e. Place accepted samples in a location where samples can be referenced.
 - f. Accepted sample shall become the project standard for tolerances and appearance.
 - g. In presence of Architect, damage part of an exposed face for each finish, color and texture, and demonstrate materials and techniques proposed for repairs to match adjacent undamaged surfaces.

H. Test Results:

1. Concrete Cylinder Tests.

I. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - MRc3 - Sourcing of Raw Materials - **Recycled Content**: Provide product data for pre- and post- consumer recycled content.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Established international reputation having work similar to that specified, in use for a minimum of 10 years.
2. Shop shall have proper equipment for Work specified, including application of finish.
3. Fabricators and finishers shall be recognized experts in the Work they are engaged to perform.
4. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over such Work.
5. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.
6. Firm presently specializing in the manufacture of the type product shown on the Drawings.
7. Assumes responsibility for engineering precast architectural concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings (optional- comprehensive engineering analysis by a qualified professional engineer- if determined as being a requirement)
8. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of precast architectural concrete that are similar to those indicated for this Project in material, design, and extent.
9. Has a quality control program that is comparable to APA or PCI that is certified by a professional engineer. Must submit program with bid.
10. Has sufficient production capacity to produce required units without delaying the Work.
11. Is registered with and approved by authorities having jurisdiction.
12. Fabricator must manufacture product within 500 miles of project site.
13. Must have a qualified sales person located within 50 miles of the project site.
14. All product to be entirely sourced and manufactured in USA.
15. Manufacture to provide history of product still in use by municipality for 10 consecutive years.

- B. Regulatory Requirements: Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Loading and Shipment:
 - 1. Carefully pack the units for shipment free from stains and other deleterious material.
 - 2. Exercise precautions against damage in transit.
- B. Storage:
 - 1. Store units on non-staining wood skids or pallets at least four inches above grade.
 - 2. Place and stack skids and units to distribute weight evenly and to prevent breakage or cracking.
 - 3. Protect and store units from weather and soiling with waterproof non-staining covers or enclosure, but allow air to circulate around units.
- C. Handling:
 - 1. Handle units to prevent chipping, breakage, soiling or other damage.
 - 2. Do not use pinch or wrecking bars without protecting edges of units with wood or other rigid materials.
 - 3. Lifts with wide-belt type slings wherever possible.
 - 4. Do not use wire rope or ropes containing tar or other substances which might cause staining.
 - 5. If required, use wood rollers and provide cushion at end of wood slides.
- D. Sequencing:
 - 1. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required for installation.

1.7 WARRANTY

- A. General Description:
 - 1. In addition to manufacturer's guarantees or warranties, Work shall be warranted for one year from the date of Final Completion against defects in materials and workmanship.
- B. Other Items Covered:
 - 1. Warranty shall cover repair of damage to any materials and workmanship resulting from defects in precast concrete specialty materials and workmanship.
- C. Exceptions:
 - 1. Contractor shall not be held responsible for failures due to neglect by Owner, vandalism and other causes outside the Contractor's control.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Precast Work:
 - 1. QCP – qcp-corp.com/.
 - 2. Or accepted equal.

- B. Micro-Reinforcement:
 - 1. Nycon, Inc. – www.nycon.com.
 - 2. Or accepted equal.
- C. Coloring Admixture:
 - 1. L.M. Scofield Company – www.scofield.com.
 - 2. Shaw & Sons – www.shawconstruction.com/
 - 3. Or accepted equal.
- D. Anchor Bolts, Nuts, Washers and Adhesive:
 - 1. Hilti Corp. – www.us.hilti.com.
 - 2. Or accepted equal.
- E. Shims:
 - 1. Williams Products, Inc. – www.williamsproducts.net.
 - 2. Or accepted equal.
- F. Form Sealer:
 - 1. Nox-Crete – www.noxcrete.com.
 - 2. Or accepted equal.
- G. Form Release Agent:
 - 1. Nox-Crete – www.noxcrete.com.
 - 2. Or accepted equal.

2.2 MATERIALS

- A. Mix:
 - 1. Material: SRC / Low-Carbon Precast Concrete Mix
 - 2. Color: Mission White
 - 3. Finish: Lt Polish
 - 4. Sealer: 4200 Anti-graffiti Sealer
- B. Cement:
 - 1. ASTM C 150, Type I (white) Portland Cement.
- C. Aggregate for Regular Weight Concrete:
 - 1. ASTM C 33, with 3/4-inch maximum size.
- D. Reinforcing Bars:
 - 1. ASTM A 615, grade 40, galvanized, deformed billet-steel bars, clean and free from rust, scale, or coating that will reduce bond.
- E. Welded Wire Fabric:
 - 1. ASTM A 185.
- F. Water:

1. Clean, potable, concrete mixing water free from injurious amounts of salts, oils, acids, alkalis, organic materials or other deleterious substances which could cause staining.
- G. Coloring Admixtures for Colored Concrete:
1. ASTM C 979, Scofield Chromix Admixture, color to match accepted sample for architectural concrete.
- H. Anchor Bolts, Nuts, Washers and Adhesive:
1. Stainless steel bolts, nuts and washers with structural adhesive anchor systems; Hilti HVA/HAS-SS, or accepted substitute.
- I. Shims:
1. ASTM D 2000, neoprene rubber; 80 – 90 pounds per cubic foot density, minus 40 to plus 200 degrees Fahrenheit temperature resistance, thickness as required to shim.
- J. Micro-Reinforcement:
1. ASTM C 1116, 100-percent nylon.
- K. Forming Material:
1. MDO or HDO composite overlaid plywood for face forms.
 2. Synthetic Polyethylene or milled wood for reveals and corner forms.
- L. Form Release Agent: Non-staining material, VOC compliant in California.
- M. Form Sealer: Nox-Crete Pre-Form transparent, penetrating polyurethane wood sealer.

2.3 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.4 MIXES

- A. Concrete Mix:
1. Minimum Compressive Strength at 28 Days: 5,000 pounds per square inch, as determined by ASTM C 140.
 2. Absorption: Five percent (5%) maximum, as determined by ASTM C 140.
 3. Coloring Agent: Achieve color by integrally mixing color admixture with concrete, as specified by the color admixture manufacturer's current printed instructions.
 4. Micro-Reinforcement: Incorporate into mix as specified by the manufacturer's current printed instructions.

2.5 FABRICATING

- A. Proportioning and Mixing:
1. Carefully measure mix constituents in a manner to achieve the desired mix proportions.

2. Meter the glass fiber and cement slurry to the spray head at rates to achieve the desired mix proportion and glass content. Check rates in accordance with standard procedures described in PCI.
- B. Hand Spray Application:
1. Spray apply a mist coat consisting of the matrix without fiber. Apply this coating not to exceed 1/32 inch thick in order to avoid an un-reinforced surface.
 2. Spray-up main body of material before the mist coat has set.
 3. Apply by spraying such that uniform thickness and distribution of glass fiber and cement matrix is achieved during the application process.
 4. Consolidate by rolling or such other techniques as necessary to achieve complete encapsulation of fibers and compaction.
 5. Control thickness by using a pin gauge or other accepted method. Perform a minimum of 2 measurements per 5 square feet of surface with at least 3 measurements per element.
- C. Forming & Molds:
1. Select mold material to provide a finish matching the accepted sample.
 2. Cast elements in molds of rigid construction, accurate in detail with precise corners and arises, and so designed as to provide a close control of dimensions and details as indicated on the accepted Shop Drawings.
 3. Prior to casting of pre-cast elements, fill, grind, file and straighten mold surfaces to provide a finished concrete surface that is smooth, dense and free of honey-combing, air pockets, offsets, sinkages, joint marks and other irregularities.
 4. Form exposed corners to produce square smooth, solid unbroken lines, unless indicated otherwise.
 5. Provide recesses and openings as shown on the accepted Shop Drawings.
 6. After forms have been placed in final position, seal forming members and corner/reveal members. Apply in two coats, wet-on-wet, and according to manufacturer's current directions.
- D. Casting:
1. Cast concrete using methods and equipment that meet requirements of industry standards for this type of Work.
 2. Perform Work at manufacturer's plant only.
 3. Handle concrete to prevent segregation of materials, and vibrate either internally or externally, to achieve proper compaction, finish and distribution of concrete.
 4. Take precautions to keep the reinforcing steel in the proper location during placing and consolidation of the concrete.
 5. Accurately place embedded items and maintain them in their proper location during the casting operation.
- E. Dimensional Tolerances:
1. Height and Width: Plus or minus 1/8 inch.
 2. Thickness: Plus or minus 1/8 inch.
- F. Color:
1. Color to match accepted submittal.
- G. Finish:
1. Polished finish to match accepted submittal.

H. Anti-Graffiti Coating

1. To match accepted submittal.

I. Curing:

1. Meet requirements of industry standards for this type of work.
2. Do not remove elements from the molds until they have reached a compressive strength of 2,000 pounds per square inch.

2.6 LEED REQUIREMENTS:

- A. **IW/PS EPD:** Products specified under this section must have either a Type III Product Specific EPD or the company must be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.

B. Notification of Unsuitable Conditions:

1. Before proceeding with Work, notify Owner and Owner's representative in writing of unsuitable conditions.

3.2 PREPARATION

A. Protection:

1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
2. Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.
3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
4. Submit written notification of damaged plants and structures.

3.3 INSTALLATION

A. Location:

1. Install at locations shown on Drawings.

B. Anchorage:

1. Shim to level and anchor in place as shown on Drawings.

3.4 FIELD QUALITY CONTROL

- A. Field Observation Reviews by Owner's representative:
 - 1. Coordinate and schedule with Owner's representative.

3.5 REPAIRS

- A. Repair exposed exterior surfaces of precast architectural concrete units to match color, texture, and uniformity of surrounding precast architectural concrete if permitted by Architect.
- B. Remove and replace damaged precast architectural concrete units if repairs do not comply with requirements.

3.6 CLEANING

- A. Precast Concrete:
 - 1. Meet requirements of manufacturer's current printed instructions.
 - 2. Clean and keep clean until Final Completion.

3.7 PROTECTION

- A. Barricades and Coverings:
 - 1. Install hazard barricades and 3/4-inch plywood covers to protect Work against damage, defacement and staining during subsequent construction operations until Final Completion.

END OF SECTION

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SECTION 034819

PRECAST CONCRETE STAIR TREADS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Precast Concrete Stair Treads and Risers and Landings at Stair C in the Atrium.
- B. Related Requirements:
 - 1. Section 051213 "Architecturally Exposed Structural Steel" for steel stringers to support Precast Concrete Stair Treads.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Shop Drawings: Show fabrication and installation of the Work. Include the following.
 - 1. Erection drawings shall show dimensions for proper fabrication; reinforcing steel sizes, grades and locations; inserts accessories and handling methods; calculations for reinforcing; details, sections, jointing, anchoring, and all other necessary information.
- C. Architectural Samples:
 - 1. Initial Selection: Furnish manufacturer's complete color selection showing full range of colors and finish characteristics. Furnish the following.
 - a. Work with Architect to match sample.
 - 2. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. 12 inch x 12 inch x 2 inch (304.8 mm x 304.8 mm x 50.8 mm) in range to match Architect's sample.
 - b. Prepare full-size sample of architectural precast concrete tread unit for Architect's inspection at production plant or on site prior to start of installation work, and after Architect review of finish samples.

1.4 INFORMATIONAL SUBMITTALS

- A. Test and Evaluation Reports:
 - 1. Perform all concrete testing in accordance with PCI MNL-116 requirements.

- B. Qualification Statements:
 - 1. Fabricator: Provide data that fabricator is member of Precast Concrete Institute (P.C.I.) and/or participate in its Plant Certification Program.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following.
 - 1. Record documents.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations authorities having jurisdiction. Obtain necessary approvals from all such authorities.
- B. Qualifications:
 - 1. Contractor: Contractor is responsible for quality control of the Work.
 - 2. Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.
 - a. Producer member of Precast Concrete Institute (P.C.I.) and/or participate in its Plant Certification Program.
 - b. Firm which has a minimum of 5 years successful experience in the fabrication of architectural precast concrete units, similar to units required for this project.
 - c. Firm with sufficient production capacity to produce, transport, and deliver required units without causing delay in the work.
 - d. Produce precast concrete units at fabricating plant engaged primarily in manufacturing of similar units.
 - 3. Installer: An installer trained in the use of the materials and equipment to be employed in the Work.
 - a. Precast Prestressed Concrete Institute Qualified Erector.
 - b. Experience: Minimum of 5 years.
 - 4. Welders: Qualify welding processes and welding operators in accordance with the following:
 - a. AWS D1.1 "Structural Welding Code - Steel"
 - b. AWS D1.4 "Structural Welding Code - Reinforcing Steel"
 - c. AWS D1.6 "Structural Welding Code - Stainless steel"
 - d. C5.4, "Recommended Practices for Stud Welding".
 - 5. Delegated Designer: Designer shall engineer Precast Concrete Stair Treads. Designer shall be a registered engineer, licensed in the State of California.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Carefully transport and handle precast concrete stairs to prevent soiling or damage. Store clear of ground in manner to prevent cracking, distortion, warping and to protect from damage and dirt. Soiling or staining of precast units may be cause for rejection of units. Lift and support units only at designated lifting or supporting points as shown on approved shop drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE

A. Design Criteria:

1. General:

- a. Design, engineer, fabricate, and install work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
- b. Provide work to withstand thermal movement, design wind pressure, gravity loads, seismic loads, and movement of building structure without failure. Work to remain free from defects.
- c. Regulations: Conform with the requirements of the applicable Building Code as it pertains to engineering, design, fabrication and installation of system.

2. Codes and Standards: Comply with provisions of following codes, specifications and standards, except as otherwise indicated:

- a. ACI 301 "Specifications for Structural Concrete".
- b. ACI 318 "Building Code Requirements for Structural Concrete".
- c. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
- d. PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products".
- e. Precast Prestressed Concrete Institute MNL 116, Manual for Quality Control for Plants and Production of Precast Concrete Products".
- f. Precast Prestressed Concrete Institute MNL 135, "Tolerance Manual for Precast and Pre-stressed Concrete Construction".
- g. Precast Prestressed Concrete Institute MNL 120, "PCI Design Handbook".

B. Performance Requirements:

1. Interior Locations:

- a. Design Pressure Loading: 5 psf
- b. Seismic Loading: Refer to Structural Drawings.

2. Structural Performance of Stairs: Precast concrete stair treads shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

- a. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
- b. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
- c. Uniform and concentrated loads need not be assumed to act concurrently.
- d. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
- e. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

3. Seismic Performance: Precast Concrete and Metal stairs shall withstand the effects of earthquake motions determined according to California Building Code and ASCE/SEI 7.

- a. See structural drawings for seismic parameters.
- b. Component Importance Factor is 1.5.

2.2 MATERIALS – GENERAL

A. Single Source Responsibility:

1. Obtain each type of work from a single manufacturer.

2. Obtain work from a single fabricator.

2.3 MATERIALS

- A. Stair Treads, Risers, and Platforms for Atrium Stair:
 1. Basis-of-Design Manufacturer: Meridian Precast, Empire Precast, or equal.
 2. Product: Custom tread/riser winder stair profile (bolted to steel stair tabs); integral visual warning strips with sanded epoxy infill.
 3. Factory Finish: Honed finish, exposed aggregate finish.
 4. Portland Cement:
 - a. ASTM C 150, Type I or Type III, grey cement.
 - 1) Use only one brand, type, and source of supply of cement throughout the project, unless otherwise acceptable to Architect.
 5. Aggregate:
 - a. Normal-Weight Aggregates:
 - 1) Fine Aggregates: ASTM C 33, washed natural sand
 - 2) Course Aggregates: Crushed stone conforming to ASTM C 33. Aggregate shall be graded crushed stone with a resulting weight of concrete up to 155 lbs./cu. ft.
 6. Admixtures:
 - a. Air-Entraining Admixture:
 - 1) ASTM C 260.
 - 2) Precast elements exposed to weather or vulnerable to deicers shall have 6% + 1.5% of air entrainment.
 - b. Water Reducing Agent:
 - 1) Conform to ASTM C494 Type A.
 - c. High Range Water Reducing Agent:
 - 1) Conform to ASTM C494 Type A.
 7. Water:
 - a. Potable, clean and free from oils, acids, salts or other injurious substances.
- B. Reinforcing:
 1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
 2. Plain-Steel Welded Wire Reinforcement: ASTM A 185 or A497 fabricated from plain steel wire into flat sheets having a minimum yield strength of 70,000psi.
 3. Plates and Angles: Cast-in loose plates and angles shall conform to ASTM 36.
- C. Grout Materials:
 1. Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 404. Mix at ratio of 1.0 part cement to 3. parts sand, by volume, with minimum water required for placement and hydration.
 2. Nonshrink Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD- C 621.
 - a. Manufacturer: Subject to compliance with requirements, provide one of the following.
 - 1) BASF "Master Builders, Masterflow 713 Plus"
 - 2) Euclid Chemical Co. "Euco N-S Grout"
 - 3) L&M Construction Chemicals, Inc. "Crystex"

2.4 FABRICATION

- A. Casting shall be done in rigidly constructed forms designed to produce dimensionally correct members with uniform surfaces per shop drawings.
- B. At time of casting, manufacturer shall incorporate all accessories, reinforcing steel and handling devices required for proper installation and handling of units.
- C. Provide finished units, which are straight, true to size and shape, and within specified casting tolerances.
- D. Make exposed edges sharp, straight, and square. Make flat surfaces into a true plane.
- E. Place and secure in the forms all anchors, clips, stud bolts, inserts, lifting devices, shear ties, and other devices required for handling and installing the precast units and for attachment of subsequent items indicated and specified.
- F. Curing:
 - 1. Form curing by moisture retention without supplemental heat until concrete reaches adequate strength for removal of product from forms, a minimum of 2,500 psi.
 - 2. Precast units shall be cured to the required 28 day strength prior to shipment.
- G. Casting tolerances: Maintain casting, bowing, warping and dimension tolerances within PCI MNL-116 and PCI MNL-135.
- H. Mixes:
 - 1. General:
 - a. Prepare design mixes for each type of concrete required.
 - b. Use of calcium chloride or admixtures containing chlorides is not permitted.
 - 2. Precast Concrete Stairs and Landings:
 - a. Compressive strength of 5000 psi (34,450 kPa) at 28 days.
 - 3. Architectural Precast Concrete Stairs and Landings.
 - a. Facing Mix: Standard - weight concrete.
 - 1) Compressive Strength: 5000 psi (34,450 kPa) minimum at 28 days.
 - 2) Total Air Content: Not less than 4% nor more than 6%.
 - 3) Water Absorption: Not to exceed 5% to 6% by weight; except between 3% to 4% for sloping surfaces (sills), for improved weathering staining resistance.
 - 4) Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
 - a) Color: Work with Architect to match sample.
 - b. Back-up Mix:
 - 1) Standard-weight concrete with compressive strength of 5000 psi (34,450 kPa) at 28 days.
 - 2) Lightweight concrete with 5000 psi (34,450 kPa) compressive strength at 28 days, and air-dry density not less than 90 nor more than 115 pcf (1842 kg/cu. m).
 - c. Design Mix:
 - 1) Prepared by independent testing facility or by qualified precast manufacturing plant personnel, at precast fabricator's option.
 - d. Proportioning Mix:

- 1) Prepared by either laboratory trial batch or field experience methods, using materials to be employed on the project for each type of concrete required, complying with ACI 318.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine and correct conditions of area to receive the Work prior to installation. Comply with the following requirements.
 1. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance of the Work.
 2. Do not install precast concrete units until supporting, building structural framing has attained minimum allowable design compressive strength or until supporting steel or other structure is complete.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
 1. Work to be performed by a PCI Qualified Erector. Install in accordance with shop drawings and manufacturer's recommended installation procedures.
- B. Handling and Erection:
 1. Temporarily stabilize all precast work until permanent connections and/or adjoining cast-in-place concrete work or masonry has been completed and the framework is stable.
 2. No welding is permitted, to avoid overheating of concrete. Only mechanical fastening during the erection process will be allowed.
- C. Grouting:
 1. After precast units have been placed and secured, grout open spaces at connections and joints between platforms and stairs, and between platforms and floor plank.
 2. Place grout in a manner to finish smooth, plumb, and level with adjacent concrete surfaces.
- D. Patching:
 1. Patch precast units if strength and appearance has not been impaired. Manufacturer of precast units shall point up all chopped areas. Pointed up areas shall have minimum variation in texture and color. Amount of variation shall be acceptable to the Architect.

3.3 CLEANING

- A. At the end of each work day, remove unused materials, debris and containers from the site.

END OF SECTION

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SECTION 035216

LIGHTWEIGHT INSULATING CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Lightweight insulating concrete.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for requirements for normal-weight and structural lightweight concrete, including concrete materials and mixes.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For lightweight insulating concrete.

- 1. Include plans, sections, and details showing roof slopes, thicknesses, and embedded insulation board.
- 2. Indicate locations of penetrations, perimeter terminations and curbs, control and expansion joints, and drains.

- C. Samples for Verification: Submit 12-inch by 12-inch sample of insulation board.

- D. Design Mixtures: For each lightweight insulating concrete mixture.

- E. Approved Applicator Certification: Signed by manufacturer certifying that Contractor is an certified applicator in good standing with the manufacturer and is qualified to perform the specified work and able to receive the required warranties.

F. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For the following:
 1. Cementitious materials.
 2. Lightweight aggregates.
 3. Foaming agents.
 4. Admixtures.
 5. Molded-polystyrene insulation board.
- C. Evaluation Reports: For lightweight insulating concrete, from ICC-ES.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1.7 FIELD CONDITIONS

- A. Do not place lightweight insulating concrete unless ambient temperature is at least 32 deg F and rising.
- B. Do not place lightweight insulating concrete during rain or snow or on surfaces covered with standing water, snow, or ice.

1.8 WARRANTY

- A. Provide a 10-year warranty from the date of substantial completion including the following requirements:
 1. The roof insulation system shall remain in condition suitable for re-roofing should the roof membrane require replacement.

2. The actual resistance to heat flow through the roof insulation system shall be at least 80 percent of design thermal resistance.
3. The roof insulation will remain in place even if the roof membrane sustains wind damage.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency.
 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- B. FM Global Listing: Lightweight insulating concrete along with other roofing components shall comply with requirements in FM Global 4454 as part of a roof assembly, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable.

2.3 MANUFACTURERS

- A. Lightweight Insulating Concrete: Subject to compliance with requirements, provide the following or equal:
 1. Basis-of-Design: Elastizell Corporation, "Elastizell".

2.4 MATERIALS

- A. Insulating Concrete: A slurry of cement, water, and preformed foam mixed and installed to provide the following physical properties.
 1. Cast Density: Range III; 42-48 pcf for a fully adhered roofing membrane.
 2. Minimum compressive strength: 250 psi; ASTM C796.
- B. Expanded Polystyrene (EPS) Insulation Board: One pound density expanded polystyrene board with bond holes equal to 3 percent of the board area. Deliver each bundle of boards to the job site with clear identification as to the manufacturer and shall carry the FM approval label on each bundle.
 1. Insulation board shall conform to ASTM C578, Type 1.
- C. Reinforcement: Keydeck Mesh Style No. 2160-2-1619 as required for fire rated systems over steel deck.
- D. Cementitious Material: Portland cement, ASTM C150/C150M, Type I, II, or III.

- E. Water: Clean, potable, and free from deleterious amount of acid, alkali, and organic material.
- F. Foaming agent: Liquid concentrate shall be manufactured and be delivered to the job site with clear identification as to manufacturer and type of material. Shall comply with ASTM C 869.
- G. Air-Entraining Admixture: ASTM C 869.
- H. Admixtures will not be used unless specifically recommended by the manufacturer.

2.5 DESIGN MIXTURES

- A. Prepare design mixtures for each type and strength of lightweight insulating concrete by laboratory trial batch method or by field-test data method. For trial batch method, use a qualified independent testing agency for preparing and reporting proposed mixture designs.
- B. Mix lightweight concrete in equipment approved by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Control Joints: As required, install control joints at perimeter of roof deck and at junctures with vertical surfaces, including curbs, walls, and vents, for full depth of lightweight insulating concrete. Fill control joints with joint filler.
- B. Surfaces to receive insulating concrete shall be even, smooth, sound, free of loose material, and free from defects that might affect application.
 - 1. Surface shall be bonded firmly and free from loose materials.
- C. Protect adjacent surfaces not scheduled to receive lightweight insulating concrete.
- D. Correct unsatisfactory conditions prior to start of Work.

3.2 MIXING AND PLACING

- A. Mix and place lightweight insulating concrete according to manufacturer's written instructions, using equipment and procedures to avoid segregation of mixture and loss of air content.
- B. Weight of installed lightweight insulating concrete shall not exceed weight approved by Structural Engineer.
- C. Install insulation board according to lightweight insulating concrete manufacturer's written instructions. Place insulation board in wet, lightweight insulating concrete slurry poured a minimum of 1/8 inch over the structural substrate. Ensure full contact of insulation board with slurry. Stagger joints and tightly butt insulation boards. Allow slurry coat to set prior to placing remaining thickness of lightweight insulating concrete.
- D. Deposit and screed lightweight insulating concrete in a continuous operation until an entire panel or section of roof area is completed. Do not vibrate or work mix except for screeding or floating. Place to depths and slopes indicated.

- E. Finish top surface smooth, free of ridges and depressions, and maintain surface in condition to receive subsequent roofing system.
- F. Begin curing operations immediately after placement, and air cure for not less than three days, according to manufacturer's written instructions.
- G. If ambient temperature falls below 32 deg F, protect lightweight insulating concrete from freezing and maintain temperature recommended by manufacturer for 72 hours after placement.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to sample materials and perform tests and inspections.
- B. Testing of samples of lightweight insulating concrete obtained according to ASTM C172/C172M, except as modified by ASTM C495, shall be performed according to the following requirements:
 - 1. Determine as-cast unit weight during each hour of placement, according to ASTM C138/C138M.
 - 2. Determine oven-dry unit weight and compressive strength according to ASTM C495. Make a set of at least six 3-inch by 6- inch cylinder molds for each day's placement, but not less than one set of 4 molds for each 100 cubic yards of roof area.
 - 3. Perform additional tests when test results indicate that as-cast unit weight, oven-dry unit weight, compressive strength, or other requirements have not been met.
 - a. Retest cast-in-place lightweight insulating concrete for oven-dry unit weight and compressive strength.
- C. Monitor the thickness and wet density of the lightweight insulating concrete at the time of placement to determine conformance to the manufacturer's requirements. Monitor the placement of proper thickness of polystyrene insulation board in accordance with the contract documents.
- D. Manufacturer to inspect and accept the lightweight concrete system prior to the roofing membrane application.
- E. Prepare test and inspection reports.

3.4 DEFECTIVE WORK

- A. Refinish, or remove and replace, lightweight insulating concrete if surfaces are excessively scaled or too rough to receive roofing according to roofing membrane manufacturer's written instructions.
- B. Remove and replace lightweight insulating concrete that fails to comply with requirements.

3.5 PROTECTION

- A. Do not expose insulating concrete to prolonged exposure to the elements more than 7 days without prior approval. Do not use as a temporary working surface without adequate surface protection, nor allow it to function as a temporary dry in.

- B. Protect insulating concrete from damage and weather. Repair as required prior to roofing membrane installation.
- C. Prevent traffic on roof deck for 48 hours minimum or longer as applicator allows.

END OF SECTION

SECTION 051200

STRUCTURAL STEEL

PART 1 GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of structural steel and related work, complete, in accordance with the Drawings and as specified herein.

For structural steel related to Seismic Force Resisting Systems

RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Section 013300
Quality Control	Section 014500
Quality Assurance: Structural Testing and Inspection	Section 014505
Sustainable Design Requirements	Section 018113
Concrete Reinforcement and Embedded Assemblies	Section 032000
Cast-In-Place Concrete	Section 033000
Structural Steel – Additional Seismic Requirements	Section 051210
Steel Deck	Section 053000
Miscellaneous Metals	Division 5
Fireproofing	Division 7
Painting	Division 9
Elevators	Division 14

1.3 CODES AND STANDARDS

- A. Building Code: Structural steel work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
 - 1. American Institute of Steel Construction (ANSI/AISC 360) "Specification for Structural Steel Buildings" per Structural General Notes.
 - 2. ANSI/AISC 341 and 341s1- Seismic Provisions for Structural Steel Buildings, Including Supplement No. 1; American Institute of Steel Construction, Inc.
 - a) Item J2.1.1 shall be deleted, and replaced by the requirements of the project Specification

3. American Institute of Steel Construction (AISC 303), "Code of Standard Practice" (COSP). Due to potential conflicts between the governing contracts and parts of Section 1 through 5 of the COSP, Sections 1 through 5 are excluded from these Contract Documents. Prior to bid, the Owner and Contractor, in consultation with the Design Professionals, can discuss and determine if any excluded provisions are appropriate to include in the Contract Documents.
4. American Welding Society, AWS D1.1, "Structural Welding Code".
5. American Welding Society, AWS D1.6, "Structural Welding Code – Stainless Steel"
6. Research Council on Structural Connections (RCSC) - "Specification for Structural Joints Using High Strength Bolts".
7. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
8. The Society for Protective Coatings (formerly Steel Structures Painting Council, "SSPC") "Steel Structures Painting Manual".

C. Definitions:

1. The term "Contract Documents" in this Specification is defined as the design Drawings and the Specifications.
2. The term "SER" in this Specification is defined as the Structural Engineer of Record for the structure in its final condition.
3. The term "Design Professionals" in this Specification is defined as the Owner's Architect and SER.
4. The term "Contractor" in this Specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Structural Steel Fabricator or Structural Steel Erector.
5. The term "Heavy Sections" in this Specification is defined to include hot rolled steel shapes with flanges exceeding 2 inches (50mm) in thickness and built up cross sections with plates exceeding 2 inches (50mm) in total thickness. For members and connections that are part of the Seismic Force Resisting System, see Section 051210.
6. The term "High Restraint Weld" describes welds in which there is almost no freedom of movement for members joined due to geometry or material thickness.
7. The term "Testing Agency" in this Specification is defined as an independent testing and inspection service engaged by the Owner for quality assurance testing and inspection of structural construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
8. The terms "for record" and "submit for record" in this Specification are defined as Contractor submittals that do not require a response from the Design Professionals.
9. The term "Working Days" in this Specification is defined as Monday through Friday, except for federal or state holidays.
10. The term "Delegated Design" in this Specification is defined as a scope of work that meets performance and design criteria established in the Contract Documents and is to be completed by the Contractor's licensed engineer.

1.4 CONTRACTOR QUALIFICATIONS

- A. Qualification Data: Submit for record qualification data (personnel and firm resumes, and project lists with references) for the Structural Steel Fabricator ("Fabricator"), Structural Steel Detailer ("Detailer"), Contractor's Engineer(s) and Structural Steel Erector ("Erector").
- B. The Fabricator shall have 10 years of comparable experience in installations of this type and shall employ labor and supervisory personnel familiar with the type of installation, experienced in fabrication and erection of structural steel for projects of similar size and complexity. At the time of bid the Fabricator shall be AISC certified to the Standard for Steel Building Structures (BU) and must submit proof of these qualifications. The Fabricator's qualifications shall be subject to review by the Design Professionals and Owner.
- C. The Detailer shall have 10 years experience preparing detailed steel shop drawings and CNC downloads for structures of this type and complexity. The detailer's qualifications shall be subject to review by the Design Professionals and Owner. All detailing shall be performed with 3D modeling software, such as TEKLA STRUCTURES, SDS-II or equivalent. Model shall be maintained to be current throughout the construction and in a form useable by the Design Professionals.
- D. The Contractor's Engineer(s) shall be qualified to perform the type of work required by the project. The Engineer shall be a Professional/Structural Engineer licensed in California. The Contractor's Engineer(s) shall have 10 years of experience being in responsible charge of work of this nature. The proposed Engineer(s) shall be subject to approval of Design Professionals and Owner.
- E. The Erector shall have 10 years of successful experience erecting structural steel for structures of this type and complexity in the region of the project. At the time of bid the Erector shall be an AISC Certified Steel Erector (CSE) and must submit documentation of this qualification. At the time of bid the Erector shall be an AISC Advanced Certified Steel Erector (ACSE) and must submit documentation of this qualification.
- F. Welding: Qualify the welding procedures, shop welders, field welders, welding operators and tackers in accordance with AWS D1.1 and for the following periods of effectiveness of certification:
 - 1. Certification and qualification, including period of effectiveness of welding personnel shall be as specified by AWS D1.1. Certification shall remain in effect for duration of work provided welders are continuously engaged in performing the type of welding for which they are certified, unless welders fail to perform acceptable welding, as determined by the Testing Agency. Certification and re-certification of welding personnel is subject to verification by the Testing Agency. Re-testing for re-certification will be the Contractor's responsibility.

1.5 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of structural drawings for shop drawings is not

permitted. Building Information Models for contractor's use may be provided as mutually agreed upon by Design Professionals.

- (1) Submittal Schedule
- (2) Shop Drawings and Erection Drawings
- (3) Submittal Letters
- (4) Pre-construction Survey
- (5) Quality Control Program
- (6) Product Data
- (7) Samples
- (8) Welding Procedures Specification (WPS)
- (9) Welder Certifications
- (10) Mill Reports
- (11) As-built surveys
- (12) LEED Submittals

1. Submittal Schedule: See Section 013300.
2. Shop Drawings and Erection Drawings (including Field Work drawings): Submit for action required shop drawings and erection drawings for all structural steel indicated on the Contract Documents.
 - b) Material shall not be fabricated or delivered before the shop and erection drawings have been approved or approved as noted by the Design Professionals and returned to the Contractor.
 - c) Structural Steel Shop Drawings: Submitted shop drawings shall include layouts and details for each member showing the steel type and grade, size, connections, cuts, copes, holes, bolts, welds, surface treatments (cleaning, shop paint, etc.) and provisions for the connection of other work. Steel type, grade and size for all attached elements shall also be shown.
 - d) Shop and erection drawings shall contain complete dimensional and geometric information, based on established dimensions shown on Contract Documents, and shall not be scaled from Contract Documents. The shop drawings shall clearly distinguish between shop and field welds and bolts, identify pretensioned high strength bolts and identify surface preparation requirements at slip critical connections.
 - e) Welds: All welds shall be indicated by standard welding symbols in the "Standard Code for Arc and Gas Welding in Building Construction" or as accepted by the SER. Shop and erection drawings shall show the size, length, and type of each weld, including the electrode type to be used.
 - f) Bolts: Details for bolt assemblies shall indicate bolt size, length, type and the presence, type and location of washers where required as part of the assembly; distinguish between N and X bolts, distinguish between slip-critical and bearing bolts; specify approved slip critical coatings; and distinguish between shop and field bolts. Also, indicate bolt orientation where required by the Contract Documents.
 - g) Erection Drawings: The erection drawings shall include plans showing exact locations of base and bearing plates, and/or anchor rods and other embedded items. All field connections not specifically shown on shop drawings shall be shown on erection drawings, including field bolt size,

type, number, location and any special installation requirements, and field weld size, type, length and location.

2. Preconstruction Survey: Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals. For all steel construction, before steel erection commences, perform and submit to the Design Professionals a complete survey for position and alignment at all points where construction by other trades will support steel elements, including but not limited to pockets, embedded plates, anchor rods and base plates. Include plan location positions relative to the building gridlines and elevations of bearing surfaces and tops of bolts relative to building Datum elevation. Immediately notify the SER of elements that are not within tolerance.
3. Quality Control Program: Submit for record complete details of the Contractor's quality control program including the names of the personnel responsible for this work.
4. Product Data: Submit for action manufacturers' specifications, test reports and applicable standards for all products listed under Part 2: Products. Standard literature shall be edited to suit job conditions.
5. Samples: Submit for record (2) samples each, (2) of shop painted products and (2) of field touch-up painted products. Samples shall be steel material.
6. Welding Procedures: Submit for record all Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR):
 - a) All Welding Procedures shall be Signed and Sealed by the Contractor's Engineer or Certified Welding Engineer, confirming all essential variables meet design requirements as applicable on the Contract Documents and weld electrode manufacturer's recommendations.
 - b) The Contractor's Engineer or Certified Welding Engineer shall develop all Special Welding Procedures for Heavy Sections and High Restraint Welds. Special Procedures shall be Signed and Sealed by the Contractor's Engineer or Certified Welding Engineer. Use of AWS D1.1, Annex E forms are recommended for Special Procedure submittals.
 - c) For stainless steel welds or bimetallic welds between stainless and carbon steels, Welding Procedures and processes per AWS D1.6 requirements.
7. Welder Certification: Submit for record certification that the welders have passed qualification tests acceptable to the Division of the State Architect (DSA) using AWS procedures.
 - a) A certification shall be submitted in standard AWS format.
 - b) Each certification shall state that the welder has been doing satisfactory welding of the required type within the six-month period prior to the subject work.

For any welder whose period of certification effectiveness has lapsed or whose workmanship is subject to question in the opinion of the Design Professionals or Testing Agency, immediate testing for recertification will be required. Tests, when required, shall be conducted at the sole expense of the Contractor.

8. Mill Reports: Submit for record certified copies of all mill reports to the Design Professionals and to the Testing Agency, covering the chemical and physical properties of all structural steel and accessories (as defined in this Specification) for the project. Where required on the Contract Documents or by the AISC Code, reports shall include results of Charpy V-notch tests.
 - a) Such certificates shall be obtained from the mills producing the steel and shall certify in a cover letter submitted with the certificates, that the steel meets the minimum requirements as to physical properties, inspection, marking and tests for structural steel as defined by the current edition of the relevant ASTM Standard Specifications. Any steel that does not meet the ASTM requirements must be clearly identified in a cover letter submitted with the certificates.
 - b) Prior to commencing steel erection, the contractor shall deliver certificates to the Owner in number and form as may be required by the local Building Department or other local and State agencies having jurisdiction.
9. As-Built Surveys: Execute and submit for record a comprehensive survey of steel structure at each level adequate to assess if the structure has been built within the tolerances specified in the Contract Documents. Each certified survey, performed by a professional surveyor employed by the Contractor, shall be submitted to the Contractor's Engineer for their approval before proceeding to the next stage of erection. If deviations from the tolerances are discovered, the Contractor shall present corrective measures to the Design Professionals within 48 hours of completion of that stage of erection. Upon completion of steel erection, submit the complete package of steel surveys for record to the Design Professionals and the Owner.
10. LEED Submittals
 - a) Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - i. MRc2 - Environmental Product Declarations (EPD):
Provide Industry-Wide or Product-Specific EPD.
 - ii. MRc3 - Sourcing of Raw Materials - Recycled Content:
Provide product data for pre- and post- consumer recycled content.

B. Submittal Process

1. See Section 013300.

C. SER Submittal Review

1. See Section 033000.

D. Substitution Request

1. See Section 012513.
- E. Request for Information (RFI)
1. See Section 033000.

1.6 TEMPORARY SUPPORT OF STRUCTURAL STEEL FRAME

The structure as shown on the Contract Documents is designed to withstand the design loads only when all structural elements are installed and fully connected. The contractor shall be responsible for the analysis of all components and assemblies for stresses and displacements that may be imposed by fabrication, shipping, handling, erection, temporary conditions, construction loads, etc. The analysis of such shall be performed by the Contractor's Engineer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Unload all structural steel promptly upon arrival and store in an area designated and approved by the Owner at the site of the work. The Contractor shall be responsible for any charges from failure to unload material promptly.
- B. Storage: Store structural steel to drain properly. Provide weep holes and clean out as required to keep steel free from water. Provide adequate protection and shoring to prevent distortion and other damage. Store structural steel on timber; do not lay on mud, directly on ground or cinders, or otherwise handle in a manner that damages finishes. Stored sections shall be readily accessible for inspection.
- C. Store fasteners in a protected place.
- D. Welding materials to be in moisture resistant, undamaged package. Maintain packages effectively sealed until electrode is required for use. Storage and handling shall be per AWS D1.1.

1.8 STRUCTURAL STEEL PRE-ERECTION CONFERENCE:

- A. At least twenty (20) working days prior to the commencing of steel erection the Contractor shall hold a meeting to review the detailed requirements of the steel erection.
- B. The Contractor shall prepare an agenda and require responsible representatives of every party who is concerned with the steel erection to attend the conference, including but not limited to the following:
1. General Contractor/Construction Manager
 2. Steel Erector / Steel Fabricator
 3. Erector's Surveyor
 4. Roof Deck Contractor
 5. All Testing and Inspection Agencies
 6. Design Professionals
 7. Owner
 8. Precast or Cladding Contractor as appropriate.

- C. Minutes of the meeting shall be recorded, typed and distributed by the Contractor to all parties listed above within 5 working days of the meeting.
- D. The minutes shall include a detailed outline of the erection procedure including a schedule of milestone dates for surveys and sign-offs on erection stages which represents an agreement reached by all parties involved. It shall also include the surveying program and submission schedule for approval.
- E. Notwithstanding any provision of the Specification, the SER shall not be responsible for and not have charge over any safety programs or precautions at the site of the Project.

1.9 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

- A. See Section 014505.

1.10 QUALITY CONTROL BY CONTRACTOR

- A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.
- B. The Owner's general review during construction and activities of the Testing Agency are undertaken to inform the Owner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.
- C. The Contractor shall immediately notify the Design Professionals of any deficiencies in the work which are departures from the Contract Documents which may occur during construction. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Owner, the Contractor shall correct the deficiency at no cost to the Owner. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in the OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS section of this Specification.

1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

- A. Observations: The Design Professionals will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.
- B. Corrections by Design Professionals: See Part 3 - CORRECTIVE MEASURES section of this Specification.

1.12 PERMITS AND WARRANTY

- A. Permits: See Section 00 72 13. In addition the Contractor shall apply for, procure, renew, maintain, and pay for all permits required by City, State, or other governing authorities,

necessary to execute work under this Contract. Contractor shall furnish copies of all permits to the Owner and Design Professionals.

- B. Warranty: See Section 01 78 36. Comply with General Conditions, agreeing to repair or replace specified materials or work that has failed within the warranty period.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

- A. Structural steel shall conform to the requirements listed on the Structural General Notes.
- B. "Heavy Sections" as defined in this Specification require minimum Charpy impact values per the Structural General Notes, in addition to any other members stated in the Notes.

2.2 SHOP COATINGS

- A. Standard Primer: Rust inhibitive, universal phenolic alkyd metal primer 2-4mls. Color to be determined by Architect. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.
- B. Zinc Rich Primer: SSPC-Paint 20, Type I or Type II, Zinc rich primer utilizing either an organic or inorganic binder with a minimum zinc content of 80 percent by weight in the dry film. The primer shall provide a surface meeting AISC Slip Critical Class B (slip coefficient =0.50 min) requirements. Color to be determined by Architect. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.
- C. Hot Dip Galvanizing: ASTM A123, weight of coating shall average not less than 2.3 oz per square foot, with no individual thickness less than 2.0 oz per square foot.
- D. Galvanizing Repair Paint: ZRC Cold Galvanizing Compound, or other coating complying with SSPC-Paint 20.

2.3 ACCESSORIES

- A. High Strength Bolts: Conform to the provisions of the Research Council on Structural Connections (RCSC) "Specification for Structural Joints Using High-Strength Bolts" except that nuts shall be ASTM A563 Grades DH or DH3 (hardened) for both A325 and A490 bolts. Twist off type bolts (Tension Control bolts) shall additionally conform to ASTM F1852 or ASTM F2280.
- B. All bolts shall be new, and not re-used.
- C. Where A325 galvanized bolts nuts and washers are required, they shall be in accordance with ASTM F2329 and ASTM A153, Class C. Where A588 steel is used, bolts, nuts and washers shall be Type 3.
- D. Direct Tension Indicators: Meet requirements of ASTM F959.

- E. Anchor Rods: Per structural General Notes.
- F. Washers:
1. Round washers shall conform to American Standard B 27.2 type b
 2. Washers in contact with high-strength bolt heads and nuts shall be hardened in accordance with ASTM Standard F436.
 3. Beveled washers shall be square, smooth and sloped so that contact surfaces of the bolt head and nut are parallel.
 4. The diameter of the hole of square beveled washers shall be 1/16 inch (1.5mm) greater than the bolt size for bolts smaller than one inch (25mm), and shall be 1/8 inch (3.0mm) greater than the bolt size for bolts larger than one inch (25mm).
 5. Comply with requirements of RCSC for all washers including thickness, size and hardness, depending on connection details.
- G. Welding Electrodes: Electrodes shall be low hydrogen type and shall have material strength matching characteristics (E70, E80, or E90) as selected from AWS D1.1, Table 3.2. Comply with CVN requirements of the Structural General Notes.
1. Shielded Metal-Arc Welding (SMAW): Welding electrodes for manual SMAW shall have a maximum H4 series level of diffusible hydrogen and conform to the Specification for Carbon Steel Electrodes; AWS A5.1, or the Specification for Low-Alloy Steel Electrodes; AWS A5.5.
 2. Gas Metal-Arc Welding (GMAW): Welding electrodes for semiautomatic GMAW shall have a maximum H4 series level of diffusible hydrogen and conform to the Specification for Carbon Steel Electrodes and Rods; AWS A5.18, or the Specification for Low-Alloy Steel Electrodes and Rods; AWS A5.28
 3. Flux Core-Arc Welding-Gas Shielding (FCAW-G): Welding electrodes for semiautomatic FCAW-G shall have a maximum H8 series level of diffusible hydrogen and conform to the Specification for Low-Alloy Steel Electrodes; AWS A5.29
 4. Flux Core-Arc Welding-Self Shielding (FCAW-S): Welding electrodes for semiautomatic FCAW-S shall have a maximum H16 series level of diffusible hydrogen and conform to the Specification for Carbon Steel Electrodes; AWS A5.20
 5. Submerged-Arc Welding (SAW): Bare electrodes and granular flux used in submerged-arc welding shall conform to F70 or F80 AWS flux classifications of the specification for Carbon Steel Electrodes and Fluxes for submerged-arc Welding, AWS A5.17.
 6. Intermixing of welding processes shall not be permitted unless clearly indicated in Contractor's WPS submission. Contractor shall coordinate and submit for record all shop/field welding procedures, which overlap different welding process fusion zones
 7. Alternate non-prequalified welding processes shall be considered based on Contractor qualifying test result submissions of Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR)
 8. Where Charpy V-Notch values are required on the base metal, an electrode meeting the Charpy V-Notch requirements listed in the Structural General Notes shall be provided.
- H. Headed Studs (shear connectors) shall be per Structural General Notes.

- I. Deformed Bar Anchors shall be as specified in Structural General Notes.
- J. Steel Castings shall conform to ASTM A27, Grade 65-35, medium strength carbon steel.
- K. Grout: Refer to Section 033000.
- L. Post-installed Anchors shall be per Structural General Notes.

2.4 LEED REQUIREMENTS

- A. Products specified under this section must have a Type III Product Specific EPD.

PART 3 EXECUTION

3.1 PREPARATION

- A. Work by Others: Examine all work prepared by others to receive work of this Section and report any defects affecting installation to Design Professionals. Commencement of work will be construed as complete acceptance of preparatory work by others. The Contractor alone shall be responsible for checking the dimensions and coordination of the structural steel work with other trades.
- B. Anchor Rods: At least 20 working days prior to the start of the structural steel erection, the Contractor shall ascertain by accurate survey the existing location, alignment, and elevation of the anchor rods embedded in the concrete by others. The Contractor shall immediately notify the Design Professionals of any discrepancies observed between the Contract Documents and the as-built conditions. Steel erection shall not start until corrective measures, if required, have been performed.

3.2 FABRICATION

- A. Fabricate and assemble structural steel in the shop to the greatest extent possible.
- B. Tolerances:
 - 1. Conform to the tolerances of the AISC "Code of Standard Practice," compensate for the difference between the temperature at time of fabrication and the mean temperature in service.
 - 2. Elevator shafts used for temporary hoists shall conform to the detailed requirements of the hoist manufacturer.
- C. Holes: Holes shall be provided in members to permit connections to the work of other trades or contracts, and for passage through the member of work of other trades. All holes shall be accurately drilled, cut, or punched at right angles to the surface of the metal in accordance with AISC Specifications. Thermally cut or water jet cut holes made with CNC equipment and that meet the requirements per both AISC and RCSC specifications are permitted. Thermally cut or water jet cut holes shall meet the surface roughness requirements of ASME B46.1. Burning or drifting unfair holes will not be permitted. Holes that must be enlarged shall be reamed. Drift pins will be allowed only to bring together the several parts for connection. Holes in base plates are permitted to be drilled or thermally

cut. Thermally cut holes in base plates shall meet the requirements of the AISC specification section M2.2. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting from drilling operations shall be removed with a suitable tool.

- D. Camber: Provide camber as indicated on the Contract Documents. Where no camber is indicated, provide natural camber up.
- E. Cutting: Manual gas-cutting in the shop may be used only if automatic or semi-automatic methods are not possible. If manual shop cutting is required, it shall be done only with a mechanically guided torch, except that an unguided torch may be used where the cut is more than 1/2 inch (12mm) from the finished dimension and final removal is completed by means such as chipping or grinding to produce a gouge-free surface of quality equal to that of the base metal. At restrained joints and as indicated elsewhere, weld access holes shall be ground smooth.
- F. Cutting of Heavy Sections: Where Heavy Sections are to be joined by partial or complete joint penetration welds in tension, preheating shall be required for all thermal cutting operations. Preheat shall be sufficient to prevent cracking but in no case less than 150 degrees F (65°C). Weld access holes and copes shall be ground to a smooth radius after cutting and tested for cracks by the magnetic particle method. All cut edges shall be free of sharp notches and gouges.
- G. Anchor Rods: Rigid steel templates and anchor rods shall be furnished, labeled and shipped in sets indicating sizes and locations of columns, together with instructions for setting of anchor rods. Plate washers per Typical Details shall be provided.
- H. Bolting: Bolts shall be driven accurately into the holes without damaging the threads. Bolt heads shall be protected from damage during driving. Bolt heads and nuts shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, beveled washers shall be provided to give full bearing under the head or nut.
- I. Bolts indicated as "finger tight" on the Contract Documents shall be prevented from backing off by using lock nuts, thread compound or deformed threads.
- J. Installation of High Strength Bolts:
 - 1. Except where "snug tight" installation is specifically permitted on design Drawings, all high strength bolts shall be installed with full pretension using Turn-of-Nut Pretensioning, Twist-Off Type Tension Control Bolt Pretensioning or Direct-Tension-Indicator (DTI) Pretensioning in accordance with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
 - 2. Comply with special washer requirements of the RCSC, such as those related to slotted and oversize holes, and tapered flanges. DTI "washers" shall not be substituted for such required washers.
 - 3. All high strength bolt assemblies (including Tension Control bolts and DTI's) used in pretensioned connections shall be verified in accordance with the Pre-Installation Verification section of the RCSC.
 - 4. Clean and re-lubricate bolts and nuts that become dry or rusty before use, except Tension Control bolts must be re-lubricated by manufacturer.
- K. Welding of Structural Steel:

1. Pre-Weld Inspection: The surface to be welded and the filler material to be used shall be subject to inspection before welding is performed.
2. Welds indicated on the Contract Documents or the approved shop or erection drawings shall be created by electric arc welding processes that comply in all respects with the codes and specifications herein noted covering the design, fabrication, and inspection of welded structures and the qualifications of welders and supervisors. Control the heat input, weld length, weld sequence and cooling process to prevent distortion of the completed assembly.
3. Each welder's work shall be traceable.
4. Special Requirements: For High Restraint welds and welds at Heavy Sections, follow approved welding procedures for weld process, sequence, pre-heating and cooling. Use stress relieving techniques where shown in the approved procedure developed by the Contractor's Welding Consultant.
 - a) Special Procedures: Prior to the start of production welding, the contractor shall demonstrate to the Testing Agency that preheat can be maintained without relying on heat from the arc. For field welding, the contractor shall provide a shelter to protect each joint from inclement weather (rain, snow, etc.), from start until completion of the joint.
 - b) Preheat and Postheat: Preheat shall be sufficient to prevent cracking, but in no case less than required by AWS D1.1. The Contractor shall prepare a written welding sequence and distortion control plan to be included in the welding procedures submittal. Assembly sequence of adjoining parts shall balance applied induced heat from preheat and welding processes to minimize distortion and shrinkage. Complex Assemblies shall include special considerations to minimize significant shrinkage stress restraint in accordance with AWS D1.1, Annex H provisions. Under conditions of severe external shrinkage restraint, preheat temperature limitations for making welds shall be in accordance with AWS D1.1, Annex H, Table H2. Under conditions of severe external restraint, reduction of induced heat and cooling rate shall be monitored under the provisions of the Hydrogen Control/HAZ Hardness Control methods of AWS D1.1, Annex H. The preheat shall be maintained throughout the thickness of the material for a distance equal to twice the material thickness on both sides of the joint at a minimum. Where different thicknesses of steel are being joined, the greater thickness shall govern. Preheat shall be measured on the face opposite the side of the heat application. Preheat shall be applied uniformly in a manner that does not harm the surface of the material nor cause surface temperatures to exceed 1100 degrees F (600°C). Should stress relief heat treatment be required, the contractor shall submit a written procedure.
 - c) Prior to heat treatment on a production weld, prepare and treat a test sample per the Contractor's written procedure for tensile and Charpy V-notch tests in accordance with ASTM requirements.
5. Welded Joint Details:
 - a) Welding Backing: The use of weld backing shall be in accordance with AWS D1.1. Weld backing shall be removed where required by the Contract Documents or for the WPS by AWS D1.1.
 - b) Weld Tabs:

- i. Use of Weld Tabs: Welds shall be terminated at the end of a joint in a manner that will ensure sound welds in accordance with AWS D1.1. Whenever necessary, this shall be done by use of weld tabs.
 - ii. Heavy Section Joint Weld Tab Removal and Finish: All welded tension splices in Heavy Sections shall have the weld tabs removed and ground smooth.
 - c) Weld Access Holes:
 - i. Weld access holes shall meet the dimensional, surface finish, and testing requirements of AISC 360 Chapter J1.6 and AWS D1.1, except as otherwise required by the Contract Documents.
 - ii. For additional weld access hole requirements at Seismic Lateral Force Resisting systems, see Section 051210.
 - d) Welding for moment connections shall be sequenced so as to minimize residual stress in the joint.
 - 6. Deficient Welds: Welds found deficient in dimensions but not in quality may be enlarged by additional welding. Any weld found deficient in quality shall be removed by grinding or melting and the weld shall be remade.
- L. Bearing:
- 1. Bearing ends of columns shall be milled or sawn square perpendicular to axis of the column, or at slope indicated in the Contract Documents.
 - 2. Finish bearing areas of base plates per AISC M2.8.
- M. Stiffeners: Fitted stiffeners shall be ground to fit closely against flanges.
- N. Cleaning and Preparation of Steel Surfaces:
- 1. Clean all steel work in accordance with the Society for Protective Coatings (SSPC) Method specified herein that corresponds to its location and exposure. Steel work to be painted shall be painted within the same day that it is cleaned.
 - a) Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): SSPC-SP-2, Hand Tool Cleaning.
 - b) Interior, Exposed in the Finished Building: SSPC-SP-6, Commercial Blast Cleaning, unless noted otherwise on the Drawings.
 - c) Exterior (exposed to weather or in unconditioned space): SSPC-SP-6, Commercial Blast Cleaning, unless noted otherwise on the Drawings.
 - d) Members to be Hot Dipped Galvanized: SSPC-SP3, Power Tool Cleaning, before galvanizing.
- O. Shop Coating:
- 1. Where painting is specified, paint all steel work in accordance with the Society for Protective Coatings (SSPC) Method specified herein that corresponds to its

location and exposure and in accordance with manufacturer's written instructions. Paint steel work the same day that it is cleaned.

- a) Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): No Paint.
 - b) Interior, Exposed in the Finished Building: SSPC – Paint 25
 - c) Exterior (exposed to weather or in unconditioned space): SSPC – Paint 20
2. Protect finished bearing surfaces with a rust-inhibiting coating which is to be removed immediately prior to erection.
 3. Do not paint:
 - a) Surfaces within six (6) inches (150mm) of field welds
 - b) Surfaces to be encased in concrete or to receive cementitious fireproofing
 - c) Contact surfaces of high-strength bolted Slip Critical connections (unless surface prep and paint has been specifically prequalified by the contractor or approved for use in this location by the SER)
 - d) Surfaces required for testing and preheat, until all testing and preheat has been performed
 - e) Finished bearing surfaces (use removable rust-inhibiting coating)
 - f) Top flange of the beam where steel deck or headed studs are to be attached
 4. Paint shall be applied thoroughly and evenly to dry surfaces only when surface temperatures are above dew-point, in strict accordance with manufacturer's instructions.
 5. Surfaces of exterior members which are inaccessible after assembly or erection shall receive their second coat of the approved paint, in a different shade, in the shop.
 6. Hot-dip galvanize the following steel members:
 - a) All angles, steel plates and shims supporting exterior masonry or exposed to the weather, including shelf, arch and relieving angles
 - b) All connections between the above angles and steel plates and the supporting structural member, including clip angles and hardware
 - c) Any other steel members indicated as "Galvanized" on the Contract Documents.
 - d) All miscellaneous metal, angles, clips, etc. on exterior masonry walls.

3.3 ERECTION

- A. Tolerances: Erect all work plumb, square and true to lines and levels in strict accordance with the structural requirements of the building within tolerances of the AISC Code of Standard Practice, unless otherwise indicated on the Contract Documents. Compensate for the difference between the temperature at time of erection and the mean temperature in service.

- B. Bracing: Brace the frame during erection in accordance with the Contractor's erection procedure.
- C. Errors: Immediately notify the Design Professionals of any errors in shop fabrication, deformations resulting from handling and transportation, and improper erection that affects the assembly and fitting of parts. Prepare details for corrective work and obtain approval of the method of correction. Approved corrections shall be made expeditiously at the sole expense of the Contractor.
- D. Column Base Plates: Support and align on steel shims or setting bolts. After the supported members have been plumbed and properly positioned, tighten anchor rod nuts in preparation for grouting. Cut off wedges and shims flush with edges of plates and leave in place. The use of leveling plates will not be permitted without prior written approval by the SER. Contractor proposing the use of levelling plates shall provide documentation of plumbing procedure and remediation procedure for gaps between leveling plate and column base plate for SER review.
- E. Grouting: Refer to General Notes. Grout base plates immediately after the first tier of columns are plumbed. Do not proceed with steel erection above the first tier until base plates are grouted.
- F. Bolting and Welding of Structural Steel: See Section on "Fabrication".
- G. Bearing Surface: Clean bearing surfaces and surfaces that will be in permanent contact before the members are assembled.
- H. Splices: Splices will be permitted only where indicated on the Contract Drawings or the reviewed shop drawings. Fasten splices of compression members only after surfaces are cleaned and abutting surfaces have been brought completely into contact. Fill any remaining gaps with steel shims driven into place and cut flush. Tack weld shims to each other and to members. Use runoff tabs at bevel weld splices. Cut off runoff tabs and ground smooth after weld completion.
- I. Driftpins: Driftpins may be used only to bring together the several parts, and shall not be used in such a manner as to distort or damage the metal. Correct poor matching of holes by drilling to the next larger size and using a larger size bolt. Plug welding and redrilling will not be permitted, unless a specific instance arises and is approved by the SER.
- J. Erection bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces. On non-exposed welded construction, remove erection bolts.
- K. Hammering: Hammering which may damage or distort the members will not be permitted.
- L. Do not use cutting torches in the field without the specific approval of the SER for each application. Where cutting torch use is permitted, all the requirements of the Section on "Fabrication" shall apply.
- M. Additional Material and Labor: If the Contractor furnishes additional material and labor for the purpose of erection or if the erection method requires that material be added to certain members, the required modifications shall be at the sole expense of the Contractor.

- N. Alignment: Following erection, accurately align, level, and adjust all members prior to final fastening. Conform to AISC standard tolerances unless otherwise noted in the Contract Documents.
- O. Touch-Up and Field Applied Paint: After erection, clean all damaged areas in the shop coat, exposed surfaces of bolts, bolt heads, nuts and washers and all field welds and unpainted areas adjacent to field welds according to manufacturer's recommendations and paint with the same paint used for the shop coat. Match the touch up and field applied paint color to the as-built paint color. After touch up, at exterior (exposed to the weather or in unconditioned space) steel members apply a full coat of the specified paint in a different shade than the shop applied coat.
- P. After erection, clean all damaged galvanized areas, welds and areas adjacent to welds and paint with the specified galvanizing repair paint.
- Q. Clean all steel members of mud and debris and construction residue prior to erection.
- R. Headed Studs and Deformed Bar Anchors:
 - 1. End weld headed studs and deformed bar anchors with an automatic process in accordance with section 7 of AWS D1.1.
 - 2. Areas to which studs are to be attached must be free of foreign material, such as rust, oil, grease, paint etc. When mill scale is sufficiently thick to cause difficulty in obtaining proper welds, remove by grinding or sand blasting.
 - 3. Remove ceramic ferrules from studs and work after welding.
 - 4. Replace any studs that crack or break. Only straighten studs that would foul other work or have less than 1 inch (25mm) cover in bent position.

3.4 CORRECTIVE MEASURES

- A. Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and erection of structural steel, and steel deck.
- B. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents either developing corrective actions or reviewing corrective actions developed by others, the Contractor is responsible for paying for additional work performed by the Design Professionals at their standard firm-wide billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

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Structural Substitution Request Form – to be completed by Contractor

Project:		Substitution Request #
Date:		
Requesting Contractor:		Pages Attached (including this form)

1. Description of Requested Substitution:

2. Related Drawings and Specification Sections:

3. Rationale or Benefit Anticipated:

4. Effect on Construction Schedule¹ (check one): NONE See Attached

5. Effect on Owner's Cost² attach data (check one): CREDIT TO OWNER EXTRA

6. Effect on Construction Documents³ (design work anticipated): NONE See Attached

7. Requesting Contractor Agrees to Pay for Design Changes (check): YES NO NOT APPLICABLE

8. Effect on Other Trades⁴:

9. Effect of Substitution on Manufacturer's Warranty (check): NONE See Attachment
Signature⁵: _____ Date: _____

Company:

General Contractor Signature⁵: _____ Date: _____

Notes:

- Contractor is responsible for means and methods and any problems that may arise from making the requested substitution.
- This is **NOT A CHANGE ORDER FORM**. A separate form is required to adjust costs and/or schedules.
- Contractor is responsible for any design impacts that may arise from this substitution, including redesign efforts.
- Contractor is responsible for effects on other trades from this substitution;
General Contractor must review and agree effects on other trades are fairly represented in items 4-9.
- Signature by a person having authority to legally bind his/her company to the above terms. Otherwise this request is void
- All items in form must be completed for substitution request to be considered.

Request Review Responses (completed by Architect and/or Engineer(s)):

ACCEPT ED	ACCEPT ED AS NOTED	REJECT ED	INSUFFICIENT DATA TO SUPPORT REQUEST	ENGINEER / ARCH / MEP SIGNATURE	DATE
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Engineer/Architect Comments:

END OF SECTION 051200

SECTION 051210

STRUCTURAL STEEL: ADDITIONAL SEISMIC REQUIREMENTS

PART 1 GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of structural steel, noted as part of Seismic Force-Resisting System (SFRS) on the Drawings.

- A. Provisions included herein apply to all members and connections denoted as "SFRS" in the contract documents.
- B. Provisions included herein are supplementary to the requirements of Section 051200.
- C. Where provisions included herein conflict with the requirements of Section 051200, the provisions of this section shall govern.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Section 013300
Quality Control	Section 014500
Quality Assurance: Structural Testing and Inspection	Section 014505
Structural Steel	Section 051200

1.4 CODES AND STANDARDS

- A. Building Code: Structural steel work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
 - 1. See Section 051200.
 - 2. American Institute of Steel Construction (ANSI/AISC 341) "Seismic Provisions for Structural Steel Buildings"
 - 3. American Institute of Steel Construction (ANSI/AISC 358 and 358s1) "Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications"
 - 4. American Welding Society, AWS D1.8, "Seismic Welding Supplement"
- C. Definitions:

1. The term "Demand Critical Welds" in this Specification is defined as welds noted as Demand Critical Weld in the Contract Documents. All Demand Critical Welds are part of the Seismic Force-Resisting System.
2. The term "Extra Smooth" in this Specification is defined as a finish with surface variation of 500 micro-inches or less (AWS C4.1, Sample #4).
3. The term "Protected Zone" in this Specification is defined as structural members, or portions thereof, to which connections of structural and non-structural elements are limited. The Protected Zone is designated on the Drawings.
4. The term "Heavy Sections" in this Specification is defined as rolled and built-up sections as defined below. This definition applies to all work related to members and connections of the Seismic Force-Resisting System.
 - a) Hot rolled shapes with flanges thicker than 1 ½".
 - b) Welded built-up members with plates exceeding 2" in thickness.
 - c) Column base plates exceeding 2" in thickness.
5. The term "Seismic Force-Resisting System" (SFRS) is defined as all items designated "SFRS" on the Drawings, including columns, beams, and braces, and their connections along grid lines denoted "SFRS" on the framing plans.

1.5 CONTRACTOR QUALIFICATIONS

- A. Welder Qualifications: Welders, welding operators, and tackers shall be qualified in accordance with AWS D1.8.
 1. See Section 051200.
 2. Supplemental Welding Personnel Testing: Welders and welding operators performing work on bottom-flange Demand Critical Welds shall pass the Supplemental Welder Qualification Testing, as required by AWS D1.8, Section 5.1. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.6 SUBMITTALS

- A. Required Submittals – Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

- (1) Shop and Erection Drawings
- (2) Welding Procedure Specifications (WPSs)
- (3) Welding Performance Qualifications (WPQRs)
- (4) Seismic Prequalified Connections

Shop and Erection Drawings: In addition to the requirements of section 051200, the detailed shop and erection drawings for structural steel and connections that are part of the SFRS shall show:

- a) Identification of members and connections of the Seismic Force-Resisting System.
- b) Location and dimensions of the Protected Zone.

- c) Identification of which welds are part of the SFRS.
 - d) Identification of Demand Critical Welds.
 - e) Additional items as required by AISC 341, Section I1.
 - f) Shop drawings shall include connection details drawn to scale for members of the Seismic Force-Resisting System.
2. Welding Procedure Specifications (WPSs): In addition to the requirements of section 051200, Welding Procedure Specifications (WPSs) shall conform to the requirements of AWS D1.8.
- a) Explicitly note which WPSs will be used for welding of members and connections of the SFRS and Demand Critical Welds.
 - b) Provide calculations and supplemental information needed to validate that the heat input on the WPSs for Demand Critical Welds are within the qualified heat input envelope.
3. Welding Performance Qualification Records (WPQRs): In addition to the requirements of section 051200, submit documentation that the welder has passed all designated supplemental welder qualification testing required for the types of welding to be performed. Submit documentation showing that the welder continued to use the applicable welding process on an ongoing basis since the WPQR test was conducted, in accordance with AWS D1.8.
4. Seismic Prequalified Connections: For all prequalified connections not fully designed on Drawings used in the Seismic Force-Resisting System, submit for record as per ANSI/AISC 341 Chapter K, including the following:
- a) General description including drawings showing key features and components.
 - b) Description of expected elastic and inelastic behavior.
 - c) Listing of systems for which connection is prequalified.
 - d) Listing of limits for all prequalification variables.
 - e) Listing Demand Critical Welds.
 - f) Definition of the Protected Zone.
 - g) Detailed connection design procedure.
 - h) List of references, test reports and other documents used as basis for prequalification.
 - i) Summary of quality control and quality assurance procedures.
- B. Submittal Process: See Section 013300.
- C. SER Submittal Review: See Section 033300.
- D. Substitution Request: See Section 012513.
- E. Request for Information (RFI): See Section 033000.

1.07 DELIVERY, STORAGE AND HANDLING

- A. See Section 051200.

- B. Electrode Storage and Exposure Limits for Demand Critical Welds: The exposure time limit for electrodes shall be in conformance with AWS D1.8 Section 6.4.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. See Section 051200.
- B. Steel Shapes, Plates, Tube, Pipe, and other sections
 - 1. Steel using complete joint penetration groove welds that fuse through the thickness of the flange or web that is part of the SFRS shall have a minimum Charpy V-notch impact testing value of 20 ft-lbs at 70 degrees Fahrenheit.
 - 2. Heavy Sections in the Seismic Force-Resisting System shall be supplied with Charpy V-notch (CVN) testing in accordance with AISC 341 requirements.
- C. High Strength Bolts, Nuts, and Washers:
 - 1. Bolted joints in the Seismic Force-Resisting System shall be pre-tensioned high-strength bolts and a Class A faying surface or better.
- D. Welding materials:
 - 1. Weld electrodes shall meet the requirements of AWS D1.8.

PART 3 EXECUTION

3.1 FABRICATION

- A. See Section 051200.
- B. General Requirements:
 - 1. Holes and attachments to structural steel in areas designated as the Protected Zone are not allowed except as explicitly shown or noted on structural drawings.
- C. Bolted Joints:
 - 1. Seismic Force-Resisting System joints shall be pre-tensioned and faying surfaces shall be Class A or better in accordance with AISC 341 requirements.
- D. Welded Construction: (shop and field)
 - 1. Weld in accordance with AWS D1.8.
 - 2. Welded Joint Details:
 - a) Weld Backing: The use of weld backing shall be in accordance with AWS D1.1. Weld backing shall be removed where required by the Contract Documents or for the WPS by AWS D1.1.

- i. Connections of the SFRS in which backing is not removed: backing shall be attached to the member or plate that does not have its surface prepared for the groove weld. Attachment shall be by either a 5/16" fillet or 3/16" groove weld along the complete bar length on the side of the bar opposite the groove weld.
 - ii. Beam-Column Connection Joints Requiring Removal of Weld Backing: Conform with AWS D1.8. Perform MT on the fillet weld and the immediately adjacent area.
- b) SFRS Beam-Column Connection Weld Tab Removal and Finish:
- i. Weld tabs of SFRS connections shall be removed where required by contract documents. Removal shall conform to AWS D1.8.
 - ii. Gouges deeper than 1/16" at locations of removal of weld tabs shall be repaired by welding according to the requirements of Section 051200 for Repair of Gouges - Deep Gouges. Weld filler metal requirements for Seismic Force-Resisting System Demand Critical Weld apply. The contour of the weld at the ends shall provide a smooth transition, free of gouges and sharp corners. A minimum radius at the corner need not be provided.
 - iii. Following weld tab removal, finishing, and completion of any necessary repairs, the exposed ends of the weld shall be inspected using Magnetic Particle testing (MT) or Penetrant Testing (PT).
- c) Weld access holes:
- i. The weld access hole shall conform to AWS D1.8 Section 6.10.1.2 unless the section is a Heavy Section.
 - ii. SFRS weld access holes shall be inspected using magnetic particle testing (MT) or liquid penetrant testing (PT) and shall be free of cracks. If a welded gouge repair has been performed, magnetic particle testing (MT) shall be performed.
- d) Web weld details: A minimum clear distance of 1/2" shall be provided between the weld access hole and fillet welds connecting the shear plate and beam web.
- e) Weave passes are not permitted in groove welds in the SFRS.
- f) Column continuity plate details:
- i. If weld backing are used and remain in place, they shall receive a reinforcing fillet weld between the backing bar and column flange. No fillet weld should be placed between backing bar and continuity plate.
 - ii. Weld terminations near the end of the column flange tips may be completed using weld tabs. Weld tabs shall be removed. Conform to AWS D1.8. Following finishing, the edge shall be inspected using MT. Fillet weld terminations between the continuity plate and column web shall be approximately 1/4" from each end of the joint

- g) Tack welds in the SFRS Protected Zone are permitted only if they are incorporated into a required weld, in accordance with AWS D1.8.
 - h) Heavy Section Joint Weld Tab Removal and Finish: All welded tension splices in Heavy Sections, shall have the weld tabs removed and ground Smooth.
- E. [Reduced Beam Sections (RBS):
 - 1. Conform to AISC 358 Section 5.7.
 - 2. RBS Cut Tolerances: The length of the cut shall be within plus or minus 15% of the specified length. RBS width shall be as measured after the repair of Gouges.
 - 3. Gouges that occur in the RBS cut shall be repaired. Weld filler metal requirements for Demand Critical Welds apply. The transitional slope of any area where gouges have been removed shall not exceed 1:10. MT testing of repaired area is required. Gouges ½" or more in depth shall be cause for rejection of the beam.]
- F. Repair of Discontinuities in Protected Zone of Seismic Force-Resisting System.
 - 1. Repair of Discontinuities: If erection aids within the Protected Zone cannot be avoided, the Design Professionals' approval of the aid's placement, use, and the repair method is required. Conform to AWS D1.8.
 - 2. Air Carbon Arc Cutting and Thermal Cutting: Air carbon arc cutting (CAC-A) and thermal cutting is permitted in the Protected Zone with the prior approval of the Design Professionals for the removal of weld backing and weld tabs, as specified in these documents.
 - 3. Gouges in members and connections in the Seismic Force-Resisting System shall be repaired according to the requirements of this Specification. Weld filler metal requirements for the Seismic Force-Resisting System apply, unless otherwise noted.
- G. Repair of Gouges: Gouges are not permitted in areas requiring a Smooth finish surface, or where specifically prohibited by AWS D1.8 or this Specification. Repair of gouges shall meet the requirements of Section 051200, Section titled "Repair of Gouges".

3.2 ERECTION

- A. See Section 051200.
- B. Requirements for bolted and welded joints specified in Part 2 of this Specification shall also apply to field connections unless otherwise noted.
- C. Attachments to structural steel in the Protected Zone, other than spot welding of metal deck to beams, are not allowed.

END OF SECTION 051210

SECTION 051213

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work of this Section Includes:

1. Stair stringers to support Precast Concrete Stair Treads.
2. HSS baguette screen at exterior - West and East facades.
3. Exposed Steel Columns.

- B. Work Specified Elsewhere:

1. Section 079200 "Joint Sealants".
2. Section 088000 "Glazing".
3. Section 099600 "High Performance Coatings."

1.3 REFERENCES

- A. General: Comply with the applicable provisions of the referenced standards except as modified by governing codes and the Contract Documents. Where a recommendation occurs in the referenced standards, it shall be considered mandatory. In the event of conflict, the more stringent standard or requirement shall govern.
 1. American Institute of Steel Construction (AISC): "Section 10, Architecturally Exposed Structural Steel, Code of Standard Practice for Steel Buildings and Bridges".
 2. The Society for Protective Coatings (SSPC): "Steel Structures Painting Manual, Volume 2, Systems and Specifications".

1.4 SUBMITTALS

- A. Product Data: Submit for Architect's action. Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating specified requirements. Submit product information for High Performance Coatings specified in Section 09 96 00, in conjunction with this submittal.
- C. Shop Drawings: Submit for Architect's action. Submit shop drawings in conjunction with Section 051200 "Structural Steel".
- D. Certifications: Submit for Architect's information. Furnish certified test reports for the following:
 1. Welding: Furnish welding certificates and details of welding procedures, including tack and sealing welds. Procedures and sequences shall minimize the effect of weld shrinkage and residual stresses.
- E. Quality Assurance/Quality Control Submittals: Submit for Architect's information.

1. Document Review Certificates: Submit a written statement signed by the Contractor and the Applicator stating that the Contract Documents, shop drawings and product data have been reviewed with qualified manufacturer representatives. The statement shall certify that selected materials are proper, compatible with contiguous materials and adequate for the application shown.
- B. LEED Submittals:
 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.5 QUALITY ASSURANCE

- A. Qualified Installer: Installer to have 5 years experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.
- B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.
- C. Pre-Installation Meetings: Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include the Owner, Architect, Architect's consultants, Contractor, and subcontractors whose work is relevant to this Specification Section.
- D. First In-Place Review: Construct full-sized, first-in place, steel channel fascia, steel tube framing, angles and other AESS elements to demonstrate aesthetic effects and to set quality standards for materials and execution of the AESS assemblies.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver and store materials in a dry location, protected against corrosion or deterioration.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. PS EPD: Products specified under this section shall have a Type III Product Specific EPD.

2.2 AESS TYPES

- A. Comply with "Section 10, Architecturally Exposed Structural Steel". Handle members with special care. Typical: provide AESS 3, as defined below.
 - a. AESS 1: Basic Elements
 - 1) Surface Preparation to SSPC-SP 6 "Commercial Blast Cleaning."
 - 2) Sharp edges ground smooth

- 3) Continuous weld appearance
- 4) Standard structural bolts
- 5) Weld spatters removed
- b. AESS 2: Feature Elements – Not in Close View (view distance > 20 ft.)
 - 1) Provide characteristics of AESS 1, along with the following (the most stringent governing).
 - 2) Visual samples for review by Architect
 - 3) One-half standard fabrication tolerances
 - 4) Fabrication marks not apparent
 - 5) Welds uniform and smooth
- c. AESS 3: Feature Elements – in Close View (view distance < 20 ft.)
 - 1) Provide characteristics of AESS 1 and AESS 2, along with the following (the most stringent governing).
 - 2) Mill marks removed
 - 3) Butt and plug welds ground smooth and filled
 - 4) HSS weld seams oriented per Contract Documents
 - 5) Cross sectional abutting surface aligned
 - 6) Joint gap tolerances minimized
 - 7) All welded connections
- d. AESS 4: Showcase Elements – Not Used.
 - 1) Provide characteristics of AESS 1, AESS 2, and AESS 3, along with the following (the most stringent governing).
 - 2) HSS seam not apparent
 - 3) Welds contoured and blended
 - 4) Surfaces filled and sanded
 - 5) Weld show-through minimized

2.3 MATERIAL

- A. General: This section applies to steel noted as AESS or Architecturally Exposed Structural Steel. Comply with more stringent requirements of Section 051200 “Structural Steel” and References, except as follows.
- B. Quality: Smooth, clean, free from surface defects, handling marks, die or roller marks, mill scale, rust, cracks, and slag inclusions.
- C. Cleaning:
 1. Exterior Steel: Near-white blast cleaning, SSPC SP-10. Use dry blast cleaning as necessary to obtain very thorough near-white cleaning and surface condition SP-10 described in SSPC Vis-1.
 2. Interior Steel: Commercial blast cleaning, SSPC SP-6.
- D. Filler: Solvent-resistant, 2-component metal and epoxy compound for repair of steel. The following or equal:
 1. “Plastic Steel Epoxy” (Devcon Corp.)
- E. Finish Coatings: As specified in Section 099600 “High Performance Coatings”.

2.4 FABRICATION

- A. General: Comply with more stringent requirements of Section 051200 “Structural Steel” and Reference Standards, except as follows.
- B. Connections: Fabricate shear plates and beam flanges and webs at connections as shown.

- C. Bolts: Type indicated.
- D. Welds: Grind and polish every weld smooth. Weld surface to be uniform with adjacent metal. Completely remove back-up bars, weld spatter, and run-off tabs where exposed to view. Fill web cutouts at backup bars. Weld show-through is not acceptable.
- E. Marks: Manufacturer's names and marks are not permitted on exposed surfaces. Do not apply erection marks to exposed surfaces.
- F. Fabricate steel plate, angles, channels, tubing and other shapes to form steel framing, and support posts of profiles and sizes as indicated on Drawings for AESS items, including, but not limited to, the following:
 - 1. Steel angles, channels and tube steel framing for entry canopy.
 - 2. Steel channel fascia on exterior wall.
 - 3. Steel tube framing to support storefront system.
 - 4. Steel plate closures at openings in existing brick wall.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Before starting work, examine adjoining work on which execution is in any way dependent for workmanship and fit. Give written notification of any existing deficiencies detrimental to proper and timely installation of work under this Section. Do not proceed until conditions are satisfactory.

3.2 ERECTION

- A. General: Provide in accordance with AISC Code "Section 10, Architecturally Exposed Structural Steel", except as otherwise specified.

3.3 CONNECTIONS

- A. General: As specified under Section 051200 "Structural Steel", except as modified under Paragraph Fabrication of this Section.
- B. Bolts: Orient heads in same direction.

3.4 FIELD QUALITY CONTROL

- A. General: As specified under Section 051200 "Structural Steel".

END OF SECTION

SECTION 053000

STEEL DECK

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to the requirements of Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the installation of composite and non-composite structural steel floor deck systems, steel roof deck systems and related work with all attachments, flashings, metal closures, concrete stops, accessories and fittings as required for a complete installation in accordance with the Drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Section 013300
Quality Control	Section 014500
Quality Assurance: Structural Testing and Inspection	Section 014505
Sustainable Design Requirements	Section 018113
Concrete	Section 033000
Structural Steel	Section 051200
Miscellaneous Metals	Division 5
Fireproofing	Division 7
Painting	Division 9

1.4 CODES AND STANDARDS

- A. Building Code: Steel deck work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
 - 1. All steel floor and roof deck manufacturers shall be listed in the Underwriter's Laboratories "Fire Resistance Index of Companies".
 - 2. American Iron and Steel Institute (AISI) "Specification for the Design of Cold-Formed Steel Structural Members".
 - 3. American Welding Society AWS D1.3 , "Structural Welding Code – Sheet Steel."
 - 4. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
 - 5. Steel Deck Institute (SDI) "Design Manual for Composite Decks, Form Decks and Roof Decks".

C. Definitions:

1. See Section 051200.

1.5 STEEL DECK MANUFACTURER AND CONTRACTOR QUALIFICATIONS

- A. The Manufacturer and the Steel Deck Erector (“Erector”) shall each demonstrate a minimum of ten (10) years of experience with the specified steel deck systems.
- B. The Erector shall use prequalified welding processes in accordance with the AWS Structural Welding Code and shall provide certification that those welders to be employed in the Work are currently qualified for those processes and have satisfactorily passed the applicable AWS qualification tests.

1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

- (1) Submittal Schedule
- (2) Shop Drawings and Erection Drawings
- (3) Manufacturer’s Certification
- (4) Manufacturer’s Installation Instructions
- (5) Welder Certifications
- (6) Research Reports or Evaluation Reports
- (7) LEED Submittals

1. Submittal Schedule: See Section 013300.
2. Shop Drawings and Erection Drawings (including Field Work Drawings): Submit for record manufacturers standard load tables and calculations for items designed by the Contractor’s Engineer including substitution requests. Submit for approval shop drawings and erection drawings for all steel deck indicated on the Contract Documents.
 - a) Materials shall not be fabricated or delivered to the site before the shop drawings have been approved or approved as noted by the Design Professionals and returned to the Contractor.
 - b) Shop Drawings shall clearly indicate:
 - i. Deck types (profiles), steel gauges, and deck finishes.
 - ii. Deck layout, including panel locations, number of deck spans per panel, structural support locations and joint locations.
 - iii. Deck dimensions and sections keyed to layout plans, including side and end details and bearing requirements.
 - iv. Deck fastener types (welds, screws, pins, proprietary systems) and layout patterns at panel sides, ends and interior supports.
 - v. Deck manufacturer, profiles, properties, vertical load capacity and in-plane diaphragm shear capacity for all as-detailed conditions.

- vi. Details and locations of accessories including hardware, framing reinforcement anchorage, sump pans, cant strips, ridge plates, valley plates and closure plates.
 - vii. Fabrication necessary to incorporate steel deck into the job.
 - viii. Correlation with other requirements, openings and flashings.
 - ix. Fully dimensioned layout of field-installed headed studs (shear connectors).
 - x. Contractor-coordinated openings for mechanical, electrical, plumbing, fire protection and other trades.
- c) The Contractor shall have reviewed and approved the shop drawings prior to submission to the Design Professionals for their review, representing that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog number and similar data with respect thereto and reviewed or coordinated each drawing and sample with the work of other trades and with the requirements of the project and the Contract Documents.
3. Manufacturer's Certification: Submit for record a letter of certification from the deck manufacturer stating that the design, the detailing and fabrication of the steel deck to be installed under this Section are in accordance with the SDI Design Manual for Composite Decks, Form Decks and Roof Decks.
4. Manufacturer's Installation Instructions: Submit for record Manufacturer's literature providing recommended installation instructions.
5. Welder Certifications: Submit for record welder certificates signed by the Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
6. Research or Evaluation Reports: Submit for record research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence steel deck's compliance with the building code in effect for the Project.
7. LEED Submittals:
- a) Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - i. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - ii. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
- B. Submittal Process: See Section 013300.
- C. SER Submittal Review: See Section 033000.
- D. Substitution Request: See Section 012513.
- E. Request for Information (RFI): See Section 033000.

1.7 COORDINATION AND TEMPORARY SUPPORT

- A. Consult and cooperate with Contractors for other trades whose work affects or is affected by work under this Section in order that all phases of the work are properly coordinated to avoid delays, errors, omissions, or damage to any part of the work.
- B. Steel Deck Contractor shall inform General Contractor of any special support requirements such as shoring of deck for wet concrete loads.
- C. General Contractor shall coordinate with Steel Deck Contractor regarding any construction loads on deck before concreting, and on completed deck in excess of the design loads shown. Such conditions may include both gravity and lateral loads.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not bend or mar decking.
- B. Store off ground with one end elevated for drainage.
- C. Cover decking with waterproof material, ventilated to avoid condensation.
- D. Do not store deck bundles on framing unless material is securely tied down and the framing has been analyzed to ensure that such storage will not cause an overload.

1.9 STRUCTURAL STEEL PRE-ERECTION CONFERENCE

- A. See Section 051200.

1.10 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

- A. See Section 014505.

1.11 QUALITY CONTROL BY CONTRACTOR

- B. See Section 051200.

1.12 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

- A. See Section 051200.

1.13 PERMITS AND WARRANTY

- A. See Sections 007213, 017836, and 051200.

PART 2 - PRODUCTS

2.1 GENERAL

The work specified herein is based on the products of Epic Metals and Verco Manufacturing Co. in order to establish design quality and function in the installed work. Products of other manufacturers shall be subject to the approval of the Design Professionals. All steel deck units shall be of the same depth and profile as shown on the Drawings and the product of one manufacturer.

2.2 MATERIALS

- A. Composite Steel Floor Deck
 - 1. Galvanized Steel Deck: shall be formed from steel sheets conforming to ASTM A653, Structural Quality with minimum yield strength of 40 ksi for Epic Deck or equal and 33 ksi for Verco or ASC Deck. Before forming, the steel sheet shall be zinc coated conforming to ASTM A924, G60.
 - 2. Phosphatized/Painted Steel Deck: shall be formed from steel sheets conforming to ASTM A1008 SS Grade 33 (minimum) with minimum yield strength of 33ksi (230MPa). Prior to painting, the steel shall be chemically cleaned and pre-treated. Following pre-treatment, the bottom side of deck shall be painted with high-heat, baked-on thermal setting primer.
- B. Steel Roof Deck, Form Deck: shall be formed from steel sheets conforming to ASTM A653, Structural Quality with minimum yield strength of 40 ksi for Epic Deck or equal and of 33 ksi (230MPa) for Verco or ASC. Before forming, the steel sheet shall be zinc coated conforming to ASTM A924-G60.
- C. Floor decking shall be formed with integral locking lugs or embossments to provide a mechanical lock between the steel floor and the concrete slab sufficient to resist at least twice the design shear force. Minimum depth of embossments or locking lugs shall be .050"(1.3mm).
- D. All steel decking shall be roll formed for uniformity in dimension and strength.
- E. Decking shall have factory punched vents where vented deck is specified on Contract Documents.

2.3 ACCESSORIES

- A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.
- B. Side Lap Fasteners: As indicated on the Drawings.
- C. Pour Stops and Girder Fillers: Steel sheet, of same material as deck panels, and of thickness and profile indicated, but not less than the deck gauge.
- D. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.

- E. Hanger Tabs: Manufacturer's standard UL rated piercing steel sheet hanger attachment devices for floor deck panels.
- F. Recessed Sump Pans: Manufacturer's standard size, single piece steel sheet 0.071-inch (1.8mm) thick minimum, of same material as deck panels, with 1-1/2-inch (40mm) minimum deep level recessed pans and 3-inch (75mm) wide flanges. Cut holes for drains in the field.
- G. Flat Receiver Pan: Manufacturer's standard size, single-piece steel sheet, 0.071" (1.8mm) thick minimum units, of same material as deck panels.
- H. Miscellaneous Roof Deck Accessories: Steel sheet ridge and valley plates, finish strips, and reinforcing channels, of same material and thickness as roof deck unless otherwise indicated.
- I. Headed Studs (shear connectors) shall be per Structural General Notes.
- J. Steel Sheet Accessories: ASTM A 653, galvanized to G60 coating class conforming to ASTM A924.
- K. Galvanizing Repair Paint: SSPC Paint 20 or MIL-P-21035, with dry film containing a minimum of 94% zinc dust by weight.
- L. Flexible Rib Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.
- M. Sound-Absorbing Insulation: As required by the Contract Documents, provide manufacturer's standard premolded roll or strip glass fiber or mineral fiber.

2.5 MISCELLANEOUS MATERIALS

- A. Arc-Welding Electrodes: AWS A5.1 E60XX or E70XX Series, as required for the conditions of use.
- B. Touch Up Paint: use galvanized repair paint specified above.
- C. Closure Tape as required to maintain cells clear of concrete at abutting panel ends.

2.6 LEED REQUIREMENTS

- A. Products specified under this section must have a Type III Product Specific EPD.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Work by Others: Examine all work prepared by others to receive work of this Section, especially plan and elevation locations of supporting frames and walls. Report any defects affecting installation to Design Professionals. The Contractor alone shall be responsible for checking the dimensions and coordination of the steel deck work with other trades.

- B. Do not place deck units on supports with debris or unapproved coatings that could affect full, level bearing and proper connections.
- C. Do not place deck units on concrete supporting structures until concrete has cured and is dry.
- D. Coordinate the location of decking bundles with a structural steel erector to prevent overloading of structural members.

3.2 ERECTION - PLACEMENT

- A. Erect steel deck in accordance with the decking manufacturer's recommendations and the requirements of the Drawings and these Specifications.
- B. Place steel deck on the supporting framework and adjust to final position with ends accurately aligned and bearing on supporting members before making permanent connections. Do not stretch or contract sidelap interlocks.
- C. Place steel deck on the supporting framework and adjust to final position with ends accurately aligned and bearing on supporting members before making permanent connections. Do not stretch or contract sidelap interlocks.
- D. Abutting ends of deck panels shall occur over supports. End bearing shall be a minimum of 2 inches (50mm), or greater if required (web crippling) by deck manufacturer.
- E. Where deck panels nest, laps shall be a minimum of 2" (50mm) and shall occur over supports. Nesting is permitted only where profiles are designed to nest and are fabricated with offset ends.
- F. Install slab edge closures and pour stops at the theoretical position with maximum tolerance of + 3/8" (10mm). Closures and pour stops shall have adequate adjustments to maintain this tolerance while accommodating the structural steel frame tolerances.

3.3 ERECTION - CONNECTIONS

- A. Connect steel deck to the steel framework at ends of units and at intermediate supports as shown on the Contract Documents and approved shop drawings.
- B. Deck to support welds shall be puddle welds of diameter and spacing shown on Contract Documents and/or approved shop drawings.
- C. Where headed studs occur, if fused to deck for full weld perimeter each headed stud may be considered to replace one puddle weld
- D. Fasten side laps and perimeter edges of panels between supports by button punching, side seam welding or screws, or as noted on Construction Drawings.

3.4 ERECTION – OPENINGS AND CLOSURES

- A. Contractor to coordinate location of all openings with other trades (see Submittals).

- B. Cut and install sleeves and holes through decking for openings indicated on the Architectural, Structural, and/or Mechanical-Electrical-Plumbing-Fire Protection Drawings. Cost shall be paid by the trade requiring such sleeves and holes. Sleeves will be furnished by the various trades requiring them. Provide and install reinforcement as required around sleeves. Where possible, leave deck intact and use block outs to hold back concrete at openings. Cut deck after concrete cures.
- C. Provide miscellaneous headers and other steel reinforcing and supports welded to decking and structural steel as required at penetrations, around columns, etc. per typical details and manufacturer's recommendations.
- D. Field cutting parallel to flutes shall be done in the low flutes, taking care to leave sufficient horizontal material to permit satisfactory welding of deck to supporting steel.
- E. Openings required for work of other trades and not indicated on Architectural, Structural, Mechanical / Electrical / Plumbing / Fire Protection / Telecom Drawings shall be permitted only upon approval of the Design Professionals as to size and location.
- F. Furnish and install tight-fitting closures at locations including but not limited to
 - 1. Open ends of flutes and sides of decking (neoprene or sheet steel)
 - 2. Open ends of all flutes at columns, walls and openings shown on Contract Drawings
 - 3. Panel ends where panels change direction or abut (sheet steel or closure tape)
 - 4. Between deck units and columns (sheet steel)
 - 5. Between columns and exterior cladding (sheet steel)
 - 6. Welding hole cover, with friction fastening, to close excess holes when required (sheet steel).

3.5 WELDING

- A. Welding of steel deck shall follow the technique outlined by the steel deck manufacturer.
- B. Welding of headed studs shall conform to all AWS requirements, including workmanship, quality control, and inspection, which shall be performed by the Contractor and observed by the Testing Agency.

3.6 CONCRETE PLACEMENT

- A. Concrete with admixtures containing chloride salts or other deleterious materials shall not be used with steel deck.
- B. Steel deck used to support concrete buggy runways shall be adequately protected against wheel damage. Decking and any runways or shoring shall be evaluated and designed by Contractor's Engineer.

3.7 TOUCH-UP

- A. After installation touch-up welds on galvanized decking with specified galvanized repair paint to a dry film thickness of 2 mils, at all locations that will not receive concrete fill.

B. Touch-Up Painting: Where exposed to view, wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of installed deck panels.

1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
2. Where shop-painted surfaces are exposed in-service, apply touch-up paint to blend into adjacent surfaces.

3.8 CORRECTIVE MEASURES

A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 051200.

END OF SECTION 053000

SECTION 054000

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 GENERAL

Work of this Section shall conform to the requirements of Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the installation of light gauge steel stud and joist framing as required for a complete installation in accordance with the Drawings and as specified herein. Work includes, but is not necessarily limited to the following:

1. Non-load bearing steel stud framing at exterior walls.
2. Interior stud wall and ceiling framing with studs.
3. Framing accessories.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS:

Submittals	Section 013300
Quality Control	Section 014500
Sustainable Design Requirements	Section 018113
Structural Steel	Section 051200
Metal Fabrications	Section 055000
Metal Framing Systems	Division 9
Gypsum Board Systems	Division 9
Miscellaneous Metals	Division 5
Fireproofing	Division 7
Painting	Division 9

1.4 CODES AND STANDARDS

- A. Building Code: Cold-Formed Metal Framing work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
 1. California Code of Regulations, Title 24, Part 2, also known as the California Building Code (CBC), 2019 Edition with A amendments.

2. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein, latest edition.
3. Federal Specifications (FS).
4. American Welding Society (AWS) D1.3: "Structural Welding Code - Sheet Steel."
5. American Iron and Steel Institute (AISI): "Specifications for the Design of Cold-Formed Steel Structural Members", latest edition.
6. Steel Stud Manufacturer's Association (SSMA), latest edition.
7. Metal Lath Association (MLA): "Specifications for Metal Lath and Furring", latest edition.
8. Society of Protective Coatings (SSPC).

C. Definitions:

See Section 051200.

1.5 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of structural drawings for shop drawings is not permitted. Building Information Models for contractor's use may be provided as mutually agreed upon by Design Professionals.

1. LEED Submittals

1. LEED Submittals

- a) Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
1. MRc2 - Environmental Product Declarations (EPD):
Provide Industry-Wide or Product-Specific EPD.
 2. MRc3 - Sourcing of Raw Materials - Recycled Content:
Provide product data for pre- and post- consumer recycled content.

PART 2 PRODUCTS

2.1 MANUFACTURERS

Acceptable Manufacturers: Any member of Steel Stud Manufacturer's Association (ICC ER-3064P).

2.2 MATERIALS

- A. Sheet Steel: ASTM A1003 or A653.
- B. Studs and tracks:
 - 1. See drawings for size and gauge.
 - 2. Galvanization per ASTM A653 with G60 minimum.
- C. Cold-Rolled Furring Channels: As specified in Section 092216, "Non-Structural Metal Framing."
- D. Vertical Deflection Clips (non-load-bearing framing): Manufacturer's standard bypass and head clips as required, capable of isolating wall stud from upward and downward vertical displacement of primary structure using mechanical fasteners. Acceptable Manufacturer: The Steel Network, Inc. Connections must be tested in accordance with ICC AC261 criteria and hold a valid ICC ERS evaluation service report to be accepted, such as ICC ESR-1903, or equivalent. Provide clips with attached bushing and screw of the series, size and configuration as required by the structural design calculations.
 - 1. VertiClip® or VertiTrack® series or equal. Mechanical attachment to structure and screw attachment to stud web using step-bushings to permit frictionless vertical movement.
- E. Drift Clips® (non-load-bearing framing): Manufacturer's standard bypass and head of wall clips (as required), capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure using mechanical fasteners. Acceptable Manufacturer: The Steel Network, Inc or equal. Connections must be tested in accordance with ICC AC261 criteria and hold a valid ICC ERS evaluation service report to be accepted, such as ICC ESR-1903, or equivalent.
 - 1. DriftClip® series or equal. Mechanical attachment to structure and screw attachment to stud web using step-bushings to permit frictionless vertical and lateral movement.
- F. Sliptrack: as indicated on approved drawings. Acceptable Manufacturers: Sliptrack Systems (ICC ESR-2049) or equal.
- G. Partition Stiffeners or Bridging: Unpunched channel shape, formed of 16-gauge steel to required dimensions.
- H. Welding Electrodes: AWS low hydrogen, rod number and diameter as approved by the Owner's Testing Agency.
- I. Touch-up Primer for Galvanized Surfaces: SSPC Paint 20 zinc rich.
- J. Metal Screws: Screws shall be self-drilling and self-tapping. Screws shall penetrate substrate by a minimum of three full threads exposed. Use low profile heads as required by architectural finish.
 - 1. Sheet Metal Screw (SMS): No. 8 and larger as noted on Drawings per ASTM 1513-13.

- a) The minimum spacing between centers of fasteners shall not be less than 3 times the fastener diameter. The minimum edge distance from the center of fastener to the edge of any part shall not be less than 1.5 times the fastener diameter.
2. Heavy Gauge Screws: Size as noted on Drawings. Use "TEKS" screws by ITW Buildex (ICC ESR-1976) or equal.
3. Hex Head Screws: Size as noted on Drawings. Use "Kwik-Flex" screws by Hilti or equal.

2.3 LEED REQUIREMENTS

- A. Products specified under this section must have a Type III Product Specific EPD.

PART 3 EXECUTION

3.1 PREPARATION

Coordinate details and requirements of other Work which adjoins or fastens to studs and requires backing or special support framing included in this Section.

1. Items requiring backing or support include, but are not necessarily limited to casework, wall-specialties, and similar items.
2. Obtain Architect's approval of backing method proposed to satisfy requirements of this Section which differs from methods noted or shown.

3.2 EXAMINATION

- A. Examine all parts of the supporting structure and the conditions under which studs will be installed.
- B. Notify the Architect, in writing, of any conditions detrimental to the proper and timely completion of the Work.
- C. Do not proceed with the installation of steel studs until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Tracks shall be securely anchored to supporting structure, with fasteners specified at not more than 24-inches on center.
- B. Complete, uniform, and level bearing support shall be provided for the bottom track at each bearing-stud location. Install full metal shims below bottom track at stud locations as needed, or set bottom track in high-strength grout.
- C. Abutting or intersecting pieces or track shall be securely anchored to a common structural element or spliced together.
 1. Splices or butt welds shall be used at all butt joints in the runner track.
 2. Do not splice studs.

- D. Wall studs shall sit in top and bottom track with 1/16" maximum gap between wall stud and track web.
 - 1. Studs shall be aligned or plumbed and securely fastened to the flanges of both top and bottom track.
 - 2. Space studs 16-inches on center maximum unless otherwise noted on Drawings.
- E. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Connect vertical (and/or drift) deflection clips to studs and anchor to primary building structure in accordance with manufacturer's recommendations.
- F. Framed wall openings shall include a header and multiple studs at each edge of opening as indicated on Drawings. Contractor's option to built-up jambs, headers, and sills: JamStud® by The Steel Network, Inc or equal. ASTM A653/A653M, Grade 50 (340) 50ksi (340MPa), minimum yield strength 65ksi (450MPa), minimum tensile strength, G-60 (Z180) hot-dipped galvanized coating.
- G. Diagonal bracing shall be installed at locations indicated for frame stability.
- H. Install bridging as indicated on Drawings.
- I. Form corners and intersections of partitions with three studs as shown on Drawings. Provide additional studs as indicated or required.
- J. Joining of members shall be made with welding; wire tying of framing members shall not be permitted.
- K. Welded connections shall be made by resistance spot fusion welding, fillet welding, or plug welding and shall be done in accordance with the latest recommended procedures and practices of the American Welding Society.
- L. Do not cut or notch stud flanges.
- M. Where exposed to weather, field abrasions and welds shall be touched up with zinc rich primer.
- N. Erection Tolerances: Install cold formed metal framing to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8-inch in 10 feet as follows:
 - 1. Space individual framing members no more than plus or minus 1/8-inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- O. Provide all angles, clips and other miscellaneous pieces necessary to attach light gauge framing to building structure or to attach other materials to light gauge framing.
- P. Do not bridge building expansion and control joints with cold formed metal framing. Independently frame both sides of joints.

3.4 INSTALLATION OF FIRE-RATED ASSEMBLIES

Install studs which are components of fire-rated wall assemblies as indicated.

3.5 BACKING IN STUD PARTITIONS

- A. Securely weld or screw cut sections of unpunched stud to at least three stud or furring supports, leaving flat surface of backing stud web to receive attachment of object to be secured.
- B. Verify that any pre-drilling of backing and attachment of spacers to prevent crushing of collateral material is done prior to application of collateral material.
- C. If it is determined by the Architect that backing was not provided for any items as required, the Contractor shall remove the finish material and install backing. The Contractor shall patch and refinish surface to match adjacent area and finish.

3.6 FIELD QUALITY CONTROL

- A. The Owner's Testing Agency will:
 - 1. Provide continuous inspection of welding, including prior fit-up, welding equipment, weld quality, and welder certification in accordance with AWS and CBC Section 1704A.3.
 - 2. Provide continuous inspection during installation as required to establish conformity of Work requirements.

END OF SECTION 054000

SECTION 055000
METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes Contractor-Engineered Systems:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
- B. Related Sections:
 - 1. Section 076200 "Flashing and Sheet Metal."
 - 2. Section 079200 "Joint Sealants."
 - 3. Section 099600 "High Performance Coatings."

1.3 PERFORMANCE REQUIREMENTS

- A. Contractor-Engineered Systems: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Paint products.
 - 2. Grout.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Show adjacent construction including adjacent finishes.

- C. Samples: For each finish specified. Minimum 4 in. square.
- D. Contractor-Engineered Submittal: For all metal fabrication items and assemblies, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

- A. Review all available Contract Documents and coordinate with relevant trades and ongoing work for proper fabrication and installation of Work.

1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.3 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Material: Cold-rolled steel, ASTM A 1008/A 1008M, structural steel, Grade 33; 0.0966-inch minimum thickness; hot-dip galvanized after fabrication.

2.4 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

2.5 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 2.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Eyebolts: ASTM A 489.
- F. Machine Screws: ASME B18.6.3.
- G. Plain Washers: Round, ASME B18.22.1.
- H. Lock Washers: Helical, spring type, ASME B18.21.1.
- I. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- J. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- K. Post-Installed Anchors: Torque-controlled expansion anchors.
 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.
- E. Dissimilar Materials: Separate dissimilar metals with coating of dielectric separator. Do not extend coating onto exposed or finished surfaces.

2.7 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Metal surface preparation to be SSPC SP-6 "Commercial Blast Cleaning."
- F. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, welds to be NOMMA #1 finish – no evidence of welded joint.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- I. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- J. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.8 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.

2.9 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- C. Field paint all exterior metals in accordance with Section 09 96 00 "High Performance Coatings."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for

use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099100 "Painting".
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

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SECTION 055113

METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Preassembled steel stairs and intermediate landings with steel risers and concrete filled pans.
 - 2. Steel tube handrails attached to walls or guardrails adjacent to metal stairs or tempered glass.
- B. Related Sections:
 - 1. Section 034819 "Precast Concrete Stair Treads."
 - 2. Section 057313 "Decorative Metal and Glazed Railings" for railings at Stair A and Stair D.
 - 3. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.
 - 4. Section 096513 "Resilient Base and Accessories" for rubber stair treads.
 - 5. Section 099100 "Painting and Coating."

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Uniform Load: 100 lbf/sq. ft.
 - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch, whichever is less.
- B. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:

- a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
- b. Infill load and other loads need not be assumed to act concurrently.

C. Seismic Performance: Refer to Structural Drawings.

1.4 ACTION SUBMITTALS

A. Product Data: For metal stairs and the following:

- 1. Metal floor plate treads.
- 2. Paint products.
- 3. Grout.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. LEED Submittals:

- 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs and railings.

- 1. Test railings according ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

- 1. Preassembled Stairs: Commercial class, unless otherwise shown on Drawings.

- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.3 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500 (cold formed), see Structural Drawings for grade.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.

2.4 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Screws: ASME B18.2.1.
- F. Plain Washers: Round, ASME B18.22.1.
- G. Lock Washers: Helical, spring type, ASME B18.21.1.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Acrylic Primer for Interior Stairs: Benjamin Moore P04 D.T.M. Acrylic Metal Primer, or equal.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Concrete: Provide normal weight concrete infill, as specified in Section 033000 "Cast-in-Place Concrete."

2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, offset railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
 - 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes are okay.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.7 STEEL-FRAMED STAIRS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
 - 1. American Stair, Inc.
 - 2. Pacific Stair.
 - 3. Worthington Metal Fabricators, formerly known as Sharon Companies Ltd. (The).
- B. Stair Framing:
 - 1. Fabricate stringers of channels.
 - a. Provide closures for exposed ends of channel stringers.
 - 2. Construct platforms of channel tube headers and miscellaneous framing members as needed to comply with performance requirements indicated.
 - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
 - 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).
 - 1. Steel Sheet: Uncoated, cold-rolled steel sheet unless otherwise indicated.

2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
4. Shape metal pans to include nosing integral with riser.
5. Attach abrasive nosings to risers.
6. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
7. Provide epoxy-resin-filled treads, reinforced with glass fibers, with non-slip-concrete aggregate finish to tread surface.
8. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.8 STAIR RAILINGS

- A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
 1. Rails and Posts: 1-5/8-inch- diameter top and bottom rails and 5/8-inch-diameter round posts, unless otherwise shown.
 2. Rail Infill: 1 5/8 in. diameter round horizontals spaced less than 4 inches clear.
- B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes are okay.
- C. Form changes in direction of railings as follows:
 1. By bending or by inserting prefabricated elbow fittings.
- D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 1. Connect posts to stair framing by direct welding unless otherwise indicated.
 2. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves.
- H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.9 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Prime metal stairs in shop after assembly.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 1. Interior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components, except those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.10 MISCELLANEOUS MATERIALS

- A. Prefilled Concrete Treads:
 - 1. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi (20 MPa) and maximum aggregate size of 1/2 inch (13 mm) unless otherwise indicated.
 - 2. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
 - 3. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, galvanized steel, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated on Drawings.
 - 4. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.
 - a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

- D. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
- B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonmetallic, nonshrink grout unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding directly to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Attach handrails to wall with wall brackets. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt. Provide bracket with minimum 1-1/2-inch clearance from inside face of handrail to finished wall surface and as required to provide continuously straight railing at each single run of stair or ramp unless otherwise indicated on Drawings. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.

3.4 PAINTING

- A. Paint stairs in field in accordance with Section 099100 "Painting." Provide manufacturer's standard paint stripe for contrasting stripe at treads, where required by code.

3.5 ADJUSTING AND CLEANING

- A. Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Paint entire assembly in accordance with Section 09 91 00 "Painting."

END OF SECTION

SECTION 057313

DECORATIVE METAL AND GLAZED RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural glass assembly with flush sill.
 - 2. Metal picket style guardrail at Stair A and Stair D.
 - 3. Stainless steel and painted steel handrails.
 - 4. Woven-wire mesh guardrail assembly.
- B. Related Requirements:
 - 1. Section 088000 "Glazing."
 - 2. Section 099600 "High Performance Coatings."

1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor and exterior deck areas and for pedestrian guidance and support, visual separation, or wall protection.

1.4 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data:
 - 1. Metal railings assembled from standard components.

2. Glass products.
 3. Glazing cement and accessories for structural glass railings.
 4. Sealant and accessories for structural glass railings.
 5. Fasteners.
 6. Shop primer.
 7. Bituminous paint.
 8. Nonshrink, nonmetallic grout.
 9. Anchoring cement.
- B. Shop Drawings: Include plans, elevations, sections, attachment details, joint locations, transitions, top rail corners, and terminations.
- C. Samples for Verification: For each type of exposed finish required.
1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 2. Base channel.
 3. Each type of glass and glass edge required.
 4. Fittings and brackets.
 5. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and glass-infill panels. Show method of finishing members at intersections. Samples need not be full height.
- D. LEED Submittals:
1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.
- C. Product Test Reports: For tests performed by a qualified testing agency, in accordance with ASTM E894, ASTM E935, ASTM E2353, and ASTM E2358.
- D. Evaluation Reports: From ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
1. For glazed decorative metal railings.
 2. For post-installed anchors.
- E. Preconstruction test reports.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
1. Build mockups as indicated on Drawings.
 2. Build mockups for each form and finish of glass-infill panel railing consisting of two posts, top rail, handrail, glass-infill panel, and anchorage system components that are full height and are not less than 24 inches in length.
 3. Build mockups for each form and finish of structural glass railing consisting of top rail, structural glass, base channel, and anchorage system components that are full height and are not less than 24 inches in length.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Aluminum: The lesser of minimum yield strength divided by 1.65, or minimum ultimate tensile strength divided by 1.95.
 2. Stainless Steel: 60 percent of minimum yield strength.
 3. Steel: 72 percent of minimum yield strength.
 4. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA CW-12, "Structural Properties of Glass."
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Other loads as shown on Drawings.
 - d. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Glass-Infill Panels:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.

- b. Infill load and other loads need not be assumed to act concurrently.
- C. Wind Loads: For exterior glazed decorative metal railings, capable of withstanding the following wind loads in accordance with the IBC and ASTM E1300:
 - 1. Wind Load: As indicated on Drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 TYPES

- A. Source Limitations for Decorative Metal Railing Components: Obtain from single source from single manufacturer for each component and installation method.
- B. Product Options: Information on Drawings and in the Specifications establishes requirements for railing system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- C. Glass-Supported Railings:
 - 1. Basis-of-Design Manufacturer and Product: CR Laurence "B5S Series Base Shoe with Taperloc TL5X10", or the following equal alternate:
 - a. Livers Bronze Co. "Struct-U-Rail".
 - b. Julius Blum "Glass Railing Shoe".
 - c. Or equal.
 - 2. Factory Finish for Exposed Metal: Stainless steel; No. 4 directional polish.
- D. Painted Metal Picket Guardrail: Custom assembly.
 - 1. Rails and Posts: 1-1/2-inch- square top and bottom rails and 1-1/2-inch- square posts, or as required by engineering.
 - 2. Picket Infill: 1/2-inch- square pickets spaced to prohibit the passage of a 4-inch diameter sphere, or as required by engineering.
- E. Woven-Wire Mesh Infill: Anti-climbing screen guardrail.
 - 1. Basis-of-Design: G-S Company "Sure-Guard Square Mesh".
 - 2. Infill Panel:
 - a. Material: Steel, 1 inch by 1/2-inch mesh pattern.
 - b. Finish: Factory-painted. Patch and paint field welds.
 - c. Color: Custom.
 - 3. Frame:
 - a. At Jamb Condition: Provide 1 inch by 1/2 inch by 11-gauge roll formed steel channel, welded and ground at corners, to 1-1/4 inch by 1-1/4 inch by 11-gauge steel tube post.
 - b. At Head and Sill Condition: Provide 1 inch by 1/2 inch by 11-gauge roll formed steel channel, welded and ground at corners, to 1/8 inch by 1 inch cold-rolled steel flat closure band.

- F. Handrails: Custom assembly. Handrails are attached to walls and guardrail assemblies.
 - 1. Stainless Steel: CR Laurence, model to be determined.
 - 2. Painted Steel: To be determined.
 - 3. Handrail Wall Brackets: Finish to match handrail. Brackets to be at center of rail, 2 ½ inches from face of wall.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes, Including Extruded Tubing: ASTM B221, Alloy 6063-T5/T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B209, Alloy 5005-H32.
- F. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.
- G. Castings: ASTM B26/B26M, Alloy A356.0-T6.

2.5 STAINLESS STEEL

- A. Tubing: ASTM A554, Grade MT 304 at interior locations; Grade MT 316 at exterior locations.
- B. Pipe: ASTM A312/A312M, Grade TP 304 at interior locations; Grade TP 316 at exterior locations.
- C. Castings: ASTM A743/A743M, Grade CF 8 or Grade CF 20.
- D. Sheet, Strip, Plate, and Flat Bar: ASTM A666 or ASTM A240/A240M, Type 304 at interior; Type 316 at exterior.
- E. Bars and Shapes: ASTM A276, Type 304 at interior; Type 316 at exterior.

2.6 STEEL AND IRON

- A. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
- B. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.

2.7 GLASS AND GLAZING PRODUCTS, GENERAL

- A. Glazing Publications: Comply with written instructions of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. NGA/GANA Publications: "GANA Laminated Glazing Reference Manual" and "GANA Glazing Manual."
- B. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.
- C. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- D. Glazing Cement and Accessories for Structural Glass Railings: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.
- E. Sealant and Accessories for Structural Glass Railings: Sealant, gaskets, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.
- F. Glazing Gaskets for Glass-Infill Panels: Glazing gaskets and related accessories as recommended or supplied by railing manufacturer for installing glass-infill panels in post-supported railings.

2.8 GLASS GUARDRAIL COMPONENTS

- A. Glazing: ASTM C1048 Kind FT, Quality q3. Provide products that have been tested for impact strength in accordance with 16 CFR 1201 for Category II materials.
 - 1. Monolithic Tempered Thickness: 3/4 inch.
 - 2. Color: Clear
 - 3. Polished, pencil edge on exposed glass edges.
- B. Fasteners: Types and sizes indicated in shop drawings.
 - 1. Center-to-center spacing of holes is 12 inches.
- C. Sill Angles for Tempered Glass Railing Assemblies: Steel angle profiles conforming to ASTM A 36, with anchoring devices, sizes indicated in shop drawing of section 05 5000, drilled and tapped for fastener types, sizes, and spacing indicated.

2.9 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Aluminum Components: Stainless steel type 304 at interior locations; type 316 at exterior locations.
 - 2. Stainless Steel Components: Stainless steel type 304 at interior locations; type 316 at exterior locations.
 - 3. Dissimilar Metals: Stainless steel type 304 at interior locations; type 316 at exterior locations.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/ASTM F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts; ASTM F594.

2.10 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast stainless steel, center of rail dimension, from face of structural glass balusters, as shown on Drawings.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Anchoring Cement: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.11 FABRICATION OF METAL RAILINGS

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- H. Form changes in direction as follows:
 - 1. As detailed.
- I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of hollow railing members with prefabricated end fittings.
- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- M. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

2.12 FABRICATION OF GLASS PANELS AND BALUSTERS

- A. Fabricate glass to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

- B. Glass-Infill Panels: Provide tempered glass-infill panels.
 - 1. Edge Finish: Clean-cut or flat-grind edges to produce smooth, square edges with slight chamfers at junctions of edges and faces.

2.13 METAL FINISH REQUIREMENTS, GENERAL

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.14 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Stainless Steel Sheet, Strip, Plate, and Bar Finishes:
 - 1. Directional Satin Finish: ASTM A480/A480M, No. 4.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with Drawings and manufacturer's written instructions for installing glazed decorative metal railings, accessories, and other components.
- B. Windborne-Debris Resistance: Anchor glazed decorative metal railings to structure using anchoring method, fastener type, and fastening frequency identical to that used in windborne-debris-resistance testing.
- C. Perform cutting, drilling, and fitting required for installing metal railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.

3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 4. Do not weld, cut, or abrade surfaces of metal railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with bituminous paint.
- E. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- F. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 METAL RAILING CONNECTIONS

- A. Nonwelded Connections:
1. Use mechanical or adhesive joints for permanently connecting railing components.
 2. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Expansion Joints: Install expansion joints at locations indicated, but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.3 METAL ANCHORING POSTS

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted in sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.
- E. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For stainless steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
- F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.4 FIELD QUALITY CONTROL

- A. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings in accordance with ASTM E894, ASTM E935, ASTM E2353, and ASTM E2358 for compliance with performance requirements.
- B. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.
- C. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.
- B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

3.6 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION

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SECTION 061000
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. Wood furring and grounds.
 2. Plywood backing panels.
- B. Related Requirements:
1. Section 099100 "Painting and Coating" for field painting of plywood backerboards.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 2. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. LEED Submittals:
1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc3 - Sourcing of Raw Materials – Forestry Stewardship Council (FSC) Certified Wood: For all wood products designated in this specification as "FSC certified," provide vendor invoices with the vendor's Chain-of-Custody (COC) number and identify each FSC certified product on a line-item basis. If FSC wood products are

modified off-site by an architectural woodworker or millworker, the woodworker shall have an FSC COC number.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Fire-retardant-treated wood.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood flat with spacers beneath and between each bundle to provide air circulation. Protect wood from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW EPD: The company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Composite Woods: Composite wood and agri-fiber products shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde (NAF).

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
- C. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

- D. Application: Treat all rough carpentry unless otherwise indicated.
 - 1. Plywood backing panels.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Cants.
 - 4. Furring.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber:
 - 1. Western woods; WCLIB or WWPA.

2.4 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness. Panels shall not contain added urea-formaldehyde. Panels shall be pre-painted, color: white.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Power-Driven Fasteners: NES NER-272.
- C. Lag Bolts: ASME B18.2.1.
- D. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- E. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

END OF SECTION

SECTION 061600

SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior wall sheathing.
- B. Related Requirements:
 - 1. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
- B. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc3 - Sourcing of Raw Materials – Forestry Stewardship Council (FSC) Certified Wood: For all wood products designated in this specification as "FSC certified," provide vendor invoices with the vendor's Chain-of-Custody (COC) number and identify each FSC certified product on a line-item basis. If FSC wood products are modified off-site by an architectural woodworker or millworker, the woodworker shall have an FSC COC number.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Composite Woods: Composite wood and agri-fiber products shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde (NAF).

2.2 WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 - 1. Products: Subject to compliance with requirements, provide the following, or equal:
 - a. CertainTeed Corporation; GlasRoc.
 - b. G-P Gypsum Corporation; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond e(2)XP.
 - d. United States Gypsum Co.; Securock.
 - 2. Type and Thickness: Type X, 5/8 inch thick.
 - 3. Size: 48 by 96 inches for vertical installation.
 - 4. Recycled Content: Provide materials with highest level of post-consumer and pre-consumer recycled content available.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.
- B. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
 - 1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
 - 2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. GA-253, ASTM C 1280 and manufacturer's recommendations.
- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

END OF SECTION

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SECTION 062023

INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood base, surface applied or built-out as shown on Drawings.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
 - 2. Section 064023 "Interior Architectural Woodwork."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
- B. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc3 - Sourcing of Raw Materials – Forestry Stewardship Council (FSC) Certified Wood: For all wood products designated in this specification as “FSC certified,” provide vendor invoices with the vendor’s Chain-of-Custody (COC) number and identify each FSC certified product on a line-item basis. If FSC wood products are modified off-site by an architectural woodworker or millworker, the woodworker shall have an FSC COC number.
 - d. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Composite Woods: Composite wood and agri-fiber products shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde (NAF).

2.2 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

2.3 INTERIOR BASE

- A. Lumber Trim for Opaque Finish (Painted Finish):
 - 1. Species and Grade: Refer to Section 090000.
 - 2. Maximum Moisture Content: 19 percent with at least 85 percent of shipment at 12 percent or less.
 - 3. Finger Jointing: Not allowed.
 - 4. Face Surface: Surfaced (smooth).

- B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
 - 1. Species and Grade: Refer to Section 090000.
 - 2. Maximum Moisture Content: 10 percent.
 - 3. Finger Jointing: Not allowed.
 - 4. Gluing for Width: Not allowed.
 - 5. Veneered Material: Allowed.
 - 6. Face Surface: Surfaced (smooth).
 - 7. Matching: Selected for compatible grain and color.

2.4 ACCESSORIES

- A. Fasteners: Provide pre-finished nails in color to match where face nailing is unavoidable.
- B. Wood Putty: Standard industry grade for use in plugging fastener holes where required on Drawings, of color to match finish; paintable where applicable.
- C. Glue: Aliphatic- or phenolic-resin wood glue recommended by manufacturer for general carpentry use.

2.5 SHOP FINISHING

- A. Finish carpentry items at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Prime woodwork for opaque finish with one coat of wood primer compatible with specified topcoats.
- C. Interior Opaque Finish: Comply with requirements indicated below for grade, finish system, color, effect, and sheen, with sheen measured on 60-degree gloss meter per ASTM D523:
 - 1. WI Finish System 7b.: Opaque pigmented lacquer.
 - 2. Colors: Match Architect's samples.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 - 4. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 - 1. Install trim after gypsum-board joint finishing operations are completed.
 - 2. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.7 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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SECTION 064023

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic laminate cabinets.
2. Hanging rail system for artwork.

B. Related Requirements:

1. Section 066116 "Solid Surfacing Fabrications" for countertops.
2. Section 079200 "Joint Sealants."
3. Section 092216 "Non-Structural Metal Framing" for backing strips.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Meeting the requirements of Architectural Woodwork Standards. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate casework.
4. Apply a WI Certified Compliance Program label to the first page of the Shop Drawings.

B. Samples for Verification:

1. 6 in. square sample of each exposed finish.
2. Cabinet door or drawer face with all surfaces including edge treatment and exposed hardware and accessories, one unit for each type and finish. Minimum 12" square.

C. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

- b. MRc3 - Sourcing of Raw Materials – Forestry Stewardship Council (FSC) Certified Wood: For all wood products designated in this specification as “FSC certified,” provide vendor invoices with the vendor’s Chain-of-Custody (COC) number and identify each FSC certified product on a line-item basis. If FSC wood products are modified off-site by an architectural woodworker or millworker, the woodworker shall have an FSC COC number.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For the following:
 - 1. Composite wood and agrifiber products.
- C. Woodwork Quality Standard Compliance Certificates: WI Quality Certification Program certificates.

1.5 QUALITY ASSURANCE

- A. Quality Standard: North American Architectural Woodwork Standards, (NAAWS), latest edition, jointly published by Woodwork Institute, Architectural Woodwork Institute, and the Architectural Woodwork Manufacturers Association of Canada.
 - 1. If there is a conflict between the requirements of the NAAWS and the Drawings and/or Specifications, the Drawings and specifications shall govern.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is licensee of the Woodwork Institute Certified Compliance Program.
- C. Installer Qualifications: A licensee of Woodwork Institute’s Certified Compliance Program and Certified Seismic Installation Program. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver casework until painting and similar operations that could damage woodwork have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinetwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.

- B. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate field-verified measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that Architectural Woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087110 "Door Hardware" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. Composite Woods: Composite wood and agri-fiber products shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde (NAF).

2.2 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide certificates from WI certification program indicating that woodwork and installation complies with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Architectural Woodwork Standards Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.

- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
 - 1. Plastic Laminate: ARPA Laminate, Formica, Nevamar, or equal.
- F. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Edges: ABS to match plastic laminate
- G. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
 - a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - 2. Drawer Sides and Backs: Solid-hardwood lumber.
 - 3. Drawer Bottoms: Hardwood plywood.
- H. Dust Panels: 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
- K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by laminate manufacturer's designations.
 - 2. Match Architect's sample.

2.3 HANGING RAIL SYSTEM FOR ARTWORK

- A. Basis-of-Design: Arakawa wall and ceiling surface-mounted and recessed railing systems.
- B. Components:
 - 1. CRB1800-a: Ceiling surface-mounted rail and BS1R gripper-type, top connector, rail clip.
 - 2. CRC1800-a: Ceiling surface-mounted rail, recessed flush into gypsum board/APC-1 and BS1R gripper-type, top connector, rail clip.
 - 3. CRJ1800-a: Wall-mounted rail system with paintable cover, end caps, and rail clips. Provide CR1 rail clip for hanging cable and CR6 hook for holding looped cable. Use two cables on two CR6 to suspend a display shelf from the rail or as shown on Drawings.
 - 4. Provide all required components for a complete assembly as shown on Drawings.

2.4 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.

2.5 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
 1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 4. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of architectural cabinets.

2.6 HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087001 "Door Hardware."
- B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:
 1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
- D. Pulls: Back mounted, stainless steel, as selected by Architect, ANSI/BHMA A156.9, B02011.

- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- F. Drawer Slides: BHMA A156.9.
 - 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
 - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
 - 3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
 - 4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
 - 5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
 - 6. For computer keyboard shelves, provide Grade 1.
 - 7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.
 - 8. Provide self-closing soft-close door slides at all drawers.
- G. Door Locks: BHMA A156.11, E07121.
- H. Drawer Locks: BHMA A156.11, E07041.
- I. Exposed Hardware Finishes: Satin stainless steel.
- J. For concealed hardware, provide manufacturer's standard painted finish or stainless steel finish.

2.7 MISCELLANEOUS MATERIALS

- A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.8 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
 - 2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition casework to average prevailing humidity conditions in installation areas.
- B. Before installing casework, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install casework to comply with same grade as item to be installed.
- B. Assemble casework and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install casework level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut casework to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Casework: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install casework with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws or toggle bolts through metal backing or metal framing behind wall finish.
- F. Touch up finishing work specified in this Section after installation of woodwork.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective casework, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean casework on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

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SECTION 066116

SOLID SURFACING FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work Included: Solid Surfacing Fabrications, complete, as shown and specified.
- B. Work Specified Elsewhere:
 - 1. Interior Architectural Woodwork: Section 064023.
 - 2. Joint Sealants: Section 079200.

1.3 REFERENCES

- A. General: Comply with the applicable provisions of the referenced standards, except as modified by governing codes and the Contract Documents. Where a recommendation occurs in the referenced standards, it shall be considered mandatory. In the event of conflict, the more stringent requirement shall govern.
 - 1. American Society for Testing and Materials (ASTM): E84, "Surface Burning Characteristics of Building Materials".
 - 2. "Architectural Woodwork Standards" (AWS), published by the Architectural Woodwork Institute (AWI), Architectural Woodwork Manufacturers Association of Canada, and Woodwork Institute (WI).

1.4 SUBMITTALS

- A. Product Data: Submit for Architect's action. Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating each specified requirement.
- B. Shop Drawings: Submit for Architect's action. Prepare details at a scale not less than 3 in. = 1 ft. Coordinate shop drawings with assemblies in Work Specified Elsewhere.
- C. Samples: Submit for Architect's action. Label samples to indicate product, characteristics, and location in the Work. Samples will be reviewed for color and appearance only. Furnish sufficient samples to establish the full range of colors and textures for materials exposed in the finished work. Compliance with other requirements is the responsibility of the Contractor.
 - 1. Solid Surfacing: 12 in. (300mm) square. Submit each color, pattern and finish.
- D. Quality Assurance/Quality Control Submittals: Submit for Architect's information.

1. Certificates:
 - a. Installer's Qualifications.

E. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc3 - Sourcing of Raw Materials – Forestry Stewardship Council (FSC) Certified Wood: For all wood products designated in this specification as “FSC certified,” provide vendor invoices with the vendor’s Chain-of-Custody (COC) number and identify each FSC certified product on a line-item basis. If FSC wood products are modified off-site by an architectural woodworker or millworker, the woodworker shall have an FSC COC number.
 - d. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.5 QUALITY ASSURANCE

- A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.
- B. Inspection: Secure inspection service of the Woodwork Institute.
- C. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.

1.6 WARRANTY

- A. Warranty: Submit for Owner's documentation. Warranty shall be for a 5 year period, signed by the Contractor, manufacturer, and installer, against defects in materials or workmanship. Make repairs and replacements upon notification of defects.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Do not deliver solid surfacing until painting, finishing, and overhead work are complete in applicable spaces.

- B. Storage: Store solid surfacing in building, out of the way of other construction activities, at a relative humidity of 50 percent to 55 percent at 70 degrees F.

PART 2 – PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Composite Woods: Composite wood and agri-fiber products shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde (NAF).

2.2 MATERIALS

- A. Plastic Products:
 - 1. Solid Surfacing: ANSI Z124.3, Type 5 or 6. Mineral filled acrylic resin material. ASTM E84, Class I. DuPont Zodiaq Quartz Surface, 3/4 in. thickened edge.
 - 2. Plastic Paneling: 3-Form Chroma System, or equal.

2.3 HARDWARE

- A. Fasteners:
 - 1. General: As required by Reference Standard and recommended by manufacturer for intended use.
 - 2. Sheet Metal Screws: Cadmium-plated steel, sizes as shown.
 - 3. Sheet Metal Angles: Fabricate angles from galvanized steel sheet, sizes and gauges as shown.

2.4 FABRICATION

- A. Field Measurements: Verify dimensions at project site so that solid surfacing will accurately fit to adjacent work.
- B. Cut-outs: Make cut-outs required to accommodate work of other Sections in the shop.
- C. Forming and Assembly: Form work to true shapes with accurate surfaces and edges. Completely shop assemble, mark, and disassemble before delivery to Project site any Work which cannot be permanently shop assembled. Assemble partial units in place in a manner that each piece of solid surfacing becomes a unified whole visually and structurally. Fabricate fillers and scribe strips of same materials and finishes as Solid Surfacing with which they are associated.
- D. Hardware: Make cuts for hardware neat and true. Install hardware and fit securely.

- E. Quality of Solid Surfacing: Custom grade. Refer to AWS Section 11.

PART 3 – EXECUTION

3.1 GENERAL

- A. Manufacturer's Instructions: Prepare substrates and install the work, including components and accessories in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions.
- B. Field Dimensions: Verify dimensions and conditions in field and adjust solid surfacing in the shop to accommodate field conditions.

3.2 INSTALLATION

- A. Comply with AWS Section 11. Install Work plumb and level; shim as necessary with concealed shims; accurately scribe and closely fit faceplates, filler strips, and trim strips to irregularities of adjacent surfaces.
- B. Maximum Allowable Gap: 1/16 in.
- C. Installation Requirements: Provide anchoring and fastening devices required, including wood and sheet metal screws, toggle bolts, lag screws and expansion shields, among others.
- D. Hardware Installation: Install auxiliary items after final finishing has been completed. Install hinges to fit snugly, flat in mortises or on surfaces. Turn screws to a flat seat.
- E. Anchorage: Anchor supporting members solidly to surrounding construction to support loads specified and to prevent distortion or misalignment.
- F. Cutting and Trimming: Cut and trim component parts only with the approval of the manufacturer or fabricator. Restore finish completely and remove evidence of cutting and trimming.
- G. Installation Tolerances:
 - 1. Variation from Plane: Limit variation from plane or location shown to 1/8 in. in 10 ft.; 1/4 in. over total length.
 - 2. Alignment: Where surfaces abut in line and at corners and where surfaces are separated by less than 1/4 in., limit offset from true alignment to less than 1/32 in.
 - 3. Offsets In End-To-End Or Edge-To-Edge Alignment Of Consecutive Members: 1/16 in. maximum offset in any alignment.

3.3 ADJUSTING AND CLEANING

- A. Defective Work: Touch-up, refinish, or replace damaged, stained, scratched, or otherwise disfigured portions of the Work to the satisfaction of the Architect.

- B. Cleaning: Following completion of installation, clean both inside and outside surfaces of Solid Surfacing.

3.4 PROTECTION

- A. General: Protect Solid Surfacing against damage until Work is accepted.

END OF SECTION

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SECTION 066400
PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Glass-Fiber-Reinforced Polyester Panels.

- B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood furring for installing paneling.

- 2. Section 079200 "Joint Sealants."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Samples: For paneling and trim accessories, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

- A. Testing Agency: Acceptable to authorities having jurisdiction.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain paneling and trim accessories from single manufacturer.

2.2 SHEET PANELING

- A. Glass-Fiber-Reinforced Polyester Panels: Fiberglass reinforced thermosetting polyester resin panel sheet complying with ASTM D5319.
 - 1. Basis-of-Design: Marlite "Marlite Standard Panels" or equal.
 - 2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 200 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 3. Nominal Thickness: Not less than 3/32-inch nominal.

2.3 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
 - 1. Color: To match fiber-reinforced paneling.
- B. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- C. Adhesive: As recommended by paneling manufacturer.
- D. Sealant: Refer to Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- D. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
 - 1. Mark plumb lines on substrate at panel joint locations for accurate installation.

3.3 INSTALLATION

- A. Install paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- D. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- E. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

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SECTION 070921
SITE CONCRETE WATER REPELLENTS

PART 1 — GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Site Water Repellents for Concrete Paving, Concrete Planter Walls, Concrete Planter Biotreatment Walls, Concrete Walls.
- B. For Site Concrete, see Section 321316.
- C. For Site Concrete Sealants, see Section 321373.

1.2 DEFINITIONS

- A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of the District’s representative in writing.

1.3 REFERENCES

- A. EPA — Environmental Protection Agency:
 - 1. VOC regulations. Most current edition.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Water Repellent.
 - 2. Anti-Graffiti Protection.
- B. Manufacturers’ Current Printed Instructions:
 - 1. Water repellent.
 - 2. Anti-Graffiti Protection.
- C. Test Results:
 - 1. Water repellent manufacturer’s test application on field samples.
 - 2. Anti-Graffiti Protection manufacturer’s test application on field sample, test performance.
- D. Manufacturer’s Field Reports:
 - 1. Water Repellent Manufacturer: Submit within 5 working days of each visit written and photographic documentation of field visits clearly documenting in detail observations, meetings, conversations, recommendations and approvals.

1.5 QUALITY ASSURANCE

- A. Contractor Qualifications:

1. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.
 2. Applicator shall have a minimum of 5 years experience in application of specified products and systems on projects of similar size and scope, and is acceptable to product manufacturer.
 3. Applicator shall have successfully completed a minimum of 5 projects of similar size and complexity to specified Work.
 4. Applicator shall be approved by water repellent manufacturer.
- B. Field Samples:
1. Concrete Water Repellents and Anti-Graffiti Coating
 2. Install at Project site an area for field sample.
 3. Concrete Water Repellents: Provide sample at Concrete Paving Field Sample include surface preparation, application of sealant, and allow for evaluation of repellent performance and finish.
 4. Anti-Graffiti Coating: Provide sample at Concrete Retaining Wall Field Sample to include surface preparation and allow for evaluation of repellent performance and finish.
 5. Conduct RILEM test on cured field sample. Adjust application until required repellent performance is achieved.
 6. Manufacturer's representative or designated representative will review technical aspects, surface preparation, application, and workmanship.
 7. Construct as many samples as necessary to achieve an accepted finish over the entire surface of the sample.
 8. Samples which are completely or partially finished incorrectly will be rejected.
 9. Place the accepted sample in a location where the applicators can easily reference the sample finish.
 10. Accepted field sample will be standard for judging workmanship on remainder of Project.
 11. Do not alter, move, or destroy field sample until Work is completed and accepted by Owner's representative.

1.6 REGULATORY REQUIREMENTS

- A. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work, including EPA VOC regulations.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Deliver materials to job site in new, original, and unopened containers bearing manufacturer's name, trade name, and label analysis.
- C. Meet requirements of manufacturer's current printed instructions.
- D. Handle materials to prevent spillage, container breakage or other damage.

- E. Store in unopened containers in a cool, dry area. Keep material from freezing in the container; do not store below 35 degree F (2 degree C) or above 100 degrees F (43 degrees C).

1.8 SITE CONDITIONS

- A. Environmental Requirements: Meet requirements of the manufacturer's current printed instructions.

1.9 WARRANTY

- A. Contractor's Warranty:
 - 1. In addition to manufacturer's warranties, warrant Work for a period of 5 years from date of Final Completion against defects in materials and workmanship.
 - 2. Warranty shall also cover repair of damage to other materials and workmanship resulting from defects in water repellent materials and workmanship.
 - 3. Contractor shall not be held responsible for failures due to normal wear, neglect by District, vandalism and other causes outside Contractor's control.
- B. Manufacturer's Warranty:
 - 1. Warranty period:
 - a. Horizontal Surfaces: 5 years from date of Final Completion.
 - b. Vertical Surfaces: 10 years from date of Final Completion.
 - 2. Performance: If surfaces coated show water penetration through structurally sound areas, or if spalling occurs from chloride salt damage or freeze-thaw damage within warranty period, water repellent manufacturer shall supply material and labor to re-coat problem areas with coatings at no cost to District.
 - 3. Products: Warrant products to be free of defects in material and workmanship under normal use and service during warranty period.
 - 4. Warranty conditions:
 - a. Substrates shall be approved in the field by manufacturer.
 - b. Product shall be applied by a manufacturer-approved applicator.
 - c. Application shall meet requirements of manufacturer's current printed instructions.
 - 5. Exceptions: Warranty shall not apply to leakage or damage resulting from cracking, scaling, concrete faultings, joint areas requiring caulking or sealants, or other problems beyond the control of the water repellent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Water Repellent:
 - 1. BASF – www.master-builders-solutions.basf.us.
 - 2. Or accepted equal.
- B. Anti-Graffiti Coating :
 - 1. Tex-Cote www.texcote.com
 - 2. Or accepted equal.

2.2 MATERIALS

- A. Water Repellent:
 - 1. MasterProtect H400.
 - 2. Or accepted equal.
- B. Anti-Graffiti Coating:
 - 1. Graffiti Gard IV Low Luster
 - 2. Or accepted equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- C. Verification of Conditions: Examine site and verify that substrate and other conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
- D. Notification of Unsuitable Conditions: Before proceeding with Work, notify District and District's representative in writing of unsuitable conditions.

3.2 PREPARATION

- A. Protection:
 - 1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
 - 2. Provide protective coverings, barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
 - 3. Completely mask off adjacent areas to protect against damage by water repellent.
 - 4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 - 5. Submit written notification of conditions damaged during construction to the District and District's representative immediately.
- B. Surface Preparation:
 - 1. Meet requirements of water repellent manufacturer's current printed instructions for each substrate condition.
 - 2. Surfaces shall be clean, structurally sound, and fully cured (28 days). Remove all dust, dirt, paint, bitumens, efflorescence, oil, pollution deposits, and curing, forming, and parting compounds.
 - 3. Complete application of sealants, pointing, and restoration work in conjunction with applying water repellent. Allow to cure. Repair materials shall be compatible with water repellent.
 - 4. Treat and remove alkali and efflorescence with proper neutralizing compound recommended by concrete or admixture supplier.

3.3 FIELD APPLICATION

- A. Manufacturer's Requirements: Meet requirements of water repellent manufacturer's current printed instructions and Material Safety Data Sheet (MSDS).

- B. Application Schedule:
 - 1. Apply water repellent to surfaces as soon as possible after installation of substrate Work and prior to winter weather.
- C. Application:
 - 1. Apply to all exposed site concrete surfaces.
 - 2. Apply with low pressure airless spray equipment, or other method approved by water repellent manufacturer.
 - 3. Apply to saturation.
 - 4. Fully saturate mortar and grout joints.
- D. Coverage:
 - 1. Because of variations in surface density, the following coverage rates are approximate and for estimating purposes only:
 - 2. MasterProtect 400: 100 - 200 square feet per gallon.
 - 3. Make test applications on actual surfaces to more accurately determine coverage rates and effectiveness of water repellent.
 - 4. Very porous surfaces may require 2 coats.

3.4 CURING

- A. Protection: Keep treated surface dry and free from staining materials for 72 hours depending on the surface.

3.5 FIELD QUALITY CONTROL

- A. Water Repellent Manufacturer's Field Services:
 - 1. Coordinate, schedule and hold a test application and pre-application instruction meeting with the manufacturer's representative to review the manufacturer's application and warranty requirements.
 - 2. Conduct test applications on mock-ups or field samples of the materials to receive water repellent to verify percentage solids required and coverage rate.
 - 3. Require attendance by personnel involved with substrate preparation and repellent application.
 - 4. Coordinate, schedule and be present during additional field visits recommended by manufacturer.
 - 5. Submit to District and District's representative manufacturer's field reports documenting test results, direction given to contractor, substrate approvals, and other observations within 3 days of each field visit.
 - 6. Work will be rejected if manufacturer's field service and reports are not provided.
- B. Field Observation Reviews by District's representative: Coordinate and schedule with District's representative.

3.6 CLEANING

- A. General: Clean Work as recommended by the water repellent manufacturer and keep clean until District accepts maintenance.

END OF SECTION

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SECTION 071326

SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Blindsight sheet waterproofing.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Prior to commencement of field operations, a pre-installation conference with the manufacturer's representative shall be held to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
 - 1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.
- C. Samples: For each exposed product and for each color and texture specified, including the following products:
 - 1. 8-by-8-inch (200-by-200-mm) square of waterproofing and flashing sheet.

D. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 1. Warranty Period: Ten years from date of Substantial Completion.
- B. Installer's Warranty: Installer agrees to repair or replace waterproofing material that does not comply with requirements or that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 MATERIALS, GENERAL

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials from single source from single manufacturer.

2.3 BLINDSIDE SHEET WATERPROOFING

- A. Bonded HDPE or Polyethylene Sheet for Blindside Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of either an HDPE film coated with pressure-sensitive adhesive and protective release liner, total 46-mil (1.2-mm) thickness, or a cross-laminated film of low- and medium-density polyethylene, coated with a modified asphalt layer and a nonwoven geotextile-fabric final layer, total 95-mil (2.4-mm) thickness; with the following physical properties:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following, or equal:
 - a. GCP Applied Technologies Preprufe 300R Plus.
 - 2. Tensile Strength, Film: 2000 psi (13.8 MPa) minimum; ASTM D 412.
 - 3. Low-Temperature Flexibility: Pass at minus 10 deg F (minus 23 deg C); ASTM D 1970.
 - 4. Peel Adhesion to Concrete: 5 lbf/in. (875 N/m) minimum; ASTM D 903, modified.
 - 5. Lap Adhesion: 2.5 lbf/in. (440 N/m) minimum; ASTM D 1876, modified.
 - 6. Hydrostatic-Head Resistance: 231 feet (70 m); ASTM D 5385, modified.
 - 7. Puncture Resistance: 200 lbf (890 N) minimum; ASTM E 154.
 - 8. Water Vapor Permeance: 0.01 perms (0.6 ng/Pa x s x sq.m) maximum; ASTM E 96/E 96M, Water Method.
 - 9. Water Absorption: 0.5 percent maximum; ASTM D 570.
- B. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

2.4 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 - 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Self-Adhesive, Cold-Applied Composite Sheet Waterproofing: GCP Applied Technologies "Bituthene 4000" or equal; 1.4 mm (0.056 in.) of rubberized asphalt and 0.1 mm (0.004 in.) of cross-laminated, high density polyethylene film specially formulated for use with water-based surface conditioner. Provide rubberized asphalt membrane covered with a release sheet, to be removed during installation without special adhesive or heat required to form laps.
- C. Surface Treatment: GCP Applied Technologies "Bituthene Deck Prep" or equal; low viscosity, two component, asphalt-modified urethane coating for leveling and repair of concrete deck surfaces prior to application of sheet waterproofing.
- D. Waterstop: GCP Applied Technologies "Adcore ES" or equal; synthetic, hydrophilic, strip waterstop.
- E. Drainage composite: GCP Applied Technologies "Hydroduct 220" or equal; 11mm thick sheet, consisting of polystyrene core covered filter fabric on one side and polymeric film on the other.
- F. Tape: GCP Applied Technologies "Preprufe Tape and Preprufe CJ Tape" or equal; two-sided pressure sensitive adhesive and weather resistant protective coating with release liner.
- G. Metal Termination Bars: Hohmann and Barnard, Inc., or equal; predrilled Type 304 stainless-steel bars, dimensions as shown on Drawings; provide fasteners and Foam-Tite Seal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
 - 1. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

3.3 BLINDSIDE SHEET-WATERPROOFING APPLICATION

- A. Install bonded blindside sheet waterproofing according to manufacturer's written instructions.
- B. Place and secure molded-sheet drainage panels over substrate. Lap edges and ends of geotextile to maintain continuity.
- C. Horizontal Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.
- D. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.
- E. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.
- F. Install sheet-waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.
- G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches (150 mm) beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

3.4 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

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SECTION 071900

WATER AND GRAFFITI REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work Included: The scope of this section includes Graffiti Resistant Coatings, for use on Exterior Concrete. Extent of Coatings shall be selected by Architect and Owner's Representative during Concrete Mockup.
- B. Work Specified Elsewhere:
 - 1. Cast-in-Place Concrete: Section 033001.
 - 2. Concrete Finishing: Section 033500.

1.3 SUBMITALS

- A. Samples: Submit for Architect's action. Following listed samples; others, if specifically requested.
 - 1. Water-Repellent Coating: Applied to each type of substrate to receive coating; 12-inches-square.
 - 2. Graffiti-Repellent Coating: Applied to each type of substrate to receive coating; 12-inches-square.
 - 3. 2-Coat System: Applied to each type of substrate to receive coating; 12-inches-square. Cover entire sample with Water-Repellent Coating. Add Graffiti-Repellent Coating to half of sample.
- B. Product Data: Submit for Architect's action. Manufacturer's specifications data, and application instructions.
- C. Certificates: Submit for Architect's information.
 - 1. Compatibility: Manufacturer's written statement that water repellent coating will not affect performance and appearance of substrate materials, sealants, metal finishes, and glass surfaces.

- D. Mock-Up Documentation: Provide written information as a submittal prior to field review of the mock-up indicating the location, products and materials used, dates scheduled for observation, and any other information pertinent to the construction of the Mock-up. Corrections, if any, shall also be submitted in writing along with any field reports that have been generated.
- E. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 QUALITY ASSURANCE

- A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.
- B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.
 - 1. Special Requirements: Regulatory Agencies: Use materials for Work of this Section which comply with volatile organic compound limits and other regulations of local Air Quality Management District and other local, state, and federal agencies having jurisdiction.
- C. Mock-up: After approval of submitted samples by Architect, apply water repellents to Architectural Concrete mock-ups, as specified in Section 033500 "Concrete Finishing." Water and graffiti repellents shall be applied to portion of mock-up, as directed by the Architect, in order to examine differences between treated and untreated concrete.

1.5 PRODUCT HANDLING

- A. Delivery: In manufacturer's original sealed containers identified with manufacturer's name and product type.
- B. Storage: Per manufacturer's instructions.

1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Do not apply when ambient or surface temperature exceeds 100 degrees F; when ambient temperature is less than 40 degrees, unless by manufacturer; when air is dust-laden; during rainy weather; nor if rain is anticipated within 2 hours of application.

1.7 SEQUENCING AND SCHEDULING

- A. General: At Contractor's option, water repellent coating may be applied before sealant work is started or after sealant work is completed. After selection, coordinate with Section 079200 for proper sequencing.
- B. Application Before Starting Sealant Work: Do not apply sealant until coating is dry. Obtain written permission from coating manufacturer before proceeding.
- C. Application After Completing Sealant Work: Do not apply coating until sealant work is completely cured. Obtain written permission from sealant manufacturer before proceeding.

1.8 EXTENDED WARRANTIES

- A. Labor & Material Warranty, Water-Repellent Coating: Prepared and signed by manufacturer and applicator. Warrant coating against defective material, workmanship, seepage, leakage, water absorption, and that substrate will remain water repellent for a period of twenty years.
- B. Labor & Material Warranty, Graffiti-Repellent Coating: Prepared and signed by manufacturer and applicator. When coating is applied and cleaned in accordance with published application instructions, coating shall render the treated sound substrate graffiti resistant for the full warranty period of ten years or ten cleaning cycles from the date of application.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 MATERIALS

- A. Water-Repellent Coating (1st coat): Evonik Industries "Protectosil Chem-Trete BSM 400-BA." Made form silane (alkyltrialkoxysilanes). Low-VOC formula for San Francisco Bay Area. Will not leave a residue on nonporous substrates, such as glass, metal or painted surfaces. Breathable system. Reactive, penetrating sealer.
- B. Graffiti-Repellent Coating (2nd coat): Evonik Industries "Protectosil Antigraffiti." Water-based silane, breathable, antigraffiti treatment for masonry, concrete and natural stone. VOCs: <

20g/l. Standard non-hazardous cleaners and low pressure waterblasting are sufficient removal methods for most graffiti.

- C. Characteristics: No staining nor discoloration of treated substrate. No change in surface reflectivity when dry.

PART 3 - EXECUTION

3.1 GENERAL

- A. Manufacturer's Instructions: Prepare substrates and apply the work, including components and accessories, in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified.
- B. General: Examine substrates to receive anti-graffiti coating to assure conditions are satisfactory for application. Verify that cementitious substrates have cured for at least 28 days. Give written notification of deficiencies. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Protection: Protect adjacent work, plant materials, and asphalt based materials from overspraying by masking, drop cloths, or other methods as recommended by manufacturer.
- B. Surface Preparation: Clean surfaces of dirt, dust, oil, wax, efflorescence, and other foreign material as required by manufacturer. Use methods that do not affect substrate texture or finish.

3.3 APPLICATION

- A. General: Apply coating(s), where shown on Drawings, by low pressure airless spray equipment per manufacturer's recommendations; no dilution of coating permitted. Coating(s) selection will be made by Architect and Owner's Representative during the Concrete Mock-up review.
- B. Application:
 - 1. General: Surface shall be sufficiently dry so spray pattern can be observed during application.
 - 2. Apply coating(s) from bottom to top to prevent run off and in one stroke to prevent overlapping.
 - 3. Rub liquid droplets away with a brush before they can dry.
- C. Schedule: Coat exterior concrete surfaces. Provide number of coats per product, as required by manufacturer to grant specified warranties.

3.4 FIELD QUALITY CONTROL

- A. General: Application shall be observed by manufacturer as required to assure proper application and coverage of coating.
- B. Field Test: Before proceeding with Work, apply coating to a 100- square-foot area, where directed, on each type of substrate. Manufacturer's representative shall perform RILEM II.4 Water Absorption Tube Test. The test measures the rate at which water moves through porous materials. Obtain written verification from manufacturer that coating has reacted properly with substrate.

3.5 CLEANING

- A. General: Remove stains and other discolorations that may be caused by coating from metal and glass surfaces per manufacturer's recommendations.

END OF SECTION

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SECTION 072100
BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Mineral Wool Board at Exterior Rainscreens
- 2. Polyisocyanurate Insulation at Penthouse Roof, Atrium Roof, Roof Wells, and Terraces.
- 3. Unfaced Glass-Fiber Blanket Insulation.
- 4. Interior Acoustic Batt Insulation.

B. Related Sections:

- 1. Section 035216 "Lightweight Insulating Concrete" for expanded polystyrene insulation (EPS) to be used in conjunction with Elastizell.
- 2. Section 061600 "Sheathing" for board sheathing over steel framing.
- 3. Section 072500 "Weather Barriers."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Plans and Elevations indicating extent of each type of exterior insulation.

C. LEED Submittals:

- 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. PS EPD: Products specified under this section shall have a Type III Product Specific EPD.
- B. Ceilings, Walls, Thermal and Acoustic Insulation: All ceilings, thermal insulation, acoustic insulation, products provided under this specification section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 CALIFORNIA ENERGY CODE REQUIREMENTS

- A. Manufacturers shall certify that insulating materials comply with *California Quality Standards for Insulating Materials* (CCR, Title 24, Part 12, Chapters 12-13), which ensure that insulation sold in the state performs according to stated R-values and meets minimum quality, health, and safety standards. Builders may not install insulating materials, unless the product has been certified by the Department of Consumer Affairs, Bureau of Home Furnishing and Thermal Insulation. Builders and enforcement agencies shall use the Department of Consumer Affairs *Directory of Certified Insulation Material* to verify the certification of the insulating material.
- B. Exposed installations of faced mineral fiber and mineral aggregate insulations shall use fire retardant facings that have been tested and certified not to exceed a flame spread of 25 and a smoke development rating of 450. Insulating facings that do not touch a ceiling, wall, floor surface, and faced batts on the underside of roofs with an air space between the ceiling and facing are considered exposed applications.

2.3 POLYISOCYANURATE INSULATION

- A. Manufacturers: Sika Sarnafil, or equal.
- B. Rigid polyisocyanurate foam insulation with black mat facer on both surfaces, 25 psi compressive strength.

2.4 MINERAL-WOOL BOARD INSULATION

- A. Manufacturers: Rockwool, or equal.

- B. Mineral-Wool Board, Types IA and IB, Unfaced: ASTM C612, Types IA and IB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics. Nominal density of 4 lb/cu. ft.

2.5 GLASS-FIBER BLANKET INSULATION

- A. Glass-Fiber Blankets: ASTM C665, Type I unfaced blanket insulation with water-resistant binders produced by combining fiberglass with thermosetting resins, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84. Provide one of the following, or equal:
 - 1. "Formaldehyde-Free Fiberglass Insulation Enhanced with Bio-Based Binder" (Johns Manville).
 - 2. "EcoTouch Flame Spread 25 Fiberglass Insulation" (Owens Corning).
 - 3. "Sustainable Insulation, Fiber Glass Building Insulation" (CertainTeed).
 - 4. "EcoBatt Insulation with ECOSE Technology" (Knauf Insulation).

2.6 INTERIOR ACOUSTIC BATT

- A. Glass-Fiber Blankets: Provide at rated and non-rated partitions, in accordance with the Partition Schedule indicated on the drawings. ASTM C665, Type I unfaced blanket insulation with water-resistant binders produced by combining fiberglass with thermosetting resins, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84. Provide one of the following, or equal:
 - 1. "Formaldehyde-Free Fiberglass Insulation Enhanced with Bio-Based Binder" (Johns Manville).
 - 2. "EcoTouch Flame Spread 25 Fiberglass Insulation" (Owens Corning).
 - 3. "Sustainable Insulation, Fiber Glass Building Insulation" (CertainTeed).
 - 4. "EcoBatt Insulation with ECOSE Technology" (Knauf Insulation).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice or rain at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

- B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

END OF SECTION

SECTION 072616
CONCRETE VAPOR TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes Concrete Vapor Treatment.
- B. Related Requirements:
 - 1. Section 09 6516 "Resilient Sheet Flooring."
 - 2. Section 09 6519 "Resilient Tile Flooring."
 - 3. Section 09 6813 "Tile Carpeting."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.

1.4 INFORMATIONAL SUBMITTALS

- A. Test Reports: Independent laboratory testing to support specified ASTM performance.
- B. Certificates:
 - 1. Installer's Qualifications

1.5 CLOSEOUT SUBMITTALS

- 1. Warranties.

1.6 QUALITY ASSURANCE

- A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.
- B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.
- C. Pre-Installation Meetings: Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include the Owner, Architect, Architect's consultants, Contractor, and subcontractors whose work is relevant to this Specification Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading: Deliver packaged materials to the project site in manufacturer's original, unopened containers with seals unbroken and labels indicating brand names, colors, patterns, and quality designations legible and intact.
- B. Storage and Protection: Do not open containers or remove labels until materials have been inspected and accepted.

1.8 FIELD CONDITIONS

- A. Environmental Conditions: Install system treatments when concrete surface temperatures exceed 60°F and rain is not expected during scope.

1.9 WARRANTY

- A. Performance Warranty: Application of preventative system shall yield a water vapor emission rate of not more than 2.5 (± 0.50) per ASTM F1869 and an alkaline value of less than 9.0pH. In the event flooring systems are installed with the use of the corrective system, warranty shall extend to the finished flooring materials for a period of fifteen (15) years. Warranty to include repair or replacement of flooring damaged by moisture vapor emission rates above specified rates at no cost to Owner. Issuance of warranty shall not remove 2.5 (± 0.50) performance requirement.
- B. Flooring Warranty: Product warranty shall apply to the sustainability of flooring products, adhesion and moisture resistance. In the event flooring products are damaged during a fifteen (15) year period by substrate by water vapor emission rates exceeding 2.5 (± 0.50) and alkaline value greater than 9.0pH, manufacturer and installer shall include replacement of flooring materials, adhesives, water vapor emission and alkalinity control systems, and labor costs for removal and replacement of those products.
 - 1. Warranty shall not exclude concrete cracking.
 - 2. Warranty shall be transferable and non-prorated.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 MANUFACTURERS

- A. Basis-of-Design Products: The design for water vapor emission and alkalinity control systems is based on a two-coat polymer-resin-based (non-silicate) system. "Synthetic 30" (Synthetics International) www.SyntheticsIntl.com, "VRS" (Diamond Stone Products) www.DiamondStoneProducts.com, "Vapor Seal 309" (Floor Seal Technology, Inc.) www.Floorseal.com, or equal.

2.3 CONCRETE VAPOR TREATMENT

- A. Liquid applied two-component polymer (non-silicate) based penetrating treatment. Two-coat application for the suppression of moisture, alkaline salts, crack resistance and flooring compatibility.
- B. Physical Properties:
 - 1. Product Color: White or clear
 - 2. Application: Two (2) coat
 - 3. Film Forming: Polymer (non-silicate) based
 - 4. Flooring Ready: 10 - 24 hours
 - 5. Foot Traffic: 8 hours
 - 6. Compatibility: All Flooring Systems
 - 7. Film Thickness: 6 – 10 mill total
 - 8. Solid Content: 36 to 60 percent
 - 9. Spread Rate: 160 - 200 square feet total
 - 10. Crack Control: Two-coat application for crack bridging properties
 - 11. VOC Content: Refer to Section 01 81 13 "LEED Requirements."
 - 12. Environmental: Solvent free, non-corrosive
 - 13. Vapor Reduction: 75 - 95% per ASTM E96 (30.0 lbs. to 2.0 lbs. per ASTM F1869)
 - 14. Alkali Resistance: Resistant to 30 day exposure to 4pH per ASTM D1308
 - 15. Potassium Hydroxide: Resistant to 30 day exposure to 35% per ASTM D1308
 - 16. Concrete Adhesion: 500 - 600psi per ASTM D4541
 - 17. Relative Humidity: 100% suppression per ASTM F2170
 - 18. Alkalinity Control: 14pH per ASTM F710

2.4 ACCESSORIES

- A. Concrete Moisture Kits: Commercially packaged anhydrous calcium chloride test kits by American Moisture Test, Inc. (866) 670-9700 www.DomeTest.com
- B. B. Cement Topcoat: Self leveling cement based product meeting a compressive strength of 4,000psi and approved by treatment manufacturer.
 - 1. Non-porous primer as required for direct adhesion to treatment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Applicator present.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare and scarify concrete surfaces not less than 90 days prior to moisture testing and installation of resilient flooring and carpet.
- B. Preparation: Grind down high spots and protrusions; clean concrete of debris and dust; and fill cracks, cavities, and low spots with a cement-based compound. Gypsum-based underlayment and filler materials not permitted.
- C. Concrete Surface: Shot- or bead-blast to scarify surface.

3.3 APPLICATION

- A. General: Provide vapor control membrane at following locations when scheduled to receive resilient flooring or carpet or wood flooring.
 - 1. Concrete slabs at or below grade.
 - 2. Suspended concrete slabs which do not comply with acceptable moisture emission criteria, as specified in the flooring Section or as required by the flooring manufacturer to provide the specified warranty.
- B. Apply by lint free nap roller at a rate of 200 - 250 square feet per gallon and allow to cure for 12 hours.
- C. Re-apply product at a rate of 200 - 250 square feet per gallon for improved crack resistance, moisture vapor reduction and film thickness.

3.4 FIELD QUALITY CONTROL

- A. Perform moisture testing directly to control system surface at a rate of one (1) test, for each 1,000 square feet of finished floor covering per ASTM F1869.
- B. Re-apply control system in areas where concrete testing exceeds vapor emissions tolerances.

END OF SECTION

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SECTION 072726

FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Vapor permeable, air and water-resistive, barrier system.
- B. Related Sections:
 - 1. Section 061600 "Sheathing".
 - 2. Section 076200 "Sheet Metal Flashing and Trim".
 - 3. Section 079200 "Joint Sealants".

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, submit manufacturer's technical datasheets, installation instructions, SDS, and warranty for approval.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
 - 2. Submit letter from primary materials manufacturer indicating approval of products not manufactured by primary manufacturer.
 - 3. Include statement that materials are compatible with adjacent materials proposed for use.
 - 4. Submit reports indicating that field peel-adhesion test on all materials to which sealants are adhered have been performed and the changes made, if required, to other approved materials, in order to achieve successful adhesion.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier materials, accessories, and assemblies specific to Project conditions.
 - 2. Include project specific details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 3. Include project specific details of interfaces with other materials that form part of air barrier.
 - 4. Include letter from manufacturer indicating that the project specific details and shop drawings have been reviewed and are approved for use.

- C. Samples: Submit clearly labeled samples, 3 inch by 4 inch minimum size of each material specified.
- D. Field Test Results: Submit mockup and in-situ test results of air leakage test and water leakage test with specified standards, including retesting if initial results are not satisfactory.
- E. Product Certificates: From air-barrier manufacturer, certifying permanent chemical and adhesive compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier, and certifying that cleaning materials used during installation are chemically compatible with each of the adjacent materials proposed for use.
- F. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- G. Fire Test Reports: Provide NFPA 285 assembly test report.
- H. Sample Warranty: Manufacturer and Installer sample warranty.
- I. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.5 QUALITY ASSURANCE

- A. Manufacturer Requirements:
 - 1. Provide an ICC-ES Evaluation report confirming compliance with AC212 Water-Resistive Coating Used as Water-Resistive Barriers over Exterior Sheathing.
 - 2. Provide a Clean Air Gold product certification verifying conformance to ANSI/ BIFMA e3 standard credits 7.6.1, 7.6.2 and/or credit 7.6.3, which includes California Department of Public Health (CDPH) Standard Method v1.2 01350 (2017), as well as conformance to low-emitting materials for WELL and LEED.
 - 3. Contractor Qualifications.
- B. Installer Qualifications:
 - 1. A qualified firm that is approved, authorized, or licensed by the manufacturer to install manufacturer's product, that is eligible to receive manufacturer's special warranty, and is experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
 - a. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- C. Preconstruction Meeting:
 - 1. Convene minimum of four weeks prior to commencing Work of this section, in accordance with Div. 01 General Requirements.
 - 2. Attendees shall include Contractor, Installer, and air barrier manufacturer's representative.
 - 3. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

D. Mock-Up

1. Prior to installation of air barrier, apply air barrier to verify details under shop drawing submittals and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as method of execution.
2. Build mockups to set quality standards for materials and execution. Mockup to be first-in-place installation, at least three sheets of sheathing wide and two sheets high. Include minimum of one typical window opening and transition to horizontal waterproofing.
 - a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - b. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturers original, unopened, undamaged containers with identification labels intact.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Store in original, unopened containers. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
 1. Protect substrates from environmental conditions that affect air-barrier performance.
 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.8 WARRANTY

- A. Provide manufacture's 20-year material warranty.
 1. Ensure all manufacturers installation guidelines, specifications, details, and warranty requirements are met.
 2. Warranty Period: 20 years from date of substantial completion.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357, Specimen 2.

2.2 MANUFACTURER

- A. Manufacturer: Momentive Performance Materials, Inc., 260 Hudson River Rd., Waterford, NY 12188. Phone: +1 877-943-7325, www.ge.com/silicones

2.3 MATERIALS

- A. Fluid-Applied Air Barrier:
 - 1. Basis-of-Design: GE Elemax 2600, or equal. Silicone air and water-resistive barrier coating. Barrier is vapor permeable.
- B. Liquid Flashing (Detail Sealant/Adhesive): GE Elemax 5000 Liquid Flashing, or the following equal alternates:
 - 1. GE SCS2000 SilPruf.
 - 2. GE SCS2700 SilPruf LM.
 - 3. GE SCS9000 SilPruf NB.
 - 4. GE SWS.
- C. Reinforcing Fabric: RF100. Widths as indicated on Drawings.
- D. Sheet Flashing: GE Elemax SS Flashing. Widths as indicated on Drawings.
- E. Silicone Transition Membrane: GE UST2200 UltraSpan. Widths as indicated on Drawings.
- F. Pre-cured silicone molded corners: GE USM UltraSpan inside and outside corners.

2.4 ACCESSORY MATERIALS

- A. Transition Membrane: Between Air Barrier Membrane and Other Adjacent Materials: Comply with both air barrier manufacturer's recommendations and adjacent material manufacturer's recommendations.
 - 1. Fluid Applied Flashing: Manufacturer's standard trowel grade liquid flashing.
 - a. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.
 - 2. High Temperature Modified Bituminous Strip: 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.
 - a. For use under metal copings and flashings directly exposed to the exterior.
 - 3. Self-adhering Stainless Steel Flexible Flashing:
 - a. York Manufacturing, Inc.; York 316 SS
 - b. Characteristics:
 - 1) Type: stainless steel core with one stainless steel face (outward facing) with a butyl block co-polymer adhesive (inward facing)Type: stainless steel core with one stainless steel face (outward facing) with a butyl block co-polymer adhesive (inward facing).
 - 2) Stainless steel: type 316, ASTM A240. Domestically sourced per DFARS 252.225-7008 and/or DFARS 252.225-7009.

4. Elastomeric Flashing Sheet: ASTM D 2000, 2BC415 to 3BC620, minimum 50- to 65-mil- (1.3- to 1.6-mm-) thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with stainless-steel termination bars and fasteners.
5. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of translucent cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
 - a. Dow Corning Corporation; Silicone Transition Strip System.
 - b. Momentive Performance Materials Inc.; US11000 UltraSpan.
 - c. Tremco Incorporated; Proglaze ETA Connections or Spectrum Simple Seal
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- C. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- D. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- E. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch (0.5 mm) thick, and Series 300 stainless-steel fasteners.
- F. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 07 92 00 "Joint Sealants."
- G. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.
- H. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel bars, approximately 1 inch by 1/8-inch thick; with anchor spacing of 9 inches on center minimum unless otherwise required by the manufacturer. Provide galvanized sheet metal backup plate at locations where adequate substrate is not available for securing the termination bar.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 1. Verify that substrates are sound and free of oil, grease, dirt, or other contaminants.
 2. Perform moisture testing as required by air-barrier manufacturer for test type, rate, and quantity to validate that substrate is acceptable, dry, and free of moisture.
 3. Verify that the minimum drying period recommended by air barrier system manufacturer has passed. Perform moisture content testing as required by the air barrier system manufacturer to verify concrete is acceptable for installation of air barrier.
 4. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form release agents, paints, curing compounds and other penetrating containments or film forming coatings from concrete.

- D. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- E. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- F. Sheathing joints must be treated per manufacturer's installation details.
- G. Spot all over and under drive fasteners with liquid flashing or Fluid-Applied Membrane Air Barrier.

3.3 JOINT TREATMENT

- H. Gypsum Sheathing: Fill joints greater than 1/4 inch (6 mm) with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 ACCESSORIES INSTALLATION

- A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
 1. Prior to application of air barrier, treat all sheathing joints and fasteners per manufacturer's written instructions.
 2. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 3. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
 4. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 5. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Provide liquid flashing at all rough openings. Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply preformed silicone extrusion so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
 1. Fluid Applied Flashing.
 2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

- G. Seal strips and transition strips around penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Seal top edge of transition membranes.
- K. Seal over seams and edges of transitions membranes with silicone sealant where in contact with silicone transition or perimeter sealant joints.
- L. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 FLUID-APPLIED MEMBRANE INSTALLATION

- A. Transition/Detailing treatment: Install appropriate materials to treat sheathing joints, expansion joints, drift joints, rough openings, transitions, terminations, penetrations and similar surface irregularities. Transitions and detailing can be performed before or after air barrier membrane application. Ensure installation is performed in accordance with manufacturers written installation instructions and details.
 1. Sheathing joints <math><1/2\text{''}</math> (13 mm) may be treated with any of the following methods:
 - a. Liquid flashing installed per manufacturers installation details.
 - b. 4" (102 mm) Reinforcing Fabric properly embedded in Fluid-Applied Air Barrier and centered on joint.
 2. Inside or outside corners. Ensure liquid flashing or reinforcement extends a minimum 3" (76 mm) onto each angle change. Any of the following methods may be utilized:
 - a. Liquid flashing installed per manufacturers installation details.
 - b. 6" (152 mm) Reinforcing Fabric properly embedded in Fluid-Applied Air Barrier and centered on corner.
 - c. 6" (152 mm) Sheet Flashing properly centered on corner.
 - d. Silicone Transition Membrane properly set in liquid flashing and centered on corner.
 3. Rough Openings. Ensure liquid flashing or reinforcement extends a minimum 3" (76 mm) onto vertical wall and into rough opening. Any of the following methods may be utilized:
 - a. Liquid flashing installed per manufacturers installation details.
 - b. Minimum 6" (152 mm) GE RF100 properly embedded in Fluid-Applied Air Barrier.
 - c. Minimum 6" (152 mm) Sheet Flashing installed per manufacturer's installation details.
 - d. Minimum 6" (152 mm) Silicone Transition Membrane properly set in GE liquid flashing.
 - e. Silicone Transition Membrane outside corners may be utilized in combination with any of the above methods.
 4. Pipe or Duct Penetrations may be treated with any of the following methods:
 - a. Liquid flashing applied around entire perimeter and properly tooled.
 - b. Reinforcing Fabric properly embedded in Fluid-Applied Air Barrier. Ensure Reinforcing Fabric extends a minimum 2" (50 mm) onto wall.
 5. Static Joints >math>>1/2\text{''}</math> (13 mm), Expansion Joints and Drift Joints may be treated with any of the following methods:
 - a. Minimum 6" (152 mm) Silicone Transition Membrane properly set in liquid flashing or Fluid-Applied Air Barrier and centered on joint. Ensure Silicone Transition Membrane extends a minimum 1" (25 mm) onto wall.
 6. Transitions may be treated with any of the following methods:
 - a. Liquid flashing installed per manufacturers installation details.
 - b. Reinforcing Fabric properly embedded in Fluid-Applied Air Barrier.
 - c. Sheet Flashing installed per manufacturer's installation details.

- d. Silicone Transition Membrane properly set in liquid flashing.
- 7. Through Wall Flashing. Sheet Flashing must be installed per manufacturer's installation details.
- B. General: Apply fluid air-barrier material to form a seal with transition membrane and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.
 - 1. Apply primer to substrates at required rate and allow it to dry.
 - 2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats as recommended by the manufacturer and as needed to achieve required bond, with adequate drying time between coats.
- C. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
 - 1. Apply to a total wet film thickness as required by the membrane manufacturer to meet the performance requirements indicated.
- D. Apply transition membrane according to air-barrier manufacturer's written instructions.
- E. Provide air barrier and accessories that are acceptable for use at horizontal surfaces without detrimental effects to material.
- F. For exterior cladding and veneer attachment devices and accessories such as clips, thermal breaks, brick ties, flashings, stone/metal coping fasteners, and metal panel anchors:
 - 1. Set device in a full bed of sealant after air barrier is cured.
 - 2. Seal over fastener heads after device is secured.
 - 3. Seal top edge of accessories installed in the horizontal orientation.
- G. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- H. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner shall engage a qualified testing agency to perform tests and inspections.
- B. Periodic Inspections: Arrange for air barrier system manufacturer's technical personnel to inspect installation weekly during periods of ongoing installation.
- C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Air-barrier dry film thickness.
 - 3. Continuous structural support of air-barrier system has been provided.
 - 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 5. Site conditions for application temperature and dryness of substrates have been maintained.
 - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 7. Surfaces have been primed, if applicable.

8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Strips and transition strips have been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.
13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

D. Field Tests:

1. Membrane Adhesion Test: Test materials for a minimum air-barrier adhesion of 16 lbf/sq. in. or to manufacturer's minimum adhesion level per substrates, whichever is greater in accordance with ABAA 0002 " Standard Test Method for Pull-off Strength of Adhered Air and Water Resistive Barriers Using an Adhesion Tester". Perform test after curing period recommended by the manufacturer. Record mode of failure and area which failed in accordance with test standard.
 - a. Test Locations: Once daily per substrate during installation and a minimum of 4 tests per major elevation per substrate.
 - b. Provide an inspection report that indicates whether or not the air barrier material has met the minimum adhesion level requirement.
2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform static-air-pressure differential as indicated and shall not evidence water penetration.
 - a. Test Locations:
 - 1) Perform one test for the first 2500 sq. ft. of installed material for each wall assembly type.
 - 2) Perform one subsequent test for every 5000 sq. ft. of installed material for each wall assembly type.
 - 3) Test locations to be selected by Architect.
 - b. Testing to be performed concurrent with Quantitative Air-Leakage Testing.
 - c. Test Size: 100 sq. ft. minimum.
 - d. Perform tests in each test area as directed by Architect. Perform tests prior to 10, 50 and 75 percent completion.
 - e. Perform tests after cladding attachments have been installed but prior to the installation of cladding/veneer material.
 - f. Test Pressure: 6.24 lbf/sq.ft.
 - g. Water Infiltration: Water leakage to the interior of the building is a failure. Water observed on interior surfaces of the system or adjacent wall systems is a failure.
 - h. Provide an inspection report that indicates results.
3. Water Spray Test: Before installation of interior finishes has begun, areas designated by the Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Perform tests at transitions to adjacent wall assemblies, control joints, deflection joints, and expansion joints.
 - b. Test 3% of the linear feet of all joint locations.
 - c. Water Infiltration: Water leakage to the interior of the building is a failure. Water observed on interior surfaces of the system or adjacent wall systems is a failure.

E. Air barriers shall be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.
3. Upon failure of testing:
 - a. Repair and retest area.

- b. Provide an additional two tests for each occurrence of a failure.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- G. Prepare test and inspection reports and provide copies to Architect, Contractor, and air barrier manufacturer's representative.

3.7 CLEANING AND PROTECTION

- A. Protect air barrier system from damage during application and remainder of construction period per manufacturer's written instructions.
 - 1. Should air barrier exceed manufacturer's limits for UV and weather exposure, remove and replace air barrier or repair exposed membrane and provide new complete air-barrier system overlay per manufacturer's written instructions. Repair and/or replacement of air barrier system shall be at no additional cost to the Owner
- B. If damage occurs repair per manufacturers installation details.
- C. Clean spills, stains and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- D. Remove masking materials after installation.

END OF SECTION

SECTION 074213

METAL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Insulated metal panels for wall and soffit conditions.
- B. Corrugated metal wall panels.

1.3 RELATED SECTIONS

- A. Section 054000 - Cold-Formed Metal Framing: Secondary support framing supporting metal panels.
- B. Section 072726 – Fluid Applied Membrane Air Barriers: Adhered waterproofing at metal panels; installation requirements for sheet membrane waterproofings.
- C. Section 079200 - Joint Sealants: Field-applied sealants not otherwise specified in this Section.

1.4 SYSTEM DESCRIPTION

- A. Design Requirements: Design system to provide movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effect, when subjected to 100-year seasonal temperature ranges.
 - 1. Design system to accommodate tolerances to structure, provided irregularities do not exceed industry recognized standards and clearances are maintained.
 - 2. Provide for positive drainage of any water entering or occurring within system.

1.5 SUBMITTALS

- A. Product Data: Two copies of manufacturer's literature for metal panel material including recommendations for cleaning and protection.
- B. Shop Drawings: Submit shop drawings showing project layout and elevations; fastening and anchoring methods; detail and location of joints, sealants, and gaskets, including joints necessary to accommodate thermal movement; trim; flashing; and accessories.
- C. Samples:
 - 1. Metal Panels: Two samples of each type of metal; 2' x full panel width minimum.
 - 2. Exposed Flashing, Exposed Closures, and Gaskets: Two samples of each component.
- D. Submit documents showing product compliance with the local building code prior to the bid. Alternate materials must be approved by the Architect prior to the bid date.

- E. Research/Evaluation Reports: For each type of wall and soffit panel required.
- F. Maintenance Data: For metal panels to include in maintenance manuals.
- G. Warranties: Samples of special warranties.
- H. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.6 QUALITY ASSURANCE

- A. Source Limitations for panels: Obtain each type, color, texture, and pattern of panel, including related accessories, through one source from a single manufacturer.
- B. Regulatory Requirements: Design, fabricate, and install metal panel system to withstand loads as required by California Building Code but not less than the following minimum design load:
 - 1. Wind Pressure: 70 mph.
 - 2. Exposure: Exposure C.
- C. Installer Qualifications: Fabricator of metal-faced composite wall and soffit panels.
 - 1. Assume undivided responsibility for all components of the exterior metal panel system including, but not limited to attachment to sub-construction, panel-to-panel joinery, metal-panel-to-dissimilar material joinery, and joint seal associated with the metal panel system.

1.7 PRE-INSTALLATION CONFERENCE

- A. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels including installers of doors, windows, and louvers.
- B. Conduct conference at Project site. Review methods and procedures related to metal panel assemblies including, but not limited to, the following:
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 3. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.

4. Review flashings, special panel details, wall penetrations, openings, and condition of other construction that will affect metal panels.
5. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
6. Review temporary protection requirements for metal panel assembly during and after installation.
7. Review panel observation and repair procedures after metal panel installation.
8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage. Protect finish and edges in accordance with metal panel manufacturer's recommendations.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal panels from exposure to sunlight and high humidity, except to extent necessary for period of metal panel installation.

1.9 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal panel fabrication and indicate measurements on Shop Drawings.

1.10 SEQUENCING

- A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.11 COORDINATION

- A. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and non-corrosive installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: Five years from date of Substantial Completion.

1.13 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Metal Wall Panels and Metal Soffit Panels: Full-size units equal to 2 percent of quantity installed.
 2. Fasteners: Equal to 2 percent of quantity installed.
 3. Starter and Closure Strips: Equal to 2 percent of quantity installed.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.3 TYPES

- A. Insulated Metal Panels: Kingspan Designwall 2000, or equal.
 1. Panel Width: As indicated on Drawings.
 2. Profile: Flat.
 3. Thickness: 2 inches.
 4. Material: 20-gauge aluminum.
- B. Corrugated Metal Panels: Kingspan Morin, exposed fasteners.
 1. Panel Width: 35 inches.
 2. Profile: BR-7-35.
 3. Thickness: 1-1/2 inches.
 4. Material: 20-gauge steel, painted.

2.4 ACCESSORIES

- A. Metal Panel Accessories: Provide starter strips, edge trim, corner cap, and other items as recommended by s panel manufacturer for building configuration.
 1. Provide accessories made from same material as adjacent panels, unless otherwise indicated.
 2. Provide accessories matching color and texture of adjacent panels, unless otherwise indicated.

3. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- B. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1 inch (25 mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Formed from stainless steel sheet as specified in Section 076000. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Fasteners: Ribbed bugle-head gasketed stainless steel screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm) or 3 screw-threads into substrate or as recommended by panel manufacturer. Do not expose fasteners except where unavoidable and then match finish of adjoining metal.
1. Finish: To match metal panel color.
- E. Dissimilar Materials: Separate dissimilar metals with coating of dielectric separator. Do not extend coating onto exposed or finished surfaces.

2.5 MISCELLANEOUS METAL FRAMING

- A. Base or Sill Angles: 0.079 inch (2.01 mm) nominal thickness.
- B. Hat-Shaped, Rigid Furring Channels:
1. Insulated Metal Panels: 16-gauge.
 2. Depth: As indicated.
- C. Z-Furring Channels:
1. Corrugated Metal Panels: 18-gauge.
 2. Depth: As indicated.
- D. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous metal framing members to substrates.

2.6 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

2.7 FABRICATION

- A. Fabricate panel system to dimension, size, and profile indicated on the Drawings based on a design temperature of 70°F.

- B. Fabricate panel system so that no restraints can be placed on the panel that might result in compressive skin stresses. Detail panels to remain flat regardless of temperature change and at all times remain air and water tight after installation.
- C. Internal and External Corners: Provide same materials, material thickness and finish as system.
 - 1. Design profile to suit system; brake form, shop cut and factory miter to required angles.
 - 2. Back mitered internal corners with minimum 22 gage sheet stock to maintain continuity of profile.
- D. Expansion Joints: Provide concealed metal expansion control throughout system.
- E. Soffits: Notch and cut panels to receive light fixtures.
- F. Sheet Metal Closures and Other Components: Brake-formed to required profile.
 - 1. Comply with requirements for sheet metal fabrication specified in Section 076000.
- G. Provide for positive drainage of any water that may enter or develop within the metal panel system.

2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying specified finish.

2.9 FINISHES

- A. Stainless Steel Panel Finish:
 - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - b. Finish: Contrarian Metal Resources; Invarimatte finish.
- B. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- C. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of panels. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Inspect surfaces to receive panels to verify substrate is even, smooth, sound, clean, dry and free from defects detrimental to work. Notify Contractor in writing of conditions detrimental to

proper and timely completion of the work. Do not proceed with erection until unsatisfactory conditions have been corrected.

- C. Verify surfaces to receive panels are structurally sound as determined by a registered Architect/Engineer.
- D. Examine primary and secondary wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
- E. Examine rough-in components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before metal panel installation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
 - 1. Soffit Framing: Clip furring channels to supports.

3.3 THERMAL INSULATION INSTALLATION

- A. Board Insulation: Extend insulation in thickness indicated to cover entire wall. Comply with installation requirements in Division 7 Section "Building Insulation."
 - 1. Retain insulation in place by metal clips and straps or integral pockets within panels, spaced at intervals according to insulation manufacturer's instructions.

3.4 METAL PANEL INSTALLATION

- A. General: Comply with panel manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply. Center fasteners in elongated slots without binding panels to allow for thermal movement. Overlap joints to shed water away from direction of prevailing wind.
- B. Install panels and accessories according to AAMA 1402.
- C. Erect panels plumb, level, and true.
- D. Attachment system shall allow for the free and noiseless vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -20°F to +180°F. Buckling of panels, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement will not be permitted.
- E. Erect panels in accordance with an approved set of Shop Drawings.
- F. Anchor panels securely and permanently according to engineering recommendations and in accordance with approved Shop Drawings to allow for necessary thermal movement and structural support.
 - 1. Use concealed fasteners except where specifically approved by Architect.

- G. Conform to panel fabricator's instructions for installation of concealed fasteners.
- H. Protect metal surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry before installing panel components.
- I. Isolate dissimilar metals by separating with rubber gaskets or elastomeric sealant. Use rubber washers where fasteners made from dissimilar metal penetrate panels. Isolate dissimilar metals behind panels by covering with polyethylene film.
- J. Apply gasketing and sealants where required to prevent direct weather penetration of the panel installation.
- K. Locate end laps over supports. Lap adjoining panels a minimum of 2 inches ensuring sidelaps are located over solid bearing.
- L. Provide expansion joints at regular basis, concealed within system.
- M. Do not install component parts that are observed to be defective, including; warped, bowed, dented, abraded, and broken members.
- N. Do not cut, trim, weld, or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in visual imperfection or a failure in performance. Return component parts which require alteration to shop for refabrication, if possible, or for replacement with new parts.

3.5 METAL SOFFIT PANEL INSTALLATION

- A. In addition to complying with requirements of "Metal Panel Installation, General" Article, install metal soffit panels to comply with the requirements of this article.
- B. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
 - 1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

3.6 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

3.7 FLASHING INSTALLATION

- A. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection.
- D. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), non-cumulative, on level, plumb, and location lines as indicated and within 1/16 inch (1.5 mm) offset of adjoining faces and of alignment of matching profiles.

3.9 ADJUSTING AND CLEANING

- A. Remove and replace panels damaged beyond repair as a direct result of the panel installation. After installation, panel repair and replacement shall become the responsibility of the General Contractor.
- B. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- D. Remove masking (if used) as soon as possible after installation. Masking intentionally left in place on any panels after panel installation, shall become the responsibility of the General Contractor.
- E. Any additional protection, after installation, shall be the responsibility of the General Contractor.
- F. After metal panel installation, clear drainage channels of obstructions, dirt, and sealant.
- G. Clean finished surfaces according to panel manufacturer's written instructions and maintain in a clean condition during remainder of construction period.

END OF SECTION

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SECTION 074229

TERRA COTTA WALL PANELS AND BAGUETTES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Terra cotta rainscreen wall panels.
 - 2. Terra cotta wall cladding attachment.
 - 3. Terra cotta baguettes and attachments.
 - 4. Mechanical anchors and fasteners utilized for the installation of the system.
- B. Related Requirements:
 - 1. Section 051213 "Architecturally Exposed Structural Steel."
 - 2. Section 054000 "Cold-formed Metal Framing."
 - 3. Section 061600 "Sheathing."
 - 4. Section 072100 "Building Insulation."
 - 5. Section 076200 "Sheet Metal Flashing and Trim."

1.3 PREINSTALLATION CONFERENCE

- A. Preinstallation conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, terra cotta panel rainscreen wall system Installer, structural-support Installer, and installers whose work interfaces with or affects terra cotta wall panel rainscreen wall system.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to terra cotta panel rainscreen wall system installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special details, penetrations, openings, and condition of other construction that affect the terra cotta panel rainscreen wall system.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for the terra cotta panel rainscreen wall system, during and after installation.

8. Review procedures for replacement of terra cotta panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 1. Include fabrication and installation layouts of terra cotta panel rainscreen wall system components; details of edge conditions, joints, panel profiles, corners, anchorages, and attachment components; and special and unique details.
 2. Accessories: Include details of the flashing, trim and anchorage at a scale of not less than 1-1/2 inches per 12 inches. Indicate metal trims, flashings, closures, and accessories that are furnished by other trades to provide dimensional requirements that may affect the terra cotta panel rainscreen system.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 1. Terra Cotta Panels: Actual terra cotta panel in size and color specified for the project; unless the panel is custom made for the project, which then requires submission of terra cotta panel for size specified and terra cotta color specified produced in the same fashion as the terra cotta panel. Include installation support framing, fasteners, and other metal accessories furnished by the terra cotta manufacturer for the terra cotta panel rainscreen wall system.
- D. LEED Submittals:
 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terra cotta panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by the manufacturer.
- B. Fire-Test-Response Characteristics: Provide terra cotta panels and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test methodology defined by UL or another testing and inspections agency acceptable to Authorities Having Jurisdiction.
 - 1. Exterior Fire-Test Exposure: Class A.
- C. Source Limitations: All primary products specified in this section will be supplied by a single manufacturer, experienced in designing and manufacturing terra cotta panel rainscreen wall systems.
- D. Mockups: Build mockups as detailed and shown in the Contract Documents to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical terra cotta panel rainscreen wall system, including, supports, attachments, and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, terra cotta panels, and other manufactured items so as not to be damaged or deformed. Package metal terra cotta panels for protection during transportation and handling.
- B. Unload, store, and erect terra cotta panel rainscreen wall system in a manner to prevent breakage, chipping, and surface damage.
- C. Store products in manufacturer's unopened packaging, covered with suitable weathertight and ventilated covering, until ready for installation. Do not store terra cotta panel rainscreen wall system components in contact with other materials that might cause staining, chipping, breakage, or other surface damage.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of terra cotta panel rainscreen wall system to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate terra cotta panel rainscreen wall system installation with moisture drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a ventilated, secure, and noncorrosive installation while maintaining the continuity of the weather barrier.

1.11 WARRANTY

- A. Special Material Warranty: Manufacturer's standard form in which manufacturer agrees to furnish components of the terra cotta panel rainscreen wall system that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including aspects of terra cotta performance defined in ASTM C67.
 - b. Deterioration of terra cotta and other materials beyond normal weathering.
- B. Special Project Warranty: Installer's Warranty, covering Work of this Section, in which the Installer agrees to repair or replace components of the terra cotta rainscreen cladding system that fails in materials or workmanship within the following warranty period:
 - 1. Warranty Period: 5 years from the date of Substantial Completion.

1.12 EXTRA MATERIALS

- A. Furnish extra materials that match the products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Terra cotta panels: For each surface texture and/or color, the lesser quantity of 60 or 2% of the installed quantity. The panels shall be provided in the longest length dimension installed on the project.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide terra cotta panel rainscreen wall system capable of withstanding the effects of the following loads, based on testing according to ASTM E330:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Loads stipulated by the Authorities and Building Codes having Jurisdiction.
 - 4. Deflection Limits: For wind loads, no greater than 1/600 of the span.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 100 deg F, ambient; 180 deg F, material surfaces.

2.2 TERRACOTTA PANEL RAINSCREEN WALL SYSTEM PANELS

- A. Terracotta Panel System: Provide factory-extruded double wall/hollow core terracotta panels formed into profile for installation method indicated. Include attachment assembly components and accessories required.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
 - a. Basis-of-Design: Terreal North America LLC, A Subsidiary of Ludowici Roof Tile. (telephone: 888-582-9052)
 - b. Boston Valley Terra Cotta USA, as approved by Architect
 - c. NBK, as approved by Architect.
- B. Basis-of Design Terracotta Wall Panels: Terreal Piterak XS terracotta.
1. Panel Thickness: 0.708 inch. (18mm)
 2. Panel Vertical Module Dimension: As indicated on Drawings.
 3. Panel Horizontal Module Dimension: As indicated on Drawings.
 4. Panel Weight: 6.5 pounds per square foot.
 5. Vertical Joint Type: Open joint without metal trims or gaskets.
 6. Horizontal Joint Type: Overlapping, ship-lap type.
 7. Panel Configuration: Double wall with hollow cores per manufacturer's standard extruding process.
 8. Panel End Configuration:
 - a. Field of Wall: Factory square cut panel ends
 - b. Building Corners: Factory quirk miter cut with a 5mm square return prior to the start of miter cut on panel end. Factory quirk miter cut panels shall be furnished 3 inches longer than shop drawing identified lengths to allow for installation maintaining a consistent width reveal at the quirk miter – panels shall be field square cut on end opposite quirk miter to allow for consistent review widths during installation.
 9. Finish Panel Production Tolerances:
 - a. Squareness: +/- 3mm.
 - b. Straightness of Panel's Top Edge: Color: +/- 3mm.
 - c. Flatness of Panel Height: +/- 2mm.
 - d. Flatness of Panel Length: +/- 3mm.
 10. Color: Custom as selected by Architect.
 11. Exterior Finish/Texture: As selected by Architect.
- C. Attachment Assembly: Rainscreen principle system.

2.3 TERRACOTTA WALL PANEL ATTACHMENT COMPONENTS

- A. General: All metal supporting members shall be fabricated from 304 Stainless Steel or 6063 T6 Aluminum for resistance to corrosion.
- B. Horizontal Support Profile:
1. Material: 304 Stainless Steel, 6063 T5 Aluminum, or 6063 T6 Aluminum

2. Thickness: As required for structural performance of the terracotta panel rainscreen wall system, 0.050 minimum.
3. Finish: Manufacturer's standard.
4. Configuration: Zee or Hat Channel shape
5. Member Depth: As indicated on Drawings
6. Member Vertical Spacing: As required for structural performance of the terracotta panel rainscreen wall system.

C. Vertical Aluminum Support Profile:

1. Material: 6063 T5 Aluminum or 6063 T6 Aluminum.
2. Thickness: 0.125 inch minimum.
3. Finish: Painted flat black with manufacturer's standard paint finish.
4. Configuration: Hat Channel shape with registration extensions on open face.
5. Member Depth: As indicated on Drawings
6. Member Horizontal Spacing: At every vertical open terracotta panel joint and at manufacturer's standard distance from openings in the terracotta panel rainscreen wall system.

D. Terracotta Panel Installation Clips:

1. Material: 304, 1/8 Hard (Fb = 100,000 psi; Fy = 55,000 psi; Eo = 27,000,000 psi) ASTM 666 Stainless Steel.
2. Thickness: 0.057 inch.
3. Finish: Manufacturer's standard, unless clip is exposed to view.
4. Configuration: Manufacturer's standard with preinstalled holes for clip attachment to supporting member.
5. Depth: Manufacturer's standard.
6. Spacing: Manufacturer's standard required for structural performance of the terracotta panel rainscreen wall system.
7. Terracotta Panel Attachment Design: Clips shall be manufactured for "friction fit" to terracotta panel to prevent terracotta panels from freely moving after clip installation.

E. Fasteners:

1. Material: 304 Stainless Steel.
2. Type: Hex head, self-drilling.
3. Size: Manufacturer's standard required for structural performance of the terracotta panel rainscreen wall system.

2.4 TERRA COTTA BAGUETTES

A. General: 2 in. by 2 in. baguettes.

1. Basis-of-Design: Terreal North America or the following equal alternates:
 - a. NBK.
 - b. Cladding Corps.
 - c. Or equal.

2.5 MISCELLANEOUS MATERIALS

- A. Flashing and Trim: Shall be aluminum material complying with the performance criteria specified and designed to allow adjustments of the system prior to being permanently installed. These items shall be shop fabricated.

2.6 FABRICATION

- A. General: Fabricate and finish terra cotta panels and accessories at the factory, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensions and performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. It is the responsibility of the Installation Contractor to examine the structure scheduled to receive the terra cotta panel rainscreen wall system and verify that it is capable of supporting the loads from the Work specified in this section. Note deficiencies immediately and do not proceed with erection of terra cotta panel rainscreen wall system until such deficiencies have been corrected or addressed by the Architect.
- B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances for the terra cotta material panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, and other structural panel support members and anchorage have been installed within alignment tolerances required by terra cotta wall panel manufacturer's written installation instructions.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by terra cotta wall panel manufacturer's written installation instructions.
 - a. Verify that air- and/or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration prior to the commencement of work.
- C. Examine roughing-in for components and assemblies penetrating terra cotta panels to verify actual locations of penetrations relative to terra cotta panel rainscreen wall system support framing and joints before commencement of work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate terra cotta panel rainscreen wall system with rain drainage work; flashing; trim; and construction of soffits, roofing, parapets, walls, and other adjoining work to provide a secure and noncorrosive installation.

3.3 FRAMING ERECTION TOLERANCES

- A. Shim and align metal support framing to allow the plane of the framing member, at the terra cotta panel attachment, to be plumb, true, untwisted, and in assembly plane.
- B. Installation Tolerances: Measurements are taken on the final installed exposed surface to view. Installation tolerances shall be defined as:
 - 1. Plumb: 1/8" in 10 feet, 1/4" in 40 feet, non-cumulative
 - 2. Level: 1/8" in 20 feet, 1/4" in 40 feet, non-cumulative
 - 3. Alignment & Offsets: limit to 1/8"

3.4 TERRA COTTA PANEL INSTALLATION

- A. Rainscreen Systems: Install terra cotta cladding systems in relation to backup construction as indicated and as recommended by terra cotta manufacturer's written installation instructions applicable to the products and applications indicated unless more stringent requirements apply.
- B. Do not install damaged or broken terra cotta components.
- C. Installation: Attach terra cotta panels to supports at locations and spacings, with fasteners, recommended by the terra cotta panel manufacturer.
- D. Accessory Installation: Install accessories with positive anchorage to building and terra cotta panel support structure to provide to proper attachment per the terra cotta manufacturer's written installation instructions to resist positive and negative wind loading on the terra cotta rainscreen system.
- E. Coordinate installation with flashings, fenestration elements, and other components.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed terra cotta panel rainscreen wall system installation, including accessories.
- B. Terra cotta panels will be considered defective if they do not pass test and inspections as defined in the manufacturer's written warrantee.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace damaged or broken terra cotta panels and baguettes and terra cotta accessory items.

END OF SECTION

SECTION 075216

MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Torch-applied, styrene-butadiene-styrene (SBS) modified bituminous membrane roofing.

- B. Related Sections:

- 1. Section 061000 "Rough Carpentry" for wood nailers.
- 2. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
- 3. Div. 22 for roof drains.

1.03 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.04 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
 - 1. Fire/Windstorm Classification: Class 1A-90.
- D. Energy Performance: Provide roofing system with initial Solar Reflectance not less than 0.70 and Thermal Emittance not less than 0.75 when tested according to Cool Roof Rating Council's

CRRC-1 and that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Base flashings and membrane terminations.
 - 2. Crickets, saddles, and tapered edge strips, including slopes.
 - 3. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Selection Samples: For liquid-applied flashing, provide sample for selection of custom color topcoat where visible at roof edge.
- D. Samples for Verification: For the following products:
 - 1. Sheet roofing materials, including base sheet, base-ply sheet, roofing membrane sheet, flashing backer sheet, membrane cap sheet, and flashing sheet, of color specified.
 - 2. Walkway pads or rolls.
- E. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc3 - Sourcing of Raw Materials – Forestry Stewardship Council (FSC) Certified Wood: For all wood products designated in this specification as “FSC certified,” provide vendor invoices with the vendor’s Chain-of-Custody (COC) number and identify each FSC certified product on a line-item basis. If FSC wood products are modified off-site by an architectural woodworker or millworker, the woodworker shall have an FSC COC number.
 - d. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of complying with performance requirements.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- D. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.
- E. Warranties: Sample of special warranties.

1.07 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
 1. Installer shall employ on Project installers and supervisors certified through the NRCA/MRCA Certified Roofing Torch Applicator (CERTA) program.
- C. Source Limitations: Obtain components for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at project site.
 1. Meet with Owner, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

G. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes membrane roofing, base flashings, fasteners, roofing accessories, and other components of membrane roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

- B. Ceilings, Walls, Thermal and Acoustic Insulation: All ceilings, thermal insulation, acoustic insulation, products provided under this specification section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.02 SBS-MODIFIED ASPHALT-SHEET MATERIALS

- A. Assembly is based on Siplast Paradiene 20/30FR system. System is to include insulation, coverboard, base ply, finish ply, flashings, other materials required by the manufacturer, and the proper installation of a complete, warrantable system. Provide Siplast veral flashing system with aluminum finish, where noted.

- B. Granule-Surface Roofing Membrane Cap Sheet: ASTM D 6164, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric); granular surfaced; suitable for application method specified, and as follows:
 - 1. Granule Color: White.
 - 2. Cap sheet to be certified by the Cool Roof Rating Council and shall have an emissivity >0.75 and a solar reflectivity of >0.70 when tested in accordance with the Cool Roof Rating Council.

2.03 INSULATION AND COVER BOARD

- A. Insulation: ASTM C 1289, polyisocyanurate foam faced with asphalt/glass mat, or polymer glass mat on both sides of foam. Where structure does not have adequate slope, provide tapered insulation as required to achieve 1/4 inch per foot minimum positive slope.

- B. Insulation Adhesive: Manufacturer's standard.

2.04 BASE-SHEET MATERIALS

- A. Base Sheet: ASTM D 4601, Type II, SBS-modified, asphalt-impregnated and -coated sheet, with glass-fiber-reinforcing mat, dusted with fine mineral surfacing on both sides.
 - 1. Weight: 25 lb/100 sq. ft., minimum.

2.05 BASE-PLY SHEET MATERIALS

- A. Glass-Fiber Base-Ply Sheet: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt.

2.06 BASE FLASHING SHEET MATERIALS

- A. Backer Sheet: ASTM D 6164, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric); smooth surfaced; suitable for application method specified.
- B. Granule-Surfaced Flashing Sheet: ASTM D 6164, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric); granular surfaced; suitable for application method specified, and as follows:
 - 1. Granule Color: White.

2.07 AUXILIARY ROOFING MEMBRANE MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.
 - 1. Liquid-applied flashing materials: Fully-reinforced, multi-component, liquid-applied, acrylic membrane installed over properly prepared or primed substrate. Flashing system shall consist of a catalyzed polymethyl methacrylate primer, basecoat, and topcoat, combined with a non-woven polyester fleece. Membrane manufacturer shall approve of specific flashing system in advance for each application.
 - a. Fleece reinforcement: Non-woven, 110 g/m², needle-punched polyester fabric reinforcement as supplied by membrane manufacturer.
 - b. Top coat: Custom color.
 - 2. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 - 3. Vapor Barrier: Manufacturer's standard.
 - a. Provide above substrate at corrugated metal deck as required.
 - b. Provide above concrete deck as required should elevated moisture content beyond manufacturer's acceptable tolerance be encountered at time of installation.
- B. Asphalt Primer: ASTM D 41.

- C. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.
- D. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing membrane components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- F. Metal Flashing Sheet: As specified in Section 076200 "Sheet Metal Flashing and Trim."
- G. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.08 WALKWAYS

- A. Walkway Pads: Reinforced asphaltic composition pads with slip-resisting mineral-granule surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 3/8 inch thick, minimum.
 - 1. Pad Size: As shown.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 - 2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
 - 4. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method per ASTM D 4263 or method recommended by manufacturer.
- B. Crew members handling torches shall be trained by an Authorized Certified Roofing Torch Applicator (CERTA) Trainer, be certified according to CERTA torch safety guidelines as published by the National Roofing Contractor's Association (NRCA), and follow torch safety practices as required by the contractor's insurance carrier. Designate one person on each crew to perform a daily fire watch. The designated crew member shall watch for fires or smoldering

materials on all areas during roof construction activity, and for the minimum period required by CERTA guidelines after roofing material application has been suspended for the day.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Mechanically fasten first layer of rigid insulation to roof structure. Adhere subsequent layers of insulation with adhesive.
- D. Cover Board: Adhere cover board to insulation with same adhesive used to attach underlying layers of rigid insulation.

3.03 ROOFING MEMBRANE INSTALLATION, GENERAL

- A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" and as follows:
 - 1. Deck Type: Nailable.
 - 2. Adhering Method: Torch-applied.
 - 3. Base Sheet: One.
 - 4. Number of Glass-Fiber Base-Ply Sheets: One.
 - 5. Number of SBS-Modified Asphalt Sheets: One.
 - 6. Surfacing Type: M (mineral-granule-surfaced cap sheet).
- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Where roof slope exceeds 1/2 inch per 12 inches, install roofing membrane sheets parallel with slope.
- D. Cooperate with testing agencies engaged or required to perform services for installing roofing system.
- E. Coordinate installation of roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
 - 1. At end of each day's work, provide tie-offs to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement, with joints and edges sealed.
 - 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
 - 3. Remove and discard temporary seals before beginning work on adjoining roofing.

- F. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.04 BASE-SHEET INSTALLATION

- A. Install lapped base-sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:
 1. Adhere to substrate in a uniform coating of cold-applied adhesive.

3.05 BASE-PLY SHEET INSTALLATION

- A. Install glass-fiber base-ply sheets according to roofing system manufacturer's written instructions starting at low point of roofing system. Align glass-fiber base-ply sheets without stretching. Extend sheets over and terminate beyond cants.
 1. Shingle side laps of glass-fiber base-ply sheets uniformly to ensure that required number of glass-fiber base-ply sheets covers substrate at any point. Shingle in direction to shed water.
 2. Embed each glass-fiber base-ply sheet in a uniform coating of cold-applied adhesive to form a uniform membrane without glass-fiber base-ply sheets touching.

3.06 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

- A. Install modified bituminous roofing membrane sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:
 1. Adhere to substrate.
 2. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.
- B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.
 1. Repair tears and voids in laps and lapped seams not completely sealed.
- C. Install roofing membrane sheets so side and end laps shed water.

3.07 FLASHING AND STRIPPING INSTALLATION

- A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions, and as follows:
 1. Prime substrates with asphalt primer if required by roofing system manufacturer.
 2. Backer Sheet Application: Adhere backer sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.
 3. Flashing Sheet Application: Adhere flashing sheet to substrate.

- B. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane.
- C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
- D. Install roofing membrane cap-sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.
- E. Roof Drains: Set 30-by-30-inch- square metal flashing in bed of asphalt roofing cement on completed roofing membrane. Cover metal flashing with roofing membrane cap-sheet stripping and extend a minimum of 4 inches beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
 - 1. Install stripping according to roofing system manufacturer's written instructions.

3.08 WALKWAY INSTALLATION

- A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.
 - 1. Set walkway pads in cold-applied adhesive.

3.09 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports.
- B. Test Cuts: Test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:
 - 1. Approximate quantities of components within roofing membrane will be determined according to ASTM D 3617.
 - 2. Test specimens will be examined for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
 - 3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
 - 1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
- D. Roofing system will be considered defective if it does not pass tests and inspections.
 - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS **<Insert name>** of **<Insert address>**, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: **<Insert name of Owner>**.
 - 2. Address: **<Insert address>**.
 - 3. Building Name/Type: **<Insert information>**.
 - 4. Address: **<Insert address>**.
 - 5. Area of Work: **<Insert information>**.
 - 6. Acceptance Date: **<Insert date>**.
 - 7. Warranty Period: **<Insert time>**.
 - 8. Expiration Date: **<Insert date>**.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding **<Insert wind speed>** mph;
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 - 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.

1. Authorized Signature: **<Insert signature>**.
2. Name: **<Insert name>**.
3. Title: **<Insert title>**.

END OF SECTION

SECTION 075500

PROTECTED MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protected Membrane Roofing Paver Assembly.

B. Related Sections:

1. Section 033000: Expansion Joint Filler Strips.
2. Section 076200: Sheet Metal Flashing and Trim.
3. Divisions 22 and 23: Flashings for Pipes, Drains, Vents and Ducts.

1.2 REFERENCES

- ###### A. General: Comply with the applicable provisions of the referenced standards, except as modified by governing codes and the Contract Documents. Where a recommendation occurs in the referenced standards, it shall be considered mandatory. In the event of conflict, the more stringent standard or requirement shall govern.

1. American Society for Testing and Materials (ASTM).
2. Canadian General Standards Board (CGSB):
 - a. CGSB-37.50-M89, "Standard for Asphalt, Rubberized, Hot Applied, for Roofing and Waterproofing".
3. Underwriters Laboratories (UL) Class A.
4. Dow Chemical Company
 - a. TechNote 508 "Ballast Design Guide for IRMA Roofs".

1.3 SYSTEM DESCRIPTION

- ###### A. Roof Classification: Class A per UL.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Roof membrane materials; acceptable to insulation manufacturer.
2. Applicator: Licensed or approved by roof membrane manufacturer and insulation manufacturer. Applicator shall have at least five years of experience performing similar projects.

- ###### B. Testing Agency: Selected and paid for by Owner; retesting paid for by Contractor.

- C. External Fire Exposure Rating: Provide roofing system and component materials tested and listed by UL for Class A external fire exposure.
- D. Coordination:
 - 1. Coordination Meeting:
 - a. Roofing Installer: Participate in coordination meeting, arranged by Contractor, to be attended by installers and material manufacturers' representatives associated with Work of this Section and related Sections.
 - b. Purpose of Meeting: Review requirements of Contract Documents to assure that details are correct and that materials are installed properly.
 - c. Conflicts: Document any conflict, incompatibility or inadequacy at this meeting.
 - d. Written Report: Following meeting, prepare written report containing:
 - 1) Meeting date and names and affiliations of those present.
 - 2) Written statements from each installer and manufacturer's representative of their acceptance of the requirements of Contract Documents for use of their materials.
 - 3) Detailed Specifications and shop drawings for materials, assemblies, and conditions, and step-by-step application procedures for installing roofing and associated work.
 - 2. Jobsite Meeting:
 - a. General: Prior to commencing installation, but following completion of coordination meeting requirements specified, arrange Jobsite meeting to be attended by Architect and participants of Coordination Meeting.
 - b. Purpose of Meeting: Discuss requirements of Contract Documents, step-by-step application procedures, job and surface readiness, and material storage and protection.
 - c. Notification: Notify Architect minimum of 2 working days prior to Jobsite Meeting and commencement of work.
 - d. Manufacturer: Prepare written statement of acceptance of requirements of Contract Documents, step-by-step application procedures, job and surface readiness and material storage and protection.
 - e. Manufacturer's Representative: Present during installation and shall review completed installation as required for compliance with manufacturer's warranty requirements.

1.5 SUBMITTALS

- A. Shop Drawings: Manufacturer's recommended details of flashings and treatment of penetrations through roof membrane.
- B. Product Data: Manufacturer's specifications, data, and installation instructions. Include statement that liquid membrane is compatible with insulation.

C. Certificates:

1. Applicator: Before starting Work, written statement that Contract Documents were reviewed with roof membrane manufacturer and jointly agree materials are proper, compatible, and adequate for purpose intended.
2. Manufacturer: Roof membrane; upon completion of Work, written statement that technical support to applicator and field supervision was sufficient to assure proper application of materials and that installation is acceptable.
3. Substrate: Certified statement from membrane manufacturer, countersigned by applicator, attesting that substrates shown to receive roof membrane and base flashing were inspected and found satisfactory to receive Work.
4. Certificates:
 - a. Certification from an approved independent testing laboratory experienced in testing rubberized asphalt material, that the material meets the CGSB-37.50-M89 standard for rubberized asphalt membranes, including applicable ASTM procedures.
 - b. Certification showing full time quality control of production facilities responsible for the manufacture of the rubberized asphalt and that each batch of material is tested to insure conformance with the manufacturers published physical properties.
 - c. Evidence that the roof membrane assembly is currently Class A listed with Underwriters Laboratories.
 - d. Evidence that the extruded polystyrene insulation if used is free from CFC's.

D. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.6 EXTENDED WARRANTY

- A. Roof Membrane: Prepared and signed by roof membrane manufacturer and Installer. Warrant roof and base flashings against defective materials and workmanship and that system will be watertight for a period of ten years.
- B. Insulation: Prepared and signed by insulation manufacturer. Warrant insulation will retain at least 80 percent of its thermal resistance and that gravel ballast will remain on roof for a period of ten years.

1.7 PRODUCT HANDLING

- A. Delivery:
 - 1. General: Deliver materials in original unopened containers or packages bearing manufacturer's labels intact and with seals unbroken.
- B. Storage:
 - 1. General: Store materials per manufacturer's recommendations in a dry location in manner to prevent damage and intrusion of foreign matter.
 - 2. Insulation: Shield insulation from sunlight if stored outdoors for extended periods. No discolored insulation permitted.

1.8 PROJECT CONDITIONS

- A. Environmental Requirements: Do not apply materials during adverse weather or when ambient temperature is below 40 degrees F, unless otherwise approved by roof membrane manufacturer.

1.9 SCHEDULING

- A. General: Coordinate with Section 03 3000 to assure curing compounds are compatible with and surfaces appropriately finished to receive roof membrane.
- B. Roof Drains: Coordinate with Division 22 to assure clamping rings are not set tight; set in manner to avoid rupturing roof flashing.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Ceilings, Walls, Thermal and Acoustic Insulation: All ceilings, thermal insulation, acoustic insulation, products provided under this specification section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PROTECTED MEMBRANE ROOF WITH PAVER ASSEMBLY

- A. Membrane
 - 1. Membrane shall be a hot, fluid applied, rubberized asphalt membrane meeting the CGSB-37.50-M89 standard and other pertinent physical properties:
 - a. "Monolithic Membrane 6125EV" (American Hydrotech, Inc.) (minimum 25% post-consumer recycled-content)
 - b. "PRM System" utilizing "Monolithic Membrane 6100" (American Permaquik, Inc.).

- B. Surface Conditioner: Asphaltic surface conditioner for concrete surfaces meeting ASTM D41. "Surface Conditioner" (American Hydrotech, Inc.), or equal.
- C. Reinforcing: Spunbonded polyester fabric (standard duty) reinforcing sheet. "Flex Flash F" (American Hydrotech, Inc.), or equal.
- D. Flashing: 60-mil thick, uncured neoprene sheet. "Flex Flash UN" (American Hydrotech, Inc.), or equal.
- E. Adhesives/Sealant: As recommended by manufacturer for complete, warrantable installation.
- F. Drainage Composite: "Hydrodrain 990" (American Hydrotech, Inc.), or equal. Three-dimensional, crush-proof, drainage core and woven filter fabric; 33,000 psi compressive strength.
- G. Protection Sheet: "Hydroflex 30" (American Hydrotech, Inc.), or equal. 85 mil. thick continuous strand glass fibers bonded with resinous binder and coated with weathering grade asphalt.
- H. Insulation: extruded polystyrene rigid board insulation. Styrofoam brand insulation "Roofmate", as manufactured by The Dow Chemical Company, marketed by American Hydrotech, Inc., or equal.
 - 1. Insulation shall meet ASTM C-578, Type VI or VII.
 - 2. Minimum compressive strength, ASTM D-1621, 40 or 60 psi
 - 3. Maximum water absorption by volume per ASTM C-272, 0.1%
 - 4. Water vapor permeance for 1" product per ASTM E-96, 1.0 perm (max.)
 - 5. Insulation shall have an R value of 5.0°F ft² h/Btu/in. of thickness when tested at 75°F mean temperature in accordance with ASTM C-518
 - 6. Product shall be free of CFC's.
- I. Pedestals and Pavers:
 - 2. Roof-Paver Metal Straps: Securement strapping fabricated from stainless steel, a minimum of 3 inches wide by 0.031 inch thick with stainless steel anchors or other corrosion-resistant, post-installed expansion anchors by insulation manufacturer.
 - 3. Roof Pavers: Heavyweight, hydraulically pressed, concrete units, square edged, factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C 67; and as follows:
 - a. Basis-of-Design Product: The following, or equal:
 - 1) Hanover Architectural Products, Inc.
 - 2) Wausau Tile, Inc.; Terra-Paving Division.
 - b. Size: 24 by 24 inches. Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch in length, height, and thickness.
 - c. Compressive Strength: 7500 psi, minimum; ASTM C 140.
 - d. Colors and Textures: As selected by Architect from manufacturer's full range.
 - e. Paver Supports: Integral corner pedestals. Provide Bison Versadjust, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine substrate to receive roof membrane; provide written notification of deficiencies. Substrates free of voids, projections, fins, honeycombs, and other detrimental imperfections. Do not proceed until unsatisfactory conditions are corrected.
- B. Moisture Test: Test horizontal substrates to determine acceptable dryness. Test method as recommended by roof membrane manufacturer.
- C. At the start of each workday, and at the start of work in new areas, pour one pint of hot, fluid-applied asphalt onto deck. Do not proceed with work if adhesion or pinholes are visible.
- D. Penetrations: Such as pipes, conduits, and ducts; securely fixed to substrate.

3.2 PREPARATION

- A. Protection:
 - 1. Adjacent Surfaces: Protect from damage; prevent materials from entering and clogging drains.
- B. Surface Preparation:
 - 1. General: Remove laitance, loose material, grease, oil, and other contaminants effecting adhesion and performance of roof membrane system.
 - 2. Cleaning: Prior to and during application, remove dirt and dust by vacuuming, sweeping, blowing with compressed air, or other similar methods.

3.3 APPLICATION

- A. Surface conditioner application:
 - 1. Apply the surface conditioner only to concrete using a hand held sprayer evenly at a rate of 300 to 600 SF/gallon, depending on surface texture. Surface conditioner shall "tan" the surface, not blacken it.
 - 2. Allow sufficient time for the surface conditioner to thoroughly dry prior to the membrane application.
- B. Membrane preparation
 - 1. The membrane shall be heated in double jacketed, oil bath or hot air melter with mechanical agitation, specifically designed for the preparation of a rubberized asphalt membrane.
 - 2. Heat membrane until membrane can be drawn-free flowing at a temperature range between 350°F and 375°F.
- C. Detailing/Flashing
 - 1. All detailing and flashing shall be done in accordance with the manufacturer's standard guideline details.
 - 2. All detailing and flashing shall be completed before installing the membrane over the field of the substrate.
 - 3. Substrate board joints shall be pre-detailed with membrane and fabric reinforcing prior to full membrane application.
- D. Membrane Application

1. Apply the rubberized asphalt membrane at a rate to provide a continuous, monolithic coat of 90 mil minimum, into which is fully embedded a layer of the spunbonded polyester fabric reinforcing sheet, followed by another continuous monolithic coat of membrane at an average thickness of 125 mil. Total membrane thickness is to be 215 mils average, 180 mils minimum.
2. Overlap fabric reinforcing sheet 1-2 inches with membrane between sheets.

3.4 WATER TEST

- A. The roof area or portions thereof shall be leak tested by means of ponding water at a minimum depth of 2" for a period of 48 hours to check the integrity of the membrane installation.
- B. Verify that the structure can support the deadload weight of a watertest before testing.
- C. If leaks should occur the water must be drained completely and the membrane installation repaired.

3.5 FIELD QUALITY CONTROL

- A. Engage independent firm to perform membrane integrity testing, electronic field vector mapping (EFVM), and installation. Perform testing in accordance with manufacturer's requirements.
 1. Perform testing following adequate precipitation, or wet membrane sufficiently, to enable accurate testing.
 2. Identify locations of membrane leaks, record locations, and document with photographs. Provide findings to Architect.
 3. Repair all identified leaks and retest to confirm watertightness of membrane.
 4. Membrane Integrity Test System: Conductor cable, placed on top of membrane, delivering direct current tension to membrane surface, enabling inspection and isolation of points of moisture infiltration through membrane to conductive substrate under membrane.
 5. Initial Membrane Test: Perform initial membrane integrity test upon completion of membrane and integrity test system installation and prior to installation of membrane over-burden.
 6. Assembly Test: Repeat membrane integrity test following installation of above-membrane components.
 7. Final Testing: Repeat membrane integrity test if waterproofing assembly is exposed to traffic or construction operations prior to Substantial Completion.

3.6 COMPONENTS INSTALLATION

- A. Insulation: Insulation shall be installed loose-laid in accordance with manufacturer's recommendations.

3.6 PROTECTION

- A. General: Protect adjacent assemblies from damage resulting from spillage or dripping of material. Prevent materials from entering and clogging drains.

END OF SECTION

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SECTION 076200

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sheet Metal Flashing and Trim.
- B. Related Requirements:
 - 1. Section 072726 "Fluid-Applied Membrane Air Barriers."
 - 2. Section 075216 "Modified Bituminous Membrane Roofing."
 - 3. Section 075500 "Protected Membrane Roofing."

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
 - 3. Review requirements for insurance and certificates if applicable.
 - 4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.

3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is FM Approvals approved.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's typical warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 1. For copings and roof edge flashings that are FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. FM Approvals Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.
- D. Recycled Content of Steel-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 PRE-FABRICATED ASSEMBLIES

- A. Property-Line Flashing to Adjacent Building:
 - 1. Horizontal flashing basis of design: Balco SS9WC-2.5-5, with stainless steel cover, flexible gutter, and 50% joint movement
 - 2. Vertical flashing basis of design: Balco FCWW-5-SIL_Veritical, with 50% joint movement. Color to be selected by Architect.

2.3 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316, dead soft, fully annealed; with smooth, flat surface. Provide for all flashing in contact with the ground. Minimum thickness: 20 gauge.
 - 1. Finish: 2B (bright, cold rolled).
- C. Aluminum Sheet: Unless otherwise noted on the Drawings, all flashing adjacent to glazing or door shall be aluminum, to match adjacent. ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required. Minimum thickness: .1090 in., to prevent oil canning.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finish:

- a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Do not use exposed fasteners unless specifically allowed by the Contract Documents.
 - 1) If specifically allowed, exposed heads to match color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder:
 1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
 2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- E. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- F. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 2. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 3. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 4. Torch cutting of sheet metal flashing and trim is not permitted.
 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not use torches for soldering.
 2. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 3. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.3 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.4 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 078100

APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes sprayed fire-resistive materials.

1.3 DEFINITIONS

- A. SFRM: Sprayed fire-resistive materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
 - 1. Extent of fireproofing for each construction and fire-resistance rating.
 - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
 - 4. Treatment of fireproofing after application.
- C. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from ICC-ES.
- D. Preconstruction Test Reports: For fireproofing.
- E. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.

- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. Asbestos: Provide products containing no detectable asbestos.

2.3 SPRAYED FIRE-RESISTIVE MATERIALS

- A. General: Provide manufacturer's standard products complying with requirements indicated for material composition and physical properties representative of installed products.
- B. Standard Durability SFRM Interior Locations, Concealed Conditions: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide GCP Applied Technologies Inc. (formerly Grace Construction Products); Grace Construction Products; Monokote MK-6 Series or a comparable product by one of the following:
 - a. Carbolite Company; a subsidiary of RPM International.
 - b. Isolatak International.
 - 2. Bond Strength: Minimum 200-lbf/sq. ft. (9.58-kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
 - 3. Density: Not less than 15 lb/cu. ft. (240 kg/cu. m) and as specified in the approved fire- resistance design, according to ASTM E 605.
 - 4. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch (9 mm).
 - 5. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 0.
 - b. Smoke-Developed Index: 0.
 - 6. Compressive Strength: Minimum 10 lbf/sq. in. (68.9 kPa) according to ASTM E 761.
 - 7. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
 - 8. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
 - 9. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
 - 10. Air Erosion: Maximum weight loss of 0.0 g/sq. ft. (0.0 g/sq. m) in 24 hours according to ASTM E 859.
 - 11. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21.
 - 12. Finish: Spray-textured finish.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
 - 1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E736.
- C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.
- D. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.
- E. Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by fireproofing manufacturer for each fire-resistance design.
- F. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.
 - 1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
 - 2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
- B. Verify that concrete work on steel deck is complete before beginning fireproofing work.
- C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning fireproofing work.

- D. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
- E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
 - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
 - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping is completed.
 - 2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For

auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

- F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- G. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
- J. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- K. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- L. Cure fireproofing according to fireproofing manufacturer's written instructions.
- M. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- N. Finishes: Where indicated, apply fireproofing to produce the following finishes:
 - 1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
 - 2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
 - 3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
 - 4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.
 - 5. Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by the applicable building code.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.

2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.
- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

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SECTION 078413

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

B. Related Requirements:

1. Section 078445 "Joint Firestopping" for joints in or between fire-resistance-rated construction, in smoke barriers.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

C. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:

- a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 WARRANTY

- A. General Warranty Requirements are specified in 01 78 36 - Warranties. Minimum 2-Year warranties per 01 78 36 shall be provided for all installed material and equipment unless more stringent requirements are noted in this section. Standard Manufacturer Warranties shall be provided where they exceed minimum warranty requirements.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.10 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PRODUCTS AND MATERIALS

- A. Provide products and materials complying with Section 01 60 00 – Materials and Equipment. Provide products from listed acceptable manufacturers and, where applicable, from listed acceptable products. Alternate equivalent products may be provided with submission and approval of a proper Request for Product Substitution per Section 01 62 00 – Request for Substitutions.

2.3 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.4 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any. Provide the following, or equal:
 - 1. A/D Fire Protection Systems Inc.
 - 2. Grace Construction Products.
 - 3. Hilti, Inc.
 - 4. Johns Manville.

- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 - 1. Permanent forming/damming/backing materials.
 - 2. Substrate primers.
 - 3. Collars.
 - 4. Steel sleeves.

2.5 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.6 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Special Inspector shall perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Where Intertek ETL SEMKO-Listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under "Firestop Systems."
- C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

END OF SECTION

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SECTION 078443
JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Engineering Judgment found on the Drawings.

1.2 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints in smoke barriers.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.
 - 2. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.8 WARRANTY

- A. General Warranty Requirements are specified in 01 78 36 - Warranties. Minimum 2-Year warranties per 01 78 36 shall be provided for all installed material and equipment unless more stringent requirements are noted in this section. Standard Manufacturer Warranties shall be provided where they exceed minimum warranty requirements.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.10 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.3 JOINT FIRESTOPPING SYSTEMS

- A. Manufacturers: Provide the following, or equal.
 - 1. A/D Fire Protection Systems Inc.
 - 2. Grace Construction Products.
 - 3. Hilti, Inc.
 - 4. Johns Manville.
- B. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint

firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

- C. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
 - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION

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SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical and fire joint sealants.
5. Compressible filler at concrete.

- B. Related Sections:

1. Section 088000 "Glazing" for glazing sealants.
2. Section 092900 "Gypsum Board" for sealing perimeter joints.
3. Section 093000 "Tiling" for sealing tile joints.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.
- E. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- E. Preinstallation Conference: Conduct conference at Project site after approval of a complete submittal.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

C. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

D. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.7 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.9 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. PS EPD: Products specified under this section shall have a Type III Product Specific EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 MATERIALS, GENERAL

- A. Provide required joint sealants as recommended by Composite Architectural Panel Fabricator for two lines of sealant.

- B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Colors of Exposed Joint Sealants: Provide custom sealants to match Architect's sample.

2.3 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 - 1. Basis of Sustainable Design:
 - a. Dow Corning Corporation; 790.
- B. Structural Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
 - 1. Products: Provide the following, or equal:
 - a. Dow Corning Corporation; 795 or 995.
- C. Weather barrier sealant at exterior glazing: Dow Corning Corporation; 795.

2.4 URETHANE JOINT SEALANTS

- A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide the following, or equal:
 - a. Sika Corporation, Construction Products Division; Sikaflex - 15LM.
 - b. Tremco Incorporated; Vulkem 921.

2.5 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following, or equal:
 - a. BASF Building Systems; Sonolac.
 - b. Pecora Corporation; AC-20+.
 - c. Tremco Incorporated; Tremflex 834.

2.6 ACOUSTICAL AND FIRE JOINT SEALANTS

- A. Acoustical and Fire Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
 1. Manufacturers: GE Construction Sealants, Hilti, Inc., Pecora Corp., Tremco Inc., USG Corp., or equal.
 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.7 PREFORMED JOINT SEALANTS

- A. Preformed Silicone Joint Sealants: Manufacturer's standard sealant consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.
- B. Products: Subject to compliance with requirements, provide the following, or equal:
 1. Dow Corning Corporation; 123 Silicone Seal.
 2. GE Advanced Materials - Silicones; UltraSpan US1100.

2.8 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 1. Provide closed-cell material at all exterior joint applications.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 COMPRESSIBLE FILLER AT CONCRETE

- A. Product: W.R. Meadows "Deck-O-Foam", or equal. Flexible, lightweight, non-staining, polyethylene closed-cell expansion joint filler. Top with urethane sealant.

2.10 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXTENT, PER CALIFORNIA ENERGY EFFICIENCY STANDARDS

- A. All joints and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weather-stripped, or otherwise sealed to limit air leakage into or out of the building. This applies to penetrations for pipes and conduits, ducts, vents, and other openings. All gaps between wall panels, around doors, and other construction joints shall be well sealed. Ceiling joints, lighting fixtures, plumbing openings, doors and windows shall be considered as potential sources of unnecessary loss due to infiltration.

3.2 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Remove laitance and form-release agents from concrete.
 - 3. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.4 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.5 INSTALLATION OF ACOUSTICAL AND FIRE JOINT SEALANTS

- A. Comply with joint sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. Fire-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of fire sealant. Install in accordance with requirements to meet requirements for Fire-Rated Assemblies.
- C. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- D. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.6 FIELD QUALITY CONTROL

- A. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.7 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.8 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

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SECTION 081113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.

8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.
- D. LEED Submittals:
1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
1. Amweld International, LLC.
 2. Ceco Door Products; an Assa Abloy Group company.
 3. Curries Company; an Assa Abloy Group company.
 4. Door Components, Inc.
 5. Steelcraft; an Ingersoll-Rand company.
 6. Stiles Custom Metal, Inc.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 DOOR JAMB AT FLUSH CONDITIONS

- A. Frameless Door Jamb at Mechanical Closets: 18 gauge, EzyJamb Single Rabbet (SRC) Door Jamb System or equal.

2.3 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Commercial Doors and Frames: NAAMM-HMMA 861. At locations indicated in the Door and Frame Schedule.
 - 1. Physical Performance:
 - a. Level A according to SDI A250.4.
 - b. Grade 3 extra heavy duty per SDI 108.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum G60A60 coating.
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Core: Steel stiffened.
 - 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum G60A60 coating.
 - b. Construction: Full profile welded, no visible seam.
 - c. Face Profile: 2-1/4" to match existing frames.
 - 4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - 2. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- H. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- J. Glazing: Comply with requirements in Section 088000 "Glazing."
- K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 - 2. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
 - 3. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.

4. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Shop fabricate fully welded frames.
1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 3. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 4. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 2. Provide loose stops and moldings on inside of hollow-metal work.
 3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
- 2.7 STEEL FINISHES
- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - c. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - d. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 4. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

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SECTION 081116

INTERIOR ALUMINUM FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes interior aluminum frames for doors installed in gypsum board partitions.
- B. Related Sections:
 - 1. Section 079200 "Joint Sealants."
 - 2. Section 081416 "Flush Wood Doors" for wood doors installed in interior aluminum frames.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 2. Locations of reinforcements and preparations for hardware.
 - 3. Details of each different wall-opening condition.
 - 4. Details of anchorages, joints, field splices, and connections.
 - 5. Details of accessories.
 - 6. Details of conduits and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied finishes.
 - 1. Include similar Samples of seals, gaskets, and accessories involving color selection.
- D. Samples for Verification: For interior aluminum frames, prepared on Samples of size indicated below:
 - 1. Framing Member: 12 inches long.
 - 2. Corner Fabrication: 12-by-12-inch- long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.
- E. Schedule: For interior aluminum frames. Use same designations indicated on Drawings. Coordinate with door hardware schedule.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For interior aluminum frames to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain interior aluminum frames from single source from single manufacturer.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver interior aluminum frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic. Store interior aluminum frames under cover at Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis-of-Design: [GS-4] RACO Interior Products, Inc. or one of the following equal alternates:
 - 2. Wilson Partitions.
 - 3. Western Integrated Materials, Inc.
- B. Basis of Design: Wilson Partitions "Snap-On Trim with 1-1/2-inch Profile". Contractor shall provide correct series to fit partition. Provide "Positive Pressure Fire Rated Frame" at rated conditions shown on Drawings.
 - 1. Where shown, provide assembly with butt-glazed vertical at internal joints. Vertical and horizontal edges to have aluminum frames.

2.2 COMPONENTS

- A. Aluminum Framing: ASTM B 221, Alloy 6063-T5 or alloy and temper required to suit structural and finish requirements, not less than 0.062 inch thick.
- B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.

- C. Ceiling Tracks: Extruded aluminum.
- D. Trim: Extruded aluminum, not less than 0.062-inch thick, with removable snap-in casing trim, and door stops without exposed fasteners.

2.3 ACCESSORIES

- A. Fasteners: Aluminum, nonmagnetic, stainless steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.
- B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals; grey color.
- C. Hardware: Comply with requirements in Section 087100 "Door Hardware".

2.4 FABRICATION

- A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted or mitered connections.
- B. Factory prepare interior aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 08 71 00 "Door Hardware."
- C. Fabricate components to allow secure installation without exposed fasteners.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. Anodized finish; AAMA 611, Class II, 0.4 mils. Color: black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and ceilings, with Installer present, for conditions affecting performance of the Work.

- B. Verify that wall thickness does not exceed standard tolerances allowed by throat size indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install interior aluminum frames plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.
- B. Set frames accurately in position and plumbed, aligned, and securely anchored to substrates.
- C. Install frame components in the longest possible lengths; components up to 72 inches long shall be one piece.
 - 1. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
 - 2. Secure clips to extruded main-frame components and not to snap-in or trim members.
 - 3. Do not leave screws or other fasteners exposed to view when installation is complete.

3.3 CLEANING

- A. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended by frame manufacturer and according to AAMA 609 & 610.
- B. Touch up marred frame surfaces so touchup is not visible from a distance of 24 inches. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

3.4 FIELD QUALITY CONTROL

- A. Partitions and office fronts may be tested for acoustic performance by the Acoustic Consultant according to the current version of ASTM E336. This testing shall be undertaken upon substantial completion of the full partition assemblies, including all doors, sealant, gaskets and void barriers as per approved construction documents and/or shop drawings. Should any acoustically rated assemblies fail to meet project NIC targets due to deficiencies in Contractor installation, Contractor shall provide a) remediation necessary to meet NIC criterion and b) post-remediation acoustic testing at no cost to Owner.

END OF SECTION

SECTION 081416
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with transparent finish.
 - 2. Solid-core doors with opaque finish.
 - 3. Factory finishing flush wood doors.
 - 4. Factory fitting flush wood doors to frames and factory machining for hardware.
 - 5. Wood door frames.

- B. Related Sections:
 - 1. Section 087000 "Hardware".
 - 2. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include factory-finishing specifications.

- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Requirements for veneer matching.
 - 6. Doors to be factory finished and finish requirements.
 - 7. Fire-protection ratings for fire-rated doors.

- C. Samples: For factory-finished doors.
 - 1. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - 2. Louver blade and frame sections, 6 inches long for each material and finish specified.

- D. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - b. MRc3 - Sourcing of Raw Materials – Forestry Stewardship Council (FSC) Certified Wood: For all wood products designated in this specification as "FSC certified,"

provide vendor invoices with the vendor's Chain-of-Custody (COC) number and identify each FSC certified product on a line-item basis. If FSC wood products are modified off-site by an architectural woodworker or millworker, the woodworker shall have an FSC COC number.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. Composite Woods: Composite wood and agri-fiber products shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde (NAF).

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
 - 1. Algoma Hardwoods, Inc.
 - 2. Eggers Industries.
 - 3. Marshfield Door Systems, Inc.

2.3 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
- B. WDMA I.S.1-A Performance Grade:
 - 1. Heavy Duty unless otherwise indicated.
 - 2. Extra Heavy Duty: Level 1 Large Meeting and Training Rooms, multiple user toilets, assembly spaces, corridors and exits, break rooms.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - 3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- E. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.

2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

F. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.

G. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.4 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade AA faces.
2. Species: Douglas fir to match Architect's wood veneer sample as specified in Section 064023.
3. Cut, Match between Veneer Leaves: Rift cut, slip-matched veneers. Where door occurs in wood paneled partition, match door to adjacent wood veneer panels. Doors visible in one space are to match each other.
4. Premium-grade doors.
5. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.
6. Core: Douglas Fir, glued wood stave, no joints at stile to rail connections.
7. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
8. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.5 DOORS FOR OPAQUE FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium.
2. Faces: MDO, applied to standard-thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.
3. Exposed Vertical and Top Edges: Any closed-grain hardwood.
4. Core: Douglas Fir, glued wood stave, no joints at stile to rail connections.
5. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
6. Adhesives: Type I per WDMA T.M.-6.
7. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.6 LIGHT FRAMES AND LOUVERS

- A. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.7 WOOD DOOR FRAMES

- A. Frames: Provide manufacturer's standard wood frames unless otherwise indicated.
 - 1. Wood Species and Finish: Hardwood to match sample in Section 064023.
 - 2. Profile: Manufacturer's standard shape, or as otherwise shown on Drawings.

2.8 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
- C. Openings: Factory cut and trim openings through doors.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.9 FINISHING

- A. General: Comply with "Premium" Grade requirements of Section 5 of the NAAWS with shop applied coatings applied in accordance with manufacturer's written instructions.
- B. Transparent Finish:
 - 1. Finish: WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
- C. Opaque Finish:
 - 1. North American Architectural Woodwork Standards. Grade: Premium.
 - 2. Color and Sheen: Match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
 - 2. Install smoke- and draft-control doors according to NFPA 105.
 - 3. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION

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SECTION 083113

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
 - 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 TYPES

- A. AD1: Standard Framed Access Door.
- B. AD2: Acoustic Access Door (fire rated door with Pemko sound seal kit).
- C. AD3: Frameless Access Door, similar to Acudor DW-5040.
Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
- D. At Acoustical Plaster: Recessed for flush applications, Acudor AT-5020.
- E. At Tile Substrates: Stainless steel type.

2.3 MANUFACTURERS

- A. Acudor, Karp, or equal.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder locks, furnish two keys per lock and key all locks alike.
 - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Stainless-Steel Finishes:
 - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

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SECTION 083326

OVERHEAD COILING GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Open-curtain overhead coiling grilles.

- B. Related Sections:

- 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Overhead coiling grilles shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

- 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- 2. Seismic Component Importance Factor: As shown on structural drawings.

- B. Operation Cycles: Provide overhead coiling grille components and operators capable of operating for not less than number of cycles indicated for each grille. One operation cycle is complete when a grille is opened from the closed position to the fully open position and returned to the closed position.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling grille and accessory. Include the following:

- 1. Construction details, material descriptions, dimensions of individual components, profiles for curtain components, and finishes.
- 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
1. Open-Curtain Grille: 18-inch-square assembly with full-size components consisting of rods, spacers, and links as required to illustrate each assembly.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer.
 - B. Seismic Qualification Certificates: For overhead coiling grilles, accessories, and components, from manufacturer.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For overhead coiling grilles to include in maintenance manuals.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
 - B. Source Limitations: Obtain overhead coiling grilles from single source from single manufacturer.
 1. Obtain operators and controls from overhead coiling grille manufacturer.
 - C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 GRILLE CURTAIN MATERIALS AND CONSTRUCTION

- A. Basis-of-Design: Cornell "VisionAire ESG12 Brick Pattern Grille". 5/16 inch diameter, solid aluminum rods, offset in rows and columns, with 2 inch vertical spacing. Heavy duty aluminum links, 3/4 inch wide, positioned by tube spacers on 9 inch staggered centers. End links to be held in place by self-locking retaining rings.

- B. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, finished to match grille. 2 x 3-1/2 inch extruded aluminum tubular section reinforced with 3 x2 x 3/16 inch aluminum angle(s).
- C. Grille Curtain Jamb Guides: Heavy duty extruded aluminum sections with snap-on cover to conceal fasteners and polypropylene pile runners on both sides of curtain. Provide [steel] [aluminum] mounting angle as required for face of wall installation.
- D. Counterbalance Shaft Assembly:
 - 1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.
 - 2. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of grille to ensure that maximum effort to operate will not exceed 25 lbs. Provide wheel for applying and adjusting spring torque.
- E. Brackets: Fabricate from minimum 3/16 inch steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.
 - 1. Finish: As selected by Architect.
- F. Hood and Fascia: **[24 gauge galvanized steel] [24 gauge stainless steel] [0.040 inch aluminum]** with reinforced top and bottom edges. Provide minimum 1/4 inch steel intermediate support brackets as required to prevent excessive sag.
 - 1. Finish: As selected by Architect.

2.2 ACCESSORIES

- A. Motor Operated Locking Device Assembly: Keyed cylinder locking into both jambs operable from both sides of curtain with motor interlock cutout switches.
- B. Emergency Egress System: Provide wall mounted manual release system pull handle to disengage motor operator and automatically open grille for emergency egress without the use of electrical power. Release of pull handle will reset grille to normal motor operation.
- C. Operator and Bracket Mechanism Cover: Provide **[24 gauge galvanized steel] [24 gauge stainless steel] [0.040 inch (1.016 mm) aluminum]** sheet metal cover **[to provide weather resistance] [to enclose exposed moving operating components]** at coil area of unit. Finish to match door hood.

2.3 ELECTRIC GRILLE OPERATORS

- A. General: Electric grille operator assembly of size and capacity recommended and provided by grille manufacturer for grille specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking grille, and accessories required for proper operation.
 - 1. Comply with NFPA 70.

2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each grille.
 - C. Grille Operator Location(s): As shown.
 - D. Electric Motors: As recommended by manufacturer.
 - E. Limit Switches: Equip each motorized grille with adjustable switches interlocked with motor controls and set to automatically stop grille at fully opened and fully closed positions.
 - F. Obstruction Detection Device: Equip motorized grille with indicated external automatic safety sensor capable of protecting full width of grille opening. Activation of sensor immediately stops and reverses downward grille travel.
 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in grille opening without contact between grille and obstruction.
 - a. Self-Monitoring Type: Designed to interface with grille operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, grille closes only with sustained pressure on close button.
 - G. Emergency Manual Operation: Equip each electrically powered grille with capability for emergency manual operation. Design manual mechanism so required force for grille operation does not exceed 25 lbf (111 N).
 - H. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
 - I. Emergency-Egress Release: Flush, wall-mounted handle mechanism, for ADA-ABA-compliant egress feature, not dependent on electric power. The release allows an unlocked grille to partially open without affecting limit switches to permit passage, and it automatically resets motor drive upon return of handle to original position.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling grilles and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling grilles, hoods, and operators at the mounting locations indicated for each grille.
- C. Accessibility: Install overhead coiling grilles, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Test grille opening when activated by detector, fire-alarm system, emergency-egress release, or self-opening mechanism as required. Reset grille-opening mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that grilles operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling grilles.

END OF SECTION

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SECTION 083343

OVERHEAD COILING FIRE CURTAIN

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Overhead Coiling Fire Curtain.
 - 2. Division 5 Section "Metal Fabrications" for supplementary metal members supporting smoke curtain systems to structure.
 - 3. Division 26 Sections for electrical wiring and connections and for smoke curtain machines.
 - 4. Division 28 Section "Fire Alarm" for connections of smoke and fire curtain machines to fire alarm per UL 864 label.
- B. Related Requirements:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 TEST REPORTS

- A. Product listing and Labeling Requirement per ISO 17065 by ANSI Accreditation. Testing Laboratory to be IAS Accredited, ISO 17025 Compliant.
- B. Required Testing Reports, Label Requirements, and Minimum Performance Standards Tested to:
 - 1. UL 10B and ASTM E2226 (Hose stream test)- Fire test of Door Assemblies listed and labeled for a two hour wall
 - 2. ASTM E119 listed and labeled for two hours in accordance with IBC 903.1.1., for use as a two hour movable fire wall.
 - 3. Guardian EE Report

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Show fabrication and installation details for steel-tex fire shutter. Include plans, sections, details, attachments to other work, and the following:
 - a. Operating clearances.
 - b. Requirements for supporting automatic smoke curtains, track, and equipment. Verify capacity of each track and rigging component to support loads.
 - c. Locations of equipment components, switches, motors and controls. Differentiate between manufacturer-installed and field-installed wiring.
- C. Samples:

1. For each type of steel-textile from dye lot to be used for the Work, with specified treatments applied, and showing complete pattern and texture repeat, if any. Mark top and face of textile.

D. Testing Laboratory Label and Accreditation:

1. For each type of product provide Guardian label affixed to Assembly.
2. The test is accredited and meets the requirements of ISO/IEC 17025 as verified by ANAB per Report AT1247.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For automatic steel-tex fire shutters to include in maintenance manuals.
- B. Warranty Documentation: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Overall Standards: Manufacturer shall maintain a quality control program for follow up service in accordance with ISO 1720.
- B. Installer Qualifications:
 1. A firm or individual in the United States with no less than five years on-site installation experience in the United States, experienced in installing fire curtain shutter system similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
 2. Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 FIELD CONDITIONS

- A. Existing Conditions: Verify rough and clear openings and the dimensions of other construction by field measurements or by hold to dimensions before fabrication and indicate measurements on shop drawings.

PART 2 - PRODUCTS

2.1 STEEL- TEX FIRE SHUTTER

- A. Basis of Design Manufacturer: U.S. Smoke & Fire Dual Hose Stream 120 as manufactured by U.S. Smoke & Fire Corporation, or equal.
- B. Description:
 1. Provide U.S. Smoke & Fire Dual Hose Stream 120 as manufactured by U.S. Smoke and Fire Corp.
 2. There are no substitutions of materials specified allowed during the bidding process. If, for any reason a deviation from materials specified by the designers is desired or warranted, a cover letter and a request for deviation. Transmittal form must be submitted to construction manager (CM). If the proposed deviation is rejected by the CM or the

Designers, it is this subcontractor's responsibility to obtain the original items and maintain the original construction schedule. The Designer has the right to require the originally specified material or item and his decision on the matter is final.

C. Performance/Design Criteria:

1. Head Box- The head box shall be manufactured from 18 gauge galvanized steel. The enclosure shall be rated at the same temperature as the fabric. Head Boxes are installed back to back with a 9 inch gap between steel-tex fire curtain shutters for temperature rise on unexposed side per ASTM E119.
2. Cover Plates- Removable cover plates shall be incorporated to allow access to the curtain rollers.
3. Sizes- Standard head box sizes shall be 9 inches x 9 inches for single rollers and 9 inches x 15 inches for multiple rollers. Larger head boxes may be required where the curtain drop is in excess of 15 feet drop height.
4. Bottom Bar- A weighted bottom bar shall be provided to prevent deflection and ensure correct operation.
5. Roller Assembly -The roller shall be constructed from a round tube, which will incorporate Motor and gearbox and a sealed heavy-duty ball bearing assembly.
6. Motor Controller t- A motor controller housed in a steel enclosure shall be mounted onto the motor end of the head box.
7. Steel Textile— The steel-tex fire shutter system shall be manufactured from wire inserted woven fiber with two hour coating. The woven wire reinforced high performance multi-layer fiber textile with 2 hour coating shall be tested to the standard of UL 10B with hose stream performance for an opening in a two hour fire wall per IBC 715.3.
8. The Dual Hose Stream 120® is listed per ASTM E119 standard and listed for 120 minutes or two hours.
9. Side Guide Assemblies- Each guide assembly shall be fabricated of a steel channel with integral pressure retaining tabs. Channels to be 2 inches by 4 inches.
10. Finish- Factory galvanized steel enclosure. Clean all metal surfaces for paint adhesion.
11. Color – Custom as selected by Architect. Paint exposed countersunk fasteners to match housing.

D. Operation

1. The SFS system shall deploy upon a signal from the fire alarm system in an emergency situation.
2. Under normal operating conditions the steel-tex fire shutter would be held in the retracted position via the motors operating a voltage.
3. Upon activation of the fire alarm, the controller will remove the supply voltage and the SFS system shall descend in a controlled manner. A dynamic braking system housed in the motor control circuit shall control the speed of the descent of the curtain. To retract the SFS system, the control panel shall supply voltage to the motor controller and motors will drive the steel-tex fire shutter to the upper position. As the bottom bar or stopping bar hits the shutter housing a current limiting circuit will step back the voltage and current and hold the bottom bar in the retracted position.
4. Limit switches are not to be used to control the upper position of the curtain.
5. power fail to the group control panel, the supply is automatically switched to the integral standby battery. The curtain remains in the
6. Control Panel: Provide Control Panel (CP). During normal operation, the CP will provide an AC supply to the fabric fire shutter motor holding them in the retracted position. Should smoke be detected, the fire alarm contact in the CP will be opened by the fire alarm control system, the CP will control the descent of the motors and the will descend in a controlled manner.
7. Open on fire- signal, close on normal mode

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Examine areas and conditions, with Installer present, for compliance with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions affecting performance of automatic smoke-curtain work. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 2. Examine inserts, clips, blocking, or other supports required to be installed by others to support boxes. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fabric fire shutter according to manufacturer's written instructions.
- B. Interface with Other Work:
 - 1. Notification of deployment- sensors may be installed by others

3.3 FIELD QUALITY CONTROL

- A. Field Tests and Preventative Maintenance Service
 - 1. Fire alarm testing- the SFS is required to deploy upon a signal from the fire alarm in an emergency situation. Drop test and commissioning per NFPA 80.

3.4 CLOSEOUT ACTIVITIES

- A. Demonstration:
 - 1. Engage a factory-authorized service representative to demonstrate system.
- B. Training: Engage a factory-authorized service representative to provide End User training per NFPA 3.

3.5 ANNUAL REQUIRED PREVENTIVE MAINTENANCE REQUIREMENT

- A. This is a high performance steel-tex fire shutter system that requires annual adjustment, maintenance and preventative maintenance service. Engage U.S. Care factory certified technician to maintain system once per annum per manufacturers operation and maintenance manual for the preventative maintenance service.
- B. No contractor nor end user shall attempt any service of the system. Such action shall void the testing laboratory label on the assembly. All maintenance by a U.S. Care factory certified technician.

END OF SECTION

SECTION 083473

SOUND CONTROL DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Steel sound-control door/frame assemblies.

- B. Related Sections:

- 1. Section 081113 "Hollow Metal Doors and Frames."
- 2. Section 085115 "Sound Control Windows."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include sound ratings, construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

- B. Shop Drawings: Include the following:

- 1. Elevations of each door design.
- 2. Details of sound-control seals, door bottoms, and thresholds.
- 3. Details of doors, including vertical and horizontal edge details and metal thicknesses.
- 4. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- 5. Locations of reinforcement and preparations for hardware.
- 6. Details of each different wall opening condition.
- 7. Details of anchorages, joints, field splices, and connections.
- 8. Details of accessories.
- 9. Details of moldings, removable stops, and glazing.
- 10. Details of conduit and preparations for power, signal, and control systems.

- C. Samples for Verification:

- 1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
- 2. Doors: Include section of vertical-edge, top, and bottom construction; door bottom gasket; core construction; glazing; and hinge and other applied hardware reinforcement.
- 3. Frames: Include profile, corner joint, floor and wall anchors, and seals. Include separate section showing fixed sound panels if applicable.

- D. Schedule: Provide a schedule of sound-control door assemblies prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with the Door Hardware Schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer.
- B. Product Certificates: For each type of sound-control door assembly, from manufacturer.
- C. Product Test Reports: Test Reports: Performed and issued by a qualified independent testing agency including acoustical performance data in the form of up-to-date test reports indicating the doors to be provided will have the specified Sound Transmission Class (STC) rating (per ASTM E-90/ASTM E 413). Refer to door schedule for the required STC ratings.
- D. Field quality-control reports.
- E. Warranty: Samples of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound-control door assemblies to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain sound-control door assemblies, including doors, frames, sound-control seals, hinges (when integral for sound control), thresholds, and other items essential for sound control, from single source from single manufacturer.
- C. Sound Rating: Provide sound-control door assemblies identical to those of assemblies tested as sound-retardant units by a qualified independent acoustical testing agency, and have the following minimum rating:
 - 1. STC Rating: _____, as determined by ASTM E 413 when tested in an operable condition according to ASTM E 90 and ASTM E 1408.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review required field quality-control procedures.
 - 2. Review procedures for coordinating frame and anchor installation with wall construction.
 - 3. Review frame grouting procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to finish of factory-finished wood doors.

- B. Shipping Spreaders: Deliver welded frames with two removable spreader bars across bottom of frames, tack welded or mechanically attached to jambs and mullions.
- C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high, wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
 - 1. If wrappers on doors become wet, remove cartons immediately. Provide a minimum of 1/4-inch space between each stacked door to permit air circulation.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install sound-control doors until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate installation of anchorages for sound-control door assemblies. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.10 WARRANTY

- A. Performance Warranty: A minimum Noise Isolation Class (NIC) rating (ASTM-E413) within 5 points of the published laboratory STC rating shall be guaranteed against defective workmanship and/or installation for one year from date of acceptance by Owner.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. At a minimum, acoustic door materials and hardware shall be guaranteed against defective workmanship for one year from date of shipment. Manufacturer's warranty is in addition to, and does not limit, other rights the Owner may have under the Contract Documents.

PART 2 - PRODUCTS

2.1 SOUND-CONTROL DOORS

- A. Basis-of-Design Product: Krieger "Sonic." Provide product from Noise Barriers, or equal. Manufacturer to provide all specified scheduled hardware for sound-rated doors
- B. Description: Provide flush-design sound-control doors, 3-1/2 inches thick, of seamless construction; with manufacturer's standard sound-retardant core as required to provide STC and fire rating indicated. Construct doors with smooth, flush surfaces without visible joints, seams, or fasteners on exposed faces or stile edges. Fabricate according to ANSI/NAAMM-HMMA 865.

1. Interior Doors: Fabricate from 14 gauge cold-rolled galvanized steel with an A60 coating weight, and filled with 6 lb. density, sound absorbing and damping elements, or thicker as required to achieve STC rating indicated.
2. Top and Bottom Channels: Closed with continuous channels of same material as face sheets, spot welded to face sheets not more than 6 inches o.c.
3. Hardware Reinforcement: Same material as face sheets.

C. Materials:

1. Cold-Rolled Steel Sheet: ASTM A653 galvanized steel, suitable for exposed applications.

D. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.2 SOUND-CONTROL FRAMES

A. Description: Fabricate sound-control split door frames with corners mitered, reinforced, and continuously welded full depth and width of frame. Fabricate according to ANSI/NAAMM-HMMA 865.

1. Weld frames according to NAAMM-HMMA 820.
2. Interior Frames: Fabricate from 14 gauge cold rolled, galvanized steel with an A60 coating weight, or thicker as required to provide STC rating indicated.
3. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 865 of same material as face sheets.
4. Jamb Anchors:
 - a. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter, metallic-coated steel bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
5. Floor Anchors: Not less than 0.079-inch nominal thickness metallic-coated steel, and as follows:
 - a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - b. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.
6. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch-wide uncoated steel unless otherwise indicated.

B. Materials:

1. Cold-Rolled Steel Sheet: ASTM A653 galvanized steel, suitable for exposed applications.

2. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
3. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
4. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching sound-control door frames of type indicated.
5. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

C. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.3 SOUND-CONTROL HARDWARE

A. Description: Provide manufacturer's standard sound-control system, including head, jamb, and door bottom seals, cam-lift hinges, and thresholds, as required by testing to achieve STC and fire rating indicated.

1. Compression Seals: One-piece units; consisting of closed-cell sponge neoprene seal held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
2. Magnetic Seals: One-piece units; consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by channel integral to fabricated door frame.
3. Door Bottom Seals: Continuous, adjustable fixed seal that shall compress against the threshold as the door is closed.
4. Cam-Lift Hinges: Full-mortise template type that raises door 1/2 inch when door is fully open; with hardened pin; fabricated from stainless steel.
5. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from stainless steel.

B. Other Hardware: Comply with requirements in Section 087100 "Door Hardware."

2.4 FABRICATION

- A. Door to be pre-hung at the factory. Assembly and adjustment of door leaf, frame, acoustic seals, hinges and associated finish hardware shall take place at the factory. The entire manufactured assembly shall be shipped to the job site ready to install and operate
- B. Sound-Control Steel Door Fabrication: Sound-control doors to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

1. Seamless Edge Construction: Fabricate doors with faces joined at vertical edges by welding; welds shall be ground, filled, and dressed to make them invisible and to provide a smooth, flush surface.
 2. Hardware Preparation: Factory prepare sound-control doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 08 7100 "Door Hardware."
 - a. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.
 - b. Locate door hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
 3. Tolerances: Fabricate doors to tolerances indicated in ANSI/NAAMM-HMMA 865.
- C. Sound-Control Frame Fabrication: Fabricate sound-control frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches in height.
 - 2) Four anchors per jamb from 60 to 90 inches in height.
 - 3) Five anchors per jamb from 90 to 96 inches in height.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
 - 5) Two anchors per head for frames more than 42 inches wide and mounted in metal stud partitions.
 - b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 5. Head Reinforcement: For frames more than 48 inches wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
 6. Hardware Preparation: Factory prepare sound-control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 08 7100 "Door Hardware."
 - a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.

- b. Locate hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
- 7. Tolerances: Fabricate frames to tolerances indicated in ANSI/NAAMM-HMMA 865.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of sound-control door assemblies.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of sound-control door frame connections before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace sound-control door frames to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install sound-control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.
- B. Frames: Install sound-control door frames in sizes and profiles indicated.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set.
 - a. At fire-rated openings, install frames according to NFPA 80.

- b. At openings requiring smoke and draft control, install frames according to NFPA 105.
 - c. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, and dress; make splice smooth, flush, and invisible on exposed faces.
 - d. Install sound-control frames with removable glazing stops located on secure side of opening.
 - e. Remove temporary braces only after frames or bucks have been properly set and secured.
 - f. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
- a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.
3. In-Place Concrete Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
5. Installation Tolerances: Adjust sound-control door frames for squareness, alignment, twist, and plumbness to the following tolerances:
- a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Doors: Fit sound-control doors accurately in frames, within clearances indicated below. Shim as necessary.
1. Non-Fire-Rated Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
- a. Jambs: 1/8 inch.
 - b. Head with Butt Hinges: 1/8 inch.
 - c. Head with Cam-Lift Hinges: As required by manufacturer, but not more than 3/8 inch.
 - d. Sill: Manufacturer's standard.
 - e. Between Edges of Pairs of Doors: 1/8 inch.
2. Fire-Rated Doors: Install fire-rated doors with clearances according to NFPA 80.
- D. Thresholds: Set thresholds in full bed of sealant complying with requirements in Section 07 9200 "Joint Sealants."

3.4 FIELD QUALITY CONTROL

- A. Upon completion of this portion of work, and prior to its acceptance by the Owner, a qualified representative of the manufacturer of the acoustical door system(s) shall visit the jobsite to confirm that installation is in conformance with the manufacturer's recommendations.
- B. Doors may be selected for in situ verification testing of the acoustical performance (ASTM E-336). Provide in-situ adjustments and modifications as required to achieve a minimum Noise Isolation Class (NIC) rating (ASTM-E413) within 5 points of the published laboratory STC rating. Contractor shall remedy all defects without expense to the Owner. Any additional testing required to verify that repaired/adjusted door/frame assemblies perform as specified above, will be at the expense of the contractor.

3.5 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and adjust seals, door bottoms, and other sound-control hardware items right before final inspection. Leave work in complete and proper operating condition.
- B. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.
 - 1. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- D. Metallic-Coated Surfaces: Clean abraded areas of doors and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

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SECTION 083483

ELEVATOR DOOR SMOKE CONTAINMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Smoke detector activated elevator door smoke containment screen and control system designed to provide a tight-fitting, smoke- and draft-control assembly to be provided for smoke control at RNEW elevator.
- B. Products Supplied but not installed under this section.
 - 1. End-of-line diode (3.9V, 2W). Installed at smoke detector to monitor the circuit.
- C. Related Sections:
 - 1. Section 092216 - Non-Structural Metal Framing: Metal backing in housing mounting area.
 - 2. Section 099100 - Painting and Coating: Field painting of specified components; repainting of existing field painted elevator door frames.
 - 3. Section 142100 - Traction Elevators.
 - 4. Division 21 Sections for Fire Detection and Alarm: Provision of smoke detectors.
 - 5. Division 26 Sections for 120VAC and control circuit power including conduit, boxes, conductors, wiring devices, and emergency power.

1.3 REFERENCES

- A. ASTM A240/240M – Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
- B. ICC Evaluation Service ES AC77 – Acceptance Criteria for Smoke-Containment Systems Used with Fire-Resistive Elevator Hoist way Doors and Frames.
- C. ICC Evaluation Service report ESR-1136
- D. NFPA Codes and Standards:
 - 1. 70 – National Electrical Code.
 - 2. 105 – Recommended Practice for the Installation of Smoke-Control Door Assemblies.
 - 3. 72-2002 and 2007 – National Fire Alarm Code
- E. 2019 California Building Code.

F. UL Standards:

1. 268 – Smoke Detectors for Fire Protective Signaling Systems.
2. 508 – Industrial Control Equipment.
3. 864 – Control Units for Fire Protective Signaling Systems.
4. 1784 – Air Leakage Tests for Door Assemblies.

1.4 SUBMITTALS

- A. Reference Section 013300 “Submittal Procedures”.
- B. Product Data: For each type of product.
- C. Shop Drawings: Include door width and height, jamb width, jamb and head projection, screen width, mounting height, and housing width. Show and identify related work performed under other sections of the specifications.
- D. Quality Assurance/Control Submittals:
 1. Qualifications:
 - a. Proof of manufacturer qualifications.
 - b. Proof of Installer qualifications.
 - c. Certifications: Copy of specified items.
 - d. Manufacturer’s installation instructions and testing procedures.

1.5 CLOSEOUT SUBMITTALS

- A. Comply Section 017700 “Closeout Submittals”; submit following items:
 1. Operation and Maintenance Manual and Video
 2. Manufacturer’s Warranties

1.6 QUALITY ASSURANCE

- A. Overall Standards:
 1. Manufacturer shall maintain a quality control program in accordance with ICC-ES Acceptance Criteria 77.
- B. Qualifications:
 1. Manufacturer Qualifications: Minimum five years of experience in producing smoke containment systems of the type specified.
 2. Installer Qualifications: Factory trained by manufacturer.
- C. Certifications:
 1. Manufacturer’s ICC Evaluation Service report ESR-1136.

2. California Department of Forestry and Fire Protection and Office of the State Fire Marshal Listing.
3. Testing Laboratory Label.
4. UL Listing.
5. OSHPD Anchorage Pre-Approval No. OPM-0233-16

D. Pre-Installation Meeting:

1. Schedule and convene a pre-installation meeting prior to commencement of field operations with representatives of the following in attendance: Owner, Architect, General Contractor, smoke containment system sub-contractor, painting sub-contractor, and electrical sub-contractor.
2. Review substrate conditions, requirements of related work, installation instructions, storage and handling procedures, and protection measures.
3. Keep minutes of meeting including responsibilities of various parties and deviations from specifications and installation instructions.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Reference Section 016600 – Product Storage and Handling Requirements.
- B. Follow manufacturer’s instructions.

1.8 WARRANTY

- A. Provide manufacturer’s standard one-year warranty.
- B. Maintenance and Testing:
 1. Perform minimum semi-annual maintenance and testing on each smoke containment system as required by the manufacturer’s warranty, code agency evaluation reports, and as required by local authority having jurisdiction.
 2. Provide test documentation.

PART 2 - GENERAL

2.1 MANUFACTURER

- A. Manufacturer:
 1. Smoke Guard, 287 Maple Grove, Boise, Idaho 83704 <http://www.smokeguard.com/>
 - a. Basis-of-Design: Model 400.
- B. Label each smoke containment system with following information:
 1. Manufacturer’s name.
 2. Maximum leakage rating at specified pressure and temperature conditions.
 3. Label of quality control agency.

2.2 PERFORMANCE REQUIREMENTS

- A. Air Leakage: Not to exceed 3 cfm (0.001416 m³/s) per sf of door opening at 0.1 in (25 Pa) water pressure differential at ambient temperature and 400 degrees F (204 degrees C) tested per IBC 2009 714.2.3.

2.3 COMPONENTS

- A. Screen:
 - 1. Film: Minimum 1 mil (0.025 mm) thick transparent polyimide film reinforced with minimum 100 denier Nomex yarn at .25 in (6.35 mm) each way.
 - 2. Magnetic Strips: Flexible multi-pole strips attached to longitudinal edges of film with adhesive tape.
- B. Housing: 20 gauge, powder coated, cold rolled steel container with dust cover and door with concealed hinges. Housings are 55, 64, or 73" in length plus 1-1/2 inches for a junction box on the left side.
- C. Self-contained control system within the housing – no remote mounting of control boxes and associated wiring to the control boxes shall be allowed.
- D. Auxiliary Rails:
 - 1. Material: 16 gage ASTM A 240/240M, Type 430, ferritic stainless steel.
 - 2. Size: 2 inches (51 mm) wide; depth as required to project beyond face of elevator door frame, as shown in Shop Drawings.
- E. Rewind Motor: NFPA 70, 90v DC.
- F. Release Mechanism: Comply with UL Standard No. 864.
- G. Screen Rewind Switch: An on-screen switch to rewind screen into housing shall be required.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates upon which work will be installed.
 - 1. Verify related work performed under other sections is complete and in accordance with Shop Drawings.
 - 2. Verify wall surfaces and elevator door frames are acceptable for installation of smoke containment system components.
 - 3. Verify existing field painted elevator door frames to be used for screen adherence have been repainted in accordance with smoke containment system manufacturer's instructions or they have the original factory paint.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

- C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

- A. Install smoke containment system components in accordance with manufacturer's installation instructions.

3.3 FIELD QUALITY CONTROL

- A. Field Test: Follow manufacturer's cycle test procedures.
 - 1. Notify Owner's Representative, local Fire Marshal, alarm sub-contractor and elevator sub-contractor minimum one week in advance of scheduled testing.
 - 2. Complete maintenance service record.

3.4 DEMONSTRATION

- A. Demonstrate required testing and maintenance procedures to Owner's Representative.
- B. Maintenance and Testing:
 - 1. Perform minimum semi-annual maintenance and testing on each smoke containment system as required by the manufacturer's warranty, code agency evaluation reports, and as required by local authority having jurisdiction.
 - 2. Retain permanent record of tests.
- C. Future Painting: Paint elevator door frame and/or auxiliary rails in accordance with Operation and Maintenance Manual.
- D. Qualified Smoke Guard Inspector assesses unit(s) after exposure to a fire event.

END OF SECTION

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SECTION 083513

FOLDING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Horizontal-sliding, accordion-folding, fire-rated, folding doors.
2. Horizontal-sliding, accordion-folding, non-fire-rated, security access, folding doors.

B. Related Sections:

1. Section 092216 "Non-Structural Metal Framing".
2. Division 26 Electrical.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for folding doors.

B. Shop Drawings:

1. Include plans, elevations, sections, and installation details.
2. Include clearances required for operation, operating and control mechanisms, access requirements, storage pockets and pocket doors, required stack depth, height of header above finished floor, requirements for anchorage and support of each door, and accessory items.
3. Fire-Release System: Describe system, including testing and resetting instructions for fire-rated folding doors.
4. Include diagrams for power, signal, and control wiring.

- C. Samples for Initial Selection: For each type of exposed finish.
 - 1. Include Samples of hardware and accessories involving color and finish selection.
- D. Samples for Verification: For each type of exposed finish.
 - 1. Include Samples of hardware and accessories to verify color and finish selection.
- E. Product Schedule: For folding doors. Use same designations indicated on Drawings.
- F. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each fire-rated folding door, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For fire-rated folding doors, from ICC-ES.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For folding doors to include in operation and maintenance manuals and shall include operating procedures, troubleshooting and repair methods, and wiring diagrams.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Installation shall be performed by factory trained and certified installers with a minimum of three years' experience installing electrically operated and fire-rated accordion folding doors.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's agent shall deliver original, unopened packages to a location designated by the General Contractor. All components shall be stored indoors, protected from moisture damage and secure from theft or other damage. General Contractor shall note damage or shortages at time of delivery.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install folding doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for building occupants after completion of construction during the remainder of the construction period.

1.10 WARRANTY

- A. Materials and installation shall be warranted against defects in workmanship for a period of one (1) year from the date of substantial completion.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 FIRE-RATED FOLDING DOORS

- A. Description: Electrically operated folding-door assembly, automatic or self-closing, listed and labeled for fire-resistance ratings indicated by a qualified testing agency, top supported, and complete with hardware, seals, track, closing devices, releasing devices, controls, and accessories necessary for intended operation.
 - 1. Manufacturer: Won-Door Corporation "Fireguard", or equal. Assembly shall contain narrow lead post.
- B. Listed Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing according to UL 10B.
 - 1. Oversize Doors: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- C. Configuration: As indicated on Drawings.
- D. Features:

1. Track: Overhead track without floor guide.
 2. Normal Position: Assembly's normal position is the open (stacked) position. Signal from fire-alarm system initiates self-closing operation.
 3. Manual Operation: Allow manual operation in either conventional or emergency mode. When opened manually during emergency mode, control mechanism automatically closes assembly.
 4. Access Control/Monitoring: Exit hardware does not respond until activated by signal from smoke detector or fire alarm.
 5. Non-Sway Construction: To resist differential air pressure.
- E. Fire Rating: One hour.
- F. Panel Construction: Formed-galvanized-steel or formed-steel sheet panels connected by hinges of matching material.
- G. Perimeter Seals and Closures: Manufacturer's standard vinyl or neoprene vertical seals, horizontal top and bottom seals, and closures identical to products tested for fire rating indicated, and forming an effective smoke and draft seal.
1. Points of Access to Elevators: Provide smoke seals that comply with requirements of authorities having jurisdiction for seals at points of access to elevators where indicated.
- H. Track and Trolley System: Single or dual steel or aluminum track systems, with ball-bearing roller trolleys and adjustable steel hanger rods for overhead support; designed for type of operation, size, and weight of fire-rated folding door indicated. Provide a continuous system of track sections and accessories identical to products tested for fire rating indicated, to accommodate configuration and layout indicated for door operation and storage.
- I. Electric Operators and Controls:
1. Operators: Factory-assembled power-drive unit consisting of motor, control panel, limit switches, torque-limiting devices, clutch, reversing magnetic motor operator, leading-edge obstruction detectors, and key-switch control for conventional operation.
 - a. Motor: In horsepower required for proper operation of door height and weight, controlled by reversing magnetic starter and equipped with overload protection.
 - b. Limit Switches: To prevent overtravel.
 - c. Roller Chain or Cable: Connected to lead posts by means of vertical stabilizer bar assembly.
 - d. Drive Mechanism: Protected by torque limiter and emergency clutch.
 - e. Travel Speed: 18 inches per second, maximum; 6 inches per second, minimum.
 2. In case of fire, closing system is activated by building's fire- and smoke-detection equipment and automatically closes fire-rated folding doors.
 3. Electrical Service: Equip for 120-V, single-phase, 60-cycle ac.
 4. Battery: Electrical current connects through relay to battery charger that continuously charges 12-V dc battery and automatically maintains battery at capacity. Automatic audible signal device sounds off if battery falls below or exceeds proper charge, power loss has occurred, or high-ac line voltage has been experienced.
 5. Leading-Edge Obstruction Detector:
 - a. Equip with pressure-sensitive leading edge that, on contact with an obstruction, causes door to stop and pause before attempting to re-close.

- b. Disable leading-edge obstruction detector until fire-rated folding door has opened swinging door on the storage pocket (pocket door).
- 6. Fire-rated folding doors can be manually opened by pushing against leading edge.
- 7. Audible alarm sounds at automatic closing of door.
- J. Accessories:
 - 1. Exit Hardware: Located on both sides of fire-rated folding door. In emergency mode, slight pressure on hardware causes door to open a minimum of 32 inches, pause for three seconds, and then automatically close. Furnish hardware that can be field programmable to allow automatic opening distances of up to the entire opening width. In conventional mode, hardware is used to operate door and move it back into storage pocket.
- K. Finishes:
 - 1. Factory-applied polyester or powder-coat finish for panels and hinges in colors as selected by Architect from manufacturer's full range.
 - 2. Manufacturer's standard finish for handles.
- L. Pocket Door: Swinging door that closes to conceal the storage pocket.
 - 1. Solid-core pocket doors with continuous hinge; 90-degree minimum swing.
 - 2. Face Finish: Match adjacent finishes.
 - 3. Magnetic Catch: Holding force of no more than 30 lbf.
 - 4. Maximum Opening Force: 50 lbf.
 - 5. Bumper on interior side of pocket door as required by fire-rated folding-door manufacturer to prevent interference with opening or retracting operation of fire-rated folding door.
 - 6. Coordinate pocket door sizes with fire-rated folding-door manufacturer.

2.3 NON-FIRE-RATED SECURITY ACCESS FOLDING DOORS

- A. Description: Horizontal-sliding, accordion-folding, access-control doors.
 - 1. Manufacturer: Won-Door Corporation "AFG0", or equal.
- B. Configuration: As indicated on Drawings.
- C. Features:
 - 1. Track: Overhead track without floor guide.
 - 2. Normal Position: Assembly's normal position is the open (stacked) position.
 - 3. Manual Operation: Allow manual operation in either conventional or emergency mode. When opened manually during emergency mode, control mechanism automatically closes assembly.
 - 4. Non-Sway Construction: To resist differential air pressure.
- D. Exit Device Operation: Provide an exit device on one or both sides of door.
- E. Door Construction: Two parallel, accordion-type walls independently suspended with no floor tracks, pantographs, or interconnections.
 - 1. Panels: 24-gauge steel, V-grooved; modular in design; capable of in-place repair.

2. Finish: All steel panels shall have factory-applied protective coatings.
 3. Color: Manufacturer's standard platinum.
- F. Suspension System: Two tracks, on 8-inch centers, attached to overhead structural support.
1. Tracks: 0.125 aluminum or 14 gauge cold rolled steel.
 2. Panel Hangers: Panels shall be suspended by a steel hanger pin and ball bearing roller system.
 3. Flat Lead Post Hangers: 8-wheel ball bearing trolley.
- G. Power Supply: 120-volt power source to power supply for main power. On loss of AC power, the 12v/24v secondary power source shall provide full operation capability.
- H. Remote Control Access: To be determined.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Confirm that electrical utilities have been installed and are accessible.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. For folding doors supported by or anchored to permanent construction, advise installers of specific requirements for placement of anchorage devices. Furnish installers of other work with templates and drawings indicating locations of anchorage devices and similar items.
- B. Fire-Rated Folding Doors: Level floor with header in path of fire-rated folding doors to tolerance of plus or minus 1/16 inch across opening; grind or fill floor as necessary.

3.3 INSTALLATION

- A. General: Install folding doors complying with manufacturer's written installation instructions. Install track in one piece.
 1. Fire-Rated Folding Doors: Comply with NFPA 80 requirements for installation.
- B. Standard Floor Clearances: 1/4 to 3/4 inch maximum (above floor finish).
 1. Fire-Rated Folding Doors: Comply with NFPA 80 requirements for floor clearances.
- C. Fire-Rated Folding Doors: Coordinate provisions for sensing devices, electrical service, and final connections for fire-rated folding doors.

3.4 ADJUSTING

- A. Adjust units to ensure smooth, quiet operation without warping or binding. Adjust hardware to function smoothly. Confirm that latches engage accurately and securely without forcing or binding.
 - 1. Fire-Rated Folding Doors: Verify that all operations are functional and comply with requirements of authorities having jurisdiction.
- B. Pocket Doors: Adjust to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.

3.5 CLEANING

- A. Clean surfaces using manufacturer's recommended methods.

3.6 STORAGE OF WASTE AND RECYCLING

- A. Store and recycle waste in accordance with Section 01 74 19 Construction Waste Management and Disposal.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-rated folding doors.

END OF SECTION

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SECTION 084128

INTERIOR ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Interior storefront framing and entrances.

- B. Related Requirements:

- 1. Section 064023 "Interior Architectural Woodwork."
- 2. Section 079200 "Joint Sealants."
- 3. Section 081216 "Interior Aluminum Frames".
- 4. Section 088000 "Glazing."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

- 1. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.

- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

- D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
- E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- F. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- G. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 MOCKUPS

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Load Criteria: Design and construct Interior Glass Entrances and Storefronts to withstand a lateral loading of minimum 5 psf positive and negative pressure, except where more stringent requirements are indicated.
- B. Deflection Criteria: Design and construct Interior Glass Entrances and Storefronts to withstand a maximum deflection of 3/4 inch for 12'-0" high by 4'-0" wide laminated glass.

2.2 MANUFACTURER

A. Storefront System:

1. Basis-of-Design: Kawneer "Trifab VG 451", 4-1/2 inches x 2 inches aluminum non-thermal framing system. System shall be butt-glazed at intermediate vertical 3/8 inch glass joints. Glass or solid wood doors and frames as determined by Architect, or one of the following equal alternates:
 - a. Arcadia AR450+ Series
 - b. Old Castle, similar system

2.3 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" (1.8 mm) wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.
- B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum framing members, trim hardware, anchors, and other components.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- E. Sealant: For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
- F. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.4 STOREFRONT FRAMING SYSTEM:

- A. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Provide concealed fasteners. Where exposed fasteners are unavoidable, propose solution to Architect, including countersunk Phillips screw heads, finished to match framing system.

- C. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard all-glass entrance doors for manual-swing operation.

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."

2.7 ACCESSORIES

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants".
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
 - 2. Omit silencers from frames at Built-Up Sound Doors. Refer to Section 083473.16.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Exposed Anodized Finish:
 - 1. Permanodic Finish: AAMA 611, AA-M10C21A44, Class I, 0.7 mm or thicker. Color: #18 Champagne.

2.10 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.

4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- B. Metal Protection:
1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers."
 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members in full sealant bed as specified in Section 079200 "Joint Sealants.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Install sealant according to Section 079200 "Joint Sealants." Install joint filler behind sealant as recommended by sealant manufacturer.
- H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

END OF SECTION

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SECTION 084413

GLAZED ALUMINUM CURTAIN WALLS AND ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Glazed aluminum curtain wall systems.
 - a. Two-sided, structural-sealant-glazed.

B. Related Requirements:

- 1. Section 079200 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
- 2. Section 088000 "Glazing" for curtain wall glazing.
- 3. Section 099600 "High Performance Coatings."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

- 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
- 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.

- d. Glazing.
 - e. Flashing and drainage.
- 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.
- E. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Installer.
 - 2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
- B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- C. Product Test Reports: For glazed aluminum curtain walls, for tests performed by manufacturer and witnessed by a qualified testing agency.

- D. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- C. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of structural-sealant-glazed curtain wall assemblies.

1.8 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on laboratory mockups.
1. Build preconstruction laboratory mockups at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.
 2. Size and Configuration: As indicated on Drawings.
 3. Notify Architect seven days in advance of the dates and times when preconstruction laboratory mockups will be constructed and tested.
- B. Preconstruction Adhesion and Compatibility Testing: Submit to structural glazing sealant manufacturer, for testing indicated below, Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.
1. Compatibility: Test materials or components using ASTM C1087.
 2. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.
 3. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 5. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
 6. Testing will not be required if data based on previous testing of current sealant products match those submitted.

1.10 WARRANTY

- A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty, Factory-Applied Finishes: Refer to Section 099600 "High Performance Coatings."

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.
- B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
 - 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
 - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4-inch (6.35-mm) for spans of greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans of less than 11 feet 8-1/4 inches (3.6 m).
- E. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at [150] <Insert number> percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding [0.2] <Insert number> percent of span.
 3. Test Durations: As required by design wind velocity, but not less than [10] <Insert number> seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.
- H. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
1. Design Displacement: As indicated on Drawings.
 2. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement and 1.5 times the design displacement.
- I. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.6 at design displacement and 1.5 times the design displacement.
 2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.7 at design displacement and 1.5 times the design displacement.
- J. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
 - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.40 Btu/sq. ft. x h x deg F (2.28 W/sq. m x K) as determined in accordance with NFRC 100.
 2. Solar Heat Gain Coefficient (SHGC):

- a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.22 as determined in accordance with NFRC 200.
- 3. Air Leakage:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa) when tested in accordance with ASTM E283.
- 4. Condensation Resistance Factor (CRF):
 - a. Fixed Glazing and Framing Areas: CRF for the system of not less than [79 as determined in accordance with AAMA 1503.
- K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 - 1. Temperature Change: 114 deg F (67 deg C), ambient; 104 deg F (100 deg C), material surfaces.
- L. Structural-Sealant Joints:
 - 1. Designed to carry gravity loads of glazing.
- M. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
 - 1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.3 SOURCE LIMITATIONS

- A. Obtain all components of curtain-wall system, including framing, entrances and accessories, from single manufacturer.

2.4 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

- A. Basis of Design:
 - 1. [C1a]: Kawneer 1600UT System 2 Curtain Wall, or equal (captured horizontally, SSG vertically.)
 - 2. [C1b]: Kawneer 1600UT System 1 Curtain Wall, or equal (fully captured).
 - 3. [C2]: 1-HR Fire Window, Safitfirst GPX Curtain Wall 300 w/ SuperLite IIXL-60 IGU; Fire Window bearing 'W' mark tested in accordance with ASTM E119 or UL 263.

- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Thermally broken.
 - 2. Glazing Plane: Front.
 - 3. Finish: Refer to Section 099600 "High Performance Coatings."
 - 4. Color: Custom color to match Kingspan insulated metal panels.
 - 5. Fabrication Method: Factory-fabricated unitized system.
 - 6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 7. Steel Reinforcement: As required by manufacturer.
- C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
 - 1. Include snap-on aluminum trim that conceals fasteners.
- D. Infill Panels: To match curtainwall mullions.
 - 1. Basis-of-Design: Mapes "Mapes R+" or the following equal alternates:
 - a. Or equal.
- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.5 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."

2.6 MATERIALS

- A. Sheet and Plate: ASTM B209 (ASTM B209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
- C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
- D. Structural Profiles: ASTM B308/B308M.
- E. Steel Reinforcement:
 - 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.7 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Exposed fasteners are not permitted.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, ASTM A240/A240M of type recommended by manufacturer.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 - 6. Components curved to indicated radii.
- D. Fabricate components to resist water penetration as follows:
 - 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 - 2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

- E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.
- F. Factory-Assembled Frame Units:
 - 1. Rigidly secure nonmovement joints.
 - 2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - 3. Seal joints watertight unless otherwise indicated.
 - 4. Install glazing to comply with requirements in Section 088000 "Glazing."
 - 5. Install structural glazing.
 - a. Set glazing into framing in accordance with sealant manufacturer and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
 - b. Set glazing with proper orientation so that coatings face exterior or interior as specified.
 - c. Apply structural silicone sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions with the framing and glazing in a fully supported position.
 - d. Brace or stiffen framing and glazing in such a manner to prevent undue stresses on the glass edge seal and structural joints or movement of the glazing, until sealant is fully cured in accordance with manufacturer's recommendations.
 - e. After structural sealant has completely cured, insert backer rod between lites of glass as recommended by sealant manufacturer.
 - f. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.
 - g. Clean and protect glass as indicated in Section 088000 "Glazing."
 - h. Retain bracing or stiffening until erected to prevent racking of units during transportation and erection.
- G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Refer to Section 099600 "High Performance Coatings."

2.10 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
- G. Seal joints watertight unless otherwise indicated.
- H. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."

3.4 INSTALLATION OF STRUCTURAL GLAZING

- A. Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- B. Set glazing into framing in accordance with sealant manufacturer's and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
- C. Set glazing with proper orientation, so that coatings face exterior or interior as specified.
- D. Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.
- E. Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer's and framing manufacturer's written instructions and in compliance with local codes.
- F. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.
- G. Allow structural sealant to cure in accordance with manufacturer's recommendations.
- H. Clean and protect glass as indicated in Section 088000 "Glazing."

3.5 INSTALLATION OF WEATHERSEAL SEALANT

- A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass, as recommended by sealant manufacturer.
- B. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

3.6 ERECTION TOLERANCES

- A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
 - 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Test Area: Perform tests on one bay at least 30 feet (9.1 m), by one story.
- C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of three tests in areas as directed by Architect.
 - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
 - 2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - a. Perform a minimum of three tests in areas as directed by Architect.
 - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
 - 3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
- D. Structural-Sealant Adhesion: Test structural sealant in accordance with recommendations in ASTM C1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
 - 1. Test a minimum of four areas on each building facade.
 - 2. Repair installation areas damaged by testing.
- E. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

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SECTION 085115
SOUND CONTROL WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Steel sound-control windows, noted as Glazing System Type 6 (GS6)

- B. Related Sections:

- 1. Section 083473 "Sound Control Door Assemblies."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include sound ratings, construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

- B. Shop Drawings: Include the following:

- 1. Elevations of each window design.
- 2. Details of sound-control seals.
- 3. Details of windows, including vertical and horizontal edge details and metal thicknesses.
- 4. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- 5. Locations of reinforcement and preparations for hardware.
- 6. Details of each different wall opening condition.
- 7. Details of anchorages, joints, field splices, and connections.
- 8. Details of accessories.
- 9. Details of moldings, removable stops, and glazing.
- 10. Details of conduit and preparations for power, signal, and control systems.

- C. Samples for Verification:

- 1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
- 2. Windows: Include section of vertical-edge, top, and bottom construction; core construction; glazing; and other applied hardware reinforcement.
- 3. Frames: Include profile, corner joint, floor and wall anchors, and seals. Include separate section showing fixed sound panels if applicable.

- D. Schedule: Provide a schedule of sound-control window assemblies prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer.
- B. Product Certificates: For each type of sound-control window assembly, from manufacturer.
- C. Product Test Reports: Test Reports: Performed and issued by a qualified independent testing agency including acoustical performance data in the form of up-to-date test reports indicating the windows to be provided will have the specified Sound Transmission Class (STC) rating (per ASTM E-90/ASTM E 413). Refer to window schedule for the required STC ratings.
- D. Field quality-control reports.
- E. Warranty: Samples of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound-control window assemblies to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain sound-control window assemblies, including frames, sound-control seals, and other items essential for sound control, from single source from single manufacturer.
- C. Sound Rating: Provide sound-control window assemblies identical to those of assemblies tested as sound-retardant units by a qualified independent acoustical testing agency, and have the following minimum rating:
 - 1. STC Rating: _____, as determined by ASTM E 413 when tested in an operable condition according to ASTM E 90 and ASTM E 1408.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review required field quality-control procedures.
 - 2. Review procedures for coordinating frame and anchor installation with wall construction.
 - 3. Review frame grouting procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver windows palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to finish of factory-finished windows.

- B. Shipping Spreaders: Deliver welded frames with two removable spreader bars across bottom of frames, tack welded or mechanically attached to jambs and mullions.
- C. Store windows under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high, wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
 - 1. If wrappers on windows become wet, remove cartons immediately. Provide a minimum of 1/4-inch space between each stacked window to permit air circulation.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install sound-control windows until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate installation of anchorages for sound-control window assemblies. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.10 WARRANTY

- A. Performance Warranty: A minimum Noise Isolation Class (NIC) rating (ASTM-E413) within 5 points of the published laboratory STC rating shall be guaranteed against defective workmanship and/or installation for one year from date of acceptance by Owner.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. At a minimum, acoustic window materials and hardware shall be guaranteed against defective workmanship for one year from date of shipment. Manufacturer's warranty is in addition to, and does not limit, other rights the Owner may have under the Contract Documents.

PART 2 - PRODUCTS

2.1 SOUND-CONTROL WINDOWS

- A. Manufacturer: Noise Barriers, LLC, Overly Corp. or equal.
- B. Description: Provide sound-control windows, of seamless construction; with manufacturer's standard sound-retardant core as required to provide STC and fire rating indicated. Construct windows with smooth, flush surfaces without visible joints, seams, or fasteners on exposed faces or stile edges.

C. Materials:

1. Cold-Rolled Steel Sheet: ASTM A653 galvanized steel, suitable for exposed applications.

D. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

E. Frame Description: Fabricate sound-control split frames with corners mitered, reinforced, and continuously welded full depth and width of frame. Fabricate according to ANSI/NAAMM-HMMA 865.

1. Weld frames according to NAAMM-HMMA 820.
2. Interior Frames: Fabricate from 14 gauge cold rolled, galvanized steel with an A60 coating weight, or thicker as required to provide STC rating indicated.
3. Jamb Anchors:
 - a. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter, metallic-coated steel bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

F. Glazing: To be determined.

G. Materials:

1. Cold-Rolled Steel Sheet: ASTM A653 galvanized steel, suitable for exposed applications.
2. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
3. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
4. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching sound-control window frames of type indicated.
5. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

H. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.2 FABRICATION

- A. The entire manufactured assembly shall be shipped to the job site ready to install and operate
- B. Sound-Control Steel Window Fabrication: Sound-control windows to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.
 - 1. Seamless Edge Construction: Fabricate windows with faces joined at vertical edges by welding; welds shall be ground, filled, and dressed to make them invisible and to provide a smooth, flush surface.
- C. Sound-Control Frame Fabrication: Fabricate sound-control frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
 - 1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches in height.
 - 2) Four anchors per jamb from 60 to 90 inches in height.
 - 3) Five anchors per jamb from 90 to 96 inches in height.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
 - 5) Two anchors per head for frames more than 42 inches wide and mounted in metal stud partitions.
 - b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 - 5. Head Reinforcement: For frames more than 48 inches wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
 - 6. Tolerances: Fabricate frames to tolerances indicated in ANSI/NAAMM-HMMA 865.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of sound-control window assemblies.

- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of sound-control window frame connections before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace sound-control window frames to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

3.3 INSTALLATION

- A. General: Install sound-control window assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.
- B. Frames: Install sound-control window frames in sizes and profiles indicated.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. At openings requiring smoke and draft control, install frames according to NFPA 105.
 - c. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, and dress; make splice smooth, flush, and invisible on exposed faces.
 - d. Install sound-control frames with removable glazing stops located on secure side of opening.
 - e. Remove temporary braces only after frames or bucks have been properly set and secured.
 - f. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.
 - 3. In-Place Concrete Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
 5. Installation Tolerances: Adjust sound-control window frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at window rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Thresholds: Set thresholds in full bed of sealant complying with requirements in Section 079200 "Joint Sealants."

3.4 FIELD QUALITY CONTROL

- A. Upon completion of this portion of work, and prior to its acceptance by the Owner, a qualified representative of the manufacturer of the acoustical window system(s) shall visit the jobsite to confirm that installation is in conformance with the manufacturer's recommendations.
- B. Windows may be selected for in situ verification testing of the acoustical performance (ASTM E-336). Provide in-situ adjustments and modifications as required to achieve a minimum Noise Isolation Class (NIC) rating (ASTM-E413) within 5 points of the published laboratory STC rating. Contractor shall remedy all defects without expense to the Owner. Any additional testing required to verify that repaired/adjusted window assemblies perform as specified above, will be at the expense of the contractor.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace defective work, including defective or damaged sound seals and frames that are warped, bowed, or otherwise unacceptable.
 1. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- C. Metallic-Coated Surfaces: Clean abraded areas of windows and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

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SECTION 086300
METAL-FRAMED SKYLIGHTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes skylights with metal framing, including IGU Honeycomb Units.
- B. Related Sections:
 - 1. Section 079200 "Joint Sealants."
 - 2. Section 088000 "Glazing" for glazing installation.
 - 3. Section 099600 "High Performance Coatings."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal-framed skylights.
 - 2. Note that Product Data listed in letter format, on company letterhead will not be accepted.
- B. Shop Drawings: For metal-framed skylights.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Indicate structural loadings and reactions to be transmitted to supporting curbs.
 - 3. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
 - 4. Include full-size isometric details of each vertical-to-horizontal intersection of assembly, showing the following:
 - a. Joinery including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.

- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Fabrication Sample: Of each framing intersection of assemblies, made from 12-inch (305-mm) lengths of full-size components and showing details of the following:
 - 1. Joinery including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.
- E. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Qualification Data: For Honeycomb IGU Supplier.
- C. Compatibility and Adhesion Test Reports: For structural-sealant-glazed skylights, test reports from sealant manufacturer indicating that joint sealants have been tested for each material that will come in contact with sealants.
- D. Product Test Reports: For metal-framed skylights, for tests performed by a qualified testing agency.
- E. Field quality-control reports.
- F. Sample Warranties: For special warranties.
- G. Honeycomb IGU Performance Certificate: Testing per Lawrence Berkeley National Laboratory Windows 7.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal-framed skylights to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturers of Honeycomb IGU products shall have a minimum of 10 years' experience in this technology and have honeycomb glazing products and projects installed in the field for over 10 years.

- B. Manufacturers of skylight system shall be a firm with a minimum of ten years' experience in the fabrication and installation of custom architectural metal-framed skylights.
- C. Structural-Sealant Glazing: Comply with recommendations in ASTM C1401, "Guide for Structural Sealant Glazing," for joint design and quality-control procedures.
 - 1. Joint designs are reviewed and approved by structural-sealant manufacturer.
 - 2. Quality-control program development and reporting comply with ASTM C1401 recommendations for material qualification procedures, preconstruction sealant-testing program, and procedures and intervals for fabrication and installation reviews and checks.
 - 3. Perform manufacturer's standard tests for compatibility and adhesion of sealants with each material that will come in contact with sealants.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical metal-framed skylights as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of metal framed skylights that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Adhesive or cohesive sealant failures.
 - d. Water leakage.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Aluminum-Finish Warranty: Refer to Section 099600 "High Performance Coatings."

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer with similar experience as required for this project assembly. Engineer shall be licensed in the state of California.
- B. Design thrusting (or minimally-thrusting) framing system, including glazing material to support the following load requirements with maximum allowable deflection of any glazing support: Member not to exceed L/180 or 1 in. maximum for spans less than 20 ft, and L/240 for spans greater than 20 ft. of the unsupported span:
 - 1. Ground wind speed (mph) plus dead load
 - 2. Concentrated live load of 250 lbs applied to any framing member at a location that will produce the most severe stress or deflection.
 - 3. Thermal of plus/minus 50 deg from ambient temperature.
- C. Structural-Test Performance: Metal-framed skylights tested according to ASTM E330, as follows:
 - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified deflection limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- D. Air Infiltration: Metal-framed skylights with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of when tested according to ASTM E283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- E. Water Penetration under Static Pressure: Metal-framed skylights that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure of 15 psf.
- F. Water Penetration under Dynamic Pressure: Metal-framed skylights that do not evidence uncontrolled water through fixed glazing and framing areas when tested according to AAMA 501.1 at a static pressure of 15 psf.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- H. Structural Sealant: Capable of withstanding tensile and shear stresses imposed without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
- I. Energy Performance: Provide metal-framed skylights certified and labeled according to NFRC.

2.3 METAL-FRAMED SKYLIGHTS

- A. Manufacturer and Product: Oldcastle BMS-3000 Sloped Glazing System, or equal.

- B. Metal-Framed Skylights: Glazed skylight assemblies supported by aluminum framing.
- C. Aluminum Framing Systems: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
- D. Aluminum: Alloy and temper as recommended in writing by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B209 (ASTM B209M).
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
 - 3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
 - 4. Structural Profiles: ASTM B308/B308M.
- E. Provide an integral gutter system to control water infiltration and condensation.
- F. Provide tubular rafter and purlin framing members with flush condensation gutters. Do not anchor sill members through integral secondary gutter area on pitches less than 4 in. on 12 in. slope from horizontal.
- G. Formed Flashing and Closures: Minimum .062 inch thick aluminum sheet.
- H. Condensation and Water Infiltration Control: Provide framing system which will collect and channel condensation and water infiltration to the exterior through baffled weep holes or drain tubes in the sill or perimeter framing members.
- I. Fabricate work to be straight, plumb, level and square. Provide work to sizes, shapes and profiles indicated on approved shop drawings. Make work with uniform, tight joints.
- J. Use factory-performed heliarc welding with all exposed welds finished to match adjacent material.
- K. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.
- L. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
- M. Anchor Bolts: ASTM A307, Grade A, galvanized steel.
- N. Framing Sealants: As specified in Section 079200 "Joint Sealants."
- O. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 GLAZING

- A. Laminated glass lite facings with encapsulated high-performance honeycomb inserts, complying with ASTM C1036, ASTM 1048, and Safety Glazing Certification Council (SGCC).
1. Basis-of-Design: Panelite LLC. "ClearShade IGU", or equal. www.panelite.com; info@panelite.us
 - a. Outboard Lite: 6mm clear.
 - b. Airspace: 12mm.
 - c. ClearShade: 7mm diameter (CS-TTW7-12).
 - d. Inboard Lite: 12.7mm laminated + Low E #4.
 - e. Silicone: Black.
 2. Overall Unit Thickness and Thickness for each Lite: Thickness as dictated by unit specification and industry and manufacturing tolerances
 3. Overall Unit Dimensions: Honeycomb IG unit are fabricated to comply with issued drawings and specifications and standard insulating glass unit tolerances. ClearShade TM Insulating Glass Units maximum size: 60" x 144"
 4. Sealing: Dual seal with primary and secondary sealants as follows:
 - a. Primary Seal: Polyisobutylene
 - b. Secondary Seal: 2 Part silicone
 - c. Color Options: As selected by Architect.
 - d. Spacer Specifications: Spacer type to be specified by Project Architect and approved by PANELITE with construction to comply with the following requirements:
 - 1) Spacer Type: mill finish aluminum.

The following was generated with LBNL Window 7.1, NFRC 100-2010:

ClearShade™ IGU Make Up		Sun Angle	Transmission			Reflectance			U-Value	SC	SHGC	LSG
			VLT	Solar	UV	Vis Out	Vis In	Solar				
Outboard Lite	6mm Clear	10	62%	40%	32%	21%	20%	17%	W/m-2K	0.64	56%	1.12
Outboard Coating	none	20	50%	33%	26%	30%	27%	23%		0.54	47%	1.07
Airspace	12mm Airspace	30	40%	26%	20%	39%	33%	30%		1.00	45%	36%	1.02
ClearShade™ Spec	CS-TTW7-12	40	31%	20%	16%	47%	36%	36%	Btu/h-ft2-F	0.37	32%	0.96
ClearShade Cell	7mm diam, 12mm depth	50	25%	16%	13%	54%	44%	41%		0.31	27%	0.93
ClearShade Color	TrueWhite™	60	21%	13%	10%	60%	47%	46%		0.26	22%	0.91
Inboard Lite	12.7 mm Clear lami + Low 'e' #4	70	16%	10%	8%	67%	52%	53%	0.35	0.20	17%	0.89
Inboard Coating	Pilkington Energy Advantage	80	7%	4%	3%	83%	71%	72%		0.09	8%	0.84

5. Performance Values:
 - a. Thermal Conductivity <.20 W/m-C per ASTM C 177
 - b. Refractive Index < 1.6 per ASTM D542
 - c. Light Transmission delta < .5 after UV aging per ASTM D4674 (HP UV) and ISO4892 Part2 Method B
 - d. Yellowing Index delta <2 after UV aging per ASTM D4674 (HP UV) and ISO4892 Part 2 Method B
 - e. Haze Index delta <2 after UV aging per ASTM D4674 (HP UV) and ISO4892 Part 2 Method B
 - f. Maximum Moisture Content of 0.02%
6. Honeycomb IGU Specification and Performance: The performance of all honeycomb IGU products shall be generated and confirmed per NFRC 100-2010 Environmental Conditions with Window 7 per Lawrence Berkeley National Laboratory, a division of the US Department of Energy. Supplier to confirm performance with verified Window 7 documentation that specified units meet or exceed specified performance requirements.
7. Honeycomb IGU products fall under the category of "Dynamic Glazing". Angularly selective performance of dynamic glazing product is dependent upon unit specifications

and sun angle of incidence.

8. All Honeycomb IGU performance data shall be generated and certified through the Window 7 glazing performance technology platform which is developed, maintained, updated and distributed solely by Lawrence Berkeley National Laboratory, a division of the US Department of Energy.
9. All performance data to be submitted for 8 angles of incidence from 10-80 degrees in 10 degree increments.
10. Performance of all unit types must also be submitted in the form of an executable BSDF file format for direct integration by project engineer into Energy Plus and Radiance models to confirm angularly selective energy and daylighting performance.

B. Structural Glazing Sealants:

1. Structural Sealant: ASTM C1184, neutral-curing silicone formulation compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant, and approved by structural-sealant manufacturer for use in metal-framed skylights indicated.
 - a. Color: As selected by Architect from manufacturer's full range.
2. Weatherseal Sealant: ASTM C920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other components with which it comes in contact; and recommended in writing by structural- and weatherseal-sealant and metal-framed skylight manufacturers for this use.
 - a. Color: Matching structural sealant.
3. Bond-Breaker Tape: Manufacturer's standard tetrafluoroethylene-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 FABRICATION

- A. Where practical, fit and assemble metal-framed skylights in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Fabricate aluminum components that, when assembled, have the following characteristics:
 1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Internal guttering systems or other means to drain water passing joints and moisture migrating within skylight to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
- C. Fabricate aluminum sill closures with weep holes and for installation as continuous component.
- D. Reinforce aluminum components as required to receive fastener threads.

- E. Factory-Glazed, Metal-Framed Skylights:
 - 1. Factory install glazing to comply with requirements in Section 088000 "Glazing."
- F. Structural-Sealant-Glazed, Metal-Framed Skylights: Prepare surfaces that will contact structural sealant according to structural-sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

- A. General: Refer to Section 099600 "High Performance Coatings."

2.7 SOURCE QUALITY CONTROL

- A. Structural-Sealant Glazing: Perform quality-control procedures complying with ASTM C1401 recommendations including, but not limited to, material qualification procedures, sealant testing, and fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions.
 - 1. Do not install damaged components.
 - 2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
 - 3. Rigidly secure nonmovement joints.
 - 4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection: Where aluminum will contact dissimilar materials, protect against galvanic action by painting contact surfaces with protective coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

- C. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.
- D. Install components to drain water passing joints, and moisture migrating within skylight to exterior.
- E. Install components plumb and true in alignment with established lines and elevations.
- F. Glazing: Install glazing as specified in Section 088000 "Glazing."
- G. Structural-Sealant Glazing:
 - 1. Prepare surfaces that will contact structural sealant according to structural-sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - 2. Install weatherseal sealant according to weatherseal-sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind weatherseal sealant as recommended in writing by weatherseal-sealant manufacturer.
- H. Erection Tolerances: Install metal-framed skylights to comply with the following maximum tolerances:
 - 1. Alignment: Limit offset from true alignment to 1/32 inch (0.8 mm) where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches (76 mm); otherwise, limit offset to 1/8 inch (3.2 mm).
 - 2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m) but no greater than 1/2 inch (13 mm) over total length.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, skylights shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - 2. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas shall be tested according to ASTM E1105.
 - a. Test Procedures: Test under uniform static-air pressure.
 - b. Water Penetration: None.
 - 3. Structural-Sealant Compatibility and Adhesion: Structural sealant shall be tested according to ASTM C1401.
 - a. Destructive test method, Method A, Hand Pull Tab (Destructive) in ASTM C1401, Appendix X2, shall be used.
 - 1) A minimum of two area(s) on each skylight face shall be tested.
 - 2) Repair installation areas damaged by testing.
 - 4. Structural-Sealant Glazing Inspection: After installation of metal-framed skylights is complete, structural-sealant glazing shall be inspected and evaluated according to ASTM C1401 recommendations for quality-control procedures.

- B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

- A. Clean exposed surfaces immediately after installing skylights. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Remove and replace IGU honeycomb glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Protect skylights from contact with contaminating substances resulting from construction operations. If contaminating substances do contact skylight surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION

SECTION 087100

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions of Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes items known commercially as door or finish hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following, but is not necessarily limited to:
 - 1. Door hardware, including electric hardware.
 - 2. Storefront and Entrance door hardware.
 - 3. Gate hardware.
 - 4. Card reader access control devices.
 - 5. Low-energy automatic operators, including sensors and actuators.
 - 6. Wall-mounted electromagnetic hold-open devices.
 - 7. Thresholds, gasketing and weather-stripping.
- C. Related Sections: The following sections are noted as containing requirements that relate to this Section, but may not be limited to this listing.
 - 1. Section 081113 - Hollow Metal Doors and Frames.
 - 2. Section 081416 - Flush Wood Doors.
 - 3. Section 083473 - Sound Control Door Assemblies.
 - 4. Section 084128 - Interior Entrances and Storefronts.
 - 5. Division 28 Sections - Access Control & Fire/Life-Safety Systems.

1.3 REFERENCES

- A. 2019 California Building Code, CCR Title 24, Part 2
- B. BHMA - Builders' Hardware Manufacturers Association
- C. DHI - Door and Hardware Institute
- D. NFPA - National Fire Protection Association.
 - 1. NFPA 80 - Fire Doors and Other Opening Protectives
 - 2. NFPA 105 - Smoke and Draft Control Door Assemblies
- E. UL - Underwriters Laboratories.

1. UL 10C - Fire Tests of Door Assemblies
2. UL 305 - Panic Hardware

F. WHI - Warnock Hersey Incorporated

G. SDI - Steel Door Institute

1.4 SUBMITTALS & SUBSTITUTIONS

- A. General: Submit in accordance with Conditions of the Contract and Division 01 Specification sections.
- B. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- C. Submit electronic PDF copies of schedule organized vertically into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:

1. Include a Cover Sheet with:

- a. Job Name, location, telephone number.
- b. Architects name, location and telephone number.
- c. Contractors name, location, telephone number and job number.
- d. Suppliers name, location, telephone number and job number.
- e. Hardware consultant's name, location and telephone number.

2. Job Index information included:

- a. Numerical door number index including; door number, hardware heading number and page number.
- b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying information when available; if it is not available at the time the preliminary schedule is submitted.
- c. Manufacturers' names and abbreviations for all materials.
- d. Explanation of abbreviations, symbols, and codes used in the schedule.
- e. Mounting locations for hardware.
- f. Clarification statements or questions.
- g. Catalog cuts and manufacturer's technical data and instructions.

3. Vertical schedule format sample:

Heading Number 1 (Hardware group or set number - HW Group #1)						
(a) 1 Single - Door #101 - Corridor 101 to Exterior			(b) 90°	(c) RH		
(d) 3'-0" x 7'-0" x 1-3/4" - Wood Door x Hollow Metal Frame - 20 Minute						
(e) 1.	(f) 3 ea	(g) Hinges -	(h) 5BB1 4.5 x 4.5 NRP	(i) 1/2 TMS	(j) 630	(k) IVE
2.	1 ea	Lockset -	ND80P6D x RHO x RH x	10-025 x JTMS	626	SCH

3.	1 ea	Closer - 4040XP x EDA x TBSRT	689	LCN
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- (a) Single or pair of doors with opening number and location.
- (b) Degree of opening.
- (c) Hand of door(s).
- (d) Door/frame dimensions and material; Label requirements, if any.
- (e) Hardware item line # (Optional).
- (f) Quantity.
- (g) Product description.
- (h) Product part number.
- (i) Fastenings and other pertinent information.
- (j) Hardware finish codes per ANSI/BHMA A156.18.
- (k) Manufacturer abbreviation.

- D. Make substitution requests in accordance with Division 01. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.
- E. Wiring Diagrams: Provide product data and wiring and riser diagrams for all electrical products listed in the Hardware Schedule portion of this section.
- F. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- G. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- H. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.
- I. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.
- J. LEED Certification Points: Submit information and certifications necessary to achieve maximum points for LEED certification; coordinate and cooperate with Owner and Architect in providing information necessary for required LEED rating.

1.5 QUALITY ASSURANCE

- A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
 - 1. Responsible for detailing, scheduling and ordering of finish hardware.
 - 2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing.
 - 3. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.

- C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.
- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.
 - 1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".
- E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
- F. Product packaging to be labelled in compliance with CA Prop 65, Safe Drinking Water and Toxic Enforcement Act of 1986.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.
- B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.
- C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.
- D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.

1.7 WARRANTY

- A. Provide warranties of respective manufacturers' regular terms of sale from day of final acceptance as follows:
 - 1. Locksets: Ten (10) years.
 - 2. Closers: Thirty (30) years.
 - 3. Automatic Operators: Two (2) years.
 - 4. Exit devices: Three (3) years.
 - 5. Electronic: One (1) year.
 - 6. All other hardware: Two (2) years.

1.8 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.9 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference at least one week prior to beginning work of this section.
- B. Attendance: Architect, Construction Manager, Contractor, Security Contractor, Hardware Supplier, Installer, Key Owner's Personnel, and Project Inspector.
- C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review Owner's keying standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

<u>Item</u>	<u>Manufacturer</u>	<u>Acceptable Substitutes</u>
Hinges	Ives	Hager, Stanley, McKinney
Locks, Latches & Cylinders	Schlage	None – District Standard
Exit Devices	Von Duprin	None – District Standard
Electronic Locks	SecureALL	None – District Standard
Closers	LCN	None – District Standard
Push, Pulls & Protection Plates	Ives	Trimco, BBW, DCI
Flush Bolts	Ives	Trimco, BBW, DCI
Coordinators	Ives	Trimco, BBW, DCI
Door Stops	Ives	Trimco, BBW, DCI
Overhead Stops	Glynn-Johnson	Or Approved Equal
Thresholds	Zero	Pemko, National Guard
Seals & Bottoms	Zero	Pemko, National Guard

2.2 MATERIALS

- A. Hinges:
 - 1. Provide hinges conforming to ANSI/BHMA A156.1.
 - 2. Hinges shall be sized in accordance with the following:
 - a. Height:
 - 1) Doors up to 42" wide: 4-1/2 inches.
 - 2) Doors 43" to 48" wide: 5 inches.
 - b. Width: Sufficient to clear frame and trim when door swings 180 degrees.
 - c. Number of Hinges: Provide 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.
 - 3. Exterior out-swinging hinges shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.
 - 4. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.
 - 5. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.

Locate electric hinge at second hinge from bottom or nearest to electrified locking component.

B. Continuous Hinges:

1. Provide aluminum geared continuous hinges fabricated from 6063-T6 aluminum conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
3. Provide continuous hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
4. Provide continuous hinges 1" shorter in length than nominal height of door, unless otherwise noted, with symmetrical hole pattern.
5. Install continuous hinges with fasteners supplied by manufacturer.

C. Heavy Duty Cylindrical Locks and Latches: Schlage "ND" Series as scheduled with "Rhodes" lever design.

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3 hour fire doors.
2. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
 - a. Abusive locked lever torque – minimum 3,100 inch-pounds without gaining access.
 - b. Offset lever pull – minimum 1,600 foot pounds without gaining access.
 - c. Vertical lever impact – minimum 100 impacts without gaining access.
 - d. Cycle Test – tested to minimum 16 million cycles with no visible lever sag; without the use of performance aids such as set screws or spacers.
3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4" backset, unless noted otherwise, with 1/2" latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate solid steel anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
9. Provide levers with vandal resistant technology as scheduled for use at abusive applications.

D. Heavy Duty Mortise Locks and Latches: Schlage "L" Series as scheduled with "06" style lever and "A" style rose.

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3 hour fire doors.
2. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
3. Provide lock case that is multi-function and field reversible for handing without opening case.
4. Provide locks with standard 2-3/4" backset with full 3/4" throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1" throw, constructed of stainless steel.
5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
6. Cylinders: Refer to "KEYING" article, herein.
7. Indicators: Where specified, provide indicator above cylinder or emergency release for visibility while operating the lock that identifies an occupied/unoccupied status of the lock or latch.

8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

E. Exit devices: Von Duprin as scheduled.

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 standards.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Provide exit devices cut to door width and height. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
6. Provide flush end caps for exit devices.
7. Exit devices shall comply with CBC Section 11B-404.2.7 and shall be mounted between 34" and 44" above the finished floor surface.
8. Provide exit devices UL certified to meet 5 lbs. maximum unlatching force requirements according to the CBC Section 11B-309.4.
9. Cylinders: Refer to "KEYING" article, herein.
10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
11. Provide cylinder dogging indicators (CDSI) for visible indication of dogging status as specified.
12. Removable Mullions: Provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
15. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
16. Provide exit devices with manufacturer's approved strikes.
17. Provide electrified options as scheduled.

F. Closers: LCN as scheduled.

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Provide certificate by independent testing laboratory that door closers have completed over 10,000,000 cycles and can still meet ANSI/BHMA A156.4 standards.
4. Cylinder Body: 1-1/2" diameter with 3/4" diameter double heat-treated pinion journal.
5. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120° F to -30° F.
6. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
7. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
8. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
9. Pressure Relief Valve (PRV) Technology: Not permitted.

10. Provide door closers powder coated to match balance of door hardware. Powder coating finish shall be certified to exceed 100 hours salt spray testing as described in ANSI/BHMA A156.4 and ASTM B117.
11. Provide special rust inhibitor (SRI) in highly corrosive areas, and where noted in hardware sets.
12. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

G. Electro Mechanical Automatic Operators: LCN Senior Swing as scheduled.

1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI/BHMA A156.19.
2. Opening: Powered by DC motor working through reduction gears.
3. Closing: Spring force.
4. Manual, hydraulic, or chain drive closers: Not permitted.
5. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
6. Cover: Aluminum.
7. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.
8. Provide drop plates, brackets, or adapters for arms as required to suit details.
9. Provide hard-wired motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.
10. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
11. Provide caution signs as described in ANSI/BHMA A156.19.

H. Flush Bolts & Dust Proof Strikes:

1. Automatic flush bolts shall be of the low operating force design.
2. Provide top bolt only model for interior doors where applicable and as permitted by testing procedures.
3. Provide dust proof strikes at openings using bottom bolts.
4. Manual flush bolts shall only be permitted on storage or mechanical openings, as scheduled.

I. Door Stops:

1. Unless otherwise noted in hardware sets, provide floor type with appropriate fasteners. Where floor type cannot be used, provide wall type. If neither can be used, provide overhead type.
2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
3. Provide backing plate at wall framing behind wall type.
4. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions. Stop-only function shall be provided at fire-rated openings.

J. Protection Plates:

1. Provide kick, mop, and/or armor plates minimum of 0.050" thick, with four beveled edges. Furnish with sheet metal or wood screws, finished to match plates.
2. Kick plates shall be sized 10" high and 2" less door width (LDW) at single doors and 10" high and 1" LDW at pairs or doors.
3. Provide mop and armor plates with sizes as scheduled in hardware sets.

K. Thresholds: As scheduled and per details.

1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope. Thresholds shall comply with CBC Section 11B-404.2.5.
2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 07 "Thermal and Moisture Protection".
3. Use 1/4" fasteners, red-head flat-head sleeve anchors (SS/FHSL).

L. Seals: Provide silicone gasket at all rated and exterior doors.

1. Smoke & Draft Control Doors: Provide UL10C Classified gasketing that complies with NFPA 80 & NFPA 252 for use on "S" labeled Positive Pressure door assemblies.

M. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

2.3 KEYING

A. Furnish a Proprietary Schlage masterkey system as directed by the owner or architect. Key system to be designated and combined by the Schlage Master Key Department even if pinned by the Authorized Key Center, Authorized Security Center or a local authorized commercial dealer.

B. A detailed keying schedule is to be prepared by the owner and/or architect in consultation with a representative of Allegion or an Authorized Key Center or Authorized Security Center. Each keyed cylinder on every keyed lock is to be listed separately showing the door #, key group (in BHMA terminology), cylinder type, finish and location on the door.

C. Furnish all interchangeable cores and cylinders in the Schlage Small Format Interchangeable Core (SFIC) style. Verify Schlage Everest "B" keyway with district. Pack change keys independently (PKI).

D. Furnish construction keying for doors requiring locking during construction.

E. Furnish all keys with visual key control.

1. Stamp key "Do Not Duplicate".
2. Stamp (BHMA) key symbol on key.
3. Stamp unique owner identifier from the key bow.

F. Furnish all cylinders with visual key control.

1. Stamp (BHMA) key symbol on side of cylinder (CKC).

G. Furnish mechanical keys as follows:

1. Furnish 2 cut change keys for each different change key code.
2. Furnish 1 uncut key blank for each change key code.

3. Furnish 6 cut masterkeys for each different masterkey set.
 4. Furnish 3 uncut key blanks for each masterkey set.
 5. Furnish 2 cut control keys cut to the top masterkey for permanent I/C cylinders.
 6. Furnish 1 cut control key cut to each SKD combination.
- H. Furnish Schlage Padlocks and the cylinders to tie them into the masterkey system for gates, storage boxes, utility valve security, roof hatches and roll-up doors keyed as directed in the keying schedule.
1. Furnish KS43F2200 padlock for use with non-I/C Schlage cylinders. Furnish 47-413 (conventional core) or 47-743 (Primus core) with above.
 2. Furnish KS43F3200 padlock for use with FSIC Schlage cylinders. Furnish 23-030 (FSIC core) or 20-740 (Primus core) with above.
- I. Furnish one Schlage cabinet lock for each cabinet door or drawer so designated on the drawings or keying schedule to match the masterkey system.
1. Furnish CL100PB for use with non-I/C Schlage cylinders.
 2. Furnish CL777R for use with FSIC Schlage cylinders.

2.4 FINISHES

- A. Generally to be satin chrome US26D (626 on bronze and 652 on steel) unless otherwise noted.
- B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.
- C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.
- D. Aluminum items to be finished anodized aluminum except thresholds which can be furnished as standard mill finish.

2.5 FASTENERS

- A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.
- B. Screws for butt hinges shall be flathead, countersunk, full-thread type.
- C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.
- D. Provide expansion anchors for attaching hardware items to concrete or masonry.
- E. All exposed fasteners shall have a phillips head.
- F. Finish of exposed screws to match surface finish of hardware or other adjacent work.
- G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.
- B. Beginning of installation means acceptance of existing conditions.
- C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer's furnished fasteners are used for installation and that it meets all criteria of a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protectives) 2016 Edition. A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDAI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.2 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and requirements of DHI.
- B. Use the templates provided by hardware item manufacturer.
- C. Mounting heights for hardware shall be as recommended by DHI. Operating hardware shall be located between 34" and 44" above finish floor to comply with CBC Section 11B-404.2.7.
- D. Door Closers:
 - 1. Place door closers inside building, stairs, rooms, etc. Closers shall be installed to permit doors to swing 180 degrees or maximum allowable by conditions.
 - 2. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors.
 - 3. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal.
 - 4. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
 - 5. Compensating devices or automatic door operators may be utilized to meet the above standards.
 - 6. Per CBC Section 11B-404.2.8.1, doors shall take minimum of 5 seconds to move from an open position of 90 degrees to 12 degrees to the latch jamb.
- E. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- G. Set thresholds for exterior doors in full bed of butyl-rubber sealant.

- H. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.
- I. Electronic Hardware:
 - 1. Hardware Installer shall coordinate with security contractor to route cable to connect electrified locks, panic hardware and fire exit hardware to power transfers or electric hinges at the time these items are installed so as to avoid disassembly and reinstallation of hardware.
 - 2. Hardware Installer shall also be present with the security contractor when the power is turned on for the testing of the electronic hardware applications. Installer shall make adjustments to solenoids, latches, vertical rods and closers to insure proper and secure operation.
 - 3. All wiring for electro-mechanical hardware mounted on the door shall be connected through the power transfer and terminated in the interface junction box specified for in the Electrical Section.
 - 4. Conductors shall be minimum 18 gage stranded, multicolored. A minimum 12 in. loop of conductors shall be coiled in the interface junction box. Each conductor shall be permanently marked with its function.
 - 5. If a power supply is specified in the hardware sets, all conductors shall be terminated in the power supply. Make all connections required for proper operation between the power supply and the electro-mechanical hardware. Provide the proper size conductors as specified in the manufacturer's technical documentation.

3.3 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surface soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.4 HARDWARE LOCATIONS

- A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.5 FIELD QUALITY CONTROL

- A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers' instructions and as specified herein.

3.6 HARDWARE SCHEDULE

- A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.
- B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called to the attention of the Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.
- C. The Door Schedule on the Drawings indicates which hardware set is used with each door.

MANUFACTURERS ABBREVIATIONS

GLY	=	Glynn-Johnson	Overhead Door Stops
IVE	=	Ives	Hinges, Door Pulls, Flush Bolts, Coordinators, Door Stops, Kick Plates & Silencers
LCN	=	LCN	Door Closers & Automatic Operators
SCH	=	Schlage Lock	Locks, Latches & Cylinders
SEC	=	SecureALL	Electronic Locks & Exit Device Trim
VON	=	Von Duprin	Exit Devices
ZER	=	Zero International	Thresholds, Gasketing & Weather-stripping

HW GROUP NO. 01

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	QEL-PA-9849-EO 24 VDC	626	VON
1	EA	ELEC PANIC HARDWARE	QEL-PA-9849-NL-OP-110MD 24 VDC	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
2	EA	LONG DOOR PULL	9264F 72" O	630	IVE
2	EA	OH STOP	100S ADJ	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TB	689	LCN
1	SET	WEATHERSTRIP	SEALS BY DOOR/FRAME MFR		
1	EA	THRESHOLD	PER DETAIL	A	ZER
1	EA	CARD READER	SA-PWR		SEC
1	EA	POWER SUPPLY	PS904 900-4RL 120/240 VAC		VON

HW GROUP NO. 01A

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	QEL-PA-9849-EO 24 VDC	626	VON
1	EA	ELEC PANIC HARDWARE	QEL-PA-9849-NL-OP-110MD 24 VDC	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
2	EA	LONG DOOR PULL	9264F 72" O	630	IVE
1	EA	CONC. AUTO OPERATOR	2853 STD/OP2 MS AS REQ (120/240 VAC)	ANCLR	LCN
4	EA	ACTUATOR	8310-853T	630	LCN
2	EA	MOUNTING BOX	8310-867F		LCN
1	EA	BOLLARD	B-6SQ-RT-32D-SM-HL	630	WIK
1	SET	WEATHERSTRIP	SEALS BY DOOR/FRAME MFR		
1	EA	THRESHOLD	PER DETAIL	A	ZER
1	EA	CARD READER	SA-PWR		SEC
1	EA	POWER SUPPLY	PS904 900-4RL 120/240 VAC		VON

HW GROUP NO. 02

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	CONT. HINGE	224XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	KR4954 X 154	689	VON
1	EA	ELEC PANIC HARDWARE	QELX-PA-AX-98-DT	626	VON
1	EA	ELEC PANIC HARDWARE	QELX-PA-AX-98-NL	626	VON
1	EA	SFIC MORTISE CYL.	80-132	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
2	EA	OH STOP	100S ADJ	630	GLY
1	EA	SURF. AUTO OPERATOR	9553 REG2 MS AS REQ (120/240 VAC)	ANCLR	LCN
4	EA	ACTUATOR	8310-853T	630	LCN
4	EA	MOUNTING BOX	8310-867F		LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	DOOR SWEEP	328AA	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	THRESHOLD	PER DETAIL	A	ZER
1	EA	CARD READER	SA-PWR		SEC
1	EA	POWER SUPPLY	PS904 900-4RL 120/240 VAC		VON

HW GROUP NO. 03

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-98-EO	626	VON
1	EA	ELEC EXIT DEVICE TRIM	SA-PHR	626	SEC
1	EA	SURFACE CLOSER	4040XP EDA TB	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	DOOR SWEEP	328AA	AA	ZER
1	SET	WEATHERSTRIP	SEALS BY DOOR/FRAME MFR		
1	EA	THRESHOLD	PER DETAIL	A	ZER

HW GROUP NO. 04

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	PANIC HARDWARE	PA-AX-98-L-06-WH	630	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TB	689	LCN
1	EA	FLOOR STOP	FS436	626	IVE
1	SET	WEATHERSTRIP	SEALS BY DOOR/FRAME MFR		
1	EA	THRESHOLD	PER DETAIL	A	ZER

HW GROUP NO. 05 - NOT USED**HW GROUP NO. 06**

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-98-EO	626	VON
1	EA	SURFACE CLOSER	4040XP EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	DOOR SWEEP	328AA	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	THRESHOLD	PER DETAIL	A	ZER

HW GROUP NO. 07

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	SURFACE CLOSER	4040XP EDA TB	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	DOOR SWEEP	328AA	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	THRESHOLD	PER DETAIL	A	ZER

HW GROUP NO. 08

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	SURFACE CLOSER	4040XP SCUSH TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	DOOR SWEEP	328AA	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	THRESHOLD	PER DETAIL	A	ZER

HW GROUP NO. 09

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 5 X 4.5 NRP	630	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP EDA TB	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	DOOR SWEEP	328AA	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	ASTRAGAL	44STST OR BY HM DOOR MFR	STST	ZER
1	EA	THRESHOLD	PER DETAIL	A	ZER

HW GROUP NO. 10

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-98-EO	626	VON
1	EA	ELEC EXIT DEVICE TRIM	SA-PHR	626	SEC
1	EA	SURFACE CLOSER	4040XP EDA TB	689	LCN
1	EA	FLOOR STOP	FS436	626	IVE
1	EA	SEALS	BY ALUMINUM FRAME MFR		

HW GROUP NO. 11

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	FLOOR STOP	FS436	626	IVE
1	EA	SEALS	BY ALUMINUM FRAME MFR		

PROVIDE 3 HINGES AT DOORS UNDER 7'-6" TALL

HW GROUP NO. 12

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	SURFACE CLOSER	4040XP RW/PA TB	689	LCN
1	EA	FLOOR STOP	FS436	626	IVE
1	EA	GASKETING	488SBK OR BY AL FRAME MFR	BK	ZER

HW GROUP NO. 13

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1HW 5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-98-EO-F	626	VON
1	EA	ELEC EXIT DEVICE TRIM	SA-PHR	626	SEC
1	EA	SURFACE CLOSER	4040XP EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436	626	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HW GROUP NO. 14

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-98-L-BE-F-06	626	VON
1	EA	SURFACE CLOSER	4040XP RW/PA TB	689	LCN
1	EA	FLOOR STOP	FS436	626	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HW GROUP NO. 15 - NOT USED

HW GROUP NO. 16

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	INVISIBLE HINGE	218	652	SOS
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	SURFACE CLOSER	4040XP SCUSH TB	689	LCN
1	EA	SEALS	BY ALUMINUM FRAME MFR		

HW GROUP NO. 17

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	BY STC ASSEMBLY MFR		
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	FLOOR STOP	FS436	626	IVE
1	SET	ACOUSTICAL SEALS	BY STC ASSEMBLY MFR		
1	EA	DOOR BOTTOM	BY STC ASSEMBLY MFR		

HW GROUP NO. 18

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK W/ IND	L9040 06A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

PROVIDE 3 HINGES AT DOORS UNDER 7'-6" TALL

HW GROUP NO. 19

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC PRIVACY LOCK	SA-CRR	626	SEC
1	EA	SURFACE CLOSER	4040XP SCUSH TB	689	LCN
1	EA	GASKETING	488SBK PSA	BK	ZER

HW GROUP NO. 20 - NOT USED**HW GROUP NO. 21**

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	SURFACE CLOSER	4040XP SCUSH TB	689	LCN
1	EA	GASKETING	488SBK PSA	BK	ZER

HW GROUP NO. 22

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	FLOOR STOP	FS436	626	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	SURFACE CLOSER	4040XP HCUSH TB	689	LCN

PROVIDE 3 HINGES AT DOORS UNDER 7'-6" TALL

HW GROUP NO. 23

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	OH STOP & HOLDER	90F	652	GLY
3	EA	SILENCER	SR64	GRY	IVE

HW GROUP NO. 24

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	BY GATE FABRICATOR		
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	SURFACE CLOSER	4040XP SCUSH TB	689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA	689	LCN

HW GROUP NO. 25

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
8	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-9849-EO-F-LBL	626	VON
1	EA	FIRE EXIT HARDWARE	PA-AX-9849-L-BE-F-06-LBL	626	VON
2	EA	SURFACE CLOSER	4040XP RW/PA TB	689	LCN
2	EA	FIRE/LIFE WALL MAG	SEM7850 12V/24V/120V	689	LCN
2	SET	MEETING STILE	328AA-S	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER

MAGNETIC HOLDERS TIED TO FIRE ALARM SYSTEM

HW GROUP NO. 26

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	AUTO FLUSH BOLT	FB31T	630	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	OH STOP	90S	630	GLY
2	EA	SURFACE CLOSER	4040XP RW/PA TB	689	LCN
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	ASTRAGAL	44STST OR BY HM DOOR MFR	STST	ZER

HW GROUP NO. 27

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	MANUAL FLUSH BOLT	FB358	626	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	OH STOP & HOLDER	90F	652	GLY
1	EA	SURFACE CLOSER	4040XP HCUSH TB	689	LCN
1	EA	ASTRAGAL	44STST OR BY HM DOOR MFR	STST	ZER
2	EA	SILENCER	SR64	GRY	IVE

HW GROUP NO. 28 - NOT USED**HW GROUP NO. 29**

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-9849-EO-F-LBL	626	VON
1	EA	FIRE EXIT HARDWARE	PA-AX-9849-L-BE-F-06-LBL	626	VON
2	EA	SURFACE CLOSER	4040XP RW/PA TB	689	LCN
2	EA	FIRE/LIFE WALL MAG	SEM7850 12V/24V/120V	689	LCN
1	SET	MEETING STILE	328AA-S	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER

MAGNETIC HOLDERS TIED TO FIRE ALARM SYSTEM

HW GROUP NO. 30 - NOT USED

HW GROUP NO. 31

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	ELEC STOREROOM LOCK	SA-CDR	626	SEC
1	EA	SURFACE CLOSER	4040XP RW/PA TB	689	LCN
1	EA	FLOOR STOP	FS436	626	IVE
1	EA	SEALS	BY ALUMINUM FRAME MFR		

HW GROUP NO. 32

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	BY GATE FABRICATOR		
1	EA	PANIC HARDWARE	CD-PA-AX-98-NL-WH	630	VON
1	EA	SFIC MORTISE CYL.	80-132 XQ11-948	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	CLOSER	BY GATE FABRICATOR		

HW GROUP NO. 33

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
5	EA	SPRING OPEN HINGE	1257 4.5 X 4.5	652	HAG
1	EA	BALL CATCH	347	626	IVE
1	EA	EDGE PULL	SR 3/8" X 4"	626	TYD

HW GROUP NO. 34

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	ROLLER LATCH	RL30	626	IVE
1	EA	FLUSH PULL	RM790	630	ROC

HW GROUP NO. 35 - HARDWARE BY DOOR MANUFACTURER**END OF SECTION**

SECTION 088000

GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Related Sections:

1. Section 057313 "Decorative Metal and Glazed Railings."
2. Section 079200 "Joint Sealants."
3. Section 084128 "Interior All-Glass Entrances and Storefronts."
4. Section 084413 "Glazed Aluminum Curtain Walls and Entrances."
5. Section 086300 "Metal-Framed Skylights."

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.

4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
 1. Insulating glass.
 2. Tempered laminated glass.
- C. Glazing Accessory Samples: For gaskets, sealants, and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations as indicated on Drawings.
- E. Contractor-Engineered Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Professional Engineer shall be licensed in the State of California.
- F. All Honeycomb IGU performance data must be generated and certified through the Window 7 glazing performance technology platform which is developed, maintained, updated, and distributed solely by Lawrence Berkeley National Laboratory, a division of the US Department of Energy. Submittals without performance data generated and verified by LBNL Window 7 will not be considered. All performance data to be submitted for 8 angles of incidence from 10-80 degrees in 10-degree increments. Performance of all unit types must also be submitted in the form of an executable BSDF file format for direct integration by project engineer into Energy Plus and Radiance models to confirm angularly selective energy and daylighting performances.
 1. Certificate verifying Honeycomb IGU performance per Lawrence Berkeley National Laboratory Windows 7 must be submitted with sample in order to be approved.
- G. LEED Submittals:
 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installers and manufacturers of insulating-glass units with sputter-coated, low-e coatings.
- B. Product Certificates: For glass and glazing products, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass and insulating glass.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Manufacturer Qualifications Honeycomb IGU products: A qualified manufacturer with a minimum of 10 years experience in this technology and have honeycomb glazing products and projects installed in the field for over 10 years.
- C. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- D. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- E. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- F. Source Limitations for Glass: Obtain coated float glass, and insulating glass from single source from single manufacturer for each glass type.
- G. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- H. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Glazing Manual."
 - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."

3. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
 - I. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 - J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
 - K. Preinstallation Conference: Conduct conference at Project site.
 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review temporary protection requirements for glazing during and after installation.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
 - B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.
- 1.9 PROJECT CONDITIONS
- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.
- 1.10 WARRANTY
- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 1. Warranty Period: 10 years from date of Substantial Completion.
 - B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning

insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Contractor-Engineered Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
 1. Design Wind Pressures: As required by California Building Code and Local Authorities Having Jurisdiction.
 2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
 5. Provide tempered or laminated glazing where required to meet safety glazing requirements of Local Authorities Having Jurisdiction (AHJ).
 6. Thickness of glass, where indicated, is minimum thickness. Contractor is responsible for engineering glass and providing thicker glass, where required by calculations.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Honeycomb IGU Performance: The performance of all honeycomb IGU products must be generated and confirmed per NFRC 100-2010 Environmental Conditions with Window 7 per Lawrence Berkeley National Laboratory, a division of the US Department of Energy. Supplier

to confirm performance with verified Window 7 documentation that specified units meet or exceed specified performance requirements.

2.3 GLASS TYPES

- A. [G1] 9/16-inch clear laminated tempered at exterior guardrail.
- B. [G2] 1-inch insulated glass: Vitro Solarban 90 Acuity + Acuity.
- C. [G3] 1-inch laminated insulated honeycomb glazing unit: Refer to Section 086300 "Metal-Framed Skylights."
- D. [G4] Bird-protection glass: 1-5/16 inch SNX 62/27 with GlasPro Bird Safe (UltraClear).
- E. [G5] 1-inch laminated insulated with interior lite laminated glass; where shown on Drawings and at south façade per acoustics.
- F. [G6] 1/4-inch clear float tempered.
- G. [G7] 3/8-inch clear float tempered, typical at interior Offices and GS-4 SF System.
- H. [G8] 11/16 inch clear laminated tempered at interior guardrail.
- I. [G9] 5/8 inch clear laminated, typical at Classrooms and GS-5 SF System.
- J. [G10] 5/8 inch clear laminated, upgrade of [G9] with partial frit (see elevations).
- K. [G11] assembly:
 - 1. Exterior IGU [G2].
 - 2. Interior IGU: Superlight IIXL-60 (+ 1-3/8-inch, 60-minute, fire-resistive).

2.4 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
- B. Strength: Provide glass products to meet local building codes. Where safety glass is required, provide tempered glass or laminated glass. Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article.
- C. Privacy Glass: Provide obscure glass at all toilet, shower, and locker room locations.

- D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 - 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.5 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - 2. For uncoated glass, comply with requirements for Condition A.
 - 3. For coated vision glass, comply with requirements for Condition C (other coated glass).
- C. Bird-Protection Glass: Glass Pro Bird Safe Glass, or equal.

2.6 INSULATING GLASS [G2]

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 - 2. Spacer: Aluminum with black, color anodic finish.
 - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 HONEYCOMB INSULATED GLAZING UNITS [G3]:

- A. Refer to Section 086300 "Metal-Framed Skylights."

2.8 LAMINATED INSULATING GLASS UNITS [G5]

- A. Double Glazed Solar Control Laminated Insulating Glass Unit: Solarban 90 on Acuity 6mm (2) / Air 1/2 inch (12.7mm) / 3mmStarphire_030PVB_3mmStarphire.
1. Basis-of-Design: Vitro Architectural Glass.
 2. Conformance: ASTM E 2190
 3. Outdoor Lite: Acuity Low Iron float glass as manufactured by Vitro Architectural Glass.
 - a. Conformance: ASTM C 1036, Type 1, Class 2, Quality q3.
 - b. Glass Thickness: 6mm (1/4 inch)
 - c. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.
 - d. Coating: Solarban 90 on Surface # 2
 4. Interspace Content: Air 1/2 inch (12.7mm)
 5. Indoor Lite: Laminate
 - a. Conformance: ASTM C1172 and complying with testing requirements
 6. Laminate Outboard Lite: Starphire float glass as manufactured by Vitro Architectural Glass
 - a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3
 - b. Thickness: 3mm (1/8 inch).
 - c. Heat-Treatment: Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201.
 7. Interlayer:
 - a. Type: Saflex QS 41 PVB
 - b. Thickness: 0.030 inch (0.76 mm)
 - c. Color: Clear
 8. Laminate Inboard Lite: Starphire float glass as manufactured by Vitro Architectural Glass
 - a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3
 - b. Thickness: 3mm (1/8 inch)
 - 1) Heat-Treatment: Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201.
 9. Performance Requirements:
 - a. Visible Light Transmittance: 53 percent minimum.
 - b. Winter Nighttime U-Factor: 0.28 (Btu/hr-ft²-°F) maximum.
 - c. Summer daytime U-Factor: 0.26 (Btu/hr-ft²-°F) maximum.
 - d. Shading Coefficient: 0.27 maximum.
 - e. Solar Heat Gain Coefficient: 0.23 maximum.
 - f. Outdoor Visible Light Reflectance: 12 percent maximum.

2.9 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.10 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated. Provide types indicated in glass types.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.11 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 088300

MIRRORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:
 - 1. Annealed monolithic glass mirrors – frameless.
- B. Related Sections:
 - 1. Section 088000 "Glazing."
 - 2. Section 108000 "Toilet & Bath Accessories."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.
- C. Samples: For each type of the following:
 - 1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
 - 2. Mirror Clips: Full size.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of mirror, from manufacturer.
- C. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For mirrors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.
- D. Glazing Publications: Comply with the following published recommendations:
 - 1. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
 - 2. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
- E. Safety Glazing Products: For film-backed mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 - 1. Warranty Period: One year from date of Substantial Completion for workmanship.
 - 2. Warranty Period against Spoilage: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

- A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Clear Glass: Mirror Select Quality.
 - 1. Nominal Thickness: 3mm.

2.2 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following, or equal:
 - a. Laurence, C.R. Co., Inc.
 - b. Liquid Nails Adhesive.

2.3 MIRROR HARDWARE

- A. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION

- A. Mirror Sizes: To suit Project conditions, cut mirrors to final sizes and shapes.
- B. Mirror Edge Treatment: Flat polished.
 - 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
 - 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Wall Mounted Mirrors: Install mirrors with mirror hardware and adhesive. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION

SECTION 088733

GLAZING FILM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Decorative film applied to interior glazing.
- B. Related Requirements:
 - 1. Section 088000 "Glazing".

1.3 ACTION SUBMITTALS

- A. Product Data: For each glazing film indicated. Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating each specified requirement.
- B. Samples: Label samples to indicate product, characteristics, and locations in the Work.
 - 1. For each type of decorative film and in each color and texture required, submit samples of glazing film adhered to clear glass, in the form of 6-inch square samples.
 - a. Prepare samples from same glass and glazing film to be used for the Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Certificates: Submit a letter from glazing film manufacturer certifying that they have reviewed the glazing details proposed for the Project, including the use of gaskets and sealants, and that each glazing film to be furnished is recommended for the application shown.
- B. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- C. Glazing Schedule: Provide a glazing schedule utilizing the same designations shown on Drawings for glazed openings listing glass types, thicknesses, composition of glass assemblies, coatings and heat treatment if any, for each size opening and location. Coordinate with Section 088000 "Glazing".
- D. Warranties: Submit special warranties specified in this Section.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each glazing film to be installed or applied, including recommendations and instructions for cleaning, maintenance, removal, and replacement of same.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has been trained and approved by the Manufacturer, and is regularly engaged in the installation of film similar in material, design, and extent to that indicated for Project. Installer shall have a minimum of five years' experience, and whose work has resulted in projects with a record of successful in-service performance.
- B. Mockups: Before installing decorative films, install mockups to demonstrate aesthetic affects and set quality standards for materials and execution.
 - 1. Install glazing film mockups as shown at the drawings.
 - 2. Simulate finished lighting conditions for review of mockups.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver film to Project site, and handle/store in accordance with manufacturer's instructions, in unopened containers and in a manner that will ensure no deterioration of, or detrimental effects on, film and its system for adhering to glass. Protect from weather and physical abuse.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Apply materials when environmental conditions are within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits. Application temperature range is 60 degrees F – 100 degrees F.

1.9 WARRANTY

- A. Manufacturer's Special Warranty for Glazing Film: Include coverage for cracking, peeling, delaminating, discoloration, changes in appearance, or failure to meet solar criteria.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. The film shall have a scratch resistant coating which, after 30 day curing time, shall facilitate cleaning the glass without damaging or scratching the film.
- B. Viewing the film from a distanced of ten feet at angles up to 45 degrees from either side of the glass, the film itself shall not appear distorted.
- C. It shall not be necessary to seal around the edges of the applied film system with a lacquer or other substance in order to prevent moisture or free water from penetrating under the film system.
- D. Coating Quality:
 - 1. The coating shall be uniform without noticeable pin holes, streaks, thin spots, scratches, or banding.
 - 2. The variation in light transmission across the width, at all positions along the length, shall not exceed 1 percent.
 - 3. The variation in total transmission across the width, at any portion along the length, shall not exceed 2 percent over the average.
 - 4. The rate of change of total transmission across the width, at any portion along the length, shall not exceed 1 percent in 4 inches.
- E. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84: Class A.
 - 1. Flame Spread: Maximum 25.
 - 2. Smoke Developed: Maximum 450.

2.2 MANUFACTURER

- A. Applied Film: A water-resistant, permanent, translucent patterned film laminated to a clear pressure sensitive adhesive and transparent synthetic liner.
- B. Color and Pattern: Refer to Finish Schedule on Drawings.
- C. Basis-of-Design Product:
 - 1. 3M, Construction Markets Division or the following equal alternate:
 - 2. Bekaert Specialty Films.
 - 3. Madico.
 - 4. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass surfaces to receive new film and verify that they are free from defects and imperfections which will affect the final appearance.
- B. Correct all such deficiencies before starting film application.

3.2 PREPARATION

- A. Clean glass surfaces to receive the application of applied film.
- B. Remove foreign deposits, including paint spatter and glazing sealant materials that have migrated from glazing channel.
- C. Wash with detergent, rinse, and dry each glass surface immediately prior to film application; comply with film manufacturer's instructions and recommendations.
- D. Control and limit unnecessary activities, occupancies, air movements, and similar incidents in each space of the building during the time of cleaning and film application so as to ensure the best possible environment for application of film on clean substrates.
- E. Comply with environmental conditions as recommended by film manufacturer prior to applying film to glass.
- F. Toweling or other absorbent material shall be placed on the window sill or sash to absorb moisture accumulation generated by the film application.

3.3 INSTALLATION

- A. All film shall be applied to the surface of the glass, in accordance with manufacturer's written instructions.
- B. Avoid seams whenever possible and, where not possible, minimize the number of seams. Produce seams which are tightly-butted, without overlaps and gaps which are visible only at viewing distances of 20 inches and less.
 - 1. Extend film to cover full expanse of each glass sheet to receive film, but without either overlapping the glass glazing materials, or leaving edge gaps of more than 1/32 inch.
- C. Apply film by method which will ensure the inclusion of no air bubbles or other foreign substances.
 - 1. In order to minimize the possibility of visible differences in the color or shading intensity of the butted films at seams, apply each film with its butted edge taken from the same end of the film roll (reverse the direction-of-application). Remove and replace film application where mismatching of film is visually noticeable where directed by Architect.
 - 2. Exercise extreme care during application of film, including the cutting and pressing-in-place of film, so as to avoid the scoring and abrading of surfaces of glass.
 - 3. Adhere film to glass using procedures recommended by film manufacturer. Press into place to ensure that entire film sheet, including edges, are firmly and permanently adhered.
- D. Film edges shall be cut neatly and square at a uniform distance of 1/16 inch to 1/32 inch of the window sealing device. Avoid scoring glass when cutting film.
- E. After final squeegee technique, the film shall be essentially flat with no obvious concentrations of moisture.
- F. The applied film shall be free of any creases or tears once applied glazing surfaces.
- G. The film surface shall be clean and free of soap residue and squeegee marks.

- H. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 CLEAN UP

- A. Dispose of backing sheets, trimmings, and blade tips.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Use manufacturer's recommended means to protect film before, during, and after installation.
- D. Do not wash or wipe the window surfaces for a minimum of 30 days after installation.
 - 1. 30 days after application of film, wash film using common window cleaning solutions, including ammonia solutions.
 - 2. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

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SECTION 089119

FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed wall louvers and frames.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants."
 - 2. Section 099600 "High Performance Coatings."

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Manufacturer's installation instructions and descriptive data of louvers and vents, including standard drawings and free area.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include layout plans and elevations, sections, details of installation, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing. Shop Drawings shall be prepared, stamped, and signed by a Professional Engineer licensed in the State of California.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
 - 3. Show project specific integrations to surrounding cladding and waterproofing components.
- C. Samples: 12-inch length of each louver blade in specified finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- C. Calculations for louvers designated as engineered by the Contractor.
- D. Sample copies of proposed warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Extended warranty.

1.7 WARRANTY

- A. Manufacturer: Furnish City with manufacturer's 20-year guarantee for finish against defects in materials and workmanship, including against delamination or pitting of finish.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS - GENERAL

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- B. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
- C. Water Penetration Resistance: Louver assemblies shall contain internal gutters and sill flashing that collect and drain water to the exterior.

2.3 MANUFACTURERS

- A. Louvers: 4 inch drainable, fixed.
 - 1. Basis-of-Design: Greenheck Louvers or the following equal alternates:
 - a. Construction Specialties Inc.(C/S).
 - b. Airolite Company.
 - c. Ruskin Manufacturing, or equal certified by AMCA.
- B. Insect Screen: 16-x-18-mesh aluminum interior mounted in a rewirable extruded-aluminum frame.
 - 1. Frame Finish: To match louver.
 - 2. Attach to louvers with stainless steel screws.

2.4 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Include supports, anchorages, and accessories required for complete assembly.

2.5 FINISH

- A. Primer: Manufacturer's standard epoxy prime coat.
- B. Finish Coat: Two coat high high-performance fluoropolymer coating containing minimum 70 percent polyvinylidene fluoride (PVDF) resin and meeting or exceeding all the requirements of AAMA 26205.
 - 1. Colors: To match Architect's sample.
 - 2. Where applicable, coordinate with other Sections for color matching.
- C. Screens: Prepainted black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, at indicated alignment with adjacent work, and in accordance with manufacturer's recommended installation instructions.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 9213 "Exterior Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.
 - 2. Touch up of minor field abrasions and damage to factory-painted finish will be permitted if approved by Architect and touch-up is not unnoticeable in completed installation.

END OF SECTION

09 00 00 - Interior Finish & Materials List (Provide these or equal)							
Cat.	Material	Material Abbrev	Spec	Product Manufacturer	Product Name / Series / Model #	Size	Color / Finish
INTERIOR							
Floors							
	Concrete Topping Slab: Ground and Polished	CONC-1	03 35 43	See Spec			
	Sealed Concrete	CONC-2	03 33 00 / 03 30 00	See Spec			
	Resilient Tile Flooring	RTF-1	09 65 19	Mannington	Teles	35" x 35"	Stalagmite
	Carpet Tile Type 1	CPT-1	09 68 13	Mohawk	chillD	12 x 36	Easy Breezy
	Carpet Tile Type 2	CPT-2	09 68 13	Mohawk	restD	12 x 36	Pause
	Carpet Tile Type 3	CPT-3	09 68 13	Interface	Net Effects	19.69" x 19.69"	Pacific
	Ceramic Tile Floor	CFT-1	09 30 00	Provenza	Ego	30cm x 60cm	Grigio Scuro
	Precast Concrete Stair Treads		03 48 19	Wausau Tile			
	Entrance Floor Grille		12 48 16	Hendrick	T16 Profile Bar, hidden mounting tab	1-1/4" depth in 2-3/8" floor recess	Stainless Steel Satin No. 4
Wall Base							
	Solid Wood Base, flush to WD-1	SWB-1	06 20 23			6" h	Species to match WP-1 wood grilles, clear seal
	Solid Wood Base, surface-mtd	SWB-2	06 20 23			6" x 3/4"	Red Oak, clear seal
	Rubber Base	RB-1	09 65 13	Burke (by Mannington)	Cove base, 100 foot coil	4"	TBD
Ceilings							
	Acoustic Ceiling Tile 1	ACT-1	09 51 13	Armstrong	Dune 2 x 2 - Tegular 9/16" grid	2' x 2'	White
	Acoustic Ceiling Tile 2	ACT-2	09 51 13	Armstrong	Optima PB Concealed #8539PB	4' x 4'	White
	Acoustic Ceiling Tile 3	ACT-3	09 51 13	Armstrong	OPTIMA® PB Shapes for DESIGNFlex® #100221 with Tegular edge w/ 9/16" grid	75o Right Parallelogram 48 x 24 x 1"	White
	Acoustic Ceiling Tile 4	ACT-4	09 51 13	Armstrong	Optima PB Concealed #8536PB	96" x 24"	White
	Grid Type 1		09 51 13	Armstrong	9/16" - Suprafine		White
	Grid Type 2		09 51 13	Armstrong	Prelude 15/16" grid		White
	Grid Type 3		09 51 13	Armstrong	Suprafine XM 9/16" for DesignFlex		White
	Painted Gyp Ceiling	GYP-1	09 29 00	N/A			
	Acoustic Plaster Ceiling	APC-1	09 23 13	Armstrong	ACOUSTIBuilt Seamless Acoustical Ceiling System. To be installed with Armstrong Drywall Grid	7/8" thick and 1.4lbs/SF	Fine texture finish Unfinish panel to be painted at the job site - color TBC by the architect in a LRV (Light Reflectance Value) of 70 or greater.
Walls							
	Wood Wall System 1 - Acoustic Wood Grille	WP-1	09 84 26	Rulon	Panel Grill/ with black acoustic layer	2 5/16" x 3/4" blades 6/per foot	Red/White Oak to match Arch sample, sanded, satin clear
	Wood Wall System 2 - Micro-Perforated Acoustical Panels	WP-2	09 84 26	Rulon	Aluratone System 700 (PERFecTion 750 staggered)	panel thickness 3/4" + face veneer and acoustical backer A750: 0.55mm dia holes @ 1.7mm O.C.	Red/White Oak to match Arch sample, sanded, satin clear
	Wood Wall System 3 - Wood Slat Wall Assembly	WP-3	09 84 26	Rulon	Panel Grill on black backers	3-3/4" x 1" spaced 3" O.C.	Red/White Oak to match Arch sample, sanded, satin clear
	Acoustic Wall Panels	AWP-1	09-83-16	Autex	Composition	1.22m x 25m	Clay
		AWP-2	09-83-17	Autex	Composition	1.22m x 25m	Simba
		AWP-3	09-83-18	Autex	Composition	1.22m x 25m	Silver
		AWP-4	09-83-19	Autex	Composition	1.22m x 25m	Atlantis
		AWP-5	09-83-20	Autex	Composition	1.22m x 25m	Calypso
		AWP-6	09-83-21	Autex	Composition	1.22m x 25m	Stately
	Fabric Wrapped Panel - ALTERNATE to AWP-1	FWP-1	09 77 23	Snap-Text		1" panel	fabric, TBD
	Digital Vinyl Wall Covering	DWC-1	09 72 00	DesignTex	Bespoke	Custom digital print on vinyl wall covering	

	Plastic Paneling		06 64 00	Marlite	Class A smooth		
	Ceramic Tile	CWT-1	09 30 00	Provenza	Ego-Frame	30cm x 60cm	Avorio
	Ceramic Wall Tile	CWT-2	09 30 00	Daltile	Color Wheel Classic	4" x 4"	Cobalt Blue, Galaxy, Sea Breeze (Alternating, random)
Interior Glazing, Doors & Openings							
	Interior Aluminum Frames	GS-4	08 11 16	RACO Interiors	Solutions Line	1.5" x depth to capture partitions up to 9-3/4"	PVDF, 3-coat to match exterior CW finish
	Aluminum Storefront - Upgraded for taller spans, butt-glazing, laminated glass	GS-5	08 41 28	Kawneer	451T SSG / 451T-005	G9 and G10 glazing types - 5/8" laminated	PVDF, 3-coat to match exterior CW finish
	Custom vinyl graphics for glass		08 87 33				
Interior Doors & Openings							
	Flush Wood Doors		08 14 16				
Arch Woodwork, Carpentry, Casework & Millwork							
	Plastic Laminate	PL-1	06 05 60	ARPA Laminate / Formica / Nevamar	Laminate HPL		White Oak
	Solid Surface	SS-1	06 61 16	Corian	Zodiaq Quartz Surface, 3/4", thickened edge	3/4" thick	Snow Flurry
		SS-2	06 61 16	3-Form	Chroma System	1/2" - 2"	White Ghost
	Wood Veneer	WV-1		White Oak Veneer			
	Solid Wood	WD-1		White Oak Solid			
Other Materials							
	Roller Window Shades - Type 1 Motorized, Automatic	WS-1	12 24 13				
	Roller Window Shades - Type 2 Manual	WS-2	12 24 13				
	Roller Window Shades - Type 3 Motorized, Remote Switched	WS-3	12 24 13				
	Blackout Window Shades, Roller, Manual	WS-4	12 24 13				
	Rollershade Fabric	fabric 1	12 24 13	Draper / Mernet	GreenScreen Revive or Evolve	opennes: 1% (S & W), 3%, (E) 5% (N)	PVC free, 100% recycling, plastic bottles
		fabric 2					
		fabric 3					
	Porcelain Marker Boards	PMB-1	10 11 00	Claridge	Profile Magnetic	4'x6', 4'x8'	
	Tack Boards	TB-1	10 11 00	Claridge	Cork	4'H	Fawn
	Green Screen backdrop		10 21 23	FJ Westcott			
	Arch Reveal 1	AR-1	06 40 23	Arakawa	ceiling surface mount (exposed)	5/8" channel profiles	
	Arch Reveal 2	AR-2	06 40 23	Arakawa	ceiling recessed	5/8" channel profiles	
	Arch Reveal 3	AR-3	06 40 23	Arakawa	- wall surface mount		

SECTION 092116

GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Gypsum board shaft wall assemblies.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants."
 - 2. Section 092216 "Non-Structural Metal Framing."
 - 3. Section 092900 "Gypsum Board."

1.3 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.
- B. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - 1. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - 2. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - 3. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For shaft wall assemblies, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.3 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated.
- B. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated. ClarkDietrich "CT Stud", or equal.
 - 1. Depth: As indicated.
 - 2. Minimum Base-Metal Thickness: 0.033 inch.
- C. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
- D. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.
- E. Elevator Hoistway Entrances: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches, matching studs in depth, and not less than 0.033 inch thick.
- F. Insulation: Sound attenuation blankets.

2.4 PANEL PRODUCTS

- A. Product: Georgia-Pacific "DensGlass Shaftliner", or equal. Fiberglass reinforced gypsum shaft liner board. Shaftliner panels shall be classified as "Type X" in accordance with ASTM C 1658.
- B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- C. Minimum Surface Density: 4 lbs/sf.

2.5 NON-LOAD-BEARING STEEL FRAMING

- A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 1. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized unless otherwise indicated.
- B. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Products: Subject to compliance with requirements, provide the following, or equal:
 - 1. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
 - 2. Grace Construction Products; FlameSafe FlowTrak System.
 - 3. Steel Network Inc. (The); VertiTrack VTD Series.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 - 1. Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
 - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.
- E. Sound Attenuation Blankets: As specified in Section 072100 "Building Insulation."
- F. Acoustical Sealant: As specified in Section 079200 "Joint Sealants."

- G. Joint Treatment Materials: As specified in Section 092900 "Gypsum Board."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 07 8100 "Applied Fireproofing."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
 - 1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
 - 2. Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.033-inch minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.

- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
 - 1. Clearances at joints and penetrations through acoustically significant construction, as defined by the Penetration Control Drawings, shall be as detailed and in accordance with Section 079200 "Joint Sealants."
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Cant Panels: At projections into shaft exceeding 4 inches, install 1/2- or 5/8-inch- thick gypsum board cants covering tops of projections.
 - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
 - 2. Where steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.
- I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

END OF SECTION

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SECTION 092216

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. The Work in this section includes Contractor-Engineered Systems.
 - 2. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 3. Suspension systems for interior gypsum ceilings, soffits, and grid systems.
- B. Related Requirements:
 - 1. Section 092900 "Gypsum Board".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include spacings, sizes, thicknesses, and types of non-structural metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.3 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated. No other coating is acceptable.
- B. Standard Studs and Runners: ASTM C 645.
 - 1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 25 gauge, unless otherwise indicated on Drawings.
- C. Slip-Type Head Joints: Provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 - 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, provide the following, or equal:
 - 1) ClarkDietrich Building Systems; BlazeFrame DSL Slotted Deflection Track
 - 2) MBA Building Supplies; FlatSteel Deflection Track.
 - 3) Steel Network Inc. (The); VertiTrack VTD Series.
 - 4) Superior Metal Trim; Superior Flex Track System (SFT).

- D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Products: Subject to compliance with requirements, provide the following, or equal:
 - a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
 - b. Grace Construction Products; FlameSafe FlowTrak System.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
- F. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
 - 1. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 25 gauge, unless otherwise indicated on Drawings.
 - 2. Depth: 7/8 in. unless otherwise indicated on Drawings.
 - 3. Product: Clark Dietrich.
- H. Furring Channel Resilient Attachment: Kinetics Noise Control Isomax resilient sound reduction clip.
- I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.4 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
 - D. Flat Hangers: Steel sheet, in size indicated on Drawings.
 - E. Carrying Channels, typical at Gypsum Board Ceilings, unless otherwise indicated on Drawings: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch-wide flanges. 1 1/2 in. deep and spaced at 48 in. on center, unless otherwise indicated on Drawings.
 - F. Furring Members:
 1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep. 25 gauge, fastened and perpendicular to carrying channels at 16 in. on center, typical, at gypsum board ceilings unless otherwise indicated on Drawings.
 - G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock. Provide where indicated on Drawings.
 1. Products: Subject to compliance with requirements, provide the following, or equal:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- D. Direct Furring:
1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- E. Z-Furring Members:
1. Erect insulation, specified in Section 072100 "Building Insulation," vertically and hold in place with Z-furring members spaced 24 inches o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches o.c.
 2. Carrying Channels (Main Runners): 48 inches o.c.
 3. Furring Channels (Furring Members): 16 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

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SECTION 092313

ACOUSTICAL GYPSUM PLASTERING

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included: Acoustical Plastering, complete, as shown and specified.
- B. Description: The Acoustical Plastering System is for reduction of reverberation time and is based on a fine porous surface that appears to be solid. The sound energy that enters through the pores is converted into heat.
- C. Work Specified Elsewhere:
 - 1. Gypsum Board: Section 092900.

1.2 SUBMITTALS

- A. Product Data: Submit for Owner's Representative's action. Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating specified requirements.
- B. Shop Drawings: Submit for Owner's Representative's action. Submit shop drawings for the fabrication and installation of the Work. Prepare details at not less than 3 in. = 1 ft. scale. Submit Base Drawings, Approved Detail Drawings and Field Measurements.
 - 1. Show dimensioned wall elevations or ceiling plans with joint locations, mounting details, transitions details to adjacent work, design, weight, thickness, color and other data necessary to install the work and coordinate work with other affected trades.
- C. Samples: Submit for Architect's action. Furnish sufficient samples to establish full range of colors and textures for materials exposed in the finished Work, but not less than two 8 1/2 in. by 11 in. samples in finishes selected by Owner's Representative. Label samples to indicate product and location in the Work. Samples will be reviewed for appearance only. Compliance with other requirements is the responsibility of the Contractor.
- D. Quality Assurance/Quality Control Submittals: Submit for Owner's Representative's information.
 - 1. Certificates:
 - a. Document Review: Submit a written statement signed by the Contractor and the Applicator stating that the Contract Documents, shop drawings and product data have been reviewed with qualified manufacturer representatives. The statement shall certify that selected materials are proper, compatible with contiguous materials and adequate for the application shown.
 - b. Installer's Qualifications
 - c. Acoustical Performance Certification

- 1) Acoustical Performance: Submit Certified Acoustical Performance Sound Absorption Test data reports, conducted by a recognized, independent, testing agency. Sound absorption reports shall not be more than 3 years old.
- 2) Fire Hazard: Evidence of compliance with regulatory agency and specification requirements.

E. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the credits.

1.5 QUALITY ASSURANCE

- A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.
- B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.
- C. Mock-Up: Install mock-up, not less than 7 ft. by 7 ft., of sound absorptive finish system. Obtain mock-up acceptance before any additional applications. Accomplish work to equal or exceed standard established by accepted job site mock-up.
- D. Pre-Installation Meetings: Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include the Owner, Owner's Representative's consultants, Contractor, and subcontractors whose work is relevant to this Specification Section.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Allow materials to become acclimated to Project conditions before installation.
- B. Ship and deliver in protective packaging to prevent freight damage.
- C. Store materials in accordance with manufacturer's recommendations in a fully enclosed space where materials will be protected against damage from moisture, direct sunlight, surface contamination and other causes. All wet work must be completed in area of storage.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with requirements of referenced plaster application standards and recommendations of product manufacturer for environmental conditions before, during and after installation.
- B. Ventilation: Ventilate building spaces as required to remove excess moisture to promote drying of applied material.
- C. Protect contiguous work from soiling, splattering, moisture deterioration and other harmful effects that may be caused by the application of the material.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.
- B. Ceilings, Walls, Thermal and Acoustic Insulation: All ceilings, thermal insulation, acoustic insulation, products provided under this specification section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Comply with the applicable provisions of the referenced standards, except as modified by governing codes and the Contract Documents. Where a recommendation occurs in the referenced standards, it shall be considered mandatory. In the event of conflict, the more stringent standard or requirement shall govern.
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM C423: Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - b. ASTM E795: Standard Practices for Mounting Test Specimens During Sound Absorption Tests.
 - c. ASTM E84: Standard Test Method for Surface Burning Characteristics and Building Materials. Class A Fire Rating.
- B. Performance Requirements:
 - 1. Noise Reduction Coefficient (NRC) for the 1.57" (40 mm) system shall be 0.80 as per ASTM C 423-07 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method. Specific performance of the 1.57" seamless absorptive plaster system shall be as follows:

Frequency, Hz	Absorption Coefficient
100	0.20
200	0.39
400	0.87
800	0.95
1,000	0.94
1,250	0.90
1,600	0.85
2,000	0.81

2,500	0.79
4,000	0.68
5,000	0.66

2.3 MANUFACTURER

- A. Acoustical plastering:
 - 1. Basis-of-Design: BASWA "BASWAphon Sound Absorptive Acoustical Finish System" or equal (no known equal). www.BASWAphonusa.com (440.951.6022 phone).

2.4 MATERIALS

- A. General: The BASWAphon seamless absorption system shall consist of pre-coated BASWAphon mineral wool supporting panels, which are adhered to a stable substrate. The seams shall be filled with BASWAphon Fill seam fill. A base coat, BASWAphon 407 and a finish coat, BASWAphon Top is applied onto the supporting panels on site, per manufacturer's specifications. The topcoat shall be troweled smooth to give the appearance of a smooth conventional plaster.
 - 1. Total system thickness: 40mm including adhesive, pre-coated mineral wool panels, base coat and finish coat.
 - 2. Trim as selected by Architect.
- B. The base and finish coats shall be integrally colored by the addition of pigments. Color shall be selected by the Architect.
- C. Light Reflectance: 0.91 as per ASTM E1477.
- D. Flame Spread: Class A (I) per ASTM E84.

PART 3 - EXECUTION

3.1 GENERAL

- A. Manufacturer's Instructions: Prepare substrates and install the work, including components and accessories, in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions.
- B. All substrates for the application shall not vary from plumb, level or "smooth consistent curvature" more than 1/4 inch in 12 feet.
- C. Verify that all mechanical and electrical services within area of application has been tested and approved, prior to commencement of application.

3.2 INSTALLATION

- A. Installation shall start only after all other work in the area of the installation has been completed.
 - 1. Provide BAS Fastener connected to stable support and pre-fill after fastener in installed.

2. Install a field applied adhesive layer 3-mm thick, using adhesive and methods in accordance with manufacturer's installation instructions and adhere panels to stable substrate. Ensure that panels are set as level and as smooth to each other as practicable.
3. Install trims with approved adhesives and cover with Pre-Coat.
4. Fill seams with Pre-Fill, sand Pre-Fill on panel seams and Pre-Fill on Trim completely smooth when dry.
5. Apply a 1.5-mm thick layer of Base-Coat 407, trowel smooth, sand completely smooth when dry.
6. Apply a 0.5-mm thick layer of Top-Coat and trowel smooth to a quality level consistent with accepted samples or mock-up. View finish under end-use lighting conditions.

3.3 PROTECTION

- A. Protection: Protect finishes from damage during construction period.

END OF SECTION

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SECTION 092400

PORTLAND CEMENT PLASTERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior plasterwork.
- B. Related Sections:
 - 1. Section 072726 "Fluid-Applied Membrane Air Barriers."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples: For each type of factory-prepared finish coat and for each color and texture specified.
- D. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the credits.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution. Mockup shall be in place from control joint to control joint for Architect approval.

1. Build mockups for each substrate and finish texture indicated for cement plastering, including accessories.
 - a. Size: 100 sq. ft. in surface area.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

- A. Manufacturer shall provide single source warranty to the Owner for 15 years, warranting against defective materials, basecoats, lamina, primer and acrylic finish.
- B. Installer shall provide a single source warranty to the Owner for 15 years, warranting against defective installation of all materials, including basecoats, lamina, primer and acrylic finish.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.8 FIELD CONDITIONS

- A. Comply with ASTM C 926 requirements.
- B. Exterior Plasterwork:
 1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
 2. Apply plaster when ambient temperature is greater than 40 deg F.
 3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
- C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard

Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E 119 by a qualified testing agency.

2.3 METAL LATH

- A. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet with ASTM A 653/A 653M, G60, hot-dip galvanized-zinc coating.
 - 1. Diamond-Mesh Lath: Self-furring, 3.4 lb/sq. yd.

2.4 ACCESSORIES

- A. General: Comply with ASTM C 1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Metal Accessories:
 - 1. Channel Screed/Control Joint: Fry Reglet Channel Screed, no. PCS-75-150, non-vented. Alloy 6063 T5 aluminum, with clear anodized coating.
 - 2. "F" Reveal Molding: Fry Reglet "F" Reveal Molding, no. FPM-75-150, non-vented. Alloy 6063 T5 aluminum, clear anodized coating.
 - 3. Perimeter Soffit Molding: Fry Reglet "Perimeter Soffit Molding", no. WPM-75-V-400, vented. Alloy 6063 T5, clear anodized coating.
 - 4. Foundation Weep Screed: Fabricated from hot-dip galvanized-steel sheet, ASTM A 653/A 653M, G60 zinc coating.
 - 5. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized-zinc coating.
 - 6. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.
 - 7. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.

2.5 PRE-MIXED PLASTER MATERIALS

- A. Basis of Design: BMI Products.
- B. Premixed Plaster Scratch & Brown Coats: BMI 690. Meets ICC-ES Evaluation Report ESR-2535, Portland Cement Plaster and ASTM C 926.
- C. Polymer-Modified Base Coat: BMI 777, fiber-reinforced, dry mix, polymer modified cementitious base coat.
- D. Mesh: BMI Mesh is a specialty woven, alkali resistant glass fiber reinforcing mesh used with the specified base coat.

- E. Colored Primer: BMI Primer 100 is an acrylic protective exterior primer.
- F. Finish Coat: BMI Acrylic Medium Sand Finish.

2.6 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fasteners for Attaching Metal Lath to Substrates: ASTM C 1063.
- C. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.
- D. Drainage Composite: Three-dimensional polypropylene or nylon randomly oriented drainage and ventilation mat laminated to non-woven, vapor permeable fabric.
 - 1. Products: Subject to compliance with requirements; provide the following:
 - a. Keene Building Products; Driwall Rainscreen 013-1

2.7 PLASTER MIXES

- A. General: Comply with ASTM C 926 for applications indicated.
- B. Base Coat: Continuously mix in a mechanical plaster mixer, in accordance with manufacturer's recommendation.
- C. Factory-Prepared Finish-Coat Mixes: For acrylic-based finish coatings, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare smooth, solid substrates for plaster according to ASTM C 926.

3.3 INSTALLING DRAINAGE COMPOSITE

- A. Drainage Composite Installation: Install in accordance with manufacturer's instructions, including:
1. Place drainage mat horizontally against exterior wall, fabric side out, entangled core to the building interior. Starting at the bottom of the wall, position the first piece of drainage mat where the bottom edge of the stone will meet the ledger board.
 2. Hold in place with small dabs of glue every 2.0 feet (0.61 m). Do not fasten through flashing.
 3. Seam adjacent piece with the selvage edge overlapping the top of the lower drainage mat piece.
 4. Install expanded metal lath over the drainage mat according to the manufacturer's recommendations.
 5. Apply stucco according to manufacturer's recommendations. Provide a weep method for ventilation and drainage.
 6. Trim drainage mat around all penetrations, windows and doors so that the material is flush to the flashing.

3.4 INSTALLING ACCESSORIES

- A. Install according to ASTM C 1063 and at locations indicated on Drawings.
- B. Reinforcement for External (Outside) Corners:
1. Install cornerbead at exterior locations.
- C. Control Joints: Locate as approved by Architect for visual effect and as follows:
1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 sq. ft.
 - b. Horizontal and Other Nonvertical Surfaces: 100 sq. ft.
 2. At distances between control joints of not greater than 18 feet o.c.
 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
 4. Where control joints occur in surface of construction directly behind plaster.
 5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.5 PLASTER APPLICATION

- A. General: Comply with ASTM C 926.

- B. Apply premixed plaster in accordance with manufacturer's ICC ESR Report #2535.
- C. Crack-Reduction/Lamina Coat:
 1. Ensure that the surface of the wall is cured for 7 days, clean, dry and free of efflorescence, oil or other contaminants that would impair adhesion.
 2. Apply modified basecoat mixture in continuous layer approximately 3/32 inch thick.
 3. Apply a layer of reinforcing mesh into the wet mixture and trowel smooth until mesh is fully embedded. Lap adjoining pieces of mesh 2-1/2 inches minimum and as described in the manufacturer's written instructions and technical bulletins.
 4. Let dry for a minimum of 24 hours, until dry, or longer as required by weather conditions.
- D. Standard Curing: Basecoat requires adequate moisture to allow continuous hydration of the cement.
 1. Minimum two (2) days of moist curing shall be provided.
 2. Provide additional moist curing to conform to code requirements, manufacturer recommendations, local practices and climatic conditions and as otherwise required to provide acceptable substrate for finish coat.
 3. Base coat shall be allowed to cure for a minimum of 7 days prior to coating with acrylic primer and Finish.
- E. Primer Application:
 1. Ensure that the surface of the wall is cured, clean, dry and free of efflorescence, oil or other contaminants that would impair adhesion.
 2. Primer color shall closely match that of the selected finish.
 3. Stir to a smooth homogeneous consistency and apply to the wall using a roller, brush or airless spray equipment. Refer to published Colored Primer data sheet for more complete instructions.
 4. Allow to completely dry, usually 24 hours.
- F. 100% Acrylic Textured Finish Application:
 1. Ensure that the surface of the wall is clean, dry and free of any contaminants that may impair the adhesion of surface finish.
 2. Spray, or trowel-apply textured finish to dried primer.
 3. Apply finish to natural breaks to avoid visible cold joints.
 4. Always work the shady side of the wall or provide temporary shading to avoid application in direct sunlight.
 5. Apply in accordance with manufacturer directions for the specific finish and texture being used.

3.6 PLASTER REPAIRS

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION

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SECTION 092900

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Moisture-resistant gypsum board.
3. Fire and Acoustical Sealant.
4. Tile backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 072100 "Building Insulation" for Sound Attenuation Blankets.
3. Section 092116 "Gypsum Board Shaft Wall Assemblies".
4. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.
5. Section 092313 "Acoustical Gypsum Plastering".
6. Section 093000 "Tiling".
7. Section 099100 "Painting and Coating".

1.3 SUBMITTALS

- A. Product Data: For each type of product.

- B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

C. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. PS EPD: Products specified under this section shall have a Type III Product Specific EPD.

- B. Ceilings, Walls, Thermal and Acoustic Insulation: All ceilings, thermal insulation, acoustic insulation, products provided under this specification section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.3 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide the following, or equal:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. National Gypsum Company.
5. USG Corporation.
6. Saint Gobain.

- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.
3. Minimum Surface Density: 2.2 lbs/sf.

- C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.
3. Minimum Surface Density: 2.2 lbs/sf.

- D. Water Resistant Gypsum Board: Glass-Mat Gypsum Board (Siliconized Gypsum Board) (SGB)
– Exterior and Perimeter Wall Locations: ASTM C1177M, gypsum based board with water-resistant treated core, fully embedded glass fiber mats on both sides with a polymer modified gypsum surface and acrylic face coating, 1200 wide by longest lengths practicable. Thickness unless specified otherwise-16 mm thickness; ends square cut, tapered.
1. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 2. Exposure Warranty: Manufacturers standard 12-month warranty.
 3. Product: DensGlass Fireguard sheathing by Georgia-Pacific Gypsum LLC.
 4. Acceptable Alternate Products: Subject to the requirements of this article “CGC Securock Glass-Mat Sheathing Type X” manufactured by CGC Inc. or “GlasRoc Sheathing Type X 5/8 inch” by CertainTeed Corp.
- E. Abuse-Resistant Gypsum Board, Type VHI: ASTM C 1278 gypsum-fiber panel with fiberglass reinforcement, providing greater resistance to surface indentation and through-penetration than standard gypsum panels, and tested according to ASTM C 1629/C 1629M.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. United States Gypsum Company; “Fiberock VHI Interior Panel.”
 - b. Equal.
 2. Core: 5/8-inch, Type X.
 3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
 4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
 5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
 6. Hard-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements according to test in Annex A1.
 7. Long Edges: Tapered.
 8. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.

- d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
- e. Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

- 1. Manufacturers: Subject to compliance with requirements, provide the following, or equal:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
- 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
- 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

- 1. Interior Gypsum Board: Paper.
- 2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

- 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
- 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
- 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
- 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
- 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound

D. Joint Compound for Tile Backing Panels:

- 1. Tile Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Fire and Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products: Subject to compliance with requirements, provide the following, or equal:
 - a. Pecora Corporation; AC-20 FTR .
 - b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - c. USG Corporation; Sheetrock (per USG) Acoustical Sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD AND WATER-RESISTANT GYPSUM BOARDS

A. Single-Layer Application:

- 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
- 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
- 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

- 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum,

from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners unless otherwise indicated.
 2. LC-Bead: Use at exposed panel edges.
 3. L-Bead: Use where indicated.
 4. U-Bead: Use at exposed panel edges.
- C. Aluminum Trim: Install in locations indicated on Drawings.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 2: Panels that are substrate for tile.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
5. Level 5: At locations indicated on the Drawings as accent, graphics and specialty walls.
 - a. Primer and its application to surfaces are specified in Section 099100 "Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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SECTION 093000

TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Porcelain and Ceramic tile.
 - 2. Waterproof membrane.
- B. Related Sections:
 - 1. Section 092900 "Gypsum Board" for tile backer board.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

- A. Dynamic Coefficient of Friction: > 0.42 when tested in accordance with ANSI A137.1.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
- D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Metal edge strips in 6-inch lengths.

E. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product, signed by product manufacturer.
- D. Material Test Reports: For each tile-setting and -grouting product and special purpose tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
 - 1. Waterproof membrane.
 - 2. Metal edge strips.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store liquid materials in unopened containers and protected from freezing.
- D. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. PS EPD: Products specified under this section shall have a Type III Product Specific EPD.
- B. Flooring: All flooring provided under this spec section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 MANUFACTURERS

- A. Tile:
 - 1. Basis-of-Design: Refer to Section 090000.

2.4 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fluid-Applied Waterproofing: Single component, self-curing liquid rubber polymer that forms a flexible, seamless waterproofing membrane.
 - 1. Products: Subject to compliance with requirements, provide the following, or equal: Laticrete "Hydro Ban."

2.5 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the following, or equal:
 - a. Custom Building Products.
 - b. Laticrete International, Inc.
 - c. MAPEI Corporation.
 - 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 - 3. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
 - 4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- B. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
 - 1. Latex Additive: Manufacturer's standard acrylic resin water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed Portland cement and aggregate mortar bed.

2.6 GROUT MATERIALS

- A. Polymer-Modified Tile Grout: ANSI A118.7.
 - 1. Provide the following, or equal:
 - a. Custom Building Products.
 - b. Laticrete International, Inc.
 - c. MAPEI Corporation.

2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
- B. Epoxy Grout at Showers: ANSI A118.3, with a VOC content of 65 g/L or less.
1. Provide the following, or equal:
 - a. Custom Building Products.
 - b. Laticrete International, Inc.
 - c. MAPEI Corporation.
 2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.7 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."
1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
1. Products: Subject to compliance with requirements, provide the following, or equal:
 - a. Dow Corning Corporation; Dow Corning 786.
 - b. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
 - c. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
 - d. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
 - e. Tremco Incorporated; Tremsil 600 White.

2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic, designed specifically for flooring applications; white zinc alloy exposed-edge material. Provide metal edge strips from Schluter Systems, or equal. PVC or neoprene parts are not acceptable.
- C. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
 2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- E. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.
 - 1. Products: Subject to compliance with requirements, provide the following, or equal:
 - a. Bonsal American; an Oldcastle company; Grout Sealer.
 - b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
 - c. C-Cure; Penetrating Sealer 978.
 - d. Custom Building Products; Surfaceguard Grout and Tile Sealer.

2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
 - 4. Do not commence installation of flooring materials until floor substrate is within the following tolerances in all directions. If substrate is not within tolerance, level the substrate using a method and a product(s) that is compatible with and acceptable to the setting materials manufacturer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
 - 1. Furnish the same lots, batches, etc. within the same contiguous areas of the site (i.e. corridors on the same floors, common rooms which adjoin each other, etc.).
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors composed of tiles 8 by 8 inches or larger.
 - c. Tile floors composed of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Maximum porcelain tile grout width: 3/16 in. (confirm with selected products).
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- I. Finished Surfaces: Unless otherwise accepted in the sample installation(s), if any, finished surfaces shall present a flat, even appearance, free from waver, projections, and depressions.
- J. Movement (Contraction, Control, Expansion, and Isolation Joints) Joints: Locate sealant filled movement joints where recommended by the manufacturer of mortar and grout materials, but not less than the requirements of TCNA EJ171 which follows, and as accepted by the Architect. Form movement joints and other sealant-filled joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles. Where movement joints are to be butted, the ends shall touch and align.
- K. Spacing Guidelines:
 - 1. 20 to 25 feet in each direction where interior tile work is not exposed to direct sunlight or moisture.
 - 2. 8 to 12 feet in each direction where interior tile work is exposed to direct sunlight and moisture.
 - 3. Where tilework abuts restraining surfaces such as perimeter walls, dissimilar floors, curbs, columns, pipes, ceilings, and where changes occur in backing materials, but not at drain strainers.
 - 4. In the joint between tiles making up the inside corner of planes.
 - 5. All contraction, control, expansion, isolation, seismic and cold joints in the horizontal structure and vertical surfaces shall continue through the tile surfaces, but not through membranes.
 - 6. Vertical and Horizontal Joints Widths: Widths for quarry tile and paver tile shall be the same as the grout joint but not less than 1/4 inch or the width of the contraction, control, expansion, seismic, isolation joint whichever is greater; widths for ceramic tile and glazed wall tile shall not be less than 1/8 inch or the width of the control, expansion, seismic, joint whichever is greater.
 - 7. Keep movement joints free from dirt, debris, grout, mortar, and setting bed materials. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."
- L. Metal Edge Strips: Install where exposed edge of wall tile meets other wall finishes that finish flush with or below face of tile and the manufacturer of the field tile does not manufacture a tile edge transition trim. Where metal edge strips are indicated and full length single units are not available, joints are to be butted, ends shall touch and align.
- M. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
 - 1. Do not install tile over waterproofing until waterproofing has cured, and at each horizontal installation, has been tested for water tightness. Test waterproofing membrane for

watertightness by damming the floor drain, and creating a dam at the perimeter of the waterproofed basin followed by filling the basin with water, marking the height, and verifying the same height after 48 hours. Repair leaks before continuing with the installation of subsequent tile.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
 - 1. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.6 FLOOR TILE INSTALLATION

- A. Thinset Tile over Concrete Slabs (Where noted): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
- B. Concrete Subfloors, Interior: TCNA F113.
 - 1. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
 - 2. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
 - 3. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch.
 - 4. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponge. Rake out joints to depth required to receive grout as tile units are set.
 - 5. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
 - 6. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. For typical installations, comply with latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- C. Thinset Tile over Crack Isolation Membrane (Janitor's Closet): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
- D. Concrete Subfloors, Interior: TCNA F125-Full.
 - 1. Apply the mortar to crack isolation membrane covered slab with the flat side of the trowel.
 - 2. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.

3. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
 4. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch.
 5. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.
 6. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
 7. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- E. LHT Set Tile (Only where indicated): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
- F. Concrete Subfloors, Interior: TCNA F205 (on-ground slabs) and TCNA F205A (above ground slabs) except apply LHT bed in thickness of 3/4" unless otherwise indicated.
1. Where required by the conditions indicated, apply underlayment using methods and within time limits recommended by the mortar manufacturer.
 2. With a trowel, having notches sized as recommended by the mortar manufacturer, place and comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturers recommendations.
 3. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
 4. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100% coverage to thickness of not less than 1/16-inch.
 5. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.
 6. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
 7. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- G. Thickset Tile (Toilet Rooms): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply. Thickness of mortar bed: Between 1-1/4-inch and 2-inches.
- H. Mortar and Bond Coat:

1. Latex-Portland Cement Mortar: ANSI A108.1A (Wet Set Method).
 2. Latex-Portland Cement Bond Coat: ANSI A108.5.
 3. Concrete Subfloors, Interior: TCNA F121.
 4. Apply the mortar to waterproofed slab with the flat side of the trowel.
 5. Apply half of the mortar bed to slab and place reinforcing wire fabric. After placing mesh, apply balance of mortar bed. The mortar shall be rodded and compacted with a steel trowel.
 6. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying bond coat to tiles
 7. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile sheets for 100 percent coverage to thickness of not less than 1/16-inch.
 8. Place tile onto the green mortar bed, maintaining 1/8-inch wide joints for typical tile units and 1/4-inch wide joints for quarry tile units if any, and true accurate pattern as shown. Tamp tile with wood block and rubber mallet to produce finish levels of tile matching adjacent tile surfaces. Beating shall take place prior to mortar taking and initial set. Exercise care to quickly remove spillage from faces of tile using water. Rake out joints to depth required to receive grout as tile units are set. Maintain fully plastic bed throughout tile installation.
 9. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
 10. Grout Installation Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. For typical installations, comply with latex Portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- I. Thresholds: Install thresholds in one piece, notched to fit neatly at door jambs; set in same type of setting bed as abutting field tile in accordance Manufacture's recommendations and TCNA Method TR61.

3.7 WALL TILE INSTALLATION

- A. Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCNA installation methods related to types of construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
- B. Latex Portland Cement Mortar Installation (using specified latex Portland cement mortar material): ANSI A108.5.
- C. Gypsum Wallboard, Interior (Latex Portland Cement Mortar) Method: TCNA W243, place tiles maintaining 1/8-inch wide joints, and true accurate pattern as shown.
- D. Cementitious Backerboard (Latex Portland Cement Mortar) Method: TCNA W244C, place tiles maintaining 1/8-inch wide joints, and true accurate pattern as shown.
- E. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in

color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

3.8 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove epoxy and latex Portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work. Replace all cracked, chipped, and broken tile units with matching tile units; patched tile units will not be permitted.
- C. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- E. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION

SECTION 095113

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Three sets of 8-inch x 11-inch Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.
 - 3. Clips: Full-size seismic clips.
- D. Shop Drawings: Submit to the Architect of record, three (3) complete sets of CAD generated shop drawings prepared by the manufacturer showing all necessary details and dimension requirements which will subsequently be field verified and revised as required by the Architect.
- E. Certification: Submit to the owner a certificate of compliance to specified acoustical and fire performance criteria as stated in Part 2 of this specification, signed by an officer of the panel manufacturer and attach independent laboratory test results for each product used, showing that the products supplied as components and complete assemblies, meet or exceed the specified requirements..

- F. **Manufacturers Approval:** The manufacturer shall have the right to approve the selection of the installing contractor and to verify that said contractor has sufficient experience and expertise to complete the project in a satisfactory manner.
- G. **Single Source:** It is the clear intent of this specification to provide a complete, fully integrated system, supplied by a single company. "Stick built" parts and pieces from various and different manufacturers will not be accepted. All custom acoustical wall and ceiling panels shall be purchased from a single supplier.
- H. **LEED Submittals:**
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.5 INFORMATIONAL SUBMITTALS

- A. **Coordination Drawings:** Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension-system members.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 - 5. Size and location of initial access modules for acoustical panels.
 - 6. Items penetrating finished ceiling and ceiling-mounted items including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
 - 7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
 - 8. Minimum Drawing Scale: 1/4 inch = 1 foot.
- B. **Qualification Data:** For testing agency.

- C. Product Test Reports: For each acoustical panel ceiling, for tests performed a qualified testing agency.
- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Manufacturer & Installer: Firm manufacturing the specified product shall have adequate capacity required for projects listed and have successfully completed similar projects for a period of not less than five years. The Installer should be approved by the Manufacturer as qualified to perform work required.
- C. Reference Standards: Conform to all governing laws, building codes, and the following performance criteria:
 - 1. Fire Performance Characteristics: Provide ceiling panels with surface-burning characteristics as determined by testing finished composite panel in accordance with ASTM E84 test procedures (building code requirements may necessitate composite panel testing using identical materials and construction representative of a typical installation, using the specified finish(es).
 - a. ASTM E-84 Classification Class "A" or "1"
 - b. Flame Spread: 25 or less
 - c. Smoke Developed: 450 or less

2. Acoustical Performance Characteristics: Provide ceiling panels with acoustical absorption characteristics as indicated in Part 2, which have been determined by testing fully assembled production material in accordance with ASTM C-423 (Type "E400" mounting as defined by ASTM E-795) by a testing organization acceptable to authorities having jurisdiction. Approved testing organization must be independent of the manufacturer.
3. Seismic Performance: Seismically test per procedures prescribed in Chapter 13 of the ASCE 2010 and the relevant ICC-ES standards. Shake table testing of ceiling systems using ICC-ES AC156 (ICC-ES 2015) protocol must be conducted, witnessed and documented by third party practicing structural engineers expert at an accredited laboratory and pass the most severe level of shaking prescribed in the building codes without any damage.
4. Ceiling panels shall have toxicity characteristics which have been determined by testing full assemblies (component tests are not acceptable) of identical materials and construction in accordance with section 27-348 of the New York State uniform fire prevention and building code MEA division. MEA Acceptance Number MEA 327-00-M.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Prior to panel installation, the site must be free of all wet and dusty trades and the climatic conditions stabilized to normal operational levels. Panels shall be allowed to stabilize on site 24 hours prior to installation.
- C. Panels must only be handled by persons wearing clean light-weight gloves. It is very important that personnel installing hardware (clips, ceiling suspension members/systems, springs etc.) do not handle the panels before putting the clean lightweight gloves on.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.11 WARRANTY

- A. Furnish to the Architect in the Owner's name, the manufacturers written guarantee covering the products supplied against defects in materials and workmanship under normal operating conditions for a period of one year from the date of shipment. Submit certificates of compliance showing warranty period by dates for each project completed to the Owner.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. PS EPD: Products specified under this section shall have a Type III Product Specific EPD.
- B. Ceilings, Walls, Thermal and Acoustic Insulation: All ceilings, thermal insulation, acoustic insulation, products provided under this specification section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E1264.
 - 2. Smoke-Developed Index: 450 or less.
- C. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.4 ACOUSTICAL PANELS

- A. Acoustical Panels (ACT-1) through (ACT-4) inclusive:
 - 1. Basis-of-Design: Armstrong World Industries or equal. Refer to Section 090000.

2.5 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.
 - 1. Basis-of-Design: Armstrong World Industries or equal.
 - 2. Suspended ceiling system with fully assembled panels as indicated shall be tested to the maximum level of the building code (SDS of 2.00g). There is to be no damage to the ceiling grid members or to the panels, with no panels dislodging after the maximum test

- level has been reached; per the requirements of the International (or California) Building Code and ASTM standards to be certified for all regions with high seismicity activity.
3. The panels shall be installed into the extruded aluminum grid system, providing 100% downward accessibility. The grid system shall consist of main tees and cross tees, which shall incorporate a continuous "panel location" fin to ensure correct panel alignment during installation and future access. The suspension system shall be completely engineered and fabricated in the factory, to avoid any field cutting of the suspension components.

B. Ceiling Suspension Systems and Trims:

1. Grid Type 1:
 - a. Basis-of-Design Manufacturer: Armstrong World Industries, Inc.
 - b. Product: Suprafine XL 9/16-inch exposed tee.
 - c. Color: White.
 - d. Edge Mouldings and Trim: To be determined.
2. Grid Type 2:
 - a. Basis-of-Design Manufacturer: Armstrong World Industries, Inc.
 - b. Product: Prelude XL 15/16-inch exposed tee.
 - c. Color: White.
 - d. Edge Mouldings and Trim: To be determined.
3. Grid Type 3:
 - a. Basis-of-Design Manufacturer: Armstrong World Industries, Inc.
 - b. Product: DesignFlex 15/16-inch exposed tee.
 - c. Color: White.
 - d. Edge Mouldings and Trim: 7800, 12'-0" Hemmed Angle Molding 7/8" Flange.

2.6 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Cast-in-place or Post-installed expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.
2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.

2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch-diameter wire.
- C. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
 - D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.
 - E. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
 - F. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
 - G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
 - H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
 - I. Ceiling Hangers: Mason Industries, Inc. "WHD". Hanger consists of a steel frame containing a rubber element molded with an integral lock in grommet at the bottom to prevent steel rod to housing contact. Dynamic Stiffness shall not exceed 1.4 nor the corrected frequency 8 Hz. Housing configurations shall be offered to accommodate bolting to structure and simple attachment to 1-1/2 x 1/2-inch channel, 12-gauge wire top and bottom or 12-gauge wire on top and 1-1/2 x 1/2-inch channel on the bottom.

2.7 METAL EDGE MOLDINGS AND TRIM

- A. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
 1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
 - D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
 - E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 - F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 6. Install hold-down, impact, and seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
 - a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.
 7. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
 - 1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
 - 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 095426
WOOD WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Wood wall panels.

1.3 ACTION SUBMITTALS

- A. General: Submit each item in this Section according to the Conditions of the Contract and Division 1 Specification Sections.

- B. Product Data: For each type of product specified.

- C. Samples: For verification of each type of exposed finish required, prepared on samples of size indicated below. Where finishes involve normal color and texture variations, include sample sets showing the range of variations expected.

- 1. 12-inch x 18-inch samples of each panel type, pattern, and color.

- D. Shop Drawings: Provide Shop Drawings/Coordination Drawings for all walls, including product details.

- E. Wood walls shall have a backing of sound-absorbing fiberglass insulation. Shop drawings to show open area of slats and sufficient access to sound absorbing area behind.

- F. LEED Submittals:

- 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:

- a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.

- b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

- c. MRc3 - Sourcing of Raw Materials – Forestry Stewardship Council (FSC) Certified Wood: For all wood products designated in this specification as “FSC certified,” provide vendor invoices with the vendor’s Chain-of-Custody (COC) number and identify each FSC certified

product on a line-item basis. If FSC wood products are modified off-site by an architectural woodworker or millworker, the woodworker shall have an FSC COC number.

- d. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 PROJECT CONDITIONS

- A. Space Enclosure and Environmental Limitations: Do not install wood panels until spaces are enclosed, conditioned, and weatherproof, wet-work in spaces is completed and dry, and ambient temperature and humidity conditions are being maintained at the levels indicated for Project when occupied for its intended use.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer, approved by wood panel manufacturer, who has completed panel walls similar in species, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. All work shall meet local codes and regulations of Authorities Having Jurisdiction.
- C. Single-Source Responsibility: Obtain wood panel from a single fabricator, with in-house Shop Drawing capabilities, in-house assembly and finishing capabilities, and with resources to provide products of consistent quality in appearance and physical properties without delaying the project.
- D. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying project.
- E. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery & Unloading: Coordinate crate sizes, weights, unloading options, and delivery schedule with manufacturer prior to fabrication. Deliver wood panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other mistreatment.
- B. Acclimatization: Before installing wood panels, permit them to reach room temperature and a stabilized moisture content (at least 72 hours) per AWI standards.
- C. Handling: Handle wood panels carefully to avoid chipping edges or damaging units in any way.
- D. Protection:
 - 1. Personnel: Follow good safety and industrial hygiene practices during handling and installing of all products and systems, with personnel to take necessary precautions and wear appropriate protective equipment as needed. Read related literature for important

information on products before installation. Contractor to be solely responsible for all personal safety issues during and subsequent to installation; architect, specifier, owner, and manufacturer will rely on contractor's performance in such regard.

2. Existing completed work: Protect completed work above suspension system from damage during installation of suspension system components.

1.7 EXTRA MATERIALS/WARRANTIES

- A. Extra Materials: Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.
- B. Warranties: Provide owner with a (1) year warranty for material and workmanship on all installed products.
 1. Manufacturers: All materials shall be warranted for (1) one year for material and workmanship.
 2. Installer: All work shall be warranted for (1) year from final acceptance of completed work.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Composite Woods: Composite wood and agri-fiber products shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde (NAF)
- C. Ceilings, Walls, Thermal and Acoustic Insulation: All ceilings, thermal insulation, acoustic insulation, products provided under this specification section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PERFORMANCE

- A. Design Criteria:
 1. General:
 - a. Provide work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
 - b. Regulations: Conform with the requirements of the applicable building code as it pertains to engineering, design, fabrication, and installation of system.

2. Fire-Test-Response Characteristics: As determined by testing identical materials applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - 1) Class C / Class III:
 - a) Flame-Spread Index: 76 to 200.
 - b) Smoke-Developed Index: 0 to 450.

2.3 MANUFACTURER

- A. Wood Panels:
 1. Basis-of-Design: Rulon International, Inc. Systems shall be bent to match custom radius, as shown on Drawings.
 - a. 9Wood.
 - b. _____.
 - c. Or equal.
 2. Provide product with a Health Product Declaration (HPD).

2.4 WOOD WALL PANELS

1. [WP-1] Wood slat grille system:
 - a. Member Size: Sizing and spacing as shown on Drawings.
 - b. Edge Profile: Square edge.
 - c. Fire Rating: Class B Flame Spread Rating.
 - d. Acoustic Board: Dimensionally stable board to be used behind grilles.
Per ASTM E84, flame spread and smoke development shall be 25 and 50 respectively.
 - 1) Basis-of-Design: Owens Corning "SelectSound Black Acoustic Board" or equal.
2. [WP-2] Perforated wood wall panels:
 - a. Member Size: Sizing and spacing as shown on Drawings.
 - b. Edge Profile: Veneered edge banding with square edge.
 - c. Fire Rating: Class B Flame Spread Rating.
 - d. Reveal Scrim: White or black color to be selected by the Architect.
Provide custom colored fasteners to match scrim fabric.
 - e. Open area for access to acoustic treatment behind: To be determined.

2.5 ANCHORAGE SYSTEM

- A. Anchorage: As shown on Drawings.

2.6 SOUND ABSORBING BACKING

- A. At Penthouse Ceiling: 2-inch fiberglass sound absorbing panel, minimum 3 pcf.
 1. Basis-of-Design Product: Owens Corning "Fiberglas" Duct Liner Board
 2. Sound absorption: Minimum sound absorption coefficient ratings as follows, per ASTM C423 (Type A mounting):

125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
.24	.79	1.0	1.0	1.0	1.0

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine substrates and structural framing, with installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other anchors whose installation is specified in other Sections.
- B. Layout: Measure each area and establish the layout of wood panel to balance border widths at opposite edges of each wall. Avoid using less-than-half-width panels at borders, and conform to the layout shown on plans, in accordance with wood panel manufacturer's approved Shop Drawings.

3.3 INSTALLATION

- A. Installation of Wood Grille: Install panels in accordance with manufacturer's installation instructions and in compliance with all local codes and regulations. Install with undamaged edges and fitted accurately to suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit, as required.
- B. Installation of Wall Panels: Install wall panels with concealed z-clips as shown on Drawings.

3.4 CLEANING

- A. General: Clean exposed wood surfaces of assemblies. Comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace wood components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 096513

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
- B. Related Sections:
 - 1. Section 096516 "Resilient Sheet Flooring."
 - 2. Section 096519 "Resilient Tile Flooring".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.
- D. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - 1. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - 2. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - 3. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups in place, of initial installation, to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Coordinate mockups in this Section with mockups specified in other Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 WARRANTY

- A. General Warranty Requirements are specified in 017836 - Warranties. Minimum 2-Year warranties per 017836 shall be provided for all installed material and equipment unless more stringent requirements are noted in this section. Standard Manufacturer Warranties shall be provided where they exceed minimum warranty requirements.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Flooring: All flooring provided under this spec section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 MANUFACTURERS

- A. Thermoset Rubber Base: Coved.
 - 1. Basis-of-Design: Burke or one of the following approved equals:
 - a. Roppe
 - b. Johnsonite
 - c. Or equal.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints. Schlueter strips, or equal. Feather with epoxy mortar or thin set during installation, as shown on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

SECTION 096519
RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rubber tile flooring.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Base and Accessories."
 - 2. Section 096517 "Resilient Sheet Flooring."

1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data for each type of product indicated.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples: Full-size units of each color and pattern of floor tile required.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.
- E. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.
- B. Mockups: Build mockups in place, of initial installation, to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups for floor tile including resilient base and accessories.
 - a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.

- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. PS EPD: Products specified under this section shall have a Type III Product Specific EPD.
- B. Flooring: All flooring provided under this spec section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm

2.3 MANUFACTURERS

- A. Rubber tile:
 - 1. Basis-of-Design: Mannington or equal.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of floor tile indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range recommended by flooring manufacturer.
 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations.
- C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
- D. Cover floor tile until Substantial Completion.

END OF SECTION

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SECTION 096623

RESINOUS MATRIX TERRAZZO

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Precast epoxy-resin terrazzo units used as stair treads and risers.
 - 2. Precast epoxy-resin terrazzo units used as landing panels.
 - 3. Setting material and grout.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
 - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Review special terrazzo designs and patterns.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, profiles, component details, and relationship to other work. Show layout of the following:
 - 1. Precast stair treads, risers, and landings.
- C. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo Sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in sizes indicated below:

1. Precast Terrazzo: Three 3-inch by 6-inch Samples.
2. Color: As selected from manufacturer's standard palette.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- D. Preinstallation moisture-testing reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terrazzo to include in maintenance manuals.
 1. Two copies of NTMA maintenance literature.

1.7 QUALITY ASSURANCE

- A. NTMA Standards: Comply with specified provisions and recommendations of the National Terrazzo & Mosaic Association, Inc. (NTMA).
 1. Manufacturer's Instructions: In addition to specified requirements, comply with precast terrazzo manufacturer's instructions and recommendations for substrate preparation, materials storage, mixing and application, finishing and curing.
 2. Qualifications: Precast Terrazzo Manufacturer and Trade Contractor shall have a minimum of 5 years of successful experience on projects of similar magnitude and complexity to that indicated project. Manufacturer and contractor shall be prequalified by Architect prior to bidding. Failure to prequalify will void bid.
 3. Manufacturer shall supply a written Quality Assurance Program and Procedure manual.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Build mockups for terrazzo including accessories.
 - a. Include first three stair treads.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaging and Shipping: Precast terrazzo shall be palletized and shrink wrapped, delivered in original unopened packaging with legible manufacturer identification, including size, piece number, quantities, manufacturer date and inspector initials.

- B. Storage and Protection: Precast terrazzo shall be stored indoors, in a climate-controlled environment, sheltered from moisture in original packaging. Protect from damage by other trades.
- C. Report all damage due to shipment immediately. Customer is required to sign the Bill of Lading slip noting damaged product. Picture proof is required.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

1.10 WARRANTY

- A. Manufacturer/Installer shall warrant installed system for a period of 1 year from date of substantial completion against failure of workmanship and materials.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- B. Compressive Strength: 10,000 psi.
- C. Flexural Strength 3,000 psi.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
 - 1. Basis-of Design: Wausau Tile, Inc. Model E-31.

2.3 MANUFACTURED UNITS

- A. Precast Terrazzo Units for Treads and Risers: Comply with manufacturer's written instructions for fabricating precast units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer. Finish exposed-to-view edges and reveals to match face finish.
- B. Sizing Tolerances:
 - 1. All units to conform to shop drawings with a 1/16" tolerance in dimension.
- C. Precast Surfaces and Edges:
 - 1. All exposed edges to be ground and polished with a minimum of 1/16" bevel.
 - 2. All finished surfaces to be ground and polished, free of holes and to have overall uniformity in matrix and aggregate.
 - 3. All precast epoxy terrazzo finished surfaces to be sealed with a sealer approved by manufacturer.

2.4 MATERIALS

- A. Epoxy Resin.
- B. Aggregates: All aggregates to meet ASTM C-33 specifications, cleaned and properly graded to size. Aggregate shall be blended to meet individual project requirements.
- C. Marble chips, size to conform with NTMA gradation standards.
- D. Abrasive Inserts: Shall consist of silica carbide and black epoxy. Specify one to three lines.
- E. Caulks & Sealants:
 - 1. Urethane or Polyurethane Sealant. Refer to Section 079000
 - 2. Color to be selected by Architect from standard color pallet.

2.5 MISCELLANEOUS ACCESSORIES

- A. Anchoring Devices:
 - 1. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- B. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- C. Cleaner: Liquid neutral chemical cleaner, with pH factor between 7 and 8, of formulation recommended by sealer manufacture for type of precast terrazzo used and complying with NTMA requirements.
- D. Sealer: Colorless, slip and stain-resistant penetrating sealer with pH factor between 7 and 8, that does not affect color or physical properties of precast terrazzo surface. Flash point (ASTM D56): 80 degrees F, Minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for defects in existing work and compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

3.3 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended in writing by NTMA and manufacturer unless otherwise indicated.
 - 1. Set in full bed of epoxy thinset per manufacturer's written requirements.
 - 2. Set accurately as shown on Shop Drawings.
 - 3. Alignment shall be straight and true, and not vary by more than 1/8 inch in length, height, or width.
 - 4. Fasten to substrate as shown on Drawings.
 - 5. Fill joints using manufacturer's recommended sealant.
- B. Do not install units that are chipped, cracked, discolored, or improperly finished.
- C. Seal joints between units with joint compound matching precast terrazzo matrix or joint sealant as shown on Drawings.

3.4 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.5 CLEANING AND PROTECTION

- A. Cleaning:
 - 1. Remove grinding dust from installation and adjacent areas.
 - 2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection:

1. Upon completion, the work shall be ready for final inspection and acceptance by owner or owner agent.
2. General Contractor shall protect the finished work from the time the terrazzo contractor completes the work.

END OF SECTION

SECTION 096813

TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes modular, carpet tile.
- B. Related Requirements:
 - 1. Section 072616 "Concrete Vapor Treatment."
 - 2. Section 079200 "Joint Sealants".
 - 3. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition, and other accessory strips.
 - 10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- E. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
 - c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups at locations as determined by Architect. Allow approximately 100 square feet of installation for each carpet type. Once installation is approved, it may become part of the finished work.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.9 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, loss of face fiber, and delamination.
 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. PS EPD: Products specified under this section shall have a Type III Product Specific EPD.
- B. Flooring: All flooring provided under this spec section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 PERFORMANCE REQUIREMENTS

- A. Floor covering material shall comply with the requirements of ASTM E648 and have a specific optical density smoke rating not to exceed 450 per ASTM E662.

2.3 MANUFACTURERS

- A. Tile carpeting:
 - 1. Basis-of-Design: Refer to Section 090000.

2.4 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints. Provide metal edge/transition strips from Schlueter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove yarns that protrude from carpet tile surface.
 - 2. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

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SECTION 097200

WALL COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Vinyl wall covering.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
 - 2. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
 - 3. Frames for light openings, 6 inches long, for each material, type, and finish required.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement seams and termination points.
- C. Samples for Initial Selection: For each type of wall covering.
- D. Samples for Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches long in size.
 - 1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied.
 - a. Show complete pattern repeat.
 - b. Mark top and face of fabric.

E. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.
- B. Manufacturer's written application instructions for all products used in installation.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation, for each type of wall covering on each substrate required. Comply with requirements in ASTM F1141 for appearance shading characteristics.
 1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F1141 for appearance shading characteristics.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. PS EPD: Products specified under this section shall have a Type III Product Specific EPD.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
 - 2. Fire-Growth Contribution: No flashover and heat and smoke release when tested in accordance with NFPA 265 and NFPA 286.

2.3 MANUFACTURERS

- A. Vinyl wallcovering:
 - 1. Basis-of-Design: DesignTex, or equal, as required to match the Architect's samples.

2.4 WALL GRAPHICS

- A. Provide custom graphics incorporating digital art provided by Architect printed onto backing media manufactured by DesignTex, or equal.
- B. Backing Media: DesignTex Substrate DW11, or equal; PVC-free wall covering with type II performance characteristics and a smooth matte finish. 30% of total product weight is post-consumer waste fiber.
 - 1. Contents: Synthetic Latex, coating pigments and additives, post-consumer waste cellulose fiber, virgin wood pulp.
 - 2. Width: 52-inches, with 52-inch maximum print area.
 - 3. Print Technology: UV Curable Inkjet.
 - 4. Fire Rating: ASTM W-84 Class A.
- C. Adhesive: Type recommended by manufacturer of Wall Covering and the same as used in test to determine flame spread rating.

2.5 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
 - 1. Wall Sealer: Provide a gypsum board sealer, recommended by the Wall Covering manufacturer in conformance with Section 099100 "Painting and Coating".
- B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099100 "Painting and Coating" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.
- C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 2. Painted Surfaces:
 - a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
 - b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL COVERING

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects
 - 1. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
 - 2. Install strips in same order as cut from roll.
 - 3. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.
 - 4. Install wall covering without lifted or curling edges and without visible shrinkage.
 - 5. Match pattern 72 inches above the finish floor.
 - 6. Install seams vertical and plumb at least 6 inches from outside corners and 3 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
 - 7. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
 - 8. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

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SECTION 098316
ACOUSTICAL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
1. Acoustical wall panels.
 2. Acoustical ceiling panels.
- B. Related Requirements:
1. Section 092216 "Non-Structural Metal Framing" for wall backing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product including:
1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- B. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- C. Samples for Verification: For each finish product specified, two samples, minimum size 6 inches square representing actual product, color, and patterns.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Ceiling suspension-system members.
 2. Structural members to which suspension systems will be attached.
 3. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 5. Size and location of initial access modules for acoustical panels.
 6. Items penetrating finished ceiling and ceiling-mounted items including the following:

- a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/4 inch = 1 foot.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- E. Field quality-control reports.
- 1.5 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Minimum 5 years experience manufacturing similar products.
- B. Installer Qualifications: Minimum 2 years experience installing similar products.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
- 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship is approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.
- 1.6 PRE-INSTALLATION MEETINGS
- A. Convene minimum two weeks prior to starting work of this section.
- 1.7 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For finishes to include in maintenance manuals.
- 1.8 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

1.10 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.11 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 MANUFACTURERS

- A. Sound Absorptive Panel (AWP-1):
 - 1. Basis-of-Design: Autex "Quietspace" or equal. Provide where shown on Drawings.
 - 2. Material: 100 percent recycled Non-woven needle-punched polyester (100 percent PET) containing not less than 45 percent post-consumer recycled material.
 - 3. Composition: Constructed from 100% polyester fibers, thermally bonded to form the structure of the panel.
 - 4. Dimensions: Panel 48" x 96"
 - 5. Panel Color: As selected by Architect
 - 6. Thickness: 0.98 inch
 - 7. Weight: 7.54 oz/sf
 - 8. Fastness to Light: ASTM 5036
 - 9. Color: As selected by Architect.
 - 10. Topping Layer Finish: As selected by Architect
 - 11. Sound Absorption: Minimum Noise Reduction Coefficient per Acoustical Report.
 - 12. VOC Concentration: 0.01 mg/m³.
 - 13. Fire Rating (0.98 inches (25 mm): ASTM E-84 Class A, FS: 0 - SD: 10.

2.3 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated and comply with layout shown on reflected ceiling plans.
- D. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 099100

PAINTING AND COATING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SYSTEM DESCRIPTION

- A. General: Paint every surface, except as otherwise shown or as follows:
- B. Surfaces Not to be Painted:
 - 1. Factory-finished items specified in various Sections.
 - 2. Prefinished wall, ceiling, and floor coverings.
 - 3. Painting specified elsewhere and included in respective Sections, including but not necessarily limited to, shop priming.
 - 4. Code-Required Labels: Keep equipment identification and fire rating labels free of paint.
 - 5. Surfaces concealed in walls and above ceilings except as specifically indicated otherwise.
 - 6. Ducts, piping, conduit, and equipment concealed in walls and ceilings, unless specifically indicated otherwise.

1.3 SUBMITTALS

- A. Product Data: Submit for Architect's action. Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating specified requirements.
- B. Samples: Submit for Architect's action. Furnish sufficient samples to establish full range of colors and textures for materials exposed in the finished Work. Label samples to indicate product and location in the Work. Samples will be reviewed for appearance only. Compliance with other requirements is the responsibility of the Contractor.
 - 1. Opaque Colors and Finishes: Submit samples, using materials accepted for Project, of each color and paint finish selected with texture to simulate actual conditions. Prepare three samples, 8-1/2 inches by 11 inches, with required number of paint coats clearly visible.
 - 2. Transparent and Stained Finishes: Prepare samples on species and quality of wood to be used in the Work. Resubmit as requested until acceptable sheen, color, and texture are achieved. Label and identify each sample as to location and application.
- C. Quality Assurance/Quality Control Submittals: Submit for Architect's information.
 - 1. Certificates:
 - a. Document Review: Submit a written statement signed by the Contractor and the Applicator stating that the Contract Documents, shop drawings and product data have been reviewed with qualified manufacturer representatives. The statement shall certify that selected materials are proper, compatible with contiguous materials and adequate for the application shown.

b. Installer's Qualifications

D. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 QUALITY ASSURANCE

- A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.
- B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs), including the Air Quality Management District. Obtain necessary approvals from AHJs.
- C. Visual Mock-Up(s): As directed by the Architect, apply on actual wall surfaces where designated, samples of each and any color selected for final review.
 1. On at least 100 square feet of surface as directed, provide full-coat finish samples until required sheen, color and texture are obtained.
 2. Duplicate painted finishes of prepared samples.
 3. Simulate finished lighting conditions for review of in-place work.
- D. Labeling: Include following on label of each container:
 1. Manufacturer's name and product name.
 2. Generic type of paint.
 3. Manufacturer's stock number.
 4. Color.
 5. Instructions for reducing, where applicable.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading: Deliver material in sealed containers with labels legible and intact.
- B. Storage and Protection:
 1. Store only acceptable Project materials on Project site.
 2. Restrict storage to paint materials and related equipment.

1.6 PROJECT/SITE CONDITIONS

- A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.

- B. Do not apply finish in areas where dust is being generated.

1.7 MAINTENANCE

- A. Extra Materials: At completion of Work, deliver to Owner extra stock of paint of one gallon of each color used of each coating material used. Tightly seal and clearly label containers.

1.8 WARRANTY

- A. General Warranty Requirements are specified in 01 78 36 - Warranties. Minimum 2-Year warranties per 01 78 36 shall be provided for all installed material and equipment unless more stringent requirements are noted in this section. Standard Manufacturer Warranties shall be provided where they exceed minimum warranty requirements.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 MANUFACTURERS

- A. General: Sherwin Williams, Kelly Moore, Benjamin Moore, Vista, PPG or equal.
- B. Substitutions: For consideration, accompany substitution request, with manufacturer's data and current statement from a recognized independent testing agency stating that each substitution for finish coat is equal to or better than specified product.

2.3 MATERIALS

- A. General: Materials selected for each paint system shall be products of the same manufacturer, and shall be compatible with each other. Materials selected shall be products of the manufacturer's highest quality line.
- B. Unsuitability of Specified Products: Claims concerning unsuitability of any materials specified will not be entertained, unless such claim is made in writing to the Architect before Work is started.

2.4 COLORS AND SHEENS

- A. Mixing: Deliver paints and stains ready mixed to Project site.
- B. Provide Flat sheen at ceiling locations, unless otherwise noted. Provide eggshell sheen at wall locations and wood, unless otherwise noted. Provide semi-gloss sheen at metal substrates, unless otherwise noted.

2.5 PAINT SYSTEMS

- A. Schedule: Only major areas are scheduled. Treat miscellaneous and similar items and areas within room or space with similar system.
- B. Number of Coats: Where number of coats is specified, it is only as a minimum requirement. Apply additional coats, at no additional cost to Owner, if necessary to completely hide base material, produce uniform color, and provide satisfactory finish result.
- C. Systems Specifications: These specifications are a guide and are meant to establish procedure and quality. Confer with Architect to determine exact finish desired.
- D. Acceptance of Final Colors: Do not apply final coats of paint for interior systems until colors have been accepted by Architect.
- E. Exterior Painting Systems:
 - 1. High Performance Polyurethane Enamel Coating System:
 - a. Prime Coat: Shop-applied under other applicable Sections.
 - 1) Touch up shop primer where needed with Ameron Amerlock VOC.
 - 2) Touch up shop primer Sherwin-Williams Macopoxy 646-100 Fast Cure Epoxy (B58-620) as a primer.
 - b. Finish Coats:
 - 1) Ameron Amershield VOC
 - 2) Tnemec's Series 1075 (1074) Endura-Shield, semi-gloss (gloss) sheen, 5 mils dry film thickness.
 - 3) Sherwin-Williams Water-Based Acrolon 100 Polyurethane, 5 mils dry film thickness.
 - 2. Galvanized Steel, Zinc-Rich Painted Steel, and Aluminum:
 - a. Prime Coat:
 - 1) KM 5725 DTM Acrylic Primer/Finish.
 - 2) Vista 4800 Metal Pro Primer.
 - 3) Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, (B66-310 Series).
 - b. Body Coat:
 - 1) KM 5885 DTM High Performance Acrylic Semi-Gloss.
 - 2) Vista 7000 Acriglo 100% Acrylic Semi-Gloss.
 - 3) Sherwin Williams, Pro Industrial Acrylic Semi-gloss, (B66W651).
 - c. Finish Coat:
 - 1) KM 5885 DTM High Performance Acrylic Semi-Gloss.
 - 2) Vista 7000 Acriglo 100% Acrylic Semi-Gloss.
 - 3) Sherwin Williams, Pro Industrial Acrylic Semi-gloss, (B66W651).
- F. Interior Painting Systems:
 - 1. Gypsum Board:
 - a. Prime Coat:

- 1) KM 971 Acry-Plex Low VOC Interior PVA Primer Sealer.
 - 2) Vista 1100 Hi-Build PVA Primer.
 - 3) Sherwin-Williams Pro Mar 200 Zero VOC Primer (B28W2600).
- b. Body Coat:
- 1) KM 1010 Premium Professional Low VOC Interior Eggshell Finish; KM 1010 Premium Professional Low VOC Interior Eggshell.
 - 2) Vista 7500 Acriglo 100% Acrylic Eggshell Finish; KM 1520 Enviro-Coat Low VOC Interior Semi-Gloss Enamel / Vista 7500 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - 3) Sherwin-Williams Pro Mar Zero VOC Interior Eg-shel (B20-2600 Series) or Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).
- c. Finish Coat:
- 1) KM 1010 Premium Professional Low VOC Interior Eggshell Finish; KM 1010 Premium Professional Low VOC Interior Eggshell.
 - 2) Vista 7500 Acriglo 100% Acrylic Eggshell Finish; KM 1520 Enviro-Coat Low VOC Interior Semi-Gloss Enamel / Vista 7500 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - 3) Sherwin-Williams Pro Mar Zero VOC Interior Eg-shel (B20-2600 Series) or Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).
2. Metal:
- a. Prime Coat:
- 1) Shop-applied under other applicable Section.
 - a) Touch up with KM 5725 DTM Acrylic Primer/Finish (if compatible).
 - b) Touch up with Vista 9600 Protec Primer (if compatible).
 - c) Touch up with Sherwin-Williams Pro Industrial Pro- Cryl Universal Primer (B66-1300 Series).
- b. Body Coat:
- 1) KM 5885 DTM High Performance Acrylic Semi-Gloss.
 - 2) Vista 7000 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - 3) Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).
- c. Finish Coat:
- 1) KM 5885 DTM High Performance Acrylic Semi-Gloss.
 - 2) Vista 7000 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - 3) Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).
3. Concrete:
- a. Prime Coat:
- 1) KM 247 Acry-Shield Masonry Primer
 - 2) Vista 4000 Uniprime II Masonry Primer
 - 3) Sherwin-Williams Loxon Exterior Acrylic Masonry Primer (LX02W0050 Series).
- b. Body Coat:
- 1) KM: Not applicable.
 - 2) Vista 7000 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - 3) Sherwin-Williams A-100 Exterior Exterior Latex Flat (A6-150 Series)
- c. Finish Coat:
- 1) KM 1200 Premium Professional 100% Acrylic Exterior Flat.
 - 2) Vista 7000 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - 3) Sherwin-Williams A-100 Exterior Exterior Latex Flat (A6-150 Series)

4. Wood:
 - a. Enamel:
 - 1) Prime Coat:
 - a) KM 973 Acry-Plex Low VOC Interior Enamel Undercoat.
 - b) Vista 4200 Terminator II Wood Primer.
 - c) Pro Mar 200 Zero VOC Primer (B28W2600).
 - 2) Body Coat:
 - a) KM 1050 Premium Professional Low VOC Interior Semi-Gloss Enamel.
 - b) Vista 7000 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - c) Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).
 - 3) Finish Coat:
 - a) KM 1050 Premium Professional Low VOC Interior Semi-Gloss Enamel.
 - b) Vista 7000 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - c) Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).
 - b. Clear Finish:
 - 1) Prime Coat:
 - a) Old Masters Penetrating Stain.
 - b) Minwax PS Wood Stain 250.
 - 2) Body Coat:
 - a) Old Masters Clear Polyurethane.
 - b) Minwax Fast Dry Poly Varnish.
 - 3) Finish Coat:
 - a) Old Masters Clear Polyurethane.
 - b) Minwax Fast Dry Poly Varnish.

G. Miscellaneous Interior Painting Systems:

1. Ductwork at Grilles and Diffusers: Apply to visible interior surfaces of ductwork.
 - a. Body Coat:
 - 1) KM 5725 DTM Acrylic Primer/Finish.
 - 2) Vista 9600 Protec DTM.
 - 3) Sherwin-Williams Pro Industrial Multi-Surface Acrylic Eg-shel (B66-1560 Series).
 - b. Finish Coat:
 - 1) KM 5725 DTM Acrylic Primer/Finish.
 - 2) Vista 9600 Protec DTM.
 - 3) Pro Industrial Multi-Surface Acrylic Eg-shel (B66-1560 Series).
2. Exposed Non-Insulated Pipes and Ductwork: Including conduit.
 - a. Prime Coat:
 - 1) KM 5725 DTM Acrylic Primer/Finish.
 - 2) Vista 9600 Protec Primer DTM.
 - 3) Sherwin-Williams Pro Industrial Multi-Surface Acrylic Eg-shel (B66-1560 Series).
 - b. Body Coat:
 - 1) KM 1010 Premium Professional Interior Low VOC Eggshell Enamel or KM 1050 Premium Professional Interior Low VOC Semi-Gloss Enamel.
 - 2) Vista 7500 Acriglo 100% Acrylic Eggshell Enamel or Vista 7000 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - 3) Sherwin Williams: Not applicable.
 - c. Finish Coat:
 - 1) KM 1010 Premium Professional Interior Low VOC Eggshell Enamel or KM 1050 Premium Professional Interior Low VOC Semi-Gloss Enamel.

- 2) Vista 7500 Acriglo 100% Acrylic Eggshell Enamel or Vista 7000 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - 3) Sherwin-Williams Pro Industrial Multi-Surface Acrylic Eg-shel (B66-1560 Series) or Pro Industrial Multi-Surface Acrylic Semi-gloss (B66-1550 Series).
3. Factory Finished Equipment: Satisfactorily refinish surfaces damaged before, during, or after installation as directed.
 - a. KM 1050 Premium Professional Low VOC Interior Semi-Gloss Enamel.
 - b. Vista 7000 Acriglo 100% Acrylic Semi-Gloss Enamel.
 - c. Pro Industrial Multi-Surface Acrylic Semi-gloss (B66-1550 Series).
 4. Finish Hardware: Specified with USP finish under Section 087000, paint as specified for metal. Color and gloss to match doors and frames as applicable, unless otherwise specified.
 5. Plywood Backing: In Telephone and Electric Closets; provide one coat
 - a. KM 1010 Premium Professional Low VOC Interior Eggshell Enamel.
 - b. Vista 7500 Acriglo 100% Acrylic Eggshell Enamel.
 - c. Sherwin-Williams Pro-Mar 200 Zero VOC Eg-shel (B20-2600 Series).
- H. Pipe Identification:
1. General: Per ANSI A13.1; buried pipe, electrical conduit, and pipe in concealed spaces such as furred spaces and shafts not included.
 2. Color Scheme: ANSI Z53.1 in combination with legend and flow markers; intermittent displays. Locate and space as specified for legend and flow markers. Safety colors as specified under applicable mechanical Section.
 3. Legend: Stencil letters of colors, type, and sizes per ANSI A13.1. Tags for identification of pipes less than 3/4 inch overall outside diameter, including valves and fittings; provided under applicable mechanical Section.
 4. Flow Markers: Provide each type with appropriate size arrows to indicate flow direction in pipe; same color as legend.
 5. Visibility: Locate legend and flow markers for easy visibility from operating floor; space not over 20 feet with at least one per room.

PART 3 - EXECUTION

3.1 GENERAL

- A. Manufacturer's Instructions: Prepare substrates, apply primers and apply the work, including components and accessories in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions.

3.2 SURFACE PREPARATION

- A. General: Remove scale, dirt, dust, grit, rust, wax, grease, efflorescence, loose material, and other foreign matter detrimental to proper adhesion of paint.
- B. Cementitious Surfaces:
 1. General: Remove oil, grease, loose particles, bond breaker coating and other foreign materials.

2. Cracks: Greater than 1/32-inch-wide; rout out to not less than 1/4-inch-wide and 1/4-inch-deep; fill groove with gun grade sealant and cap with buttering grade sealant. Cracks less than 1/32-inch-wide; cap with buttering grade sealant. Repair minor cracks and holes; roughen when necessary to assure good adhesion.
3. Alkali Conditions: Test surfaces for presence of alkali. If present, neutralize as recommended by paint manufacturer, after drying remove precipitate by brushing. Do not paint if pH is above 12.

C. Gypsum Board:

1. Narrow, Shallow Cracks and Small Holes: Fill with spackling compound.
2. Deep, Wide Cracks and Deep Holes: Rake out, dampen with clear water, and fill with thin layers of gypsum board joint compound.
3. Curing: Allow to dry.
4. Sanding: Sand smooth after drying; do not raise nap of paper on gypsum board.

D. Metals:

1. Chipped or Abraded Areas in Shop Coatings: Touch-up using appropriate primer.
2. Galvanized Surfaces: Apply a wash coat of Jasco's Prep 'n' Prime. Allow to dry completely.
3. Stainless Steel: Scarify surfaces before applying prime coat.

E. Wood:

1. General: If required, sandpaper surfaces smooth before applying primer. Thoroughly clean knots; apply thin coat of knot sealer over surfaces shown to receive opaque finish. Old chipped paint at wood flagpole and similar items shall be properly scraped and sanded prior to priming.
2. Back Priming: Back prime surfaces installed against cementitious surfaces; give particular attention to sealing cross-grained surfaces.
3. Puttying:
 - a. General: Fill nail holes, cracks, and other depressions flush with putty after prime coat application. Allow putty to dry; sandpaper smooth before applying body coat.
 - b. For Opaque Finish: Linseed oil type putty.

F. Protection:

1. General: Properly protect floors and other adjacent work by drop cloths or other suitable coverings. In areas scheduled for painting, maintain wrappings and factory-applied protection provided by other trades.
2. Hardware and Other Obstructions: Remove or protect factory finished items such as hardware, plates, lighting fixtures, grilles, and similar items placed prior to painting. Reposition or remove protection upon completion of each space. Equipment adjacent to surfaces requiring paint disconnected, moved, reset, and reconnected by respective trades.
3. Fire Precautions: At end of each work day, place in metal containers or remove from premises, solvent soaked cloths, waste, and other materials which constitute a fire hazard.

- G. Moisture Content: Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer.

3.3 APPLICATION

- A. General: Apply paint per manufacturer's instructions and as specified. Thoroughly stir paint and keep at uniform consistency during application. Apply paint evenly, free from drops, ridges, waves, laps, and brush marks; finished surface uniform in sheen, color, and texture. Apply succeeding coats to unscarred and completely integral base coats; slightly vary color of

undercoats to distinguish them from preceding coat. Allow sufficient time between coats to assure proper drying. Sandpaper smooth interior finishes between coats.

- B. Prime Coat: Do not thin primers in excess of manufacturer's printed directions. Apply by brush, unless otherwise specified, within 8 hours after cleaning.
- C. Body and Finish Coats: Do not thin; apply by brush, roller or spray.
- D. Drying Time: Comply with recommendations of product manufacturer for drying time between succeeding coats.
- E. Moldings and Ornaments: Leave clean and true to details with no undue amount of paint in corners and depressions.
- F. Edges of Paint: Where adjoining other materials or colors, make clean and sharp with no overlapping.
- G. Refinishing: Refinish entire wall where portion of finish is deemed not acceptable.
- H. Precaution: Do not paint over fusible links, UL labels, or sprinkler heads.
- I. Exposed Plumbing and Mechanical Items: Finish items without factory finish such as conduits, pipes, access panels, and items of similar nature to match adjacent wall and ceiling surfaces, unless otherwise directed.

3.4 CLEANING

- A. General: Touch up and restore finish where damaged. Remove spilled, splashed, or spattered paint from surfaces. Do not mar surface finish of item being cleaned.
- B. Storage Space: Leave clean and in condition required for equivalent spaces in Project.

END OF SECTION

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SECTION 099600

HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: High Performance Coatings, complete as shown and specified.
- B. Related Sections:
 - 1. Section 051213 "Architecturally Exposed Structural Steel."
 - 2. Section 0844130 "Glazed Aluminum Curtain Walls and Entrances."

1.2 SUBMITTALS

- A. General: Submit the following in conjunction with submittals required for substrates, specified in other Sections.
 - B. Product Data: Submit for Architect's action. Submit manufacturer's literature, specifications and application instructions describing the general properties of each material and accessory to be used in the Work.
 - C. Samples: Provide in accordance with Section 052100 "Structural Steel", Section 055000 "Metal Fabrications", and other Sections that reference this Section. Label samples to indicate product and location in the Work. Samples will be reviewed for color and appearance only. Compliance with other requirements is the responsibility of the Contractor.
 - D. Quality Assurance/Quality Control Submittals: Submit for Architect's information.
 - 1. Certificates:
 - a. Document Review: Submit a written statement signed by the Contractor and the Applicator stating that the Contract Documents, shop drawings and product data have been reviewed with qualified manufacturer representatives. The statement shall certify that selected materials are proper, compatible with contiguous materials and adequate for the application shown.
 - b. Applicator Qualifications.
- A. LEED Submittals:
- 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Product-Specific EPD.

- b. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.3 QUALITY ASSURANCE

- A. Qualified Applicator: Applicator to have 5 years experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.
- B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.

1.4 WARRANTY

- A. Warranty for Fluoropolymer Coatings on Aluminum and Steel: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 2. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 3. Warranty Period: 20 years from date of Substantial Completion.
- B. Warranty for Coating on Exterior Steel Substrates: Submit for Owner's documentation. Warranty shall be for a 15 year period, signed by the Contractor, manufacturer, and installer, against the loss of film integrity, chalking, fading, non-uniformity, corrosion and the overall performance of color of the resinous coatings. Make repairs and replacements upon notification of defects.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have Type III Product Specific EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 SYSTEMS

- A. Color and Sheen: Match Architect's sample.
- A. Shop-Applied Fluoropolymer Coatings at Aluminum and Coil Coatings at Steel: High-Performance Organic Finish: 3 -coat fluoropolymer finish complying with AAMA 2605, AAMA 620 or AAMA 621, and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. Coatings for Interior Steel:
 - 1. Surface Preparation: SSPC-SP6.
 - 2. Shop Primer: Tnemec 27WB Typoxy. Apply at 3.0 to 5.0 mils DFT. Or PPG PAINTS Multiprime 4160. Apply at 2.5-3.0 mils DFT.
 - 3. Touch all damaged or bare spots per SSPC-SP 15 (feather-in all edges) and spot prime with Tnemec 27WB at 3.0-4.0 mil DFT.
 - 4. Finish Coat, applied in Field:
 - a. Steel Stairs: Tnemec 1029 Endurathone low semi-gloss. Apply at 2.0 – 3.0 mils DFT. Or PPG Paints Devflex 4216HP Low Semi-Gloss at 2.0-4.0 mils DFT.
- C. Coatings for Exposed Steel at Exterior. Provide two-coat system from one manufacturer, over galvanized steel. Provide the following, or equal:
 - 1. Galvanized Steel, as specified in other Sections.
 - 2. Field Applied Intermediate Coat: Tnemec Series 1075. 2.5 mils DFT. OR PPG Paints Corafon ADS Epoxy Primer 573 at 3.0-5.0 mils DFT for BARE Steel. PPG Paints Corafon ADS Epoxy Primer 510 at 2-0-4.0 mils DFT for Steel previously coated with PVDF.
 - 3. Field Applied Finish Coat: Tnemec 1072 V Fluoronar. 2-3 mils DFT. OR PPG Paints Corafon ADS Intermix Fluoropolymer Finish at 1.8-2.2 mils DFT. ** Metallic or Mica Colors in EXTERIOR applications must also have a Barrier Coat of ADS564.
- D. Coatings for Exposed Ferrous at Exterior OPTION 2; A 2 Coat System for Solid Colors.
 - 1. Field Applied PPG Paints Amercoat 68HS Zinc Rich Primer. 2-5 mils DFT.
 - 2. Field Applied PPG Paints PSX-805 Polysiloxane Satin Finish 3-6 mils DFT.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Substrate Acceptability: Commencement of installation shall constitute acceptance of substrate conditions by the Installer.

3.2 COATINGS FIELD APPLICATION

- A. General: Use applicator and techniques best suited for substrates and type of material being applied. Apply materials at not less than recommended spreading rate to establish a total dry film thickness as indicated or, if not indicated, as recommended.
- B. Mix materials thoroughly before application to produce a mixture of uniform density; strain if necessary, before using. Do not mix surface film into material. If necessary, remove surface film and re-strain material before using. Do not adulterate ready-mixed materials except in accordance with the manufacturer's printed instructions. Use only approved thinners and only within recommended limits.
- C. Apply materials with care to a uniform and proper film thickness, showing no runs, holidays, sags, crawls or other defects. Apply with a minimum of brush marks. Finish surfaces shall be uniform in sheen, color and texture.

END OF SECTION

SECTION 099646

INTUMESCENT PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and application of fire-retardant intumescent paint to interior and exterior items and surfaces.
- B. Related Sections:
 - 1. Section 099100 "Painting and Coating" for primers and finish coats that may be used with intumescent paint finishes.
 - 2. Section 051200 "Structural Steel Framing"

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include manufacturer's recommended spreading rate for each separate coat for each type of substrate indicated.
- B. Samples for Initial Selection: For each intumescent paint finish indicated.
- C. Samples for Verification: For each type of coating system and each color and gloss of intumescent paint finish indicated.
 - 1. Submit Samples steel, not less than 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:

- a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
- b. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For each intumescent paint.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are from same production run (batch mix) as materials applied and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent of each color applied, but not less than of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each paint system from single source from single manufacturer or provide a system approved in writing by intumescent paint manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. Mockups: Apply benchmark Samples of paint system indicated and of each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one actual substrate of each type to represent surfaces and conditions for application of coating.
 - 2. Apply benchmark Samples after permanent lighting and other environmental services have been activated.
 - 3. Final approval of color selections will be based on benchmark Samples.
 - a. If preliminary color selections are not approved, apply benchmark Samples of additional colors selected by Architect at no added cost to Owner.
- D. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 PROJECT CONDITIONS

- A. Apply waterborne intumescent paints only when temperatures of surfaces to be painted and ambient air temperatures are between 50 and 90 deg F.
- B. Allow wet surfaces to dry thoroughly and to attain temperature and conditions specified before starting or continuing coating operation.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Interior Wet Applied Products: All wet-applied on-site paints, coatings, adhesives, and sealants products provided under Part 2 of this specification section shall be compliant with the VOC limits outlined under IEQc2: Low Emitting Materials in 018113 Sustainable Design Requirements. In addition, all paints and coatings shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 INTUMESCENT PAINT MATERIALS, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each material or coat, provide products and spreading rates recommended in writing by intumescent paint manufacturer for use on substrate indicated. Comply with requirements for fire-retardant coating classification and surface-burning characteristics indicated.
- B. Colors and Gloss: As selected by Architect from manufacturer's full range.

2.3 INTERIOR AND EXTERIOR, PIGMENTED, INTUMESCENT PAINT SYSTEM

- A. Primer: Intumescent paint manufacturer's recommended primer compatible with substrate and other materials indicated.
 - 1. Products: Provide the following, or equal:
 - a. At interior locations:
 - 1) Basis-of-Design: Contego International Inc. "Contego Original Formula Reactive Fire Barrier Intumescent (RFB)"; primer as approved by Contego.
 - b. At exterior locations:
 - 1) Basis-of-Design: Akzo Nobel "Interchar 212"; primer as approved by Akzo Nobel.
- B. Topcoat/Overcoat: Water-based, latex-type, pigmented, fire-inert, protective-finish coating that will not affect fire-retardant class of intumescent coating. Topcoat to be approved by intumescent paint manufacturer.
- C. Provide thickness of intumescent paint as required to meet fire rating shown on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for surface treatments, shop-primed surfaces, maximum moisture content, and other conditions affecting performance of the Work.
- B. Do not apply when relative humidity exceeds 80% or the surface to be coated is less than 50 degrees F or less than 15 degrees F above the forecasted dew point.
- C. Verify suitability of substrates, including surface conditions, and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.
- B. Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

- C. Clean substrates of substances, including dirt, oil, grease, and incompatible paints and encapsulants, that could impair bond of coatings. Do not coat surfaces if surface moisture content or alkalinity exceeds that permitted in manufacturer's written instructions.
 - 1. Remove incompatible primers, and reprime substrate with compatible primers as required to produce coating systems indicated.
 - 2. Perform cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.
 - 3. Exterior system: Properly prepare steel by commercial blast cleaning & priming on the same day.

3.3 APPLICATION

- A. General: Apply intumescent paints according to manufacturer's written instructions and to comply with requirements for fire-retardant coating classification.
 - 1. Use equipment and techniques best suited for substrate and type of material being applied.
 - 2. Coat surfaces behind movable items the same as similar exposed surfaces.
 - 3. Apply each coat separately according to manufacturer's written instructions.
 - 4. Finish doors on faces with intumescent finish. Paint tops, bottoms, and side edges with fire-inert finish.
- B. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.
- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 - 1. Pigmented Finishes: If undercoats or other conditions show through pigmented topcoat/overcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by the CBC, 1704.13.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of intumescent painting for the next area until test results for previously completed applications of intumescent painting show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Intumescent painting will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace intumescent paint that does not pass tests and inspections, and retest.
 - 2. Apply additional intumescent paint, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.6 PAINT SYSTEM SCHEDULE

- A. Prime Coat: If required and approved by intumescent paint manufacturer.
- B. Fire-Retardant Intumescent Coating: Minimum one coat to comply with requirements for fire-retardant coating classification and surface-burning characteristics indicated.
- C. Topcoat/Overcoat: Apply if required or recommended and approved by intumescent paint manufacturer.

END OF SECTION

SECTION 101100
VISUAL DISPLAY SURFACES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Magnetic plastic laminate markerboards.
 - 2. Magnetic porcelain enamel markerboards.
 - 3. Cork tackboards.
 - 4. Hardware and accessories for complete installation.

- B. Related Sections: Requirements that relate to this section are included but not limited to the section below.
 - 1. Section 06 1000 “Rough Carpentry” for wood blocking and grounds.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site and related Work.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer’s technical data and installation instructions.

- B. Shop Drawings: Dimensioned elevations, sections, and details.

- C. Samples:
 - 1. Board: 5 inches x 8 inches, full thickness, illustrating each color and finish.
 - 2. Sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

- D. Samples:
 - 1. Initial Selection: Furnish manufacturer’s complete color selection showing full range of colors and finish characteristics.
 - 2. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only.
 - a. Board: 5 inches x 8 inches, full thickness, illustrating each color and finish.
 - b. Sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

1.4 CLOSEOUT SUBMITTALS

- A. Manufacturer's cleaning and maintenance instructions covering both routine (daily or weekly) and long-term (yearly or longer) operations.
- B. Extended warranty.

1.5 WARRANTY

- A. Porcelain-Enamel Markerboards: Furnish manufacturer's 20-year written warranty agreeing to replace boards that do not retain their original writing and erasing qualities, that become slick and shiny, or that exhibit crazing, cracking, or flaking, provided manufacturer's instructions with regard to handling, installation, protection, and maintenance have been followed.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations authorities having jurisdiction. Obtain necessary approvals from all such authorities.
- B. Qualifications:
 - 1. Contractor: Contractor is responsible for quality control of the Work.
 - 2. Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.
 - 3. Installer: An installer trained in the use of the materials and equipment to be employed in the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and Acceptance Requirements: Deliver materials in manufacturer's original packaging with label indicating pertinent information identifying the item.
- B. Storage and Handling Requirements: Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.

1.8 PROJECT CONDITIONS

- A. Ambient Conditions: Proceed with the Work in accordance with manufacturer's requirements and instructions and any agreements or restrictions of the Pre-Construction Conference.
- B. Project Conditions: Field measure at location of the Work prior to preparation of the shop drawings. Include measurements of adjacent construction to which the Work must fit. Coordinate construction to ensure that actual opening dimensions correspond to fabricated dimensions of the Work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

PART 2 – PRODUCTS

2.1 DESCRIPTION

- A. Design Requirements:
 - 1. Provide work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
- B. Performance Requirements:
 - 1. Fire Performance Characteristics: Provide fabric-faced tackboards with surface burning characteristics indicated below, as determined by testing assembled materials composed of facings and backings identical to those required in this section, in accordance with ASTM E 84, by a testing organization acceptable to authorities having jurisdiction.
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 10 or less.

2.2 MATERIALS – GENERAL

- A. Single Source Responsibility:
 - 1. Obtain materials from a single manufacturer for each different product required.
- B. Sustainable Requirements:
 - 1. Provide materials to comply with the requirements of Division 01 Section “Sustainability Requirements”.

2.3 PORCELAIN MARKER BOARDS

- A. Basis-of-Design: Refer to Finish Schedule as shown on Drawings.
 - 1. Marker tray: Full length aluminum marker tray with ends filed smooth and one set of 4 pens and eraser for each board.
 - 2. Mounting: At top and bottom edges, provide manufacturer’s recommended mounting angle clips at 24 inches on center, or at studs, and spotting adhesive behind all boards.

2.4 TACK BOARDS

- A. Basis-of-Design: Refer to Finish Schedule as shown on Drawings.
 - 1. Mounting: At top and bottom edges, provide manufacturer’s recommended mounting angle clips at 24 inches on center, or at studs, and spotting adhesive behind all boards.

2.5 PROJECTABLE BOARDS

- A. Basis-of-Design: Refer to Finish Schedule as shown on Drawings.
 - 1. Mounting: At top and bottom edges, provide manufacturer’s recommended mounting angle clips at 24 inches on center, or at studs, and spotting adhesive behind all boards.

2.6 ALUMINUM TRIM AND ACCESSORIES

- A. Aluminum Trim: Slip-on type; 6063-T5 alloy extrusions of at least 0.062 inch wall thickness.
 - 1. Finish: Clear anodized, AA designation M12C22A31.
 - 2. Provide trim in single lengths wherever possible, otherwise keep joints to a minimum.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine and correct conditions of area to receive the Work prior to installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.

3.3 CLEANING

- A. At the end of each work day, remove unused materials, debris and containers from the site.
- B. Construction Waste Management:
 - 1. At the end of each work day, recycle or dispose of unused material, debris and containers in accordance with Division 01 Section "Construction Waste Management and Disposal."

3.4 PROTECTION

- A. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

END OF SECTION

SECTION 101400
SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. The work included under this section consists of furnishing all products, materials, finishes, supplies, equipment, tools and transportation, and performing all labor and services necessary for, required in connection with, or properly incidental to furnishing and installing signage as described in this section of the specifications, shown on the accompanying drawings, or reasonably implied therefrom, except as hereinafter specifically excluded.\
- B. Work Summary:
 - 1. Create final production artwork and layouts for each sign face.
 - 2. Furnish materials and labor associated with fabricating and finishing all signs.
 - 3. Provide packaging and transportation of all signs to the project site.
 - 4. Furnish material and labor required for installation of signage.
 - 5. All code required signage shall be field inspected per CBC 11B-703.1.1.2
- C. Alternates
 - 1. Provide separate pricing for alternate designs shown on sheet W3.4. These alternate designs substitute for signs with the same sign type designation shown on sheets W3.1-W3.3. Quantities and locations are the same.

1.2 SUBMITTALS

- A. Color Samples: Submit three sets of 6"x6" samples of each color for approval. See design drawings for colors and materials.
- B. Product Data Sheets. Supply product data sheets for all products used in the manufacture and installation of signage.
- C. Contractor shall be responsible for the structural design of freestanding signs, internal illumination, and methods for fastening and installation.
- D. Applicable Standards and Publications: Unless otherwise specified or shown, signage shall conform to the following standards and publications:
- E. ANSI A-117.1 and the Americans with Disabilities Act (ADA).
- F. ATBCB Design Guidelines for Signage in relation to the Americans with Disabilities Act.
- G. California Building Code (CBC), 2019, Sections 11B-216 and 11B-701-703.
- H. California Grade 2 Braille shall be used whenever Braille symbols are specifically required. Refer to CBC Section 11B-703.
- I. ANSI A-117.1 and the Americans with Disabilities Act (ADA).
- J. ATBCB Design Guidelines for Signage in relation to the Americans with Disabilities Act.

- K. California Building Code (CBC), 2019, Sections 11B-216 and 11B-701-703.
- L. California Grade 2 Braille shall be used whenever Braille symbols are specifically required. Refer to CBC Section 11B-703.
- M. Contractor shall be responsible for the quality of materials and workmanship of any firm acting as the Contractor's subcontractor.
- N. Welding, where required, shall be in accordance with procedures specified in American Welding Society Standards using procedures, materials, and equipment of the type required for the work.

1.3 GUARANTEE

- A. At a minimum, the Contractor shall warrant that all work installed under this Contract is free of defect and will remain in good working order for a period of one year for all surface improvements and five years for all underground work. If warranties specified elsewhere in these documents are for a longer period of time than that specified in this section, the longer warranties shall apply.
- B. Manufacturer's Standard Product Warranties:
 - 1. Plastic Elements: Manufacturer's warranty against yellowing, cracking, crazing, or other visible and performance defects for a period of 5 years from the date of installation.
 - 2. Paint Coating: Acrylic polyurethane coating manufacturer's 5-year warranty against defects in materials.

PART 2 - CODE REQUIRED SIGNAGE

2.1 TYPES OF SIGNS

- A. Room Identification: Interior and exterior signs identifying permanent rooms and spaces shall comply with CBC Sections 11B-703.1, 11B-703.2, 11B-703.3 and 11B-703.5. Where pictograms are provided as designations of permanent rooms and spaces, the pictograms shall comply with CBC Section 11B-703.6 and shall have text descriptors complying with CBC Sections 11B-703.2 and 11B-703.5.
- B. Egress Signage: Signs for means of egress shall comply with CBC Section 11B-216.4.
- C. Directional & Informational: Signs that provide direction to or information about interior and exterior spaces and facilities of the site shall comply with CBC Section 11B-703.5.
- D. Toilet Room Signage: Signage for toilet rooms shall comply with CBC 11B-216.8.
- E. Assistive Listening Systems: Signage for assistive listening systems shall comply with CBC 11B-216.10

- 2.2 RAISED CHARACTERS: Raised characters shall comply with CBC Section 11B-703.2 and shall be duplicated in Braille complying with CBC Section 11B-703.3. Raised characters shall be installed in accordance with CBC Section 11B-703.4.
- 2.3 BRAILLE. Braille shall be contracted (Grade 2) and shall comply with CBC Sections 11B-703.3 and 11B-703.4.
- 2.4 INSTALLATION HEIGHT AND LOCATION. Signs with tactile characters shall comply with CBC Section 11B-703.4.
- 2.5 VISUAL CHARACTERS. Visual characters shall comply with CBC Section 11B-703.5.
- 2.6 PICTOGRAMS. Pictograms shall comply with CBC Section 11B-703.6.
- 2.7 SYMBOLS OF ACCESSIBILITY. Symbols of accessibility shall comply with CBC Section 11B-703.7.
- 2.8 BACKGROUNDS: All sign backgrounds to have a non-glare finish.

PART 3 - PRODUCTS

3.1 MATERIALS

- A. Acrylic Sheet. Cast methyl methacrylate monomer plastic conforming to ASTM D788, Sign Grade; "Plexiglas SQ" by Altuglas or equal, unless otherwise recommended by fabricator. Sizes and thicknesses as shown.
- B. Silicone adhesive to be Dow Corning or approved equal, clear unless otherwise specified.
- C. Adhesive tapes to be 3M or approved equal.
- D. Paint products to be low VOC Matthews Acrylic Polyurethane or approved equal in colors specified. All finishes to be non-glare. Provide primer as recommended by coating manufacturer for each type of substrate.
- E. Screen-printing enamel to be Nazdar or approved equal.
- F. Engraving substrate to be Rowmark or approved equal. www.rowmark.com
- G. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.
- H. Vinyl opaque film with pressure-sensitive adhesive backing, suitable for exterior applications, to be 3M or approved equal.

- I. Sealant: As required to prevent light and water leakage. No exposed sealant shall be allowed except as indicated on the reviewed shop drawings.
- J. LED lighting components to be Bitro Group or approved equal. Light color temp to be warm white, 2,700°K to 3,000°K.

PART 4 - EXECUTION

4.1 GENERAL

- A. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary flanges, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- B. Shop fabricate so far as practicable. Joints shall be fastened flush to conceal reinforcement or welded where thickness or section permits.
- C. Contact surfaces of connected members must be assembled so joints will be tight and practically unnoticeable, with minimal use of filling compound.
- D. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises
- E. unbroken, profiles accurate and ornament true to pattern. Plane surfaces to be smooth flat and without oil-canning, free of rack and twist. Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth surfaces.
- G. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.
- H. Form joints exposed to weather to exclude water.
- I. Finish hollow signs with matching material on all faces, tops, bottoms and ends. Edge joints shall be tightly mitered to give appearance of solid material.
- J. All painted surfaces shall be properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface shall be smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.
- K. Movable parts, including hardware, are be cleaned and adjusted to operate as designed without binding or deformation of members. Doors and covers shall be centered in openings or frames. All contact surfaces fit tight and even without forcing or warping components.
- L. All fasteners to be non-corrosive.
- M. Security head screw to be used for all fasteners. Contractor to coordinate type of security screws used with campus facilities department.

4.2 CUTTING & FINISHING

- A. All materials shall be cut with proper equipment using sharp blades. Shapes shall have square corners, straight edges and shall be sized as shown in the design drawings. Blade/cutter marks and scratches will not be accepted.
- B. Materials shall be prepared and primed according to product manufacturer's instructions before painting.
- C. Finishes shall be applied according to product manufacturer's instructions, then properly cured and protected after application.

4.3 APPLICATION OF GRAPHICS

- A. All graphics shall be cut, etched and/or printed to comply with the specified typeface and graphic shapes. Graphics and type shall be clean and crisp without deformation of characters, ticks, gaps or irregularities.
- B. Finished surfaces shall be protected from damage during application of graphics.

4.4 PACKAGING

- A. Completed signs shall be packed for shipment to the project site to protect from damage.
- B. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

PART 5 - INSTALLATION

5.1 GENERAL

- A. Protect products against damage during field handling and installation. Protect adjacent existing and newly placed construction, landscaping and surrounding wall and/or building finishes as necessary to prevent damage during installation. Paint and touch up any exposed fasteners and connecting hardware to match color and finish of surrounding surface.
- B. All exterior signs to be staked by contractor for owner's approval prior to sign installation or excavation.
- C. Contractor will be responsible for verifying that, at each sign location, there are no utility lines that will be affected by installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.

- D. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices, which may involve other trades.
- E. Mount signs in proper alignment, level and plumb. When exact position, angle, height or location is in doubt, contact Designer for clarification.
- F. Remove or correct signs or installation work Owner determines as unsafe or as an unsafe condition.

5.2 CLEANING & ADJUSTING

- A. Return items that cannot be refinished in the field to the shop. Make required alterations and refinish entire unit or provide new units.
- B. Verify gaskets and flanges interface properly to provide a lightproof installation at monument sign.
- C. After installation, clean soiled sign surfaces according to manufacturer's instructions. Protect from damage until acceptance by University.
- D. At completion of sign installation, clean exposed sign surfaces. Clean and repair any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.

5.3 PUNCHLIST & PROJECT CLOSEOUT

- A. Sign contractor shall review all installed work with the Client or Client's representative and make all required punchlist corrections. Once complete, the sign contractor shall back-check all punchlist items and receive Client's final approval of installation.

5.4 RECORD DOCUMENTS

- A. As-Built Drawings
- B. The Contractor shall submit to the University's Representative, 10 calendar days after Final Completion, fully updated As-built Drawings and Shop Drawings for review.
- C. The As-Built Drawings and Shop Drawings shall be in PDF format. Email is acceptable.

END OF SECTION

SECTION 102113
TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Solid Color Reinforced Composite (SCRC) Substrate.
 - 1. Toilet partitions.
 - 2. Urinal privacy screens.
- B. Related Requirements:
 - 1. Section 055000 - Metal Fabrications.
 - 2. Section 061000 - Rough Carpentry.
 - 3. Section 093300 - Tiling.
 - 4. Section 095123 - Acoustical Ceilings.
 - 5. Section 102813 - Toilet Accessories for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. USA Certificate of Origin: Manufacturer shall supply with first submittal, an example of their Certificate of Origin declaring toilet compartments are wholly manufactured and assembled specifically in the United States, including city and state locations. A notarized Certificate of Origin shall be provided with closeout documents.
- D. Shop Drawings: Submit manufacturer's shop drawings for each product specified, including the following:
 - 1. Plans, elevations, details of construction and attachment to adjacent construction.
 - 2. Show anchorage locations and accessory items.
 - 3. Verify dimensions with field measurements prior to final production of toilet compartments.
- E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

- F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 10 year experience manufacturing similar products.
- B. Installer Qualifications: Minimum 2 year experience installing similar products.
- C. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.
- D. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirements as applicable.
- E. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship is approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.5 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.9 WARRANTY

- A. **Manufacturer's Warranty:** Manufacturer's standard 25 year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship. Manufacturer's standard 1 year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis of Design Products:** Based on the quality and performance requirements of the project, specifications are based on the products of Bobrick Washroom Equipment, Inc. 2092G.67P Sierra Series toilet compartments. Location of manufacturing shall be the United States.
- B. Requests for substitutions will be considered in accordance with provisions of Section 016000 - Product Requirements.

2.2 SOLID COLOR REINFORCED COMPOSITE (SCRC) SUBSTRATE (Bobrick SierraSeries)

- A. **Solid Color Reinforced Composite (SCRC) Toilet Partitions: Bobrick SierraSeries.**
 - 1. **Design Type:**
 - a. **Maximum Height.**
 - 1) Door Height: 96"
 - 2) Divider Panel Height: 108"
 - 3) Floor Clearance: 1" AFF
 - 2. **Privacy Style Partitions:** No sightlines with gap-free interlocking doors and stiles routed 0.300 inches (7.6 mm) from the edge to allow for 0.175 inch (4.4 mm) overlap to prevent line-of-sight into the toilet compartment. Privacy strips fastened or adhered onto the partition material are not acceptable.
 - 3. **Mounting:**
 - a. **Floor-Mounted, overhead-braced with satin finish, extruded anodized aluminum headrails, 0.065 inch (1.65 mm) thick with anti-grip profile.**
 - 1) Stile Maximum Height: TBD by manufacturer
- B. **Solid Color Reinforced Composite (SCRC) Urinal Screens: Bobrick SierraSeries.**
 - 1. **Mounting Configuration:**
 - a. **Wall-Hung.**
 - 1) Screen Height: 48 inches (122 cm) with 12 inches (30 cm) floor clearance.

- C. Materials: Solid color reinforced composite (SCRC) material for stiles, panels, doors, and screens with Bobrick GraffitiOff coating, thermoset and integrally fused into homogenous piece; high density polyethylene (HDPE), high density polypropylene not acceptable.
1. Composition: Dyes, organic fibrous material, and polycarbonate/phenolic resins.
 2. Surface Treatment: Non-ghosting, graffiti resistant surface integrally bonded to core through a manufacturing steps requiring thermal and mechanical pressure.
 3. Edges: Same color as the surface.
 4. Color:
 - a. To be selected by the architect from Bobrick standard color offering.
 5. Acceptable SCRC Products: Or manufacturer approved equal.
 - a. Ultimate Corian System by Shower Shapes.
 - b. WilsonArt Gibraltar Material.
 - c. WilsonArt EarthStone Material.
- D. Performance Requirements:
1. Graffiti Resistance (ASTM D 6578): Passed cleanability test; 5 staining agents.
 2. Scratch Resistance (ASTM D 2197): Maximum load value exceeds 10 kilograms.
 3. Impact Resistance (ASTM D 2794): Maximum impact force exceeds 30 inch-pounds.
 4. Smoke Developed Index (ASTM E 84): Less than 450.
 5. Flame Spread Index (ASTM E 84): Less than 75.
 6. National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class B.
- E. Finished Thickness:
1. Stiles and Doors: 3/4 inch (19 mm).
 2. Panels and Screens: 1/2 inch (13 mm).
- F. Stiles: Floor-Anchored stiles furnished with expansion shields and threaded rods.
1. Leveling Devices: 7 gauge, 3/16 inches (5 mm) thick, corrosion-resistant, chromate-treated, double zinc-plated steel angle leveling bar bolted to stile; furnished with 3/8 inch (10 mm) diameter threaded rods, hex nuts, lock washers, flat washers, spacer sleeves, expansion anchors, and shoe retainers.
 2. Stile Shoes: One-piece, 22 gauge (0.8 mm), 18-8, Type 304 stainless steel, 4 inch (102 mm) height; tops with 90 degree return to stile. One-piece shoe capable of adapting to 3/4 inch (19 mm) or 1 inch (25 mm) stile thickness and capable of being fastened (by clip) to stiles starting at wall line.
- G. Anchors: Expansion shields and threaded rods at floor connections as applicable. Threaded rods secured to supports above ceiling as applicable. Supports above ceiling furnished and installed as Work of Section 05 50 00 - Metal Fabrications.

- H. Hardware: Chrome-plated "Zamak", aluminum, extruded plastic hardware not acceptable.
1. Compliance: Operating force of less than 5 lb (2.25 kg).
 2. Emergency Access: Hinges, door latch allow door to be lifted over keeper from outside compartment on inswing doors.
 3. Materials: 18-8, Type 304, heavy-gauge stainless steel with satin finish.
 4. Latch: At doors to accessible compartments, latch shall be of flip-over style, sliding, or which otherwise does not require user to grasp or twist.
 5. Door pull: Comply with CBC Section 11B-404.2.7 shall be placed on both sides of the door.
 6. Doorstops: Prevents inswinging doors from swinging out beyond stile; on outswing doors, doorstop prevents door from swinging in beyond stile.
 7. Fastening: Hardware secured to door and stile by through-bolted, theft-resistant, pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts. Fasteners secured directly into core not acceptable.
 - a. Threaded Brass Inserts: Factory-installed; withstand direct pull force exceeding 1500 lb (680 kg) per insert.
 8. Clothes Hooks: Projecting no more than 1-1/8 inch (29 mm) from face of door.
 9. Occupancy Indicator Latches: All doors to receive occupancy indicator latches. Constructed of 304 stainless steel. At wheelchair and ambulatory stalls, operable parts shall be operated with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate operable parts shall be 5 pounds (22.2 N) maximum.
 10. Locking: Door locked from inside by sliding door latch into keeper.
 11. Hinge Type:
 - a. Standard.
 - 1) Balanced, with field-adjustable cam to permit door to be fully closed or partially open when compartment is unoccupied.
 12. Mounting Brackets:
 - a. Full-Height.
 - 1) Mounting Brackets: 18 gauge (1.2 mm) stainless steel and extend full height of panel.
 - 2) Mounting Brackets: Provided at ceiling to seal off the gap between divider panel and ceiling.
 - 3) U-Channels: Secure panels to stiles.
 - 4) U-Channels: To seal off gap between divider panel and floor. Panel to slide into.
 - 5) Angle Brackets: Secure stiles-to-walls and panels to walls.
 - 6) Bobrick 1001375 flat strip bracket to be installed opposite door swing to block the gap between headrail and ceiling.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates including but not limited to blocking and supports in walls and ceilings at points of attachment using methods recommended by the manufacturer for achieving the best result for the substrates under the project conditions.
1. Inspect areas scheduled to receive compartments for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets.
 2. Verify spacing of plumbing fixtures to assure compatibility with installation of compartments.
- B. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

- C. Do not proceed with installation until substrates have been properly prepared with blocking and supports in walls and ceilings at points of attachment and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

3.2 INSTALLATION

- A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:
 1. Verify blocking and supports in walls and ceilings has been installed properly at points of attachment.
 2. Verify location does not interfere with door swings or use of fixtures.
 3. Use fasteners and anchors suitable for substrate and project conditions.
 4. Install units rigid, straight, plumb, and level.
 5. Conceal evidence of drilling, cutting, and fitting to room finish.
 6. Test for proper operation.

3.3 ADJUSTING, CLEANING AND PROTECTION

- A. Adjust hardware for proper operation after installation. Set hinge-cam on in-swinging doors to hold doors open when unlatched. Set hinge cam on out-swinging doors to hold unlatched doors in closed position.
- B. Touch-up, repair or replace damaged products.
- C. Clean exposed surfaces of compartments, hardware, and fittings.

END OF SECTION

SECTION 102123

GREEN SCREEN CURTAINS AND TRACK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Green screen curtains and track systems.
- B. Related Sections:
 - 1. Section 092216 "Non-Structural Metal Framing".
 - 2. Section 092900 "Gypsum Board Assemblies".
 - 3. Section 095113 "Acoustical Panel Ceilings".

1.3 QUALITY ASSURANCE

- A. Provide cubicle curtains, track, and hardware from a firm that has specialized in the fabrication and installation of such work for at least five (5) years in projects of similar size and scope.
- B. Provide cubicle curtains, track, and hardware as complete units produced by a single manufacturer, including the necessary mounting brackets, hardware, fittings, fastenings, and installation.
- C. Installation shall be performed by an authorized manufacturer's representative experienced in the installation and maintenance of such assemblies.

1.4 SUBMITTALS

- A. Manufacturer's Data: Include durability, laundry temperature limit, fade resistance, and fire-test response characteristics for each type of curtain fabric indicated.
- B. Shop drawings: Submit drawings and a schedule showing layout and cubicle configurations, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements. Include details on blocking above ceiling and in walls.
- C. Verification Samples: Submit Full-size units of each type of the following products:
 - 1. Cubicle Curtains: Submit 12-inch square swatch (memo) samples illustrating fabric color, pattern repeat, and weave for each fabric specified.
 - 2. Curtain Track: Submit sample assembly not less than 4 inches long included a full-size carrier, end cap, and pull out.
- D. Maintenance Instructions: Submit manufacturer's printed instructions for cleaning and maintenance of the products.

1.5 DELIVERY STORAGE AND HANDLING

- A. Subcontractor shall not install cubicle tracks or curtains until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceiling is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for its intended use.
- B. Inspect materials at delivery to assure that specified products have been received and are free of damage.
- C. Field measurements: Verify dimensions by field measurements before fabrication. Schedule with construction progress to avoid delaying the Work.

1.6 WARRANTY

- A. Provide a written warranty agreeing to repair or replace fabric curtains, hardware or materials due to faulty workmanship or installation for a period of one (1) year.

PART 2 - GENERAL

2.1 PERFORMANCE REQUIREMENTS

- A. Fabrics shall withstand a maximum temperature of 160 degrees F.
- B. Curtains shall conform to NFPA 701 Fire Tests for Flame and Resistant Textiles and Films, and California Title 19 regulations.
 - 1. Identify fabrics with appropriate markings of applicable testing and inspecting agency.

2.2 MANUFACTURER

- A. Basis-of-Design Track: ModoMed, 5505 36h Street SE, Grand Rapids, MI 49512; 800-258-8871; custsvc@modomed.com, or equal (no known equal).
- B. Basis-of-Design Curtain: Angler, Gradus Group LLC; 212-594-2120; anglerlights.com, or equal (no known equal).

2.3 MATERIALS

- A. Curtains: Provide (2), 10 x 24 chromakey curtains, fasten clips to 24' horizontal dimension of curtain at 6 inches on center.
 - 1. Manufacturer/Mill: As selected by Architect
 - 2. Color: To be determined.
 - 3. Fabric Width: To be determined.
- B. Curtain Track:
 - 1. Cube Care Classic Track System.
 - a. Material: Extruded 6063 aluminum 0.06 wall thickness; satin anodized aluminum finish.

- b. Dimensions: 3/4 inches high by 1-3/8 inches wide
 - c. Length: Required for installation as shown on Drawings.
 - d. Provide straight and bent sections as indicated on drawings.
 - e. Provide factory fabricated curved track with 12-inch radius bends.
 - 1) Curve shall be 90 degrees, 2 feet by 2 feet, color: grey
 - f. Finish: Satin coat anodized aluminum.
2. Track Accessories:
- a. Splices: Aluminum Splices to join track sections and curves. (Part No. CCA14).
 - b. End Caps: Aluminum, (Part No. CCA13).
 - c. Nylon Wheel Carriers: 2.5 carriers per linear foot
 - d. Pull Out: Aluminum, provide one per each configuration (Part No. CCA12)
 - e. Optional: Provide Nickel-plated curtain tie back, 48" long chain (Part No. CCTB02.)
3. Suspended Track System: Utilizes Suspended Track Assembly in addition to Classic Track and Accessories.
- a. Provide Suspended Track assembly attached to ceiling every 48"
 - b. Classic Ceiling Bracket: Aluminum (Part No. CCST01).
 - c. Classic Extension Tubing: Aluminum, size to be determined per field conditions (Part No. CCST02-X)
 - d. Classic Socket: Aluminum, (Part No. CCST03)
 - e. Classic Wall Mount Bracket: Aluminum, (Part No. CCST04)
 - f. Support Riser: Aluminum, Cubicle Curtain Track Heavy Duty Riser.
4. Heavy Duty Tarp Clip: Provide for curtain to carrier attachment:
- a. Basis-of-Design: 610 EasyKlip Midi Tarp and Banner Clip; www.curtain-tracks.com

PART 3 - GENERAL

3.1 EXAMINATION

- A. Examine substrates, adjoining construction and conditions under which the work is to be installed. The work shall not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install all materials level and plumb, according to manufacturer's written instructions.
- B. Surface Mounted Track: Fasten surface-mounted tracks at intervals of not less than 24 inches. Fasten support at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:
 - 1. Mechanically fasten to suspended ceiling grid with spacer.
 - 2. Mechanically fasten to suspended ceiling grid with screws.
- C. Suspended Track Mounting: Install track with suspended supports at intervals of not more than 84 inches. Fasten support at each splice and tangent point of each corner. Secure ends of track to wall with flanged fittings or brackets.
- D. Track Accessories: Install end caps, splices, pull outs, carriers, and other accessories as required for a secure and operational installation.

- E. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along the full length of the curtain.
- F. Curtains: Hang curtains on each curtain track. Test for smooth operation of carriers.

3.3 PROTECTION

- A. Protect installed products until the completion of the project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Remove debris and clean surfaces per manufacturer's instructions upon completion.

END OF SECTION

SECTION 102213
WIRE MESH PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wire mesh partitions and gates at IT Delivery Cage.

1.3 DEFINITIONS

- A. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.
- B. Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site and related Work.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, anchorage, and attachments to other work.
 - 2. Provide location template drawings for items supported or anchored to permanent construction
- C. Samples for Initial Selection: Furnish manufacturer's complete color selection showing full range of colors and finish characteristics for units with factory-applied color finishes.

D. Samples for Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.

- a. Wire Mesh: 6 inch x 6 inch sample in color selected.
- b. Frame: 6 inch length in color selected.

E. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:

- a. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wire mesh partition hardware to include in maintenance manuals.
- B. Record drawings.

1.8 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations authorities having jurisdiction. Obtain necessary approvals from all such authorities.
- B. Qualifications:
 1. Contractor: Contractor is responsible for quality control of the Work.
 2. Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.
 3. Installer: An installer trained in the use of the materials and equipment to be employed in the Work.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire mesh items in manufacturer's original packaging, with label identifying item, to provide protection during transit and project-site storage. Use vented plastic.
- B. Inventory wire mesh partition door hardware on receipt, and provide secure lockup for wire mesh partition door hardware delivered to Project site.
 - 1. Tag each item or package separately with identification, and include basic installation instructions with each item or package.
- C. Storage and Handling Requirements: Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.

1.10 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design: Cisco-Eagle Welded Wire Security Cages, or equal. Details to be determined.

2.2 MATERIALS – GENERAL

- A. Single Source Responsibility:
 - 1. Obtain materials from a single manufacturer.
 - 2. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.3 MATERIALS

- A. Wire Mesh Partitions:
 - 1. Thickness: 0.189 inch.
 - 2. Weight: 2.939 lbs/sq. ft.
 - 3. Maximum sheet size: 48 inches x 120 inches.
 - 4. Open area: 6 percent.
 - 5. Material: _____.
- B. GATES
 - 1. To be determined.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine floors for suitable conditions where wire mesh items will be installed.
- C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate and Furnish: Anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of items having integral anchors embedded in concrete or masonry construction. Coordinate delivery of such items to the project site.

3.3 WIRE MESH PARTITIONS ERECTION

- A. Anchor wire mesh partitions to floor with 3/8-inch- diameter postinstalled expansion anchors at 12 inches o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.
 - 1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.
- B. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace defective work, including framing that is warped, bowed, or otherwise unacceptable.

END OF SECTION

SECTION 102600

WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Corner guards.
 - 2. Wall protection panels.

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.
- B. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.
 - 1. Include similar Samples of accent strips and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below. Include Samples of accent strips to verify color selected.
 - 1. Wall and Corner Guards: 12 inches long. Include examples of joinery, corners, end caps, top caps, and field splices.
- E. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.

- b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.
- c. MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Certificates: For each impact-resistant plastic material, from manufacturer.
- C. Material Test Reports: For each impact-resistant plastic material.
- D. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

1.6 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Wall-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of units installed, but no fewer than two, 8-foot- long units.
 - 2. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of units installed, but no fewer than two, 4-foot- long units.
- B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Section 014000 "Quality Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.
- E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
 - 2. Keep plastic sheet material out of direct sunlight.
 - 3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
 - a. Store corner-guard covers in a vertical position.
 - b. Store wall-guard covers in a horizontal position.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.
- B. Ceilings, Walls, Thermal and Acoustic Insulation: All ceilings, thermal insulation, acoustic insulation, products provided under this specification section shall be compliant with CDPH Standard Method v1.2-2017 emissions testing with proper unexpired CDPH testing certificates or acceptable third party certification.

2.2 MATERIALS

- A. Stainless-Steel Sheet: ASTM A240.
- B. Vinyl: Chemical and stain resistant polyvinyl chloride with impact modifiers.
- C. Adhesive: As recommended by wall protection manufacturer.

2.3 CORNER GUARDS

- A. Surface-Mounted, Stainless Steel Corner Guards:
 - 1. Basis-of-Design: Refer to Finish Schedule on Drawings.
- B. Surface-Mounted Vinyl Corner Guards:
 - 1. Basis-of-Design: Refer to Finish Schedule on Drawings.

2.4 WALL PROTECTION PANELS

- A. Stainless Steel.
 - 1. Basis-of-Design: Refer to Finish Schedule on Drawings.
- B. Engineered PETG.
 - 1. Basis-of-Design: Refer to Finish Schedule on Drawings.

2.5 FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. For impact-resistant wall protection units attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.
- C. Protection: Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.

3.3 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions and in strict accordance with the manufacturer's recommendations using approved adhesive. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 - 1. Adhere corner guards in accordance with manufacturer's recommendations, unless otherwise shown.
 - 2. Temperature at the time of installation must be between 65-75°F and be maintained for at least 48 hours after the installation to allow for proper adhesive set-up.
 - 3. Relative humidity shall not exceed 80%.
 - 4. Do not expose wall covering to direct sunlight during or after installation. This will cause the surface temperature to rise, which in turn will cause bubbles and delamination.
 - 5. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Provide anchoring devices to withstand imposed loads.

- b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.
- c. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.
- C. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION

SECTION 102813
TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Washroom accessories.

B. Related Sections:

- 1. Section 102113 "Toilet Compartments."

C. Coordination:

- 1. Contractor shall provide thicker partitions where recessed accessories are indicated to be installed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

- 1. Construction details and dimensions.
- 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- 3. Material and finish descriptions.
- 4. Features that will be included for Project.
- 5. Manufacturer's warranty.
- 6. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
- 7. Identify products using designations indicated.

B. LEED Submittals:

- 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- C. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

- A. Refer to Schedule on Drawings.

2.4 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf , when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

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SECTION 104400

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Fire extinguisher and cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
 - 2. Show location of knockouts for hose valves.
- B. Shop Drawings: For fire-protection cabinets.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required, prepared on samples 6 by 6 inches square.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers, fire hoses, hose valves, and hose racks indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 FIRE-PROTECTION CABINET

- A. Provide rated fire extinguisher cabinets at fire rated partitions.
- B. Cabinet Type: Suitable for hose, rack, valve, and extinguisher.
- C. Manufacturers: Provide cabinet from Larsens Manufacturing, Potter Roemer, or equal.
- D. Cabinet Construction: Nonrated.
- E. Cabinet Material: Cold-rolled steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- F. Recessed Cabinet:
 - 1. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
- G. Cabinet Trim Material: Steel sheet.
- H. Door Material: Steel sheet.
- I. Door Style: Flush opaque panel, frameless, with no exposed hinges.
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting lever handle with cam-action latch.
 - 2. Concealed hinge.
- K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Coordinate type and location with Owner to match Building Standards.

L. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color: As selected by Architect from manufacturer's full range.

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Miter corners and grind smooth.
 3. Provide factory-drilled mounting holes.
 4. Prepare doors and frames to receive locks.
 5. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.

- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for hose valves and racks and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification:
 - 1. Apply lettering at locations indicated. Coordinate with Owner to match building standards.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 105123

PLASTIC-LAMINATE-CLAD LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood lockers with plastic-laminate-faced wood doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lockers.
- B. Shop Drawings: For lockers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for items installed in lockers.
 - 4. Show locker fillers, trim, base, sloping tops, and accessories.
 - 5. Show locker numbering sequence.
- C. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc3 - Sourcing of Raw Materials – Forestry Stewardship Council (FSC) Certified Wood: For all wood products designated in this specification as “FSC certified,” provide vendor invoices with the vendor’s Chain-of-Custody (COC) number and identify each FSC certified product on a line-item basis. If FSC wood products are modified off-site by an architectural woodworker or millworker, the woodworker shall have an FSC COC number.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- C. Source Limitations: Obtain lockers and accessories from single source from single manufacturer.
- D. Regulatory Requirements: Where lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities." and ICC/ANSI A117.1.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are same as that in final installation location and comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install lockers until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature between 60 and 90 deg F and humidity conditions between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of concealed framing, blocking, and reinforcements that support lockers by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure lockers can be supported and installed as indicated.

- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087100 "Door Hardware" to fabricator of lockers; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Clothes Locker: 15 inches deep by 12 inches wide; 3 high arrangement.
 - 1. Basis-of-Design Product: Hollman Laminate Lockers or equal.
- B. Color as selected by Architect from manufacturer's standards.

2.2 MATERIALS

- A. Forest Certification: Fabricate lockers with wood produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Thermoset Decorative Overlay for interior of lockers: Surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1 for application over particleboard or medium-density fiberboard.
- D. High-Pressure Decorative Laminate for Exterior of Lockers: NEMA LD 3, grades as follows:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade VGS.
- E. Adhesives: Adhesives shall not contain urea formaldehyde.
- F. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- G. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as indicated on Drawings.
 - 2. Provide toothed-steel or lead-expansion sleeves for drilled-in-place anchors.

2.3 LOCKER HARDWARE

- A. General: Provide manufacturer's standard locker hardware complying with the requirements in this Section.

- B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges; back mounted.
 - 1. Provide two hinges for doors 36 inches high and less.
 - 2. Provide three hinges for doors more than 36 inches high.
- C. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.
- D. Shelf Rests: BHMA A156.9, B04013.
- E. Exposed Hardware Finishes: Unless otherwise indicated, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

2.4 DOOR LOCKS

- A. General: Fabricate lockers to receive locking devices. Provide one locking device for each locker door unless otherwise indicated. Locks to be digital re-programmable.

2.5 LOCKER ACCESSORIES

- A. Hooks: Manufacturer's standard, ball-pointed aluminum or steel; finished to match other locker hardware. Attach hooks with at least two fasteners.
 - 1. Provide one double-prong ceiling hook and two single-prong wall hooks for each bottom compartment of top-modified lockers.
- B. Number Plates: 1-1/2-inch-diameter, etched, embossed, or stamped, aluminum plates with black numbers and letters at least 1/2 inch high. Identify lockers in sequence indicated on Drawings.

2.6 FABRICATION

- A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.
 - 1. Fabricate lockers to dimensions, profiles, and details indicated.
 - 2. Ease edges of corners of solid wood members to 1/16-inch radius.
- B. Fabricate components square, rigid, without warp, and with finished faces flat and free of scratches and chips. Accurately machine components for attachments in factory. Make joints tight and true.
 - 1. Fabricate lockers using manufacturer's standard construction with joints made with dowels, dados, or rabbets. Dado side panels to receive shelving except where indicated to be adjustable.
 - 2. Fabricate lockers with joints that are dadoed or rabbeted, glued full length, and stapled. Dado side panels to receive shelving except where indicated to be adjustable.
 - 3. Join drawer subfronts, backs, and sides with manufacturer's standard glued joints.
- C. Accessible Lockers: Fabricate as follows:
 - 1. Locate bottom shelf no lower than 15 inches above the floor.

2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- F. Attach PVC edging to panels by thermally fusing edging to panels after panel fabrication.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting locker installation.
- B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Condition lockers to average prevailing humidity conditions in installation areas before installation.
- B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

- A. Assemble knocked-down lockers with manufacturer's standard fasteners, with no exposed fasteners on face frames.
- B. Install lockers level, plumb, and true; use concealed shims.
- C. Connect groups of lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

- D. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.
 - 2. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.
- E. Attach sloping-top units to lockers, with end panels covering exposed ends.
- F. Install number plates after lockers are in place.
 - 1. Attach number plate on each locker door, near top, centered, with at least two screws with finish matching number plate.

3.4 ADJUSTING, CLEANING, AND PROTECTING

- A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding.
- B. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 105613
METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Four-post metal storage shelving.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance for Four-Post Metal Storage Shelving: Capable of withstanding the loads indicated according to MH 28.1.
- B. Seismic Performance: Metal storage shelving shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Seismic Component Importance Factor: Refer to Structural Drawings.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal storage shelving.
- B. Shop Drawings: For customized metal storage shelving. Include plans, elevations, sections, details, and attachments to other work. Include installation details of connectors, lateral bracing, and special bracing.
- C. Samples for Verification: For the following components, of size indicated below:
 - 1. Vertical Posts: 12 inches tall.
 - 2. Shelves: Full size, but not more than 24 inches wide by 12 inches deep.
 - 3. Connectors for Shelf to Post: Full size.
 - 4. Shelf-Label Holders: Full size.
- D. Product Schedule: For metal storage shelving. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Seismic Qualification Certificates: For metal storage shelving, accessories, and components, from manufacturer.
- C. Product Certificates: For each type of metal storage shelving from manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal storage shelving to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Shelves: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than five shelves.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain metal storage shelving from single source from single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

- A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.
- B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating.
- D. Floor Anchors: Galvanized-steel, post-installed expansion anchors, power-actuated fasteners or threaded concrete screws. Provide number per unit recommended by manufacturer unless additional anchors are indicated in calculations.
- E. Wall Anchors: Manufacturer's standard, galvanized-steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.

2.2 FOUR-POST METAL STORAGE SHELVING

- A. Open Four-Post Metal Storage Shelving: Factory-formed, field-assembled, freestanding system, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units similarly, so each unit is independent. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide bulk storage racks, or comparable product, by:
 - a. Global Industrial or equal.
 - 2. Load-Carrying Capacity per Shelf: _____ lb.
 - 3. Posts: Fabricated from hot-rolled steel; in manufacturer's standard shape; with perforations at 2 inches o.c. to receive shelf-to-post connectors.
 - a. Steel Thickness, Nominal: 18 gauge unless otherwise indicated on Drawings.
 - b. Post Base: Adjustable steel floor plate, drilled for floor anchors.
 - c. Post Cap: Nylon or plastic.
 - 4. Bracing: Manufacturer's standard, single diagonal cross bracing at ends; as required for stability, load-carrying capacity of shelves, and number of shelves.
 - 5. Shelf Quantity: Three shelves per shelving unit in addition to top and bottom shelf.
 - 6. Shelf-to-Post Connectors: Manufacturer's standard boltless connectors.
 - 7. Base: Open, with exposed post legs
 - 8. Overall Unit Width: 48 inches.
 - 9. Overall Unit Depth: 24 inches.
 - 10. Overall Unit Height: 72 inches.
 - 11. Finish: Baked enamel.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 FABRICATION

- A. Shop Fabrication: Prefabricate shelving components in shop to greatest extent possible to minimize field fabrication; temporarily preassemble shelving components where necessary to ensure that field-assembled components fit together properly. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate metal storage shelving square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.
 - 1. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
 - 2. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
 - 3. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
 - 4. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.
- C. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- D. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a 1/2-inch- wide hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch. Shear and punch metals cleanly and accurately. Remove burrs.
- E. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling."
- B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine floors for suitable conditions where metal storage shelving will be installed.
- C. Examine walls and ceilings to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Vacuum finished floor and wet mop resilient flooring over which metal storage shelving is to be installed.

3.3 INSTALLATION

- A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.
 - 1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - 2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
 - 3. Adjust post-base bolt leveler to achieve level and plumb installation.
 - 4. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.
 - 5. Install seismic restraints.
 - 6. Connect side-to-side and back-to-back shelving units together.
 - 7. Install shelves in each shelving unit at spacing indicated on Drawings or, if not indicated, at equal spacing.
 - a. Four-Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.

3.4 ERECTION TOLERANCES

- A. Erect four-post metal storage shelving to a maximum tolerance from vertical of 1/2 inch in up to 10 feet of height, not exceeding 1 inch for heights taller than 10 feet.

3.5 ADJUSTING

- A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.

- B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.
- C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.
- D. Replace metal storage shelving that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 108113

BIRD CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Bird control devices of the following type(s):
 - 1. Bird wire.

1.3 SUBMITTALS

- A. Product Data: Include details of dimensions, profiles, and finishes.
- B. Shop Drawings: Provide details of connection of control devices to storefront system and flashings where required by Drawings.
- C. Samples: Submit 12-inch long sample of bird control material.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Provide storage to keep shipping boxes dry, clean and undamaged. Do not stack or place other packaging on the shipping boxes.
- B. Keep product in original packaging until time of installation.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify installation surfaces by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish surface dimensions and proceed with fabricating bird control devices without field measurements. Coordinate construction to ensure that actual surface dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BirdMaster Bird Control Systems.
 - 2. Bird Barrier America, Inc.
 - 3. Bird B Gone.

4. Nixalite of America, Inc.

2.2 MATERIALS

- A. Wires: 316 stainless steel, 0.041-inch (1mm) diameter, full-hard spring temper, 250,000 lbs. / in. (44,645 kg/cm) tensile strength.
- B. Base Strip: 316 stainless steel, 0.25-inch wide x 0.02-inch-thick (6.3mm x 0.5mm), fully annealed.

2.3 COMPONENTS

- A. Bird Control at Ledge of new Café Window: Bird B Gone
 - 1. Product: Bird Wire 2000 Stainless Steel Post and Wire system, or approved equal.

2.4 ACCESSORIES

- A. Anchorage Devices: Stainless steel mounting clips, anchors, nails and hardware recommended by manufacturer for type of substrate to receive bird control units.
- B. Finish: Natural stainless steel finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify surfaces are ready for installation. Do not proceed until unsatisfactory conditions have been corrected.
- B. Clean installation surfaces thoroughly. Remove all bird droppings and related refuse. Surface must be clean and dry before installation.
- C. Verify all surface finishing is complete before installation of bird control devices. Do not apply any surface finishes to installed control devices or mounting hardware.
- D. Remove or relocate all plants or foliage that overhang installation surfaces.

3.2 INSTALLATION

- A. Install bird control devices in accordance with manufacturer's written installation instructions.
- B. Install number of rows as shown on Drawings.
- C. Gaps in the bird control coverage are not permitted.
- D. Fasten bird control devices to the surface with mounting hardware recommended by the manufacturer. Follow hardware spacing guidelines and installation procedures supplied by manufacturer.
- E. Inspect finished installation and make adjustments as required to conform to manufacturer's recommendations.

END OF SECTION

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SECTION 108211

PRE-ENGINEERED SECURITY GATES AND SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Coiled wire grilles and screens
- B. Related Sections:
 - 1. Section 055000 - Metal Fabrications.
 - 2. Section 061000 - Rough Carpentry.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate field measurements and fabrication schedule with progress of construction to avoid construction delays.
- B. Preinstallation Meetings: Conduct meetings including Contractor, Architect, fabricator, installer and other subcontractors whose work involves coiled wire fabric to confirm project requirements, framing and support conditions, mounting surfaces and manufacturer's installation requirements.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product used, including preparation instructions, storage and handling requirements, and installation methods.
- C. Shop Drawings: Submit detailed shop drawings for fabrication and installation, including plans and elevations, detailed sections, materials, finishes, fittings, hardware, anchorages, fastening details, and manufacturer's technical and descriptive data.
 - 1. Provide setting diagrams and templates for anchorages and hardware being installed by others.
 - 2. Indicate distinction between factory-assembled and field-assembled work on shop drawings.
 - 3. Materials or fabrications that are indicated to comply with design loadings, include material and safety factor properties, and other information necessary for structural analysis.

- D. Samples: Submit samples for color verification of each specified finish, at least 6 inch long.
- E. Certificates: Submit certificates signed by manufacturers of coiled wire products certifying that products furnished comply with requirements.
- F. Delegated Design Submittals: Submit comprehensive structural analysis of overall design for specified loads prepared by qualified professional engineer.
- G. Designer's Qualification Statement.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.
- J. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- K. Submit "Final Installation Contractor Checklist" to ensure warranty requirements have been met; see CCD website for copy of checklist.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Perform structural design under direct supervision of a Professional Engineer; Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years experience.

1.6 MOCK-UPS

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Provide mock-up of coiled wire fabric system (if required) for evaluation of desired appearance, performance, application and workmanship; size of mock-up not to exceed 50 sq. ft.
 1. Locate where directed by Architect; as indicated on drawings.
 2. Mock-up may; or may not remain as part of the Work.
 3. Do not proceed with remaining work until mock-up is approved by Architect.
 4. Modify mock-up as required to produce acceptable work.
 5. Retain mock-up during construction as quality standard.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in manufacturer's original, unopened packaging, with labels clearly identifying manufacturer and material.
- B. Exercise care not to scratch, mark, dent, or bend metal components during delivery, storage, and installation.

- C. Store materials indoors, protected from moisture, humidity, and extreme temperature fluctuations until ready for installation.

1.8 FIELD CONDITIONS

- A. Verify dimensions of actual openings by field measurements before fabrication; provide recorded measurements on shop drawings.

1.9 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a one year period after Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Guardian Grade Coiled Wire Grilles and Screens Manufacturers:
 1. Cascade Coil Drapery, Inc, dba Cascade Architectural: PO Box 3707, 19505 SW 90th Court, Tualatin, OR 97062; (800) 999-2645; info@cascadecoil.com; www.cascade-architectural.com.

2.2 GUARDIAN GRADE COILED WIRE GRILLES AND SCREENS SYSTEMS

- A. Provide guardian grade coiled wire grilles and screens system with attachment method, materials, weaves, and finish as indicated; manufacturer and contractor to engineer and fabricate components and assemblies as required for installation in accordance with manufacturer's Custom Architectural System.
 1. Attachment Method: Motorized custom curved track system with threaded rod brackets. Motor platform to be suspended above the track in the ceiling.
 2. Fabricoil Guardian Grade Coiled Wire Fabric Weaves:
 3. Aluminum: 5/16-inch thick, 14 gage wire.
 4. Factory Finishes: Powder Coated – Color TBD, powder coatings tested in accordance with [ASTM D3451](#).
 5. Fullness: 3 percent.

2.3 PERFORMANCE REQUIREMENTS

- A. Structural Requirements: Guardian grade coiled wire fabric systems capable of withstanding applied loads and stresses within designated limits and under conditions as indicated on drawings.
 1. Provide coiled wire fabric and attachment system components in accordance with applicable building code to withstand dead and live loads.
 2. Provide coiled wire fabric systems capable of accommodating expansion and contraction of metal components without causing undue stress, buckling, opening of joints, and distortion.

3. Provide structural framing and hardware of coiled wire fabric systems capable of withstanding loads and maintain deflection limitations in accordance with applicable building codes when systems are fully installed.

2.4 COMPONENTS

- A. Wire Attachment: Stainless steel, Type 304; Stainless steel, Type 316; Copper clad steel.
- B. Pipes: Hot-dipped galvanized steel; Stainless steel, Type 304; Stainless steel, Type 316.
- C. Tubes: Hot-dipped galvanized steel; Stainless steel, Type 304; Stainless steel, Type 316.
- D. Plates: Hot-dipped galvanized steel; Stainless steel, Type 304; Stainless steel, Type 316.
- E. Angles: Hot-dipped galvanized steel; Stainless steel, Type 304; Stainless steel, Type 316.
- F. Wire Ropes: Stainless steel, Type 304; Type 316; or Type.
- G. Wire Rope Swages: Stainless steel, Type 304; Type 316; or Type.
- H. Adjustable Mid-Span Tube Couplers: Stainless steel, Type 304; Type 316.
- I. Rings: Stainless steel, Type 304; Type 316.
- J. Fasteners: Nuts, bolts, washers, and machine screws; stainless steel, Type 304; Type 316.
- K. Stainless Steel: Comply with ASTM A666.
- L. Galvanized Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS); Structural Steel (SS); Forming Steel (FS, with G60/Z180; G90/Z275; G115/Z350 coating; continuous coil-coated on exposed surfaces with specified finish coating, and manufacturer's standard panel back coating.
- M. Aluminum Coated Steel Sheet: Aluminum-zinc alloy-coated steel sheet, ASTM A792/A792M, Commercial Steel (CS) or Forming Steel (FS); Commercial Steel (CS); Forming Steel (FS); with AZ50/AZM150; AZ55/AZM165; AZ60/AZM180 coating; continuous coil-coated on exposed surfaces with specified finish coating, and manufacturer's standard panel back coating.
- N. Steel Plate Base: Factory-welded, ASTM A1003/A1003M.

2.5 FABRICATION

- A. Tolerances: Verify field dimensions prior to start of shop fabrication.
- B. Fabricate steel and stainless steel components in accordance with manufacturer's requirements and the following:
 1. Comply with requirements indicated for metal materials, thickness, design, and details of construction; fabricate metal accurately and without any burrs.
 2. Provide welded connections in compliance with American Welding Society (AWS) standards for recommended practice in shop welding.
 3. Provide welds located behind finished surfaces that are without distortion or discoloration of exposed side.

4. Provide components that are accurately cut, drilled and/or tapped to receive coiled wire fabric, hardware, fasteners, and accessories.
- C. Shop fabricate components in accordance with requirements indicated on drawings and specified performance requirements.
- D. Shop fabricate hardware, interconnected parts, and assemblies to eliminate necessity for any field cutting adjustments.
- E. Coordinate system requirements, dimensions and spacing of attachment components to ensure required factory drilled holes in supporting framework are properly located.
- F. Provide exposed joints that are butt, flush, and hairline.
- G. Fabricate exterior connections that will be exposed to weather in a manner that prevents water from entering interior portions of structure, in accordance with Architect.
- H. Upon completion of fabrication, clean and prepare applicable coiled wire fabric system in accordance with ASTM A380/A380M.

2.6 ACCESSORIES

- A. Fasteners: Comply with ASTM F593 for stainless steel or ASTM A307 for carbon steel, sizes to suit installation conditions.
- B. Anchors and Inserts: Corrosion resistant; type, size, and material required for loading and installation as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to start of installation, verify that existing conditions are acceptable for installation of coiled wire fabric and attachment systems in accordance with manufacturer's installation instructions.
- B. Coordinate with setting diagrams, plans, templates, and drawings to ensure that proper installation of necessary anchors and supporting devices has been completed.
- C. Ensure that supporting system for coiled wire fabric has been properly prepared for attachment of framework, hardware, anchors, wire rope, and transfer of calculated loading.
- D. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions prior to proceeding.
- E. Coordinate with appropriate entity to correct any unsatisfactory conditions.
- F. Start of this work indicates acceptance of areas and conditions as satisfactory by installer.

3.2 PREPARATION

- A. Verify inventory of system components to ensure required components are available for installation; inspect components for damage and replace damaged components as necessary.
- B. Verify that alignment, support dimensions, and tolerances are correct.
- C. Verify that necessary structural framing is installed prior to mounting coiled wire fabric attachment system components.
- D. Verify that support framing and other surfaces to receive coiled wire fabric and attachment systems are clean and free of obstructions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's written installation instructions.
- B. Attach coiled wire fabric to structural framing using applicable hardware provided by manufacturer as indicated on approved shop drawings.
- C. Provide necessary anchorage devices and fittings to securely fasten to on-site construction; including additional knife plates, embeds, framework, blocking, threaded rods, and anchors.
- D. Provide for separation of dissimilar materials using bushings, grommets, or washers to prevent electrolytic corrosion.
- E. Upon completion of final adjustments, provide tamper-resistant lock-tight material at mechanical fittings.
- F. Provide for tension in coiled wire fabric as indicated on drawings, or as necessary to remove slack.
- G. Coiled Wire Fabric Attachment System:
 - 1. Install coiled wire fabric attachment system components in accordance with approved shop drawings.
 - 2. Install attachment system assemblies based on manufacturer's dimensions.
 - 3. Install joints that accommodate for expansion and contraction of metal components without causing undue stress, buckling, joint fatigue and/or distortion.
 - 4. Install structural blocking at wall locations used for mounting of attachment system.
 - 5. Install coiled fabric mounting hardware onto attachment systems as indicated on approved shop drawings for specified attachment system; attach with approved fasteners and techniques to ensure that framing members are horizontal and parallel to grade or slab, and straight to within 1/16 inch in 4 feet.
 - 6. Install attachment system plumb, level, square, and rigid without having any kinks or sags in coiled wire fabric.
- H. Coiled Wire Fabric:
 - 1. Install coiled wire fabric in accordance with approved shop drawings.
 - 2. Install coiled wire fabric based on manufacturer's dimensions.
 - 3. Install joints that accommodate for expansion and contraction of metal components without causing undue stress, buckling, joint fatigue and/or distortion.
 - 4. Install coiled wire fabric mounting hardware onto coiled wire fabric as indicated on approved shop drawings for specified attachment system; attach with approved fasteners

and techniques to ensure that sections are horizontal and parallel to grade or slab, and straight to within 1/16 inch in 4 feet.

5. Install coiled wire fabric infill with attachment system plumb, level, square, and rigid without having any kinks or sags.

3.4 CLEANING

- A. Remove temporary protective coverings of adjacent work areas, and clean installed materials prior to Date of Substantial Completion.
- B. In heavy traffic areas, establish cleaning program to pressure wash or hand-wash coiled wire fabric and attachment system on a monthly basis prior to Date of Substantial Completion.
- C. Clean coiled wire fabric system components with mild detergent and water applied with wet wrap and wiped with clean dry rag; abrasive cleaners are not permitted.
- D. Remove from project site and legally dispose of construction debris associated with this work.
- E. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

3.5 PROTECTION

- A. Provide protection of installed coiled wire grilles and screens and finished surfaces to ensure they are without damage until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.
- C. Replace defective or damaged components as directed by Architect.

END OF SECTION

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SECTION 113100

PANTRY APPLIANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Contractor furnished and installed residential grade appliances.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, operating characteristics, dimensions, furnished accessories, finishes for each appliance, and manufacturer's catalog cuts of equipment with model numbers and optional accessories to be provided clearly marked.
- B. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.
- C. Product Schedule: Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of appliance, from manufacturer.
- C. Field quality-control reports.
- D. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

- B. Service agreement.
- C. Warranty certificates, including manufacturer's operating and maintenance instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with the following:
 - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
- C. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1 Insert requirement.

1.7 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within standard warranty period.

PART 2 - PRODUCTS

2.1 APPLIANCES

- A. General:
 - 1. Where model numbers scheduled are not current, provide equal features on a current model as acceptable to City.
 - 2. The color of all appliances will be stainless steel, except as otherwise noted.
 - 3. Appliances shall be Energy Star Rated, where applicable. Refer to Schedule found on the Drawings.
- B. Basis-of-Design: To be Determined.

2.2 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Examine walls, ceilings, and roofs for suitable conditions where microwave ovens with vented exhaust fans will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Comply with plumbing and electrical requirements.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

- C. An appliance will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION

SECTION 115123
LIBRARY STACK SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. Library shelving.
 2. Accessories.
- B. Related Sections:
1. Section 066116 "Solid Surfacing Fabrications" for end panels of Library Stack Systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for library stack systems and accessories.
- B. Shop Drawings:
1. Include plans, elevations, sections, and details.
 2. Show clear-aisle widths from face of units.
 3. Show location to column grids from center of shelving units.
 4. Detail fabrication and installation of library stack systems including methods of anchoring to building structure at locations recommended by manufacturer and as required for seismic restraint.
- C. Samples for Verification: For the following products, one of each, in manufacturer's standard sizes:
1. Flat shelving.
 2. Each type of specialized shelving.
 3. End panels.
 4. Top panels.

D. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

- 1.4 MRc4 - Material Ingredients, Provide manufacturers Declare label, Health Product Declaration (HPD), Cradle to Cradle Certification, or Cradle to Cradle Health Product Certificate.

INFORMATIONAL SUBMITTALS

 - A. Qualification Data: For Installer.
 - B. Sample Warranty: For manufacturer's special warranty.

- 1.5 CLOSEOUT SUBMITTALS
 - A. Maintenance Data: For library stack systems to include in maintenance manuals.

- 1.6 MAINTENANCE MATERIAL SUBMITTALS
 - A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Shelf Units: Five percent of quantity installed for each size and type indicated, but no fewer than 10 units.

- 1.7 QUALITY ASSURANCE
 - A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

- 1.8 WARRANTY
 - A. Special Warranty: Manufacturer agrees to repair or replace components of library stack systems that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Deterioration of metals, metal finishes, and other materials beyond normal wear.
 2. Warranty Period: [Five] <Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Library stack systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.3 SHELVING

- A. Mobile Shelving:
 - 1. Basis-of-Design: MJ Industries "Concealed Canaster Mobile Shelving" or the following equal alternates:
 - a. MJ Industries "Concealed Canaster Mobile Shelving".
 - b. Ross McDonald Co.
 - c. Or equal.
- B. Cantilever Shelving: Shelving designed for library use and consisting of full end, top, and back panels, with end panels made to receive adjustable shelves in slots or to receive clips to support adjustable shelves.
 - 1. Basis-of-Design: Estey Designer Series by Tennsco or the following equal alternates:
 - a. Or equal.

2.4 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STEEL FINISHES

- A. Baked-Enamel: Manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to achieve a minimum dry film thickness of 2 mils (0.05 mm).
 - 1. Color and Gloss: Custom as selected by Architect.

2.6 ACCESSORIES

- A. Floor Anchors: Galvanized steel, post-installed expansion anchors, power-actuated fasteners, or threaded concrete screws as required to securely attach stack system.
- B. Wall Anchors: Manufacturer's standard galvanized-steel anchors.
- C. Top Bracing: Minimum 1- by 1-3/4-inch (25- by 44-mm) transverse struts, 0.048-inch- (1.22-mm-) thick steel channels, welded or bolted to top of stack units and securely fastened to structure.
- D. Bookstops: Match stacks.
- E. End Panels: Custom-fabricated, as specified in Section 064023 "Interior Architectural Woodwork."
 - 1. Provide 3-Form Chroma end panels 1 inch thick, color: Ghost.
- F. Accessories: To be specified through manufacturer's shop drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of library stack systems.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean finished floor over which shelving is to be installed.

3.3 INSTALLATION

- A. Install library stack systems at locations indicated on Drawings and according to manufacturer's written instructions.
- B. Starter/Adder Units: Connect groups together with standard fasteners according to manufacturer's written instructions, using concealed fasteners where possible.
- C. Enclosure Panels: Install end panels with concealed fasteners.
- D. Level and plumb bookstack units to a tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm).
- E. Filler Panels: Install corner and intermediate wall filler panels where indicated to fill gaps at abutting shelving units.

- F. Install type of shelves at locations indicated and at spacing indicated or, if not indicated, at equal spacing in each unit.
- G. Mark the reference section on each shelf or group of shelves.

3.4 ANCHORAGE

- A. Bookstack Anchorage: Install bookstacks using floor anchors, wall anchors, or top bracing in locations recommended by manufacturer and as indicated on Shop Drawings.

3.5 CLEANING AND PROTECTING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Protect installed products from damage during remainder of the construction period.

END OF SECTION

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SECTION 122413
ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Manually-operated roller shades with single rollers
- 2. Motor-operated roller shades with single rollers.
- 3. Solar Depth Penetration Automation for motor-operated roller shades.

B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
- 2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

- 1. Plan drawings showing location of each shade.
- 2. Details of all shade types.
- 3. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples for Verification: For each type of roller shade.

- 1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.

2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

D. Roller-Shade Schedule: Use same designations indicated on Drawings.

E. LEED Submittals:

1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
 - b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of shadeband material, signed by product manufacturer.
- C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roller shades to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Basis-of-Design: Draper, Inc. or one of the following approved equals:
 - a. _____.
 - b. _____.
 - c. Or equal.
- B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.3 MANUALLY-OPERATED SHADES WITH SINGLE ROLLERS

- A. Shadebands:
 - 1. WS-2:
 - a. Product: "Phifer Shearweave".
 - b. Openness Factor by Elevation:
 - 1) South and West: 1%.
 - 2) East: 3%
 - 3) North: 5%
 - c. Colors and Patterns: As selected by Architect from manufacturer's full range.
 - 2. WS-4:
 - a. Product: Room Darkening, "Phifer Shearweave SW7500".
 - b. Colors and Patterns: As selected by Architect from manufacturer's full range.
 - 3. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.

- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Stainless steel.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 - 1. Roller Drive-End Location: As indicated on Drawings.
 - 2. Direction of Shadeband Roll: Regular, from back of roller.
 - 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Installation Accessories:
 - 1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than [6 inches (152 mm)] [5 inches (127 mm)] [4 inches (102 mm)] [height indicated on Drawings] <Insert dimension>.
 - b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
 - 2. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
 - 3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 MOTOR-OPERATED SHADES WITH SINGLE ROLLERS

- A. Shadebands:
 - 1. WS-1 and WS-3: Light-filtering Fabric, PVC-free material.
 - a. Product: Draper, Inc. "Phifer Shearweave".
 - b. Openness Factor by Elevation:
 - 1) South and West: 1%.
 - 2) East: 3%
 - 3) North: 5%
 - c. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
- B. Shade Motor and Control System:
1. Intelligent Technology Motor - 110 VAC motor with built-in low voltage controller with 3-wire pig tail and data cable. No external motor controls are required. Available with optional three prong plug. Tubular motor concealed inside each shade roller tube.
 2. Quiet Intelligent Technology Motor - 110 VAC quiet motor with built-in low voltage controller with 3-wire pig tail and data cable. Motor operates at 38 Db measured 3 feet from the motor. Available with optional three prong plug. Tubular motor concealed inside each shade roller tube.
 3. Motor Characteristics:
 - a. Motor lifting capacity shall be a minimum of 4 Nm torque or greater for line voltage motors without the need for any external mechanical components (springs).
 - b. Intelligent motors shall be available with wired and wireless communication options.
 - c. Intelligent motors shall be rated for both interior and exterior applications.
 4. Each motor shall be capable of being positioned at fully-up, fully-down or any position between 0-100 percent in 0.5 percent increments.
 5. Each motor shall be UL, CUL recognized, and meet CSA standards.
 6. Motors shall have factory-assigned individual unique addresses and can be individually configurable over the network without needing to physically access motor.
 7. Motor shall have an onboard communication port for bi-directional communication allowing for status updates, configuration and operation from a PC with the applicable system software.
- C. A scalable shading system, with a system-wide master controller, comprised of intelligent motors and controls utilizing RS485 shall have the ability to:
1. Network Characteristics:
 - a. Manage the intelligent motors and controls on a RS485 network.
 - b. Manage unique addresses for each intelligent motor.
 - c. Allow the operation of both AC Line Voltage Motors and DC Low Voltage motors on a single common intelligent shade network without requiring gateway devices.
 - d. Allow for upper and lower limits to be pre-set by shade manufacturer and adjustable on site via handheld device or PC, without the need to access the roller assembly or external mechanical limit wheels or buttons.
 - e. Allow for intelligent keypads, schedules, motor grouping and virtual switches to be configurable and managed from its own internal IP network, from the building's internal network, or remotely over the internet.
 - f. Provide an isolated RS485 communication bus input for sensor information to ensure motor and keypad data integrity
 - g. Include integrated IP networking infrastructure hardware to allow for stand-alone operation, separated from building IP network.
 - h. Be comprised of multiple bus segments, with each segment up to 4000 feet long with up to 255 devices.
 - i. Expand system capacity from one bus segment to multiple through the use of repeaters or IP Sub Controllers.
 - j. Allow for each motor to automatically align itself to a referenced shade position upon receiving a command from the network.
 2. Automated direction of system components
 - a. Provide two methods of automated sun based control.
 - 1) Methods:
 - a) Solar Entrance Depth Management: Automatic management of light entrance into the building space. Move solar shading system based

- on the following user defined parameters, including but not limited to the following:
- i. Building location, precise longitude/latitude.
 - ii. Window's cardinal direction.
 - iii. Time of year.
 - iv. Time of day.
 - v. Size of window.
 - vi. Allowable distance of sunlight entrance into the space.
 - vii. Portion of window that should be un-shaded at all times.
 - viii. Shade position if light level drops below programmed threshold.
 - ix. Sun position based on astronomic time clock with programmable offset.
- b) Solar Entrance Depth Management shall provide for on and off delays to account for momentary changes of cloud cover.
 - c) Solar Entrance Depth Management shall provide for override timers to turn sun control on and off at a programmable time.
- b. Perform astronomic and real-time scheduled events.
3. Provide a graphical user interface (GUI) for motor commissioning and system configuration.
 - a. Allow for the auto discovery of motors, intelligent keypads and weather sensors present on the Network.
 - b. Allow visual identification and assignment of motor location to specific window location within a building.
 - c. Have a graphical user interface allowing for "drag and drop" programming of the system.
 4. Exterior Roof mounted brightness sensor shall provide real time measurement of ambient light level to determine sunny and overcast conditions.
 5. Occupant Control: Provide the following for occupant control of shades:
 - a. Wall Switch: 6 button RS 485 switch to control 1 group up/stop/down and 3 presets.
 - b. Color: As selected by Architect from manufacturer's full range.
 6. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
- D. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Roller Drive-End Location: Right side of inside face of shade.
 2. Direction of Shadeband Roll: Regular, from back of roller.
 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- F. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

- G. Installation Accessories: Provide for both surface-mounted and recessed installations, as shown on Drawings.
1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
 2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners. Shop-applied finish to match Architect's sample.

2.5 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
 2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

SECTION 124816

ENTRANCE FLOOR GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Entrance mats and frames, complete, as shown and specified. Provide entrance mats and frames at entrances to building as shown on plan.
- B. Work Specified Elsewhere:
 - 1. Setting of Frames in Concrete Slab: Section 033000.

1.2 REFERENCES

- A. General: Comply with the applicable provisions of the referenced standards except as modified by governing codes and the Contract Documents. Where a recommendation occurs in the referenced standards, it shall be considered mandatory. In the event of conflict, the more stringent standard or requirement shall govern.
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM A276 "Stainless Steel Bars and Shapes".
 - b. ASTM A479 "Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels".
 - c. ASTM A666 "Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar".

1.3 SUBMITTALS

- A. Samples:
 - 1. Frame: 12-inch-long piece of specified extrusion.
 - 2. Floor Mat: 12-inch-square corner sample of specified type and color.
- B. Product Data: Manufacturer's specifications, data, and installation instructions.
- C. Shop Drawings: Submit shop drawings and coordination drawings. Provide details of intersections at 1/4 inch scale.
- D. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:

- a. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD.
- b. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for pre- and post- consumer recycled content.

1.4 PRODUCT HANDLING

- A. General: Deliver, store, and handle materials per manufacturer's recommendations.

PART 2- PRODUCTS

2.1 LEED REQUIREMENTS

- A. IW/PS EPD: Products specified under this section shall have either a Type III Product Specific EPD or the company shall be listed in the industry group responsible for the Industry Wide Externally Verified EPD.

2.2 MANUFACTURERS

- A. Entrance floor grilles:
 - 1. Basis-of-Design: Hendrick Architectural Products, Inc. or equal.

2.3 MATERIALS:

- A. Stainless Steel Foot Grille: 1 1/8 in. depth. No. 4 finish.
- B. Stainless Steel Material: ASTM A666, type 316.
- C. Stainless Steel Angles: ASTM A276 or ASTM A479.
- D. Provide hidden lock down to secure the foot grille in place.
- E. Recessed Frame Assembly: 3 in. deep recess in Type 316 stainless steel with 1/8 in. exposed surface.
 - 1. Profile bar: Model T16.

2.4 FABRICATION

- A. Shop fabricate entrance mats and frames to greatest extent possible. Unless otherwise noted, provide each entrance mats as a single unit. Do not exceed manufacturer's recommendations for maximum size for cleaning capability.
- B. Fabricate frame members in single lengths, unless otherwise recommended by manufacturer. Where joints occur, they shall be hairline joints. Splice joints with straight connecting pins, hidden from view.

PART 3- EXECUTION

3.1 GENERAL

- A. Manufacturer's Instructions: Prepare substrates and install the work, including components and accessories, in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions. Coordinate with other trades as required.
- B. Clean and protect Entrance Mats and Frames in accordance with manufacturer's recommendations. Installation shall be per expansion anchors and button head cap screws at bottom of entrance grate assembly.
- C. In case of damage, repair Entrance Mats and Frames in accordance with manufacturer's recommendation. If repair is not acceptable to Owner, provide new assemblies.

END OF SECTION

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SECTION 142123

MACHINE ROOM-LESS TRACTION PASSENGER ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes two new machine room-less electric gearless traction passenger elevators, including but not limited to:
1. Where a component, device, system or part of the equipment is referred to in the singular, such reference shall not limit the quantity furnished and shall apply to any and all of such devices or parts as may be required for a complete installation.
 2. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 3. Respondent must clearly identify any and all exceptions, clarifications or other variations from contract documents, citing the affected requirement by version date, sheet or section, paragraph or detail and page, providing the proposed substitution, alternative or economic credit represented in their response, prominently and conspicuously displayed with underline or highlight, adjacent to or referenced in their offer pricing.
 4. Error in or conflict among requirements not specifically identified in the response shall be resolved by application of the most stringent and/or beneficial to the owner, at the sole determination of the architect.
- B. Related work required by other trades:
1. Hoistway and Pit
 - a. Proper construction for code compliant hoistway, pit and machine room.
 - b. Wall blockouts and fire rated closure for control and signal fixture boxes which penetrate walls, chases and openings.
 - c. Cutting and patching of hoistway walls for installation of hall fixtures.
 - d. Grouting under landing sills; repair or replacement of fireproofing.
 - e. Finish painting except as noted.
 - f. Protect open hoistways and entrances during construction per OSHA Regulations.
 2. Machine Room – Construction as required for Code approved enclosure.
 3. Electrical Service, Conductors, and Devices

- a. Lighting and GFCI convenience outlets in pits and machine room
- b. Three-phase mainline copper power feeder with true earthen grounding to terminals of each elevator controller in the machine room with protected, lockable “open” disconnecting means, having auxiliary contacts to allow Elevator Contractor to electronically interlock battery power lowering unit
- c. Single-phase copper power feeder to each elevator controller for car lighting and exhaust blower with individual protected, lockable “open” disconnecting means located in machine room
- d. Fire alarm initiating devices in each elevator lobby and each machine room to initiate firefighters’ return feature. Provide alarm initiating signal wiring from hoistway or machine room connection point to elevator controller terminals. Device in machine room and at top of hoistway to provide signal for general alarm and discrete signal for Phase II firefighters’ operation.
- e. Louvers, screens and gratings.
- f. Lighting, receptacles, switches and ventilation of pit, hoistway and machine room.
- g. Access ladders, guards and doors, including guardrails.
- h. Adequate and appropriate building structure for machines, safety/hoist beams, guide rail bracket attachment and support, buffers, landing sills and hoistway entrances.
- i. Adequate, convenient, secured on-site storage for tools and materials and lay-down staging space in proximity to hoistway.
- j. Appropriate analog telephone lines, jacks, wiring to and termination in elevator controller panels.
- k. Fire life/safety sensors, addressable initiating devices, fire extinguishers, signals and connections to appropriate elevator control contacts.
- l. Life safety or intercom interfaces and speakers for installation by elevator contractor.
- m. Assist with elevator installation of cameras, card readers or other security devices provided by others.

1.2 DEFINITIONS

- A. Definitions in ASME A17.1 apply to work of this Section.
- B. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.3 REFERENCES

Applicable Codes (Latest Edition):

- A. American Society of Mechanical Engineers, Safety Code for Elevators and Escalators (ASME A17.1).
- B. Building Officials and Code Administrators International, Inc., Basic Building Code (BOCA).
- C. American Disabilities Act - ADAAG published in 28 CFR Part 36 Federal Register.
- D. National Electrical Code - NFPA 70.
- E. National Fire Protection Association - NFPA 72.
- F. Fire Test of Door Assemblies NFPA 252
- G. American Welding Society (AWS) D1.1 - Structural Welding Code Steel.
- H. California Code of Regulations, Title 8 (Labor) and 24 (Building).
- I. Department of the State Architect. (DSA).
- J. American National Standard Accessible and Usable Buildings and Facilities (ANSI A117.1).
- K. Earthquake provisions as required by local code.
- L. Local codes.
- M. Authorities having jurisdiction.

1.4 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
 - 1. Door operator and related equipment
 - 2. Microprocessor controller
 - 3. Guide shoes
 - 4. Signal fixtures
- B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating machine room layout, lobby elevations, relationships with other construction, and locations of equipment and signals.
 - 1. Include scale layout of car operating panel and hall fixtures.

2. Include electrical requirements based on the speed and capacity specified to include maximum and average power demands. Design for planned electrical power supply.
 3. Include elevator equipment heat output for design of controller room cooling.
- C. Samples: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch-square Samples of sheet materials; and 4-inch lengths of running trim members.
 - D. Operation and Maintenance Data: Provide Owner's Manuals with operation and maintenance instructions to include manufacturers contact information, manufacturer's reference and serial numbers, operating instructions, recommended spare parts lists, maintenance recommendations and schedules.
 - E. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

1.5 QUALITY ASSURANCE

Approved Manufacturers: Elevator systems shall be one of the following, or equal:

- A. Otis Elevator Company – G20
- B. KONE, Inc. – MonoSpace 700
- C. Schindler – 5500
- D. ThyssenKrupp – Synergy Building Supported
- E. Mitsubishi - DiamondTrac

1.6 PERMIT, TESTING, AND INSPECTION

- A. Obtain and pay for permit, license, and inspection fee necessary to complete installation.
- B. Perform test required by governing authority in accordance with procedure described in ASME A17.2 Guide for Inspection of Elevators, Escalators, and Moving Walks in the presence of Authorized Representative.
- C. Supply personnel and equipment for tests and final performance review by Consultant, as required.

1.7 DOCUMENT AND SITE VERIFICATION

- A. In order to discover and resolve conflicts or lack of definition which might create problems, Contractor must review Construction Documents for compatibility with its product prior to submittal of quotation. Review structural, electrical, and mechanical plans for compatibility with Contractor's products. Purchaser will not pay for change to structural, mechanical, electrical, or other systems required to accommodate Contractor's equipment.

B. Site Condition Inspection:

1. Prior to delivery of equipment or beginning installation, examine hoistway and machine room areas. Verify no irregularities exist which affect execution of work specified.
2. Do not proceed with installation until work in place conforms to project requirements.

1.8 DESIGN CRITERIA

A. Provide equipment to fit within the spaces and structural conditions shown.

B. Performance:

1. Contract Speed: within 3% of the specified speed under any loading conditions
2. Floor-to-floor performance time: Measured from the start of doors closing at one floor until doors are $\frac{3}{4}$ open and the car is stopped at the next successive floor in either condition under any loading condition, based on 14'-0" floor height: 10.6 seconds
3. Door Open Time: From start of opening to fully opened: 2.3 seconds
4. Door Close Time: From start of closing to fully closed: 3.5 seconds
5. Door Dwell Times: Comply with accessibility requirements and provide separate adjustable timers for car and hall calls with initial settings as follows:
 - a. Hall Calls: 5.0 seconds
 - b. Car Calls: 5.0 seconds
 - c. Interrupted Door Beam: 1.0 seconds
6. Nudging: Adjustable with initial setting of 20 seconds. If doors fail to close after the set time, doors close at reduced speed and pressure and activate nudging buzzer
7. Leveling: Within 1/8-in. under any loading condition. Level into floor at all times, do not overrun floor and level back.

C. Operating Qualities: The Owner's Representative will judge riding quality of car and enforce the following requirements. Make all necessary adjustments.

1. Starting and stopping shall be smooth and comfortable. Slowdown, stopping and leveling shall be without jars or bumps.
 - a. Acceleration and deceleration: Maximum 4.0 ft. per second squared
 - b. Jerk: 8.0 feet per second cubed
 - c. Vertical Vibration: Maximum 30 mg

- d. Horizontal Vibration: Maximum 30 mg peak-to-peak measured at full speed for full travel in both directions
 2. Full Speed Ride: Free from vibration, shudder, bumps or sway.
 - D. Sound Control:
 1. Vibration: Sound isolate all equipment from building structure to prevent objectionable noise and vibration transmission to occupied building,
 2. Airborne Noise: Maximum acoustical output level of:
 - a. 85 dBA measured in machine room
 - b. 55 dBA measured in elevator car during all sequences of operation
 - c. 70 dBA measured in elevator lobbies
 - E. Motor Control: Operate at plus or minus 10% of normal feeder voltage plus or minus 3% of normal feeder frequency without damage or interruption of elevator service. Include protective devices to prevent damage resulting from over or under voltage conditions and loss or reversal of phase.
 - F. Control System: Operate hoist motor continuously at contract speed and load for a one-hour period, stopping at each floor for no more than 10 seconds per stop. Under the same conditions, the elevator system shall not adversely affect stability of voltage and frequency controls of emergency generator set or loads connected to emergency power bus during standby power operations.
 - G. Car Balance: Statically and dynamically balance elevator cars to minimize loading or roller guide wheels. Do not exceed 15-lb. maximum pressure on empty car.
- 1.9 NOISE AND VIBRATION CONTROL
 - A. Coordinate with other trades to avoid rigid contact between isolated equipment and the building structure.
 - B. Equipment Vibration Isolation:
 1. Hoist Machines - Mount in proper alignment on isolated bedplate or mountings utilizing resilient isolation material. Select isolation material so that the natural frequency does not exceed 40 Hertz. Bolts utilized for seismic restraint of the hoist machines shall not short-circuit the resilient isolation material.
 2. Solid State Power Conversion or Cabinets Containing Relays and Contractors – Mount on Mason Industries Model BR isolators, or equal, with a 0.2-inch static deflection, with hold down bolts and grommets to provide seismic restraint and to avoid short-circuiting the isolators.
 3. Deflector Sheaves - Provide resilient isolation materials including isolating grommets and washers at hold down bolts between deflector sheaves and the building structure.

- C. Provide filters on power conversion and regulation units to suppress acoustic noise. The A-weighted sound pressure level should not exceed 60 dB when measured three feet from the unit under all load conditions.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
- B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.11 COORDINATION

- A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
- B. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
- C. Coordinate locations and dimensions of other work relating to the elevator including pit ladder, and electrical service, electrical outlets, lights, and switches in pits, hoistway overhead machine space and controller room.

1.12 WARRANTY

- A. Material and workmanship of installation shall comply in every respect with Construction Documents. Correct defective material or workmanship which develops within one year from date of Substantial Completion of all work to satisfaction of the Purchaser and Consultant at no additional cost, unless due to ordinary wear and tear, or improper use or care by Purchaser.
- B. Defective is defined to include, but not be limited to: operation or control system failures, car performance below required minimum, excessive wear, unusual deterioration, or aging of materials or finishes, unsafe conditions, the need for excessive maintenance, abnormal noise, or vibration, and similar unsatisfactory conditions.

PART 2 - PRODUCTS

2.1 ELEVATORS

- A. Approved Manufacturers: Elevator systems shall be manufactured by one of those listed in Section 1.5, or equal:
- B. Elevator Description – EL 1 & 2
 - 1. Type: Gearless traction
 - 2. Machine Location: Upper hoistway, building supported
 - 3. Rated Load: 3500 lbs.

4. Platform Loading: Class A
5. Rated Speed: 350 fpm
6. Operation System: Duplex Selective Collective
7. Auxiliary Operations:
 - a. Emergency operation: Battery-powered Rescue Control
 - b. Earthquake Operation: Per CA code for location
 - c. Independent service Toggle switch in service cabinet
8. Stops & Openings: 3 levels, front-only openings
9. Car enclosure:
 - a. Inside Width: Manufacturer's standard for duty.
 - b. Inside Depth: Manufacturer's standard for duty.
 - c. Inside Height: 8'-0" (nominal)
 - d. Finishes: See Section 2.8
10. Hoistway Entrances:
 - a. Size: 3'-6" x 7'-0"
 - b. Type: Single-speed, side opening
 - c. Frames: Bolted construction
 - d. Finishes: See Section 2.9
11. Signal Fixtures:
 - a. Car Operating Panels: Main, swing-return type.
 - b. Other components: See Section 2.10

2.2 HOISTWAY EQUIPMENT

- A. Machines: Manufacturer's standard PMAC gearless machine with VVVF drive, designed to be mounted in the elevator hoistway.
 1. Provide means for absorbing regenerated power when elevator system is operating on standby power.

2. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
 3. Provide bearing plates, anchors, angles, blocking, and templates required for installation and support of elevator equipment.
 4. Provide anti-friction bearings with easy access for lubrication.
 5. Mount motor, brake, and drive sheave in proper alignment on common frame. Machine armature, drive sheave, and brake disc to be dynamically balanced at place of manufacture at twice operating speed.
- B. Guiderails: Provide minimum 15 lb./ft. car and counterweight rails. Attach directly to building structure with brackets and non-corrosive shims and sliding rail clips. Install rails plumb and straight within 1/16-in. tolerance from top to bottom of the hoistway. Locate rail joints and fishplates to allow for building compression without interference with rail brackets.
- C. Car Frame: Welded or bolted steel channel construction.
- D. Counterweights: Provide welded or bolted frame with filler weights. Install blocking or shims to eliminate rattling for quiet travel. Provide blocking to allow for rope stretch without increasing overhead clearance.
- E. Guide Shoes: Roller type with three, spring-loaded, sound-reducing, rubber rollers per assembly, at top and bottom of car and counterweight frames. Include retainer plates between guide shoes and car frame to engage entire machined surface of guide rail. Minimum 6" diameter rollers for car guides and 3" diameter rollers for counterweight guides.
- F. Platform: Steel frame with steel or wood subfloor.
- G. Buffers: Provide spring return oil buffers including blocking, access ladders, and platforms
- H. Hoisting and Governor Ropes: Provide steel ropes or belt type suspension with adjustable shackles. Provide belt monitoring device as permanent installation to the elevator system.
- I. Compensation: Provide encapsulated type chain with dampening guides for quiet operation where required by elevator manufacturer

2.3 VIBRATION ISOLATORS

- A. Type PN - Ribbed Neoprene Pads from Mason Industries Type "W", or equal.
- B. Type RCA - Neoprene mounting with captive steel insert Mason Industries Type RCA, or equal.

2.4 SEISMIC RESTRAINTS

- A. General Properties:
 1. Restraints shall permit adjustment during installation to ensure sufficient clearance between vibration isolated element and rigid restraining device.

2. Restraints shall not be installed until vibration isolators have been loaded and adjusted to achieve the specific static deflection and clearances.

B. Seismic Restraint Description:

Restraining devices at all base supported vibration isolated equipment shall be separate components sized and installed to meet the general requirements specified above, may be built into the vibration isolator, or may be provided by anchor bolts which do not short-circuit the vibration isolator

2.5 OPERATING SYSTEMS

A. General: Provide a non-proprietary microprocessor-based control system as required to perform the functions of elevator motion, car operation, and door control

1. Include sleep mode that turns car lights and fan off when there is no demand; provide adjustable time period between normal operation and activation of sleep mode.
2. Include hardware required to connect, transfer, interrupt power, and protect motors against overloading. Properly shield each controller cabinet containing memory equipment from line pollution. Design system to accept reprogramming with minimum down time.

B. Operation of Individual Elevators:

1. Include hardware necessary to protect hoist motors and door operators.
2. Controllers containing memory equipment must be properly shielded from line feeder pollution.
3. Individual elevators shall operate on the basis of directional single cancellation collective automatic control in accordance with the following:
 - a. The control and indicating devices and supplementary service modes to be provided, together with the basic functioning of these and of power doors, door protective devices and similar items, are detailed in the relevant paragraphs of this specification.
 - b. Register calls from pushbuttons located at each floor and in each car. Slow cars and stop automatically at floors corresponding to the registered calls. Make stops at successive floors for each direction of travel irrespective of the order in which calls are registered except when bypassing hall calls to balance and improve overall service.
 - c. Provide "anti-nuisance service" whereby all car calls will be canceled if the load weighing device detects that an abnormal number of calls are registered given the number of passengers in the car. System using false call answering to accomplish this is not acceptable.

4. Fault Diagnostic System:
 - a. Provide a diagnostic system for microprocessor systems capable of determining faults most difficult to find. It shall constantly monitor the condition of all car computers. When variances occur from the normal mode, the change or fault shall be detected, the location of the elevator, time of day, number of times fault occurred, along with fault code message shall be stored on memory. This information shall be retrievable and shall be displayed on a CRT monitor in the machine room.
 - b. Provide required hardware such as keyboard or maintenance tool as specified under "Maintenance Data" and all necessary supporting documentation and materials required to perform diagnostic and restorative services.
 - c. The data link required to monitor all car computers shall be permanent. Installation requiring disconnect/reconnect of data line in order to retrieve specific car data is unacceptable.
- C. Duplex Automatic Operation: Provide duplex automatic operation that assigns calls on a real-time basis using estimated time of arrival. Each controller shall be equipped with a computer capable of dispatching cars to hall calls.
 1. Register calls from push buttons located at each floor and in each car. Slow cars and stop automatically at floors corresponding to the registered calls. Make stops at successive floors for each direction of travel irrespective of the order in which calls are registered except when bypassing hall calls to balance and improve overall service.
 2. Operate system to meet changing traffic conditions on a service demand basis. Include provisions for handling traffic which may be heavier in either direction, intermittent, or very light. As traffic demands change, automatically and continually modify group and car assignment to provide the most effective means to handle current traffic conditions.
- D. Battery-Powered Rescue Operation:
 1. Upon loss of normal power, provide controls to automatically move the car at inspection speed to the nearest landing based on the load in the car. If the car is at a floor, open the doors, and shut down. System includes rechargeable battery and automatic recharging system.
 2. Upon restoration of normal power, the elevator shall automatically resume normal operation.
- E. Other Operations:
 1. Load Weighing: provide means for weighing car passenger load. Control system to provide dispatching at main floor in advance of normal intervals when car is filled to capacity. Provide hall call by-pass when the car is filled to preset percentage of rated capacity and traveling in down direction. Field adjustment range: 10% - 100%.
 2. Independent Service: Provide controls for operation of each car from its pushbuttons only. Close doors by constant pressure on the desired destination floor button or door close button. Open doors automatically upon arrival at selected floor.

3. Door Hold Open: Provide push button in car operating panel to hold doors open for an adjustable period of 30-90 seconds to allow for loading and unloading of the elevator. Button to illuminate when Door Hold is activated. Door Hold time to be discontinued by activation of the door close or a floor push button.
- F. Earthquake Operation: Per Code requirements.
 - G. Firefighters' Service: Provide equipment and operation in accordance with Code requirements.
 - H. Automatic Car Stopping Zone: Stop car within 1/8" above or below the landing sill. Maintain stopping zone regardless of load in car, direction of travel, distance between landings, rope stretch or slippage.
 - I. Remote Monitoring and Diagnostics: Equip each controller with standard ports, interface boards, and drivers to accept maintenance, data logging, fault finding diagnostic and monitoring computers, keyboards, modems, and programming tools. The system shall be capable of driving remote color CRT monitors that continually scan and display the status of each car and call. Provide each group with a full, interactive elevator monitoring (EEMS) system located in elevator controller room.
 - J. Door Operation: Automatically open doors when car arrives at main floor. At expiration of normal dwell time, close doors. Reopen doors when car is designated for loading.
 - K. Standby Lighting and Alarm: Car mounted battery unit with solid-state charger to operate alarm bell and car emergency lighting. Battery to be rechargeable with minimum 5-year life expectancy. Include required transformer. Provide constant pressure test button in service compartment of car operation panel. Provide lighting integral with portion of normal car lighting system.
 - L. Security Systems
 1. Card Reader: Include provisions for card readers provided by others. Mount readers as directed, and cross connect from car pushbuttons to control module in machine room. Provide filler plate to match card slot size and car return panel finish, including direction of graining, where card slot or proximity reader cutout is not initially utilized. Elevator control systems shall facilitate system tracking of persons accessing secure floors via printout by passenger ID number, floor accessed, and time of entry.
 2. Security Camera: Include provisions security cameras provided by others. Mount cameras as directed and wire to controller room for interface control specified in other sections.

2.6 WIRING

- A. General: Use only copper conductors; run in metal conduit or galvanized duct. Provide 10% spare conductors in conduit, duct, and wire runs. No splices in wiring; connect wiring directly to terminal blocks in control cabinets or junction boxes. Tag spares inside controller cabinet.
- B. Traveling cables: provide lighting, communication, security systems, and control wiring circuits in traveling cables from controller room to car connection point. Include a minimum of four (4) spare pairs of shielded communication wires. Provide means to prevent cables from rubbing or chafing against hoistway, structural beams, elevator equipment, and the car.

- C. Work light and plug receptacle: provide work light on top of car with lamp guard and plug receptacle.
- D. Conduit: where provided use EMT type conduit. Include a flexible conduit to sound isolated equipment and components.
- E. Run 4 pairs of continuous un-spliced shielded twisted wires from emergency phone in car operating panel to elevator controller room junction box. Provide junction box as part of this section.

2.7 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304. Satin finish directional polish finish (US 32D). Graining in longest dimension.
- E. Stainless Steel: ASTM A 240/A 240M, Type 304
 - 1. Satin Finish: No. 4 (US 32D), grain to run in the longest dimension
 - 2. Patterned Finish: 5WL by Rigidtex, or equal.
- F. Stainless-Steel Bars: ASTM A 276, Type 304
- G. Stainless-Steel Tubing: ASTM A 554, Grade MT 304
- H. Aluminum: Extrusions per ASTM B221; sheet and plate per ASTM B209
- I. Fire-Retardant Treated Particle Board Panels: Minimum 3/4" thick backup for natural finished wood and plastic laminate veneered panels, edged and faced as shown, provided with suitable anti-warp backing. In finished configuration, panels must meet ASTM E84 Class "I" rating with a flame-spread rating of 25 or less, registered with Local Authorities for elevator finish materials.
- J. Plastic Laminate: NEMA LD3.1, Fire-Rated Grade (GP-50), Type 7, 0.050" ±.005" thick, color and texture as follows:
 - 1. Exposed Surfaces: Premium grade equivalent to FRL, color and texture as selected by Architect.
 - 2. Concealed Surfaces: Manufacturer's standard color and finish
- K. Prime Painted Finish: Clean all metal surfaces receiving a baked enamel paint finish of oil, grease, and scale. Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces. Sand smooth and apply final coat of primer.

- L. Final Painted Finish: Manufacturer's standard baked enamel or powder coat finish: Prime finish per above. Unless specified "prime finish" only, apply and bake three additional coats of enamel in the selected solid color
- M. Manufacturers' Nameplates:
 - 1. Manufacturer's name plates and other identifying markings shall not be affixed on surfaces exposed to public view. This requirement does not apply to Underwriter's Laboratories and code required labels.
 - 2. Each major component of mechanical and electrical equipment shall have identification plate with the Manufacturer's name, address, model number, rating, and any other information required by governing codes.

2.8 CAR ENCLOSURES

- A. General: Provide painted steel enclosure with removable wall panels as specified
 - 1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
 - 2. Provide finished car including materials and finishes specified.
- B. Materials and Finishes:
 - 1. Enclosure shell: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
 - 2. Canopy: Sheet steel construction painted white. Attach to wall panels with continuous rubber gasket tape. Provide light-tight baffles.
 - 3. Ventilation:
 - a. Provide concealed vents at top and bottom of wall panels
 - b. Provide two-speed squirrel cage exhaust blower sound isolated from canopy, type OE by Man-D-Tech, or equal.
 - 4. Front Returns and Transoms: 14 gage no. 4 stainless steel
 - 5. Sound deadening: Spray on or tool applied to back of cab shell, 1/8-inch thick.
 - 6. Fabricate car with recesses and cutouts for signal equipment.
 - 7. Fabricate car door frame integrally with front wall of car.
 - 8. Doors: Flush, hollow-metal construction; fabricated from or clad with satin stainless steel, no 4 finish
 - 9. Sight Guards: Provide sight guards on car doors in matching finish.

10. Sills: Extruded aluminum
11. Side and Rear Wall Panels: Applied plastic laminate panels, removable from inside the car.
12. Reveals: Satin stainless-steel between panels
13. Base: Satin stainless-steel.
14. Finished Flooring: Architectural rubber flooring as selected by the Architect.
15. Ceiling: Satin stainless-steel with LED downlights.
16. Handrails: 1 ½" diameter at rear wall, satin stainless-steel finish.
17. Protection Pads: Provide permanently installed buttons and one complete set of full height pads for each car – 2 total sets. Provide for side and rear walls and front walls with cutouts for operating fixtures.

2.9 HOISTWAY ENTRANCES

- A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrance assemblies complete with track systems, hardware, sills, and accessories, bearing 1 1/2-hour UL label.
 1. Provide frame size and profile to coordinate with hoistway wall construction.
 2. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.
- B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
 1. Frames: Fabricate from 14-gauge material, bolted construction to form one-piece unit frame. Apply effective sound deadening on inside of frame.
 2. Doors: Flush, hollow-metal, sound deadened, from minimum 16-gauge material with 2 gibs per door panel. Construct doors to prevent rattling.
 3. Sight Guards: Provide sight guards on doors matching door edges
 4. Fascia, Toe Guards, Dust Covers: Provide minimum 16-gauge factory painted or galvanized sheet steel. Hanger covers to extend full width of door track.
 5. Sills: Provide full width of hoistway extruded aluminum sills.
 6. Sill Supports: Provide entire assembly of all angles, brackets, and fastenings to support sill connection to building structure.
 7. Finish:
 - a. Frames: Satin stainless steel #4 at first floor only; painted at typical floors.

- b. Doors: Satin stainless steel #4 at main floor only; painted at typical floors.

2.10 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been completed. Provide blue LEDs for all illuminated devices and adjustable tones for all audible devices. Locate and operate all devices in conformance with accessibility requirements.
- B. Car Operating Panels: Provide a single car operating panel. Panels shall be hinged and constructed of stainless steel #4 finish.
 - 1. Provide swing return type operating panel.
 - 2. Identify all devices including floor, alarm, door open, door hold open, and door close buttons with Braille /tactile symbols. Configure plates per local building code accessibility standards.
 - 3. Provide digital position indicator with direction of travel arrows located at the top of car operating panel.
 - 4. Provide push button and plates in an oval design. Push buttons to be fully illuminated over the face of the button. Locate floor buttons in rows with the highest buttons at 48-in. Locate emergency push-to-call and alarm button at 35-in.
 - 5. Provide minimum 3/4-in. diameter raised floor pushbuttons which illuminate to indicate car registration.
 - 6. Provide alarm button to ring bell located on the car. Illuminate button when actuated.
 - 7. Provide firefighters' locked box and devices as required by Code.
 - 8. Provide lockable service compartment with hairline flush door, key removable in locked position only. Door material and finish to match car operating panel faceplate. Inside surface of door shall contain an integral horizontal flush window for displaying the elevator operating permit. Include the following toggle type switches with function and operating positions identified by permanent signage or engraved legend:
 - a. Inspection switch
 - b. Light switch
 - c. Three-position fan switch
 - d. Constant pressure emergency light test button
 - e. 120-volt GFCI duplex outlet
 - f. Two-position switch to choose audible tones or voice annunciator
 - g. Stop switch

9. Provide engraved and black painted capacity and elevator number on service cabinet door.
- C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
1. On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station.
 2. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded.
 3. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Voice Annunciator: Provide electronic system with easily programmable message using a female voice to announce car direction, floor location, and emergency instructions.
- E. Hall Push-Button Stations: Pushbutton design to match buttons in car operating panel. Provide Firefighters' Phase I devices and instruction in main floor hall station.
- F. Hall Position Indicators: Provide digital type indicator with car direction arrows at first floor only.
- G. Hoistway Access Switches: Provide new devices with satin stainless-steel faceplate in side jamb of entrance frames at top and bottom entrances.

2.11 DOOR OPERATING EQUIPMENT

- A. Door Operator: New, high speed, heavy duty, linear belt drive type machine capable of opening doors at no less than 2.5 fps. Reverse door direction upon interruption of infrared beams in no more than 2 ½-in. of movement. Provide solid state control with closed loop circuitry to constantly monitor and automatically adjust door operation based on velocity, position, and motor current. Maintain consistent, smooth, and quiet door operation at all floors, regardless of door weight or air pressure.
- B. Door Protection: Provide door reopening devices with uniform array of 40 or more microprocessor-controlled, infrared light beams projecting across full height of car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.
- C. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound, and doors shall begin to close at reduced kinetic energy.

2.12 CONTROLLER ROOM EQUIPMENT

- A. General: Arrange equipment within the available controller space. Coordinate related electrical and mechanical work.
- B. Controller: As standard with approved manufacturer; overload relays in three legs of power circuit and in loop circuit; cabinets with NEMA-1 enclosures and doors arranged with locks or mechanical

latches. Provide permanently marked symbols or letters identical to those on wiring diagrams adjacent to each component.

1. The controller wiring shall be carried out in a neat and workmanlike manner in accordance with relevant requirements of National Electric Code.
2. All external connections to the equipment on each controller shall be made by means of approved cable thimbles and/or solder less cable lugs, depending on the current to be carried.
3. Condenser activated or dash pot timers, motors or incandescent globes for dampening acceleration and deceleration steps are unacceptable.
4. Main contactors or starter switches shall be horsepower rated and are not to be mounted directly to the steel cabinets, to ensure quiet operation of controllers.
5. The controllers must be properly shielded from line feeder pollution.

C. Solid State Power Conversion and Regulation Unit:

1. General:
 - a. All circuitry shall be as approved by the enforcing code. Operation shall be quiet, and the performance standards herein specified shall be provided.
 - b. Design system to control starting and stopping and to prevent damage to motor from over-load or excess current and to automatically disconnect power supply. Apply brake and bring car to rest in event of power failure or safety device operation.
 - c. Controllers shall not have failure modes which results in full power being applied to drive machine operation in event of phase reversal, phase failure or low voltage which might result in elevator malfunction.
2. Provide regenerative VVVF/AC drives that utilize IGBT converter/inverter and dynamic braking during overhauling condition
3. Design unit to limit current, suppress noise, and prevent transient voltage feedback into building power supply. Provide internal heat sink cooling fans for the power drive portion of the converter panels. Conform to IEEE standards 519-1992 for line harmonics and switching noise
4. Isolate unit to minimize noise and vibration transmission. Provide isolation transformers, filter networks, and choke inductors
5. Suppress solid-state converter noises, radio frequency interference, and eliminate regenerative transients induced into the mainline feeders or the building standby power generator
6. Supplemental direct-current power for the operation of hoist machine brake, door operator, dispatch processor, signal fixtures, etc., from separate static power supply

7. Provide a commutation fault protection system to shut off current flow in the event of unexpected high current, which may occur during power regeneration back into the AC line combined with a sudden loss of AC power.

2.13 SEISMIC RESTRAINTS

A. General Properties:

1. Restraints shall permit adjustment during installation to ensure enough clearance between vibration isolated element and rigid restraining device.
2. Restraints shall not be installed until vibration isolators have been loaded and adjusted to achieve the specific static deflection and clearances.

B. Seismic Restraint Description:

1. Restraining devices at all base supported vibration isolated equipment shall be separate components sized and installed to meet the general requirements specified above, may be built into the vibration isolator, or may be provided by anchor bolts which do not short-circuit the vibration isolator

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
 1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions and requirements of regulatory agencies. Make finished work strong, rigid, neat in appearance, and free from defects. Make plain surfaces smooth and free from warps and buckles. Apply molded members straight and true. Make connections between various members tight to eliminate vibrations.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to minimize transmission of vibrations to structure and thereby minimize structure-borne noise from elevator system.

- D. Lubrication: Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- F. Manufacturer's Nameplates: Including trademarks and other identifying symbols are not allowed on surfaces visible to the public.
- G. Graphics: Engrave on fixtures when visible to public; Helvetica Medium unless otherwise directed.
- H. Fasteners: Not permitted on surfaces exposed to public view except as specified. Where specified and shown, fasteners to be #10-32 tamper resistant security torx type, material and finish to match adjacent surface.
- I. Key Switches: Provide key switches from single manufacturer using same key design. Provide separate key for each switch unless otherwise specified.
- J. Set sills flush with finished floor surface at landing. Fill space under sill solidly with non-shrink, nonmetallic grout.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.
- B. Operating Test: Load one elevator of each type to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Performance Testing: Provide personnel, test instruments, and equipment to assist Owner, Architect, and Consultant in making the following tests to assure workmanship and equipment comply with Contract Documents:
 - 1. Contract Speed
 - 2. Floor to floor time
 - 3. Vertical acceleration and deceleration
 - 4. Leveling accuracy
 - 5. Door operation
- D. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

- E. Corrections: Replace or remedy defects and discrepancies at no cost to Owner

3.4 FINAL CLEANING AND PAINTING

- A. Clean hoistway and elevator equipment and remove all rust, filings, welding slag, rubbish, loose plaster, mortar drippings, extraneous construction materials, dirt, and dust, including walls, building beams, sill ledges, and divider beams.
- B. Restore all work areas and routes, including floors, walls, and ceilings, to their original condition.
- C. Clean down surfaces and areas which require final painting and finishing work. Cleaning includes removal of rubbish, broom cleaning of floors, removal of any loose plaster or mortar, dust, and other extraneous materials from finish surfaces, and surfaces that will remain visible after the work is complete.
- D. Paint machine room floor and pit floors with two coats of paint appropriate for these spaces.

3.5 FINAL REVIEW REQUIREMENTS

- A. Final review and evaluation of the finished work will be conducted by the Consultant. Notify the Consultant in writing no less than five (5) days prior to the elevators being ready for review. Provide all labor, materials, and equipment necessary to aid in this review and evaluation.
- B. The installation is considered ready for final review when all tests and inspections by AHJs and inspecting authorities have been completed, permits received, final adjusting of all equipment is finished, and elevators restored to regular operation.
- C. Consultant will provide a written punch-list identifying any performance or material deficiencies not in compliance with the specifications. Final Field Review and evaluation will include the following characteristics or conditions at a minimum:
 - 1. At Consultant's option, performance evaluation will be conducted under full load and no-load conditions
 - 2. At Consultant's option, perform a one-hour full load run test, stopping for 10 seconds at each landing, to verify heat rise of less than 50^o C. in motor winding.
 - 3. Floor to floor and door performance times
 - 4. Elevator speed
 - 5. Ride quality including starting, acceleration, full speed ride, deceleration, stopping, and noise level
 - 6. Door operation, noise level, and closing pressure
 - 7. Testing of specified features and operations
- D. Provide the consultant with a completed punch-list verifying that all punch-list items have been addressed and corrected. Consultant will conduct a back-check to verify

3.6 PURCHASER'S INFORMATION

- A. Owner's Manuals: Provide one neatly bound hard copy and one electronic copy of all manufacturer's information, parts lists, straight-line as-installed wiring diagrams, parts list, lubrication charts, operating instructions. Summary page at beginning of manual to identify and include specific information including complete manufacturer information, model, serial number, for each major component to include but not limited to controller, door operator, signal fixtures, guide shoes.
- B. Provide complete software for controller equipment installed.

3.7 PROTECTION

Temporary Use: Comply with the following requirements for elevator used for construction purposes:

- A. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
- B. Provide strippable protective film on entrance and car doors and frames.
- C. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
- D. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
- E. Do not load elevators beyond their rated weight capacity.
- F. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
- G. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

END OF SECTION

SECTION 211313

WET-PIPE SPRINKLER AND STANDPIPE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet pipe sprinkler systems.
 - 2. Standpipe and hose connection system.
- B. Drawings supplied with this specification shall be used as a reference for the requirement and general location of system components.
- C. At the time of bid, all exceptions taken to these Specifications, variances from these Specifications and all substitutions of equipment specified shall be listed in writing and forwarded to Peralta Community College District (Owner). Any such exceptions, variances, or substitutions, which were not listed at the time of bid shall not be approved or considered.
- D. The Work includes all labor, materials, tools, transportation, temporary demolition, and temporary construction necessary to design, fabricate, install, test and flush a fully operational and code compliant automatic sprinkler system throughout the library building as indicated on the drawings that includes:
 - 1. Fire protection mains and risers.
 - 2. Electrically supervised indicating control valves.
 - 3. Check valves.
 - 4. Pressure gauges.
 - 5. Flow and supervisory switches.
 - 6. Overhead pipe, fittings, hangers and sprinklers.
 - 7. Inspector's test connections, main drains and auxiliary drains.
 - 8. Fire-stopping for all openings associated with this Work.
- E. The Work includes all fees and activities required to secure approvals for necessary State and Local permits.
- F. The Work includes preparing and submitting detailed Working Plans, Hydraulic Calculations and Product Data to for submittal to local officials for approval and permit.
- G. The Work includes performing field quality control activities.
- H. The Work includes documenting and submitting the results of integrity and functional testing.

- I. The Work includes performing overall system “Owner Demonstration” test(s) for the Owner’s approval.
- J. The Work includes performing overall system “Final Authority Acceptance” test(s) for Authority approval.
- K. The Work includes preparing and submitting Closeout Documentation including As-built Plans to the Owner.
- L. The Work includes training Owner’s facilities personnel on the operation of the system, required maintenance tasks and frequencies, and the locations of all spare tools and equipment, valves, flow switches, risers and equipment necessary to maintain and operate the sprinkler system.

1.3 DEFINITIONS

- A. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water that is connected to a water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent or 5 PSI, whichever is greater, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. All areas except those identified below: Light Hazard.
 - b. Storage Spaces, Mechanical Spaces, Porte Cocheres: Ordinary Hazard
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft.
 - b. Ordinary Hazard: 0.15 gpm over 1500-sq. ft.
 - 4. Maximum Protection Area per Sprinkler (unless otherwise indicated as “extended coverage” on design drawings):
 - a. Light Hazard: 225 sq. ft.
 - b. Ordinary Hazard: 130 sq. ft.
 - 5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:

- a. Light Hazard: 100 gpm for 30 minutes.
 - b. Ordinary Hazard: 250 gpm for 60 to 90 minutes.
6. The standpipe system shall deliver 500 gpm at the two most hydraulically remote standpipe connections at a residual pressure of 100 psi. Each additional standpipe shall have a flow rate of 250 gpm at a residual pressure of 100 psi.

1.6 ORDER OF PRECEDENCE

- A. Should conflicts arise out of discrepancies between documents referenced in this specification, the most stringent requirement shall apply; however, should a level of stringency be indeterminable, the discrepancies shall be resolved as follows:
1. State and local codes shall take precedence over this specification.
 2. The National Fire Protection Association Standards shall take precedence over this specification.
 3. Drawing specific requirements as documented on the RFP drawing package.

1.7 SUBMITTALS

- A. Product Data: For the following:
1. Piping materials, including dielectric fittings, and sprinkler specialty fittings.
 2. Pipe hangers and supports.
 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
 5. Hose connections, including size, type, and finish.
 6. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
 7. Alarm devices, including electrical data.
- B. Shop Drawings: For wet-pipe sprinkler systems.
1. Include plans, elevations, sections, details, and attachment to other work.
 2. Include diagrams for power, signal, and control wiring.
- C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Domestic water piping.
 2. Compressed air piping.
 3. HVAC hydronic piping.
 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.

- D. Hydraulic supply report results.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- G. Welding certificates.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.8 AS-BUILT (RECORD) DRAWINGS

- A. On a daily basis the contractor's superintendent shall record as built conditions on a set of Shop Drawings maintained at the job site. Three sets of Shop Drawings reflecting as built conditions shall be available prior to and for use in the final acceptance test. Two weeks after the acceptance test and before final acceptance of the work, furnish three complete sets of as built drawings. The drawings shall be prepared on uniform sized sheets not less than 36 by 48 inches in size. In addition, provide a USB flash drive containing AutoCAD (Version to be coordinated with Owner) DWG and PDF format of all as built drawings and schematics. The drawings shall include:
 - 1. As built location of all devices and equipment.
 - 2. Riser diagram.
 - 3. All deviations from the project drawings and approved shop drawings.

1.9 QUALITY ASSURANCE

- A. Equipment and devices shall be labeled and listed for the intended use in the Underwriters Laboratories, Inc. (UL), UL FPED *Fire Protection Equipment Directory*.
- B. Electrical components, devices, and accessories shall be Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction.
- C. All materials and equipment shall be new and unused.
- D. All equipment shall be first quality and capable of complying with all requirements of this specification and shall have been in continuous production and in service in commercial applications for at least one year. Obsolete equipment shall not be used.
- E. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Installer shall base calculations on results of fire-hydrant flow test or hydraulic supply analysis.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
 - b. Foreman: Provide proof of competence of both their company and the individual foreman that will be assigned to this project, in the area of installing automatic fire sprinkler systems for at least five (5) years and acceptable to Owner. Once assigned, the foreman shall not be changed without the approval of the Owner.
 - c. Service Organization: Capable of providing a service technician on-site within 4 hours of a request for on-site service.

- F. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

- G. Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 1. NFPA 13, "Installation of Sprinkler Systems."
 2. NFPA 14, "Installation of Standpipe and Hose Systems."
 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
 4. California Fire Code
 5. DSA Guidelines

1.10 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Coordinate sprinkler installation with other portions of the Work to comply with NFPA 13 requirements for obstruction to sprinkler discharge.
- C. Coordinate pipe installation with other portions of the Work to facilitate proper pitch and accessibility for components installed.
- D. Coordinate with the Fire Alarm portion of the Work for the connection and testing of waterflow and valve supervisory switches.
- E. Coordinate sprinkler and pipe installation with other trades, etc.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers

required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

1.12 WARRANTY

- A. Guarantee equipment installed to be free from defects in workmanship and inherent mechanical defects for a period of one (1) year from the date of substantial completion of the project.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

- A. Sprinkler piping shall be hydraulically calculated and sized, using actual C factors for the material used. These computer calculations shall be submitted for approval as a part of the shop drawing submittal.
- B. Standard-Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- C. Steel Pipe: Piping 2 ½" and smaller shall be Schedule 40 black steel. Piping larger than 2 ½" shall be Schedule 40 or Schedule 10 black steel.
- D. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- E. Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.
- F. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME 16.1, Class 125.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
 - 1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.
 - 2. Grooved-Joint, Steel-Pipe Appurtenances:
 - 3. Pressure Rating: 175-psig minimum.
- K. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

- L. All fittings on suction side of pump shall be flanged; remaining pump room fittings may be flanged, screwed, grooved or welded as permitted by NFPA 20.
- M. Remaining fittings on steel pipe may be welded, screwed or grooved; galvanized fittings shall be used on galvanized pipe. The used of plain end fittings is prohibited.

2.2 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating and made of materials compatible with piping.
- B. Outlet Specialty Fittings:
 - 1. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.
- C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
- D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

2.3 UL LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Ball Valves: Comply with UL 1091, except with ball instead of disc.
 - 1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - 3. NPS 3: Ductile-iron body with grooved ends.
- C. Butterfly Valves: UL 1091.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
- D. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
- E. Gate Valves: UL 262, OS&Y type.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.

- F. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
 - 1. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
 - 2. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

2.4 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.5 SPECIALTY VALVES

- A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
 - 1. Riser Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for drain and pressure gauges.
- B. Automatic (ball drip) Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.

2.6 MANUAL CONTROL STATIONS

- A. Manual Control Stations: UL listed or FMG approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.7 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Sprinklers shall be of a type, style and specification as indicated on the drawings. Heads shall be heavy duty type and installed either exposed or concealed per Architect's design.
- C. Student toilet rooms shall be provided with concealed flush to ceiling style heads having a painted cover plate, per Architect's design.

D. Operating Element: Quick Response (QR) as indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Pendent sprinklers.
2. Upright sprinklers.
3. Sidewall sprinklers

F. Available Manufacturers

1. Star Sprinkler Inc.
2. Central Sprinklers Inc.
3. Viking.

2.8 FIRE DEPARTMENT CONNECTIONS

A. Two-Way, Exposed Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and marking similar to "AUTO SPKR and Standpipe"

1. Type: two-way, exposed, freestanding.
2. Finish: Polished brass.

B. Fire Department Hose Valves: 2-1/2-inch hose valves for fire department use shall be installed in all building stairwells. Valves shall be recessed in approved fire department valve cabinets, where applicable.

2.9 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm: UL 464, with an approved diameter for the City of Oakland, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.

C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

D. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

2.10 PRESSURE GAUGES

- A. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gauge with range of 0 to 250 psig minimum.

- 1. Water System Piping: Include caption "WATER" on dial face.

2.11 SIGNS

- A. Steel with vitreous enamel finish, lettering on contrasting background to identify and indicate the function of:

- 1. Control valves.
 - 2. Drain, test, and check valves.
 - 3. Hydraulic Design Nameplate Data: Size approx. 9 x 12 inches, inscribed with the following:
 - a. SPRINKLER SYSTEM HYDRAULICALLY DESIGNED (in block letters).
 - b. Location and area of hydraulically designed section.
 - c. Discharge density over designed area in gallons per minute.
 - d. Residual pressure at base of riser supplying water to designed section.

2.12 HANGERS

- A. Pipe hangers and anchoring means shall be designed in accordance with NFPA 13.
- B. Pipe shall be supported with clevis-type or swivel ring hangers of steel constructional hangers shall be UL listed for their intended use.
- C. Hangers shall be supported directly by building structure by listed expansion anchors, beam clamps, center load clamps, wall brackets, concrete inserts, wood screws/fasteners or equal hanging systems certified by a professional engineer to support the sprinkler piping as required by NFPA 13 and all other supported loads.
- D. Hangers shall account for all seismic loading on system piping.
- E. Only sprinkler or standpipe piping may be supported by sprinkler/standpipe system hangers; no other utilities, equipment or devices shall be supported by sprinkler hangers or piping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Hydraulic supply analysis shall be performed. Data shall not be more than six months old.
- B. Report test results promptly and in writing.

3.2 PIPING APPLICATIONS, GENERAL

- A. Welded piping must be shop welded. Other pipe and fitting materials and other joining methods must also be specified to permit field assembly of shop-welded piping.

1. Shop weld pipe joints where welded piping is indicated.
2. Do not use welded joints for galvanized-steel pipe.
3. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
4. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
5. Underground Service-Entrance Piping: Ductile-iron, mechanical-joint pipe and fittings and restrained joints. Include corrosion-protective encasement.

3.3 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. If more than one type of material and joining method is used for a particular pipe size, identify materials on Drawings and show points of transition from one material to another.
 1. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
 - a. Sprinkler-Piping Fitting Option: Specialty sprinkler fittings, NPS 2-1/2 and smaller, including mechanical-T and -cross fittings, may be used downstream from sprinkler zone valves.
 - b. NPS 2: Threaded-end, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
 - c. NPS 2-1/2 to NPS 6: Grooved-end, standard-weight steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.4 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 - b. Throttling Duty: Use ball or globe valves.

3.5 JOINT CONSTRUCTION

- A. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads.
- B. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

1. Steel Pipe: Square-cut. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
- C. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.
 2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
 3. NPS 5 and Larger: Use dielectric flange insulation kits.

3.6 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 22 Section "Facility Water Distribution Piping" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping. Refer to Division 22 Section "Facility Water Distribution Piping" for backflow preventers.
- C. Install shutoff valve, check valve, pressure gauge, and drain at connection to water service.

3.7 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction and the Owner. File written approval with Architect before deviating from approved working plans
 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. All piping shall be installed at a height so as not to obstruct any portion of a window, doorway, stairway or a passageway, and shall not interfere with the operation of any mechanical or electrical equipment.
- J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- K. Install alarm devices in piping systems.
- L. Hangers and Supports: Comply with NFPA 13 for hanger materials.
 - 1. Install sprinkler system piping according to NFPA 13.
- M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each riser. Include pressure gauges with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal and install where they will not be subject to freezing.
- N. Fill wet-pipe sprinkler system piping with water.

3.8 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

3.9 SPRINKLER APPLICATIONS

- A. Sprinklers are to be provided and installed as indicated on the drawings.
- B. Where applicable, all public and occupant areas shall be equipped with concealed sprinklers with non-painted metallic cover plates.
- C. All mechanical, closet, storage and plenum spaces shall use brass finish sprinklers.

3.10 SPRINKLER INSTALLATION

- A. Install sprinklers in accordance with NFPA 13 and in the general patterns indicated on the submitted Working Drawings.

- B. The contractor shall be responsible for furnishing additional sprinklers and piping to provide additional coverage that may be required to avoid lights and diffusers not indicated on the drawings.
- C. Contractor responsible for relocating lights, if necessary to accommodate the contractors shop drawings, if the lights constitute an obstruction to sprinkler pattern development in accordance with NFPA 13.
- D. Provide recessed pendent sprinklers with white finish centered in the width of ceiling tiles. Pendant sprinklers located in 4-foot long ceiling tiles may be installed only at the mid or quarter points of the tile's long side.
- E. Do not install sprinklers, mains or branchline pipes in locations where likely to be inadvertently damaged, such as in front of access hatches, doors, cabinets, etc.

3.11 FIRE DEPARTMENT CONNECTIONS

- A. Install two-way, freestanding, fire department connections.
- B. Install ball drip valve at each check valve for fire department connection.

3.12 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping.
- D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- E. Connect piping to specialty valves, specialties, fire department connections, and accessories.
- F. Connect alarm devices to fire alarm.
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.13 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.14 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Energize circuits to electrical equipment and devices.
4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
5. Coordinate with fire alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Owner and authorities having jurisdiction.

3.15 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

3.16 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION 211313

SECTION 213113

ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes electric-drive, split-case centrifugal fire pumps and the following:
 - 1. Full service fire pump controllers.
 - 2. Fire-pump accessories and specialties.
 - 3. Pressure-maintenance pumps, controllers, accessories, and specialties.
 - 4. Fire pump power is provided under a separate contract. Fire pump monitoring and alarms are furnished by the Electrical Contractor.
- B. Drawings supplied with this specification shall be used as a reference for the requirement and general location of system components. Work includes visiting the site to observe the existing conditions, and confirmation of the required quantities of devices and specific options for locations of the same.
- C. At the time of bid, all exceptions taken to these Specifications, variances from these Specifications and all substitutions of equipment specified shall be listed in writing and forwarded to Peralta Community College District (Owner). Any such exceptions, variances, or substitutions, which were not listed at the time of bid shall not be approved or considered.
- D. The Work includes all labor, materials, tools, transportation, temporary demolition, and temporary construction necessary to design, fabricate, install, and test a fully operational and code compliant electric fire pump and controller as indicated on the drawings.
- E. The Work includes all fees and activities required to secure approvals for necessary State and Local permits.
- F. The Work includes preparing and submitting detailed Working Plans, Hydraulic Calculations and Product Data to the Owner for review prior to submitting same to local officials for approval and permit.
- G. The Work includes performing field quality control activities.
- H. The Work includes documenting and submitting the results of integrity and functional testing.
- I. The Work includes performing overall system, half-day "Owner Demonstration" test(s) for the Owner's approval.
- J. The Work includes performing overall system, half-day "Final Authority Acceptance" test(s) for Authority approval.

- K. The Work includes preparing and submitting Closeout Documentation including As-built Plans to the Owner.
- L. The Work includes training Owner's facilities personnel on the operation of the system, required maintenance tasks and frequencies, and the locations of all spare tools and equipment necessary to maintain and operate the system.

1.3 PERFORMANCE REQUIREMENTS

- A. Compliance: Comply with NFPA 20, the California Fire Code, and DSA Guidelines.
- B. Seismic Performance: Fire pumps shall withstand the effects of earthquake motions determined according to NFPA and the California Fire Code.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified (and the unit will be fully operational after the seismic event)."
 - 2. Component Importance Factor: 1.5
- C. Pump, Equipment, Accessory, Specialty, and Piping Pressure Rating: 175-psig minimum working-pressure rating, unless otherwise indicated.

1.4 ORDER OF PRECEDENCE

- A. Should conflicts arise out of discrepancies between documents referenced in this specification, the most stringent requirement shall apply; however, should a level of stringency be indeterminable, the discrepancies shall be resolved as follows:
 - 1. State and local codes shall take precedence over this specification.
 - 2. The National Fire Protection Association Standards shall take precedence over this specification.
 - 3. Drawing specific requirements as documented on the RFP drawing package.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, certified pump performance curves with each selection point indicated, operating characteristics, and furnished accessories and specialties for each fire pump and pressure-maintenance pump. Products may include but are not limited to:
 - 1. Pumps
 - 2. Pump controllers
 - 3. Motor
 - 4. Air-release valves
 - 5. Circulation relief valves
 - 6. Pressure gauges
 - 7. Eccentric reducers
 - 8. Concentric reducers
 - 9. Pressure-maintenance pumps
 - 10. Enclosures

11. Control valves
 12. Sensing lines
 13. Flow meters
- B. Shop Drawings: For fire pumps and drivers, fire-pump controllers, fire-pump accessories and specialties, pressure-maintenance pumps, pressure-maintenance-pump controllers, and pressure-maintenance-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Product Certificates: For each type of fire pump and fire-pump controller, signed by product manufacturer.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For fire pumps and drivers, pressure-maintenance pumps, controllers, accessories and specialties, alarm panels, and flowmeter systems to include in emergency, operation, and maintenance manuals.

1.6 AS-BUILT (RECORD) DRAWINGS

- A. On a daily basis the contractor's superintendent shall record as built conditions on a set of Shop Drawings maintained at the job site. Three sets of Shop Drawings reflecting as built conditions shall be available prior to and for use in the final acceptance test. Two weeks after the acceptance test and before final acceptance of the work, furnish three complete sets of as built drawings. The drawings shall be prepared on uniform sized sheets not less than 36 by 48 inches in size. In addition, provide a USB flash drive containing AutoCAD (Version to be coordinated with Owner) DWG and PDF format of all as built drawings and schematics. The drawings shall include:
1. As built location of all devices and equipment.
 2. As built schematics of electrical service connections
 3. All deviations from the project drawings and approved shop drawings.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire pumps, pressure-maintenance pumps, and controllers through one source from a single manufacturer for each type of equipment.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of fire pumps, pressure-maintenance pumps, and controllers and are based on specific systems indicated.
- C. Equipment and devices shall be labeled and listed for the intended use in the Underwriters Laboratories, Inc. (UL), UL FPED *Fire Protection Equipment Directory*.

- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. All materials and equipment shall be new and unused.
- F. All equipment shall be first quality and capable of complying with all requirements of this specification and shall have been in continuous production and in service in commercial applications for at least one year. Obsolete equipment shall not be used.
- G. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire hydrant flow test or hydraulic supply analysis.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
 - b. Foreman: Provide proof of competence of both their company and the individual foreman that will be assigned to this project, in the area of installing automatic fire sprinkler systems for at least five (5) years and acceptable to Owner. Once assigned, the foreman shall not be changed without the approval of the Owner.
 - c. Service Organization: Capable of providing a service technician on-site within 4 hours of a request for on-site service.
- H. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- I. Comply with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Pad and grouting of the pump base is by others.

1.9 WARRANTY

- A. Guarantee equipment installed to be free from defects in workmanship and inherent mechanical defects for a period of one (1) year from the date of substantial completion of the project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in Section 2.2 C1.

2.2 CENTRIFUGAL FIRE PUMPS

- A. Description, General: UL 448, factory-assembled and -tested, electric-drive, centrifugal fire pumps capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shutoff head limited to 5 percent of total rated head.
 1. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
 2. Nameplate: Complete with capacities, characteristics, and other pertinent data.
- B. Fabricate base and attachment to fire pumps, pressure-maintenance pumps, and controllers with reinforcement to resist movement of pumps and controllers during a seismic event when their bases are anchored to building structure.
- C. Single-Stage, Vertical In-Line Fire Pumps: End suction type with pump and driver mounted on same base and connected with coupling.
 1. Available Manufacturers:
 - a. A-C Pump; ITT Industries.
 - b. Armstrong Darling, Inc.
 - c. Aurora Pump; Pentair Pump Group.
 - d. Fairbanks Morse; Pentair Pump Group.
 - e. Paco Pumps, Inc.
 - f. Patterson Pump Company.
 - g. Reddy-Buffaloes Pump Co.
 - h. Sterling Peerless Pump; Sterling Fluid Systems Group.
 2. Pump: Axially split cast-iron casing with suction and discharge flanges machined to ASME B16.1, Class 125 dimensions, unless otherwise indicated.
 - a. Impeller: Cast bronze of construction to match fire pump, statically and dynamically balanced, and keyed to shaft.
 - b. Wear Rings: Replaceable, bronze.
 - c. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 3. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
 4. Driver: UL-listed, NEMA MG 1, open-drip proof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.
- D. Fire-Pump Characteristics and Specialty Data:

1. The following Fire Pump Criteria will be determined in the design process:
 - a. Rated Capacity: 750 gallons per minute.
 - b. Total Rated Head: 110 pounds per square inch.
 - c. Inlet Size: 6 inch.
 - d. Outlet Size: 6 inch.
 - e. Outlet Flange Class 125.
2. Speed: Same as driver.
3. Electric-Motor Driver: 75 HP, 3600 RPM, 3 Phase, 60 Hz.
4. Test Header Size: 6 inch.
5. Hose Valves Required: 3.
6. Hose Valve Size: NPS 2 ½ inches.

2.3 FIRE-PUMP CONTROLLERS

- A. Fire-Pump Controllers, General: UL 218 and NFPA 20; listed for electric-drive, fire-pump service and service entrance; combined automatic and manual operation; factory assembled and wired; and factory tested for capacities and electrical characteristics. Provide a variable frequency drive to control the speed of the fire pump for the purpose of limiting system pressure in the sprinkler system.
 1. Available Manufacturers:
 - a. Firetrol, Inc.
 - b. Hubbell Industrial Controls, Inc.
 - c. Joslyn Clark.
 - d. Master Control Systems, Inc.
 - e. Metron, Inc.
 2. Rate controllers for scheduled fire-pump horsepower and short-circuit withstand rating at least equal to short-circuit current available at controller location. Take into account cable size and distance from substation or supply transformers.
 3. Enclosure: UL 50, Type 2, drip proof, indoor, unless special-purpose enclosure is indicated. Include manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
 4. Controls, devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used, and specific items listed.
 - a. Isolating means and circuit breaker.
 - b. "Power on" pilot lamp.
 - c. Fire-alarm system connections for indicating motor running condition, loss-of-line power, and line-power phase reversal.
 - d. Automatic and manual operation, and minimum run-time relay to prevent short cycling.
 - e. Water-pressure-actuated switch with independent high and low calibrated adjustments responsive to water pressure in fire-suppression piping.
 - f. Automatic and manual shutdown.
 - g. System pressure recorder, electric ac driven with spring backup.

5. Nameplate: Complete with capacity, characteristics, approvals and listings, and other pertinent data.
6. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous-metal sensing piping, NPS 1/2, with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32-inch orifice in clapper or ground-face union with noncorrosive diaphragm having 3/32-inch orifice.

B. Full-Service Fire-Pump Controllers:

1. Type Starting: Across the line.
2. Mounting: Floor stand type for field electrical connections.

2.4 FIRE-PUMP ACCESSORIES AND SPECIALTIES

A. Match fire-pump suction and discharge ratings as required for fire-pump capacity rating. Include the following:

1. Automatic air-release valve.
2. Circulation relief valve.
3. Suction and discharge pressure gauges.
4. Eccentric-tapered reducer at suction inlet.
5. Concentric-tapered reducer at discharge outlet.
6. Test-Header Manifold: Ductile-iron, cast steel or brass body for hose valves, hemispherical in construction, with sufficient number of 2 1/2" valves, UL listed and capable of the designed flow in gallons per minute.
7. Hose Valves: UL 668, straightway pattern, and bronze. Include NFPA 1963 hose thread that complies with local fire department standards and finish same as for test-header manifold escutcheon plate. Valves will be in place only for pump testing; provide caps for openings when valves are stored.
8. Ball Drip Valve: UL 1726.
9. Finish: Manufacturer's standard factory-applied red paint unless brass or other finish is specified.

2.5 PRESSURE-MAINTENANCE PUMPS

A. Pressure-Maintenance Pumps, General: Factory-assembled and -tested pumps with electric-motor driver, controller, and accessories and specialties. Include cast-iron or stainless-steel casing and bronze or stainless-steel impellers, mechanical seals, and suction and discharge flanges machined to ASME B16.1, Class 125 dimensions unless Class 250 flanges are indicated and except that connections may be threaded in sizes where flanges are not available.

1. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.
2. Nameplate: Complete with capacity, characteristics, and other pertinent data.

B. Regenerative-Turbine, Pressure-Maintenance Pumps: Close-coupled type complying with HI 1.1-1.2 and HI 1.3 requirements for regenerative-turbine centrifugal pumps. Include base.

1. Available Manufacturers:

- a. Aurora Pump; Pentair Pump Group.
 - b. Crane Pumps & Systems, Inc.
 - c. Fairbanks Morse; Pentair Pump Group.
 - d. Grundfos
 - e. MTH Tool Co., Inc.
 - f. Paco Pumps, Inc.
2. Driver: NEMA MG 1, open-drip proof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.
- C. Controllers: UL 508; factory-assembled, -wired, and -tested, across-the-line type for combined automatic and manual operation. Provide a variable frequency drive to control the speed of the fire pump for the purpose of limiting system pressure in the sprinkler system.
- 1. Available Manufacturers:
 - a. Firetrol, Inc.
 - b. Hubbell Industrial Controls, Inc.
 - c. Tornatech
 - d. Joslyn Clark.
 - e. Master Control Systems, Inc.
 - f. Metron, Inc.
 - 2. Enclosure: UL 508 and NEMA 250, Type 2, wall-mounting type for field electrical wiring.
 - a. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.
 - 3. Rate controller for scheduled horsepower and include the following:
 - a. Fusible disconnect switch.
 - b. Pressure switch.
 - c. Hand-off-auto selector switch.
 - d. Pilot light.
 - e. Running period timer.
- D. Accessories and Specialties: Match pressure-maintenance-pump suction and discharge ratings as required for pump capacity rating. Include the following:
- 1. Circulation relief valve.
 - 2. Suction and discharge pressure gauges.
- E. The following Fire Pump Criteria will be determined in the design process. Pressure-Maintenance-Pump Characteristics and Specialty Data:
- 1. Rated Capacity: 7.5 gpm.
 - 2. Total Rated Pressure: 121 psi.
 - 3. Electric-Motor Driver Size: Approximately 1.5 HP, 3 Phase, 60 Hz.

2.6 PRESSURE GAUGES

- A. Description: UL 393, 3-1/2- to 4-1/2-inch- (90- to 115-mm-) diameter dial with range of 0-250 psig (0- to 1725-kPa) (0- to 2070-kPa) minimum. Include caption "WATER" on dial face.
 - 1. Available Manufacturers:
 - a. AGF Manufacturing Co.
 - b. AMETEK, Inc.; U.S. Gauge.
 - c. Brecco Corporation.
 - d. Dresser Equipment Group; Instruments Div.
 - e. Marsh Bellofram.
 - f. WIKA Instrument Corporation.

2.7 GROUT

- A. Description: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

2.8 SOURCE QUALITY CONTROL

- A. Test and inspect fire pumps with their controllers according to NFPA 20 for certified shop tests.
- B. Verification of Performance: Rate fire pumps according to requirements indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, concrete bases, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for fire pumps, pressure-maintenance pumps, and controllers.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch(450-mm) centers around full perimeter of base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Cast-in-place concrete materials and placement requirements are provided by the others.

3.3 INSTALLATION

A. Install and align fire pump, pressure-maintenance pump, and controller according to NFPA 20 and manufacturer's instructions.

B. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Set base-mounting-type pumps on concrete bases. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.

1. Support pump baseplate on rectangular metal blocks and shims or on metal wedges having small taper, at points near anchor bolts, to provide 3/4- to 1-1/2-inch gap between pump base and concrete base for grouting.

2. Adjust metal supports or wedges until pump and driver shafts are level. Verify that coupling faces and pump suction and discharge flanges are level and plumb.

D. Install suction and discharge piping equal to or greater than diameter of fire-pump nozzles.

E. Install valves that are same size as piping connecting fire pumps, bypasses, test headers, and other piping systems.

F. Install pressure gauges on fire-pump suction and discharge at pressure-gauge tappings.

G. Support pumps and piping separately so weight of piping does not rest on pumps.

H. Install piping accessories, hangers and supports, anchors, valves, meters and gauges, and equipment supports.

I. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical installer.

3.4 ALIGNMENT

A. Align split-case fire-pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.

B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.

C. Align piping connections.

- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.
- E. Align vertically mounted, split-case pump and driver shafts after complete unit has been made plumb on concrete base, grout has set, and anchor bolts have been tightened.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect controllers to pumps.
- D. Connection of the fire-pump controllers to building fire-alarm system is by the Electrical Contractor.
- E. Ground equipment according to the California Fire Code and NFPA 70.
- F. Connect wiring according to the California Fire Code and NFPA 70.
- G. All drain lines are to be piped to the nearest floor drain. Discharge onto the floor will not be accepted.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
- B. Perform field tests for fire pump when installation is complete. Comply with operating instructions and procedures in NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or that does not perform as indicated, then retest to demonstrate compliance. Verify that each fire pump performs as indicated.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Final Checks before Startup: Perform the following preventive-maintenance operations and checks:
 - a. Lubricate oil-lubrication-type bearings.
 - b. Remove grease-lubrication-type bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
 - c. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.

- d. Verify that pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.
3. Starting procedure for pumps is as follows:
 - a. Prime pump by opening suction valve and closing drains and prepare pump for operation.
 - b. Open sealing-liquid supply valves if pump is so fitted.
 - c. Start motor.
 - d. Open discharge valve slowly.
 - e. Observe leakage from stuffing boxes and adjust sealing-liquid valve for proper flow to ensure lubrication of packing. Do not tighten gland immediately but let packing run in before reducing leakage through stuffing boxes.
 - f. Check general mechanical operation of pump and motor.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Contractor is responsible for proper disposal of water if large quantities are required.
 5. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Fire hoses are for field-acceptance tests only and are not property of Owner.

3.7 DEMONSTRATION

- A. Final acceptance test:
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps, drivers, controllers, and pressure-maintenance pumps.

END OF SECTION 213113

SECTION 220000

PLUMBING

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Work included in Division 22 Plumbing: Provide all materials, equipment, fabrication, installation and tests as noted in Contract Documents in conformity with applicable codes and authorities having jurisdiction.
- B. Related Sections
 - 1. All work in every Section must also comply with such general conditions of the specifications as are applicable, including, but not limited to
 - a. Instructions to Bidders
 - b. General Conditions
 - c. Special Conditions
 - d. Supplementary Conditions
 - e. Division 1 General Requirements
 - 2. Section 01120 LEED® Requirements, provisions of LEED® environmental categories and credits and submittal requirements
 - 3. Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation. See also Coordination Table in Section 230501 Basic Mechanical Materials & Methods.
- C. Related Work Specified Elsewhere
 - 1. Commissioning: See Section 019100 Commissioning
 - 2. Utilities five feet beyond building line unless noted otherwise: See Division 33 Utilities
 - 3. Underground de-watering piping: See Division 31 Earthwork
 - 4. Irrigation piping: See Division 32 Exterior Improvements
 - 5. Pre-cast concrete planter boxes and site drainage structures: See Division 3 Concrete
 - 6. Structural steel (except as specified herein): See Division 5 Metals
 - 7. Miscellaneous lumber and framing work, such as for framing, soffits and support of mechanical materials and equipment: See Division 6 Wood, Plastics, and Composites
 - 8. Scupper downspout overflow drains: See Division 7 Thermal and Moisture Protection
 - 9. Painting: See Division 9 Finishes
 - 10. Accessories including soap dispenser: See Division 10 Specialties

1.2 REFERENCE STANDARDS

- A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.
- B. Work shall be performed in accordance with all applicable requirements of the latest edition of all governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not.

- C. Requirements of Regulatory Agencies
1. In accordance with the requirement of Division 1 General Requirements
 2. Nothing in contract documents shall be construed to permit work not conforming to current and applicable laws, ordinances, rules and regulations.
 3. When contract documents exceed requirements of applicable laws, ordinances, rules and regulations, comply with documents establishing the more stringent requirement.
 4. It is not the intent of contract documents to repeat requirements of codes except where necessary for completeness or clarity.
 5. Seismic construction and restraints: In accordance with requirements of Title 17 of California Administrative Code.
 6. Comply with the Safety Orders issued by California Occupational Safety and Health Act, COSHA and any other safety, health or environmental regulations of the State of California and any districts having jurisdictional authority. Where an omission or conflict appears between COSHA requirements and the Drawings and Specifications, COSHA requirements shall take precedence.
 7. Applicable codes as listed below, in addition to others specified in individual sections
 - a. CEC – California Electrical Code
 - b. CBC – California Building Code
 - c. CMC – California Mechanical Code
 - d. CPC – California Plumbing Code
 - e. City and County Codes and Amendments
 - f. California Code of Regulations, including Titles 8, 17, 19, 20, 21, 22 and the California Building Standards Code Part 2, Basic Building Regulations.
- D. Published specifications, standards, tests or recommended method of trade, industry or governmental organizations as listed below apply to all work in Division 22 Plumbing, in addition to other standards which may be specified in individual sections.
- E. All base material shall meet ASTM and ANSI standards
- F. All Pressure Vessels, Relief Valves, Safety Relief Valves and Safety Valves: Comply with standards, ASME stamped
- G. All Electrical Devices and Wiring
1. Conform to standards of CEC/NEC
 2. All devices UL or ETL listed and identified
- H. Guidelines and Standards: The latest edition of guidelines and standards published by the following groups will govern the Mechanical Systems and associated support system design. The systems shall be designed to meet or exceed these guidelines and standards.

AGA	American Gas Association
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWS	American Welding Society
COSHA	California Occupational Safety and Health Act
ETL	Intertek Semko (Formerly Electrical Testing Laboratories)
GISO	General Industry Safety Orders
HI	Hydraulic Institute
IEEE	Institute of Electrical and Electronic Engineers

NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
OSHPD	Office of Statewide Health Planning and Development
PDI	Plumbing and Drainage Institute
SFA	California State and Local Fire Marshall
UL	Underwriters' Laboratories, Inc.

1.3 QUALITY ASSURANCE

- A. Supply all equipment and accessories in compliance with the applicable standards listed in Paragraph 1.2 and with all applicable national, state and local codes.
- B. All equipment and accessories shall be new and the product of a manufacturer regularly engaged in its manufacture.
- C. All items of a given type shall be the products of same manufacturer.
- D. All work in Division 22 Plumbing shall be commissioned. See Section 019100 Commissioning and Section 220800 Plumbing Commissioning.

1.4 SUBMITTALS

- A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformity with the design intent and the Contractor has responded to all comments to the satisfaction of the Owner's Representative.
- B. Submit drawings, product data, samples and certificates of compliance required as hereinafter specified.
 - 1. See also Division 1 Shop Drawings, Product Data and Samples. Conditions in this Section take precedence over conditions in above referenced Section.
 - 2. Provide submittals promptly in accordance with schedule and in such sequence as to cause no delay in work or in work of any other division.
 - 3. It is not required (nor desired) for all products to be submitted concurrently. Rather, submittals may be staggered based on schedule and required equipment release dates.
 - 4. Allow 15-working days for review, unless the Owner's Representative agrees to accelerated schedule.
 - 5. For substitutions, list any features or characteristics that are not strictly in compliance with specifications. If none are listed with the submittal, Contractor is guaranteeing that substituted product is functionally equivalent to the specified product in accordance with Paragraph 1.6.
 - 6. Submittal reviews by the Owner's Representative are intended to assist the Contractor in complying with the design intent and requirements of the drawings and specifications. Reviews do not relieve the Contractor from compliance with these requirements, and comments or lack thereof do not constitute approval of changes in these requirements.
- C. Submission and Resubmission Procedure
 - 1. Each submittal shall have a unique serial number that includes the associated specification section followed by a number for each sub-part of the submittal for that specification section, such as "SUBMITTAL 220000-01"

2. Each resubmittal shall have the original unique serial number plus unique revision number such as "SUBMITTAL 220000-01 REVISION 1"
3. Submit in format specified below. Submissions made in the wrong format will be returned without action.
 - a. Product Submittals: One copy in word-searchable electronic format per Paragraph 1.5A.4.c.
 - b. Shop Drawings:
 - 1) One copy in electronic format .dwg, .dwf, .pdf or .tif
 - 2) Two and only two copies on paper; any additional copies will not be returned
 - c. Samples: As indicated in each specification section
4. Owner's Representative will return a memo or mark-up of submittal with comments and corrections noted where required.
5. Make corrections
 - a. Revise initial submittal to resolve review comments and corrections.
 - b. Indicate any changes that have been made other than those requested.
 - c. Clearly identify resubmittal by original submittal number and revision number.
6. Resubmit revised submittals until no exceptions are taken.
7. Once submittals are accepted and stamped with no exceptions taken, provide
 - a. Complete submittal of all accepted products in a single electronic file for each specification section.
 - b. Photocopies for coordination with other trades, if and as required by the General Contractor or Owner's Representative.

D. Product Data Submittals

1. Contents
 - a. Manufacturer's name and model number
 - b. All information required to completely describe materials and equipment and to indicate compliance with drawings and specifications, including, but not limited to:
 - 1) Schedule when more than one of each item is covered by submittal
 - 2) Physical data, as applicable
 - a) Dimensions
 - b) Weight
 - c) Finishes and colors
 - d) Dimensional shop drawings
 - 3) Performance data, as applicable
 - a) Rated capacities
 - b) Performance curve
 - c) Operating temperature and pressure
 - 4) Flow and wiring diagrams as applicable
 - 5) Description of system operation
 - c. All other pertinent information requested in individual sections
2. Format
 - a. See Division 1 Shop Drawings, Product Data and Samples
 - b. Identify clearly if submittal is substitution: Refer to Paragraph 1.6
 - c. Reference specification Division, Section, Title, Paragraph and Page number or drawing number as applicable
 - d. Use same nomenclature, legend, symbols and abbreviations on submittal material as used in contract documents

E. Layout Shop Drawings. See Section 230501 Basic Mechanical Materials and Methods.

F. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table. "R" means required.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Drains and cleanouts	R	R		R
Plumbing pipe and fittings	R	R		R
Plumbing fixtures and trim	R	R		R
Insulation	R	R		
Trap primers	R	R		R
Plumbing valves	R	R		R
Water heating equipment	R	R		R
Water sterilization	R	R		R

1.5 COMPLETION REQUIREMENTS

A. Procedure

1. Until the documents required in this section are submitted and approved, the system will not be considered "accepted"
2. Before requesting acceptance of work, submit one set of Completion Documents for review and approval of Owner's Representative
3. After review, furnish quantity of sets indicated below to Owner
4. Format
 - a. See Paragraph 1.5F for required format of Completion Documents
 - b. Paper copies; assemble in chronological order following alpha-numeric system used in specification, in heavy three-ring binder
 - c. Where electronic copies are called for in Paragraph 1.5F, comply with the following:
 - 1) Provide in word-searchable electronic format; acceptable formats are MS Word, Adobe Acrobat (pdf) and HTML; submit other formats for review and approval prior to submission; scanned paper documents not acceptable
 - 2) For submittals, provide separate file for each type of equipment
 - 3) Record drawings shall be in AutoCAD version 2000 or later.

B. Operating and Maintenance (O&M) Manual

1. In accordance with requirements of Division 1 Operating and Maintenance and as follows
2. O&M Manual shall include but is not limited to the following
 - a. Complete Product Data Submittals per Paragraph 1.4 so that the details of the device are known
 - b. Manufacturer's name, model number, service manual, spare-parts list and descriptive literature for all components
 - c. Operating instructions
 - d. Maintenance and repair requirements
 - e. Wiring diagrams
 - f. Requirements for special tools, test kits and calibration instructions
 - g. Replacement parts list
 - h. Name, address and phone number of contractor's equipment suppliers and service agencies

C. Record Drawings

1. Keep up-to-date during progress of job, one set of reproducible and erasable transparencies of Mechanical Drawings indicating the Record installation. In addition to changes made during course of Work, show following by dimension from readily obtained base lines
 - a. Fully illustrate all revisions made by all crafts in course of work

- b. Include all field changes, adjustments, variances, substitutions and deletions, including all Change Orders
 - c. Exact location, type and function of concealed valves, dampers, controllers, piping, air vents and piping drains
 - d. Exact size, invert elevations and location of underground and under floor piping and ducts
2. Progress drawing set shall be available for inspection by Owner's Representative weekly
 3. Update shop drawings and record drawings to reflect revisions and additional data listed above at completion of Project
 - a. Original engineering design drawings will be provided to Contactor in electronic format compatible with AutoCAD version 2000 or higher
 - b. Both shop and record drawings shall be in format compatible with AutoCAD version 2000 or later

D. Commissioning & Training

1. See Section 220800 Plumbing Commissioning

E. Miscellaneous Certificates

1. Pressure Test documentation/certificates
2. Training/Instruction completion certificates
3. Fire Marshal and Fire Department approvals of system, as required
4. Final inspection certificate signed by governing authorities
5. Warranty period, including start and end period
6. Field test report, including as applicable
 - a. Start up documents with date and name of technician
 - b. Piping pressure tests
 - c. Flex coupled pump alignment verification
 - d. Letters from manufacturers certifying their supervision of equipment installation and start-up procedures
 - e. Machinery vibration test reports where specified
 - f. Certificates of sterilization/chlorination of plumbing systems
 - g. Others as specified herein

F. Format of Completion Documents

1. Provide the type and quantity of media listed in table below
2. Optical media shall be readable on Operator Workstation: See Section 250000 Building Automation Systems
3. Where indicated in table, the electronic files shall be stored on the BAS systems' Operator Workstation. See Section 250000 Building Automation Systems

	Document	Paper (binder or bound)	Electronic	
			Read only optical disk	Loaded onto Operator Workstation
1.	O&M Manuals	3	1	1
2.	Record Drawings	2 Full size 2 Half size	1	1
3.	Commissioning Reports	5	1	–
4.	Miscellaneous Certificates	1	–	–
5.	Warranty documents	1	–	–
6.	Training materials	1 per trainee	1	1

1.6 SUBSTITUTIONS AND PRODUCT OPTIONS

A. Contractor's Options

1. For products specified only by functionality and/or reference standard, select product meeting that functionality and/or standard, by any manufacturer.
2. For products specified by manufacturer and model number
 - a. Where "Or Equal" lists specific alternative manufacturers including specific model numbers, any of these specific products may be selected and will not be considered a substitution.
 - b. Where "Or Equal" lists specific alternative manufacturers but no specific model numbers
 - 1) Functionally equivalent products by listed alternative manufacturers may be selected.
 - 2) Functionally equivalent products by manufacturers not listed may be selected but may be rejected by Owner's Representative for any reason if there is any question with respect to functional equivalency including unfamiliarity with manufacturer and local representation.
 - 3) Functional equivalent products to the product specified are those that
 - a) Are equal or better in quality, function, capacity, efficiency, serviceability, local support, etc.
 - b) Fully meet the product specifications unless otherwise approved by the Owner's Representative
 - c) Meet site and application constraints including but not limited to size, weight, appearance, and clearance requirements.

B. Substitution Requirements

1. Where substitutions are proposed for products indicated in design documents, the Contractor shall take full responsibility for coordinating with others the requirements of the proposed substitution including but not limited to:
 - a. Adequate space, including service access space
 - b. Power and other electrical connections
 - c. Pads or other equipment supports
 - d. Control devices and interfaces
2. Include all costs for redesign and other work required by all disciplines affected by a substitution.

1.7 DESCRIPTION OF BID DOCUMENTS

A. Specifications

1. Specifications, in general, describe quality and character of materials and equipment
2. Specifications are of simplified form and include incomplete sentences
3. Words or phrases such as "The Contractor shall," "shall be," "furnish," "provide," "a," "an," "the," and "all" have often been omitted for brevity

B. Drawings

1. Drawings in general are diagrammatic. Intention is to show size, capacity, approximate location, direction and general relationship of one work phase to another, but not exact detail or arrangement.
2. Scaled and figured dimensions are approximate and are for estimating purposes only. Indicated dimensions are limiting dimensions where noted. Duct and piping elevations are indicated for initial coordination; final requirements shall be determined by the Contractor after final coordination with other trades.
3. Before proceeding with work check and verify all dimensions in field.

4. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
 5. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom and avoid architectural openings, structural members and work of other trades.
 6. For exact locations of building elements, refer to dimensional Architectural and Structural drawings.
- C. Do not use equipment exceeding dimensions indicated on drawings or equipment or arrangements that reduce required clearances or exceed specified maximum dimensions.
- D. If any part of Specifications or Drawings appears unclear or contradictory, apply to Owner's Representative for an interpretation and decision as early as possible.
1. Do not proceed with work without the decision of the Owner's Representative.

1.8 DEFINITIONS

- A. Definitions of term used in Division 22 Plumbing may differ from those given in general and supplementary conditions and take precedence over them.
- B. "Provide": to furnish, supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically noted.
- C. "Supply": to purchase, procure, acquire and deliver complete with related accessories.
- D. "Work": labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation.
- E. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and related items.
- F. "Wiring": raceway, fittings, wire, boxes and related items.
- G. "Concealed": embedded in masonry or other construction, installed in furred spaces, within double partitions, above hung ceilings, in trenches, in crawl spaces, or in enclosures.
- H. "Exposed": not installed underground or "concealed" as defined above.
- I. "Indicated," "shown" or "noted": as indicated, shown or noted on drawings or specifications.
- J. "Reviewed," "approved," or "directed": as reviewed, approved, or directed by or to Owner's Representative.
- K. "Motor Controllers": starters, variable speed drives, and other devices controlling the operation of motors.
- L. "Control or Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

1.9 PROJECT CONDITIONS

- A. Examine site related work and surfaces before starting work of any Section
1. In case of conflict, the most stringent takes precedence
 2. For purposes of clarity and legibility, Drawings are essentially diagrammatic to extent that many offsets, bends, unions, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Especially note a number of required duct and pipe offsets to coordinate with structure and not shown. Coordinate dimensioned conditions, including invert elevations, with other trades prior to installation by any trade.
 3. Exact routing of piping, ductwork, etc. shall be governed by structural conditions, obstructions. Not all offsets in ductwork or piping are shown on the Mechanical Drawings. Determine which item to offset or relocate. Maintain required slope in piping. Make use of data in Contract Documents. In addition, Owner's Representative reserves right, at no additional cost to the Owner, to make any reasonable change in location of mechanical items, exposed at ceiling or on walls, to group them into orderly relationships or increase their utility. Verify Owner's Representative's requirements in this regard prior to rough-in.
 4. Take dimensions, location of doors, partitions, similar physical features from Architectural Drawings. Verify at Site under this Division. Consult Architectural Drawings for exact location of outlets to center with Architectural features, panels, etc., at the approximate location shown on mechanical Drawings.
 5. Mounting heights of brackets, outlets, etc., as required
 6. Report to Owner's Representative, in writing, conditions which will prevent proper provision of this work
 7. Beginning work of any Section without reporting unsuitable conditions to Owner's Representative constitutes acceptance of conditions by Contractor
 8. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to the Owner
- B. Coordination
1. Work out all "tight" conditions involving Work specified under this Division and Work in other Divisions in advance of installation. If necessary, and before Work proceeds in these areas, prepare supplementary Drawings under this Division for review showing all Work in congested area. Provide supplementary Drawings, additional Work necessary to overcome congested conditions, at no additional cost to the Owner.
 2. Conflicts: Difference or disputes concerning coordination, interference or extent of Work between sections shall be decided as follows
 - a. Install mechanical and electrical systems in the following order of preference (those trades listed below another must reroute to resolve the conflict):
 - 1) Drain piping required by code to be sloped
 - 2) Supply air and exhaust air ductwork connected to fans
 - 3) Electrical conduit 4 inches and larger
 - 4) Hydronic piping connected to pumps
 - 5) Domestic water piping
 - 6) Fire sprinkler piping
 - 7) Electrical conduit smaller than 4 inches
 - 8) Sprinkler piping
 - 9) Transfer ducts and other ductwork not connected to fans
 - 10) Control system piping and wiring
 - b. Continued disputes shall be decided by Contractor and Contractor's decision, if consistent with Contract Document requirements, shall be final.
 3. Supervision: Personally or through an authorized and competent representative, constantly supervise the work from beginning to completion and, within reason, keep the same foreman and workmen on the Project throughout the Project duration.
 4. Provide templates, information and instructions to other Divisions to properly locate holes and openings to be cut or provided.

5. The drawings govern in matters of quantity, and the specifications govern in matters of quality. In the event of conflict within the drawings involving quantities, or within the specifications involving quantities, or within the specifications involving quality, the greater quantity and higher quality shall apply. Such discrepancies shall be noted and clarified in the Bid. No additional allowances will be made because of errors, ambiguities, or omissions that reasonably should have been discovered during the preparation of the Bid.

C. Equipment Rough-In

1. Rough-in locations shown on Drawings for equipment furnished by the Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from following sources
 - a. From Shop Drawings for equipment provided under this contract
 - b. From Owner's Representative for Owner furnished-Contractor installed equipment
 - c. From existing equipment where such equipment is relocated under this Contract
2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on Drawings obtain clarification from Owner's Representative and provide as directed by the Owner's Representative at no additional cost to the Owner.
3. Make final connections

1.10 CLEARANCE FROM ELECTRICAL EQUIPMENT

A. Piping

1. Prohibited, except as noted, in
 - a. Electric rooms and closets over equipment, as restricted by CEC
 - b. Telephone rooms and closets
 - c. Elevator machine rooms
 - d. Electric switchboard room
2. Prohibited, except as noted, over or within 5 feet of
 - a. Transformers
 - b. Substations
 - c. Switchboards
 - d. Motor control centers
 - e. Standby power plant
 - f. Bus ducts
 - g. Electrical panels

1.11 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. See Division 1 Product Requirements
- B. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Provide protective coverings during construction.
- C. Handle and ship in accordance with manufacturer's recommendations
- D. Identify materials and equipment delivered to Site to permit check against approved materials list, reviewed with no exceptions taken Shop Drawings

- E. Protect from loss or damage. Replace lost or damaged materials and equipment with new at no additional cost to the Owner
- F. Where necessary, ship in crated sections of size to permit passing through available space

1.12 PROJECT MANAGEMENT AND COORDINATION SERVICES

- A. See Division 1 Project Coordination
- B. Overview: Provide a project manager/engineer for the duration of the Project to coordinate the Division 22 Plumbing work with all other trades. Coordination services, procedures and documentation responsibility shall include, but shall not be limited to the items listed in this section.
- C. Review of shop drawings prepared by other subcontractors
 1. Obtain copies of all shop drawings for equipment provided by others that require electrical service connections or interface with Division 22 Plumbing work.
 2. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 22 Plumbing contract documents. Document any discrepancy or deviation as follows:
 - a. Prepare memo summarizing the discrepancy
 - b. Provide a copy of the specific shop drawing, indicating via cloud, the discrepancy
 3. Prepare and maintain a shop drawing review log indicating the following information
 - a. Shop drawing number and brief description of the system/material
 - b. Date of your review
 - c. Indication if follow-up coordination is required
- D. Request for information (RFI)
 1. See Division 1 Request For Information

1.13 REVIEW OF CONSTRUCTION

- A. Work may be reviewed at any time by the Owner's Representative
- B. Advise Owner's Representative that work is ready for review at following times:
 1. Prior to backfilling buried work
 2. Prior to concealment of work in walls and above ceilings
 3. When all requirements of Contract have been completed
- C. Neither backfill nor conceal work without Owner's Representative's consent.
- D. Maintain on job set of Specifications and Drawings for use by Owner's Representative's
 1. Include all change orders.
- E. Contractor is responsible for construction methods, sequences and safety precautions

1.14 CUTTING AND PATCHING

- A. See Division 1 Cutting, Patching and Matching

1.15 UTILITY CONNECTIONS

- A. See Paragraph 1.1C.2
- B. Connection to utility company mains
- C. Connection to on-site piping mains
- D. Payment of service charges
- E. Provisions for temporary utilities
- F. Provide concrete pads, stainless steel pipe supports, anchors and stainless steel caged enclosures for connections to exterior pressure regulating valve assemblies and exterior backflow preventer assemblies provided by utility company or provided under this section of work. Installation of pads, supports, anchors and enclosures shall be per the requirements of the authority having jurisdiction or the utility company.

1.16 WARRANTY

- A. In accordance with Division 1 Guarantees, Warranties, Bonds, Service & Maintenance Contracts and as follows
- B. Warranty all materials, equipment, apparatus and workmanship to be free of defective materials and faulty workmanship for period of one year from date of filing of Notice of Completion or upon beneficial use, at the direction of the Owner's Representative.
- C. Provide new materials, equipment, apparatus and labor to replace that determined by Owner's Representative to be defective or faulty
- D. This guarantee also applies to services including instructions, adjusting, testing, noise, balancing, etc.
- E. Furnish Manufacturers' standard Warranties in excess of one year

PART 2 PRODUCTS

2.1 PLUMBING FIXTURES

- A. All fixtures are subject to review and approval by the Architect
- B. Vitreous china fixtures shall be twice fired white vitreous china.
- C. All plumbing fixtures shall be certified by and comply with the State of California Energy Commission (CEC) water conservation regulations and CalGreen.
- D. All fixtures for handicapped personal shall be mounted in accordance with the California Code of Regulations, Title 24, handicapped regulations.
- E. Seal up joints between fixtures and wall or floor with white mastic.

- F. Provide tubing supplies, traps, pipe flanges and wastes to wall of not less than #17 gauge polished chromium-plated brass. Unless noted otherwise, supplies and traps shall be centered, plumb, and perpendicular to wall for lavatories and sinks.
- G. Water Closets (WC-1 and WC-1H): Toto CT708UV(G), or equal, wall mounted, vitreous china water closet, ECOPOWER Ultra High-Efficiency (1.1 gpf) flush valve. Water closet seat shall be Bemis, Church, or equal, white plastic seat with self-sustaining check hinge. Water closets marked WC-1H are for handicapped personnel.
 - 1. Water Closet Carriers: Adjustable combination wall closet fitting and chair carrier, Watts ISCA Series, Zurn, or equal.
- H. Lavatories (LV-1): SloanStone Series Sink model ELGR 8X000 Gradient Style Sink or equal, wall mount per manufacturers recommendations; Toto Model #TEL1A3-D20E series Libella ECOPOWER sensor faucet (0.20 GPC) with ASSE 1070 certified mixing valve, Provide McGuire or equal; grid strainer, polished chrome cast brass tailpiece, trap, and McGuire hot and cold water supply stop valves. LV-1H units shall be mounted in accordance with ADA accessibility guidelines. Provide floor mounted fixture carrier
- I. Lavatories (LV-2): Kohler K-2005 "Kingston", American Standard, or equal. Wall mounted vitreous china; Toto Model #TEL1A3-D20E series Libella ECOPOWER sensor faucet (0.20 GPC) with ASSE 1070 certified mixing, Provide McGuire or equal; grid strainer tailpiece, offset waste, trap, and McGuire hot and cold water supply stop valve. Provide floor mounted fixture carrier. Mount at ADA height.
- J. Lavatory (LV-3): Kohler K-2882-0 "Verticyl Rectangle", American Standard, or equal undermount sink. Toto Model #TEL1A3-D20E series Libella ECOPOWER sensor faucet (0.20 GPC) with ASSE 1070 certified mixing valvem, Provide McGuire or equal; grid strainer tailpiece, offset waste, trap, and McGuire hot and cold water supply stop valve.
- K. Sink (SK-1): Elkay ELUHAD211550 stainless steel 23 1/2"x18 1/4" x 4 7/8" single bowl undermount ADA sink with Chicago Faucet 1100-GN2AE35-317AB hot and cold water sink faucet with wrist blade handles, gooseneck spout, 1.5 gpm aerator, ceramic disc operating cartridges and faucet with polished chrome finish. Provide McGuire crumb cup strainer, tailpiece, insulated offset waste, supply stop valves and trap. Entire assembly shall be, be mounted in accordance with ADA accessibility guidelines.
- L. Sink Staff Lounge and Library Classroom (SK-2): Elkay LRADQ312255 or equal: Self rimming Laney Plumb counter mount with overall dimensions of 31" left to right; 22" front to back, 18 gauge, type 304 stainless steel with full undercoating, off centered drain opening and crumb-cup strainer and tailpiece. Sink shall be complete with Chicago Faucet 1100-GN2AE35-317AB hot and cold water sink faucet with wrist blade handles, gooseneck spout, 1.5 gpm aerator, ceramic disc operating cartridges and faucet with polished chrome finish. Provide McGuire crumb cup strainer, tailpiece, insulated offset waste, supply stop valves and trap. Entire assembly shall be mounted in accordance with ADA accessibility guidelines.
 - 1. Provide piping rough-ins and connections to dishwashers, coffee machines, refrigerator ice makers.
 - 2. Provide a fully accessible wall cleanout inside the base cabinet for sink.
- 1. Provide sinks with InSinkErator Badger 5 Food Waste Disposer, continuous feed, with 1/2 H.P. motor, galvanized steel grinding elements with two stainless steel 360 degree swivel lugs and Self service wrench.
- M. Shower Valve (SH-1H): Symmons 6701-EX-L/HD-L/HS Shower/Hand shower trim, Powers or equal, complete with Symmons 352SH-3-1.5 shower head – 1.5 gpm flow restrictor,

261XBODY-CHKS pressure balancing shower valve with integral check stops, temperature limit stop screw, lever handle, and 1/2" IPS connections, ADACHS hand spray unit (1.5 GPM) with minimum 60" long flexible stainless steel hose, wall hook and wall connection with in-line vacuum breaker. Diverter valve included for toggling between hand shower and shower head.

Provide all interconnecting piping within the wall. Entire assembly shall be located on the wall as shown on the Architectural drawings. Entire assembly shall be installed and shall comply with State of California Accessibility Guidelines.

- 1) Grab bars, benches, soap dishes, and shower receptors will be furnished and installed under another Division.

- N. Service Sinks (SSK): Florestone, Fiat, or equal, 24"x 24"x10" high, pre-cast terrazzo with acid resisting tiling flanges cast-in, brass drain cast in center with chromium plated removable open grid strainer, and stainless steel caps integrally cast in on exposed ledges. Receptor shall be reinforced throughout. Install cast iron hub & spigot p-trap below floor. Faucet shall be Chicago 897 faucet, polished chrome plated, with wall brace, integral stops, hose spout with pail hook and vacuum breaker. Mount faucet on wall 3'-0" above bottom of receptor.
- O. Drinking Fountain (DF): Haws H1119.14, Elkay, or equal, dual height, wall mounted, all 18-gauge type 304 stainless steel with No.4 satin finish, and complete with common single piece back plate, bubblers, automatic stream controls, dual push buttons, traps and screwdriver stops, vandal-proof bottom access plates, wall box, and all necessary mounting accessories and devices. Back plate shall be absolutely true and each shall be secured with concealed fasteners.

2.2 DRAINS AND CLEANOUTS:

- A. Zurn, Wade or as noted, or equal
- B. Floor Drains, (FD-1): Z415 with 6" diameter adjustable nickel-bronze strainer, with cast iron body, clamping device and double drainage flange. Except for shower drains, provide cast iron p-trap with 1/2" primer tap.
- C. Floor Drains, (FD-2): Z556, cast iron body with clamping device, 1/2" trap priming connection, and double drainage flange, with heavy duty tractor strainer, 1/2" trap primer, 7" diameter strainer. All exposed components shall be nickel-bronze.
- D. Floor Sinks, (FSK): cast iron floor sink with acid-resisting porcelain enameled interior, internal dome, nickel bronze frame. Set frame flush with the finished floor. All floor sinks shall be provided with a 1/2" trap primer connection.
 1. FSK: Zurn 1900, rectangular 12" x 12" x 6" deep, with 1/2" grate
- E. Roof Drain, (RD-1): Zurn Z-121-R-C or equal 12" diameter coated cast iron body with combination membrane flashing clamp / gravel guard, cast iron low silhouette dome strainer, underdeck clamp, sump receiver flange.
- F. Roof Overflow Drain, (OD-1): Zurn Z-121-R-C or equal 12" diameter coated cast iron body with combination membrane flashing clamp / gravel guard, 2" high dam, internal dome strainer, underdeck clamp.
- G. Roof Drain, (RD-2): Zurn Z125 8 3/8" diameter or equal, Dura-Coated cast iron body with combination membrane flashing clamp/gravel guard and low silhouette Poly-Dome.

- H. Roof Overflow Drain, (OD-2): Zurn Z125-89 with 2" high external water dam, 8 3/8" diameter or equal, Dura-Coated cast iron body with combination membrane flashing clamp/gravel guard and low silhouette Poly-Dome.
- I. Cleanouts: Z1440A, cast iron body or equal, sealed with raised head bronze threaded plug, shall be complete with cast iron body, raised head bronze threaded plug.
- J. Wall Cleanouts (WCO): Z1445-4 or equal, smooth chromium-plated bronze access cover and frame. Unit shall be complete with a cleanout assembly and smooth chromium-plated bronze access cover and frame. Provide wall cleanout to serve each urinal
- K. Floor Cleanout (FCO): Z1400 or equal, floor level cleanout with round top , cast iron body with clamp ring and flange, neoprene seal, bronze threaded plug and scoriated nickel-bronze cover. Heavy duty cleanouts shall be provided in all parking garage levels, loading dock and garage ramp areas.
- L. Cleanout to Grade (COTG): Z1400 or equal, cast iron floor cleanout with round heavy-duty scoriated cast iron tractor cover.
- M. Furnish suitable wrenches for each style of cleanout plug or cap.
- N. All floor drains and floor sinks shall be trapped, primed and vented.
- O. All floor drains, floor sinks and floor cleanouts in areas with epoxy flooring or a similar float-on finish shall have integral extended flange, same material and drain body to receive the epoxy or similar flooring. Contractor shall confirm locations with the Architect.

2.3 SHOCK ABSORBERS

- A. Wade, MIFAB, or equal
- B. Provide complete with a line size shut-off valve.
- C. Size of units shall be per PDI (Plumbing and Drainage Institute) Standards

2.4 TRAP PRIMERS

- A. MIFAB, or equal
 - 1. 3 psi pressure drop actuated type.
 - 2. Provide complete with a line size shut-off valve and union.
 - 3. Trap priming provisions shall be provided for all floor drains.
- B. Zurn P6000-TPO, or equal
 - 1. Flush valve type, complete with 1-1/2" flush tube with trap primer collar, spud coupling and flange for top spud connection. 3/8" x 12" supply tube and fittings, vacuum breaker, vacuum breaker tube and wall nut and wall escutcheon.

2.5 ICE MAKER BOXES (IM) (FOR REFRIGERATORS WITH ICEMAKERS):

- A. Guy Gray Mfg. Co. Model BIM875, 18-gauge steel box and cover complete with compression outlet.
- B. Refer to Architectural Drawings for locations.
- C. Water supply to each box shall include a fully accessible shut-off valve.

2.6 (HB-1, HB-2) HOSE BIBBS

- A. HB-1, Wall Hydrants: Zurn Z1320XL or equal, Encased Ecolotrol, lead free automatic draining wall hydrant for flush installation. Hydrant features integral backflow preventer with anti-siphoning technology, copper casing, all bronze interior components with ½ turn long-life ceramic disc cartridge, combination ¾" female solder and ¾" male pipe thread inlet connection, and ¾" male hose connection. Hydrant furnished with type 304 stainless steel housing with locking hinged cover stamped "WATER" and includes operating key. Install accessible ball valve in each wall hydrant supply which is not otherwise controlled by other local shut-off valve.
- B. HB-2, Hot and Cold Wall Faucet: Zurn Z1348-BFP or equal, exposed non-freeze anti-siphon dual hot/cold wall faucet complete with automatic draining hose connection backflow preventer, exterior chrome finish, brass casing, all bronze interior parts, operating rod with spring-loaded compression closure valve, replaceable seat washer, combination ½" female solder inlet and ½" male IP inlet connections standard, and ¾" male hose connection.

2.7 THERMOSTATIC MIXING VALVES

- A. Sinks – Watts or equal; Series LFMMV unit
- B. Install inside within base cabinet

2.8 WATER HEATING EQUIPMENT

- A. (EWH) Electric Water Heater
 1. A.O. Smith model DRE-80-40.5, State, or equal
 2. Electric tank type water heater rated at 40.5 kW, 480V, 3 ph. Complete with ASME rated drain valve, T and P valve. Water heater shall be certified and listed by the State of California Energy Commission and ASME rated.
 3. Refer to Equipment Schedule on drawings.
 4. Provide a Holdrite 40-S-24-A or equal 24" x 24" galvanized support stand assembly below water heater units. The Contractor shall arrange and pay for a licensed Structural Engineer in the State of California to provide structural calculations for support of the electric water heater .
 5. Provide Holdrite or equal, heater restraints. Provide wall backing to receive restraints and mounting hardware.
 6. Provide a Smitty or equal drain pan. Provide drain piping from pan outlet and terminate to spill over floor sink
 7. The Contractor shall arrange and pay for a licensed Structural Engineer in the State of California to provide structural calculations for seismic restraints of water heater.
- B. Hot Water Circulating Pump
 1. As specified on Plumbing Equipment Schedule.

2. Domestic Hot Water Circulating Pump: Shall be Grundfos, or acceptable equivalent, lead free, all bronze in-line, with 120V, single phase motor, complete with mechanical seals, resilient mounting, and threaded connections.
3. Pump shall be controlled by BMS.

C. Hot Water Expansion Tank

1. Watts DETA-20 or equal with pre-charged fixed butyl bladder. Tank shall be constructed in accordance with Section VII of the ASME Boiler and Pressure Vessel Code.

2.9 PIPE MATERIALS AND JOINING SYSTEMS:

A. Sanitary Waste and Vent Piping Below Grade

1. Pipe shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with cell class 12454 as identified in ASTM 1784. PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785 and ASTM D 2665. Injection molded PVC DWV fittings shall conform to ASTM D 2665. All pipe and fittings shall be manufactured in the United States. All systems shall utilize a separate waste and vent system. Pipe and fittings shall conform to NSF International Standard 14. Solvent cement joints shall be made in a two-step process with primer conforming to ASTM F 656 and solvent cement conforming to ASDT D 2564. Below grade pipe shall be supported from underside of slab.

B. Sanitary Waste and Vent Piping Above Grade

1. ASTM A74A and CISPI 301 standard weight cast iron soil pipe and fittings. All piping & fittings shall have a standard rust inhibiting coating and shall carry the CISPI mark.
2. Couplings
 - a. Waste Piping: Husky 2000 or 4000 No-Hub Couplings, or equal, type 304 stainless steel couplings with neoprene gasket.
 - b. Vent Piping: Husky Standard No-Hub Couplings, or equal, type 301 stainless steel couplings with neoprene gasket.

C. Rainwater Leader, Storm Drain, and Overflow Drain Piping: Same as for sanitary soil, waste, and vent piping. Insulate overhead horizontal runs of exposed pipe.

D. Trap Priming, Hot and Cold Water Piping:

1. Piping above Slab on Grade: Type "L" copper tubing and wrought copper sweat type fittings per ANSI B16-22, ASTM B 813 and ASTM B 828. Solder shall be lead free.
2. Piping above Slab on Grade: Type "L" copper tubing and wrought copper sweat type fittings per ANSI B16-22, ASTM B 813 and ASTM B 828. Solder shall be lead free.
3. Piping below Grade (Main Cold Water Service): Type "K" copper tubing and wrought copper sweat type fittings and brazed joints. Copper tubing and fittings shall be per ANSI B16-22, ASTM B 813 and ASTM B 828. Copper tubing and fittings below grade shall be wrapped within 8 mil thick polyethylene tubing.
4. Piping below Slab on Grade (Trap Priming): Type "K" copper tubing and wrought copper sweat type fittings and brazed joints. Copper tubing and fittings shall be per ANSI B16-22, ASTM B 813 and ASTM B 828. Copper tubing and fittings below grade shall be wrapped within 8 mil thick polyethylene tubing.

E. Condensate Drain Piping: Type "M" copper tubing and wrought copper sweat type fittings.

- F. Relief Valve and Indirect Drain Piping: Type "M" copper tubing and wrought copper sweat type fittings.
- G. Piping System Accessories
- H. Piping system components shall be selected for maximum design operating pressure based on static head and pressure relief valve setting.
- I. Reduced Pressure Backflow Preventer (Main Domestic Cold Water):
 - 1. Watts Model 375, or equal
 - 2. Main body and access cover shall be epoxy coated ductile iron (ASTM 536), the seat ring and check valve shall NORYL, the stem shall be stainless steel (ASTM 276) and the seat disc elastomers shall be EPDM. The checks and relief valve accessible for maintenance without removing the device from the line.
- J. Reduced Pressure Backflow Preventer (Mechanical Make-up Water):
 - 1. Watts Model 975XL2, or equal
 - 2. Main body and access cover shall be low lead bronze (ASTM B 584), the seat ring and internal polymers shall NORYL and the seat disc elastomers shall be silicon. The first and second checks shall be accessible for maintenance without removing the relief valve from the line.
- K. Strainers:
 - 1. Watts LF777, or equal
 - 2. Unleaded bronze "Wye -pattern" body to match piping material
 - 3. Perforated stainless screen, size of perforations to suit service
 - 4. Provide valve with lead free hose bib adapter with cap for all strainers
 - 5. Provide strainers at the inlet to all hot water circulating pumps and pressure reducing valves
- L. VALVES
 - 1. Ball Valves
 - a. 3 inches and smaller
 - 1) Copper silicon
 - 2) 316 SS trim
 - 3) Two piece body
 - 4) Standard port
 - 5) 600 pounds per square inch water on gage (WOG) at 100 degree F, 150 pounds per square inch saturated steam
 - 6) Equal to Watts
 - 7) Threaded - LFB6000
 - 8) Soldered - LFB6001
 - b. 4 inches and larger: Not used
- M. Check Valves
 - 1. Check Valves, Water Service
 - a. 3 inches and smaller
 - 1) Swing check
 - 2) 200 psig @ 250 degree F water
 - 3) Brass disc
 - 4) Screw-in cap
 - 5) Soldered ends
 - 6) Equal to Milwaukee

- a) Soldered - UP968
- b. 4 inches and larger
 - 1) Swing Check
 - 2) Class 125 (125 psi steam, 200 psi water)
 - 3) Regrinding bronze disc
 - 4) Bolted cap
 - 5) Flanged body
 - 6) Equal to Nibco F-918-8 and suitable for potable water service

- N. Point of Use Thermostatic Mixing Valves at Domestic Water Faucets
 - 1. Zurn,ZW1070XL or equal, ASSE 1070 listed, minimum flow of 0.35 GPM with check stops and strainers. At SK units shall be installed against back inside wall of cabinet. For lavatories install along wall.
- O. Safety Relief Valves
 - 1. Size: ASME Code
 - 2. Similar to Watts No. LF140
 - 3. Lead free
 - 4. Adjustable
- P. WATER METERS
 - 1. Water meter supplied by Division 25 BAS, installed by Division 22. See plans for location.

2.10 MISCELLANEOUS

- A. Pipe Supports:
 - 1. Cooper B-Line, Superstrut, or equal (Provide type 316 Stainless Steel for below grade installation)
 - 2. Where pipe is insulated, protect insulation at hangers by installing a 22 gauge shield and clamp sized to allow pipe insulation to pass continuously through the hanger.
 - 3. For all hot water piping, provide 360 degree high density calcium silicate insert within shield.
- B. Equipment Connections: At a minimum, provide at all equipment connections:
 - 1. Isolation valves and union for each connection
 - 2. Drains with ball valve and hose connection with cap
- C. Escutcheons: Provide chromium steel escutcheons at piping penetrations of walls where exposed public view and required for proper appearance. Provide galvanized steel escutcheons at penetrations of masonry walls elsewhere. Escutcheons not generally required at drywall penetrations where not exposed to public view.
- D. Sleeves:
 - 1. Provide sleeves where pipes pass through floors above grade, roofs, poured-in-place masonry walls, and exterior walls.
 - 2. Sleeves shall be standard weight steel pipe, except sleeves for concealed piping through floors not in structural members may be 25-gauge galvanized sheet metal.
 - 3. Floor sleeves for piping shall extend from the bottom of the slab to 2-inches above the finished floor.
 - 4. Seal between piping and sleeve with fire-rated caulk at all penetrations of fire-rated partitions and floors.

5. Make sleeves through outside walls watertight. Caulk between uninsulated pipe and sleeve.
6. Size sleeves for insulated pipes to allow full thickness insulation.
7. Coordinate with the requirements of the Structural Engineer regarding any sleeves/penetrations through any structural members. Submit proposed penetrations for Structural Engineer review and approval prior to the Shop Drawing Submittal.

E. Water Proof Sleeve Assembly (WSA):

1. Calpico Pipe Linx Model CSL-SSS with 316 grade stainless steel pressure plate.
2. Calpico Wall Sleeve model C-PWS with 2" water stop.

F.

G. Thermometers

1. Weksler, Ashcroft, or equal
2. Stainless steel construction and range of 30 °F to 240 °F

2.11 VIBRATION ISOLATION

A. Manufacturers

1. Vibration Isolation:
 - a. Mason Industries, Inc.
 - b. Kinetics Noise Control, Inc.
 - c. M.L. Saussé & Co. (Vibrex).
 - d. Or equal
2. Seismic Restraints:
 - a. Hangers: Any manufacturer who can verify compliance with SMACNA standards and the California Building Code
 - b. Strut: Channel Framing: Any manufacturer who can verify compliance with the CBC standards
 - c. Anchors: Drill in, wedge type: Any manufacturer within the ICBO standards approved for seismic
 - d. Snubbers: Any manufacturer within the CBC standards

B. Piping Isolation for Noise Control

1. Isolate water piping from structure with Acousto-Plumb System isolators, holders and guides for 1-inch and smaller.
2. Isolate waste pipes and water pipes larger than 1-inch with B-Line B3195 Isolator System components
3. Do not allow the piping, connectors and valves to directly touch the structure, studs, gypsum board, or other pipes

2.12 ANCHORS, INSERTS AND FASTENERS:

A. All anchors and inserts shall be installed according to the CBC standards

B. Do not use any anchor or insert in concrete which does not have a signed structurally engineered design value based on its installed application and one of the following:

1. ICC evaluation report
2. Lab test report verifying compliance

- C. All over-head concrete anchors or inserts shall be selected to comply with the ICC report or CBC table for the anchor or insert
- D. Torque testing of anchors shall be allowed to verify compliance of anchor installation. However, torque testing shall not justify usability of anchor. Only load or pull testing shall be allowed to justify usability of anchors. Failure of torque shall constitute failure of anchor.
- E. Bolts and nuts:
 - 1. Bolts and heavy hexagon nuts: ANSI B18.2.1 and ASTM A307 or A576
 - 2. Bolts, underground: ASTM A325, stainless steel
 - 3. Expansion anchors: Federal Specification A-A-1922

2.13 INSULATION

- A. Manufacturers
 - 1. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
 - 2. Insulation: fiberglass
 - a. Owens-Corning Fiberglass Corporation
 - b. Manville
 - c. Certaineed Corporation
 - d. Knauf
 - e. Or equal
 - 3. Insulation: Elastomeric Closed Cell:
 - a. Armstrong World Industries, Inc.
 - b. Rubatex Corp.
 - c. Or equal
 - 4. Adhesives
 - a. Foster Div. Amchem Products Inc.
 - b. Childers Products Company
 - c. Epolux Mfg. Corporation
 - d. Insul-Coustic/Birma Corporation
 - e. Armstrong 520 Adhesive
 - f. Or equal
 - 5. Mechanical Fasteners
 - a. AGM Industries, Inc.
 - b. Miracle Adhesives Corporation
- B. General
 - 1. Energy Codes: The current versions of California Title 24 and California Building Code shall govern where requirements for thickness exceeds thickness specified
 - 2. All insulation materials, including jackets, facings, adhesives, coatings, and accessories are to be fire hazard rated and listed by Underwriters' Laboratories, Inc., using Standard UL 723 (ASTM E-84), (NFPA-255), (ASA A2.5-1963)
 - 3. Flamespread: maximum 25
 - 4. Fuel contributed and smoke developed: maximum 50
 - 5. Flameproofing treatments subject to deterioration from moisture or humidity are not acceptable
 - 6. Insulation and accessories shall not provide any nutritional or bodily use to fungi, bacteria, insects, rats, mice, or other vermin, shall not react corrosively with equipment, piping or ductwork, and shall be asbestos free: Duct lining shall meet ASTM C1136 and ASTM C665 for biological growth in insulation

C. Materials

1. Pipe Insulation
 - a. Fiberglass:
 - 1) Molded: one piece, maximum 0.26 K factor at 75 degrees Fahrenheit mean temperature
 - 2) Equal to Owens-Corning ASJ/SSL-II Pipe Insulation
 - b. Flexible, closed cell elastomeric thermal insulation
 - 1) Insulation ASTM C534
 - 2) Service rating of 220 degrees Fahrenheit
 - 3) Density 6.0 pounds per cubic foot
 - 4) Closed cell foam: Vapor permeability ASTM E96 0.2 perm
 - 5) Max moisture absorption: 1.0 percent by volume, 10 percent by weight
 - 6) Molded pipe insulation
 - a) Maximum 0.27 K factor at 75 degrees Fahrenheit mean temperature
 - b) Maximum water vapor transmission rating of 0.17 perm-inches
2. Jackets
 - a. Factory Applied Vapor Barrier All Service Jacket (ASJ)
 - 1) ASTM C921, White kraft paper bonded to aluminum foil and reinforced with glass fiber yarn
 - 2) Moisture Vapor Transmission: ASTM E96; 0.02 perm inches
 - 3) Secure with self-sealing longitudinal laps and butt strips
 - 4) Secure vapor barrier mastic
 - 5) Tie Wire: minimum 16 gauge copper clad annealed steel wire with twisted ends on maximum 12 inch centers
 - 6) Vapor Barrier Lap Adhesive: Compatible with insulation
 - b. Aluminum Jacket: ASTM B209:
 - 1) Use for weatherproof jacket
 - 2) Thickness: 0.016 inch sheet
 - 3) Finish: Embossed
 - 4) Joining: Longitudinal slip joints and 2 inch laps
 - 5) Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner
 - 6) Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel
 - c. Preformed PVC
 - 1) Polyvinylchloride covers similar to Manville "Zeston."
 - 2) Color: white
3. Preformed Pipe Fitting Covers:
 - a. Aluminum
 - 1) Factory fabricated formed covers
 - 2) Equal to General Aluminum Supply Corp. GASCO
 - 3) Exposed insulation: Insulation exposed to weather shall be protected by a smooth or corrugated aluminum jacket or colored plastic jacket approved for outdoor installation, minimum 0.016 inch thick, secured 3" on center, overlapped at joints and sealed watertight.

2.14 SEISMIC RESTRAINTS

A. General:

1. Capable of safely accepting indicated external forces without failure
2. Maintain equipment and piping in a captive position
3. Seismic design Criteria:

4. See Note CD-5 on sheet S1.01 of the structural package for the current code requirements.
 5. Provide seismic restraints to meet the more stringent requirements of the CBC or the local building code.
 6. Restraints shall not short-circuit vibration isolation systems under normal operation.
 7. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning, or uplift of Plumbing equipment, and piping. Restraints shall meet requirements of the CBC.
- B. Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this section:
1. CBC – California Building Code
 2. CPC - California Plumbing Code
- C. Seismic load calculations for piping:
1. Calculations required for supports and bracing for situations not covered by referenced "Guidelines" and any revisions to seismic load calculations provided in contract documents at time of bid.
 2. Include horizontal and vertical reaction loads at connections to building structures for all seismic restraints, including those covered by referenced "Guidelines." Coordinate reaction loads and attachment details with structural engineer for building.
 3. Calculations made and signed by registered structural engineer knowledgeable in seismic design:
 - a. Hired under this Section of work
 - b. Cost of calculations borne under this Section
 - c. Refer to 4/S4.21 for pad detail/ calculations. Refer to 10/S5.10 7 7/S5.01 for hanger connection to slab detail/calculations. Refer to PSBD1.01 and PSBD1.02 for attachment details.
 4. Bracing system: One of the following methods as most applicable for each brace:
 - a. Material used, except for pipes, shall be structural steel with ASTM A36. Steel pipes shall conform to ASTM A501
 - b. Complete system of factory fabricated components
 - c. Complete system of job fabricated components
 - d. Miscellaneous metal structural shapes

2.15 BACKFLOW PREVENTERS

- A. Watts LF009, Zurn Model 375, or equal, lead free reduced pressure device
- B. Each unit shall be complete with upstream lead free strainer, check valves, relief valve, ball valves, and test cocks. Furnish and install air gap drain funnel at each reduced pressure device, connect drain piping full size, and terminate over drain provisions as noted on plans.
- C. All units shall be listed on the list of approved devices.
- D. Contractor shall arrange and pay for device certification per the Authority Having Jurisdiction.

PART 3 EXECUTION

3.1 PROTECTION OF WORK DURING CONSTRUCTION

- A. Protect from damage, water, dust, etc., material, equipment and apparatus provided under this Division, both in storage and installed, until Notice of Completion has been filed.
- B. Provide protective covers, skids, plugs or caps to protect equipment and materials from damage and deterioration during construction. Cover motors and other moving machinery to protect from dirt and water during construction.
- C. Material, Equipment or Apparatus:
 - 1. Material, equipment or apparatus damaged because of improper storage or protection will be rejected.
 - 2. Remove damaged material, equipment or apparatus from site and provide new, duplicate, material, equipment or apparatus in replacement of that rejected.
 - 3. Porous materials, such as pipe insulation, shall be protected from weather. If such material becomes wet during construction, it shall be removed and replaced at no cost to Owner; drying is not sufficient due to possible microbial contamination.

3.2 INSTALLATION AND WORKMANSHIP

- A. All equipment and material shall be installed in a neat and workmanlike manner.
- B. Repair all damaged or temporarily removed walls, roofs, roofing, equipment, etc.
- C. Follow manufacturer's installation instructions and recommendations.
- D. All equipment must be anchored to the building. All hung equipment shall incorporate vibration isolation.

3.3 PIPING

- A. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leak resistant piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes where indicated by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.
- B. Wherever possible, piping shall be run in beam bays before offsetting to below a beam.
- C. Verify all invert elevations and pitched lines before starting work.
- D. Coordinate all pipe runs below structural slab at first floor with the Structural Engineer. Offset piping over top of grade beams/footings; vertical penetrations of structural foundation members is not permissible.
- E. Provide insulating couplings or dielectric unions at all connections of ferrous piping to non-ferrous piping.

3.4 VALVES

- A. For valves in multiple parallel runs of piping, provide 4" clearance between valve handle and adjacent pipe, or insulation. Install valve handles in horizontal position between pipes. Do not install valve handles on top of pipe.
- B. Install valves in accordance with manufacturer's written installation instructions
- C. Provide valves as shown on drawings
- D. Provide all valves (except control valves), strainers, and check valves of same size as the pipes in which they are installed unless otherwise indicated
- E. Pressure rating of valves same as piping in which installed
- F. Install valves with stems upright or horizontal, not inverted
- G. Install valves with cast directional arrows in direction of flow
- H. Support line valves at the valve in addition to regularly spaced pipe supports shown and specified
- I. Check valves:
 - 1. Provide silent check valves at discharge of pumps. Install swing checks and gravity closing lift checks in horizontal position.
- J. Provide blow-down ball valves and hose adaptors at strainers, air separators, tanks, pipe traps, equipment drains, etc. of same size as strainer blow-off connection
- K. Provide drain valves at main shut-off valves, low points of piping and apparatus
- L. Locate wheel handles to clear obstructions with hand
- M. Install valves only in accessible locations
- N. Wherever possible, install valves accessible from floor level. Provide guided chain operators on valves over 7 feet above floor in equipment areas. Extend chains to within 6 feet 6 inches of floor.
- O. Locate equipment shut-off valves to be accessible without climbing over equipment
- P. Provide operating handles for all valves and cocks without integral operators, unless otherwise noted. Provide adequate clearance for easy operation
- Q. Provide open-ended line valves with plugs or blind flanges

3.5 PIPE INSULATION SCHEDULE

- A. Insulation Application Types
 - 1. Type P-2:
 - a. Molded Fiberglass
 - b. All-service jacket
 - c. Provide calcium silicate inserts for all pipe sizes
 - 2. Type P-3: Flexible elastomeric insulation

B. Application Schedule

<u>Service</u>	<u>Type</u>	<u>Size</u>	<u>Thickness</u>
Domestic Hot Water (All piping from water heaters to each point of use)	P-2	All	Per Title 24 for circulated systems minimum.
Sanitary waste piping serving air-gap assemblies (including underside of drain bodies) within 10 feet of receiving condensate or indirect waste from ice makers	P-3	All	1/2 inch
Condensate drains	P-3	All	1/2 inch
Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities	P-3	All	1/2 inch

C. Non-insulated piping and equipment

1. Vent, overflow, drain and relief, except as noted otherwise

3.6 PIPE INSULATION INSTALLATION

- A. Install materials in accordance with manufacturer's instructions
- B. Coordinate with work of other trades
- C. Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness
- D. Install insulation where it cannot become wet. If insulation becomes wet, remove and dispose of properly and replace with new, dry insulation. Wetted insulation is not acceptable. Ensure insulation is dry before and during installation.
- E. Insulate all piping, valves, fittings, flanges and accessories
- F. Provide calcium silicate inserts for all pipe sizes and all types of supports
- G. Insulate fittings, joints and valves with insulation of same material and thickness as adjoining pipe. Use pre-molded fiberglass fitting covers or radial mitered segments of pipe insulation. For strainers, expansion joints, fittings and accessories requiring servicing or inspection insulation shall be removable and replaceable without damage. Enclose within two-piece no. 15 gauge aluminum covers fastened with cadmium-plated bolts and nuts.
- H. Insulate flanges with insulation sleeve of same material as pipe insulation to cover flange and overlap insulation on adjacent piping
- I. Continue insulation through walls, sleeves, pipe hangers and other pipe penetrations

- J. Finish insulation at supports, protrusions and interruptions. No hangers or supports shall be embedded in insulation.
- K. Elastomeric Tubing
 - 1. Provide insulation
 - 2. Butt edges neatly. Seal longitudinal and transverse joints with adhesive to maintain minimum vapor permeance. Adhesive shall be selected and applied in accordance with insulation manufacturer's recommendations.
 - 3. Apply additional jacket as specified
- L. Perform work at ambient and equipment temperatures as recommended by adhesive manufacture
- M. Protection: Protect against dirt, water, chemical, or mechanical damage before, during, and after installation. Repair or replace damaged insulation at no additional cost

3.7 VIBRATION ISOLATION

- A. Installation:
 - 1. Install isolators and seismic restraints in accordance with manufacturer's written instructions
 - 2. Make no rigid connections between equipment and building structure that degrade noise and vibration isolation system herein specified:
 - a. Electrical conduit connections to isolated equipment shall be flexible liquid tight conduit of sufficient length to incorporate a right angle bend, an offset of not less than 8 inches or a loop to allow free motion of isolated equipment
 - b. The Plumbing Sub-contractor shall not install any equipment, piping or conduit which makes rigid contact with the "building" unless permitted in this Specification. Building includes, but is not limited to, slabs, beams, columns, studs and walls
 - c. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce the vibration isolation.
- B. Piping Isolation:
 - 1. Isolate water piping from structure with Acousto-Plumb System isolators, holders and guides for 1-inch and smaller.
 - 2. Isolate waste, rainwater leader, pipes and water pipes larger than 1-inch with Holdrite Silencer System components or equal.
 - 3. Wall and Floor Penetrations: Do not allow the piping, connectors and valves to directly touch the structure, studs, gypsum board, or other pipes All piping to be isolated shall freely pass through walls and floors without rigid contacts or connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork, and maintain 0.75 inches to 1.25 inches clearance around the pipe or duct outside surfaces:

3.8 CLEANING

- A. During construction:
 - 1. Keep openings in piping closed to prevent entrance of foreign matter.
 - 2. Clean pipe, fittings and valves internally.

- B. Clean plumbing fixtures with soap and water. Remove marks and labels. Clean and polish chrome. Remove paint, concrete, plaster and other foreign materials.
- C. Clean all drains, and traps, of dirt and debris.
- D. Remove shipping paper from cleanout covers and drain strainers and polish.
- E. Remove and clean out all dirt and debris from pipe spaces, including all wire, and blocking.
- F. All equipment and materials furnished by this Section shall be completely dust and paint free, clean and rust free and freshly painted or polished when the final inspection is made.
- G. Thoroughly clean and flush interior and exterior of all piping systems (wet systems, and drainage systems) of any nature of all pipe contaminates such as cuttings, fillings, grease, solder, flux and welding residue.

3.9 STERILIZATION

- A. Aquatect. or equal
- B. At the completion of testing and adjusting, and before domestic water systems are put into use, they shall be sterilized. Perform the entire disinfection procedure under the supervision of the Authority Having Jurisdiction. Until sterilization of the domestic water system has been made, all water outlets shall have signs posted at their locations stating the water system has not been sterilized and shall not be used for human consumption. The Plumbing Contractor shall furnish and install all valves, outlets, and devices required by the sterilization sub-contractor to complete the sterilization work.

3.10 EXCAVATING, TRENCHING, AND BACKFILLING

- A. Perform all excavating, trenching, removal of surplus material, and backfilling required for installation of material and equipment under this Section. Provide and maintain dewatering pumps as required. Any rock excavation and disposal shall be included in Base Bid price.
- B. Minimum bury depths, safety and installation requirements shall concur with the Authority Having Jurisdiction.

3.11 EQUIPMENT AND PIPING IDENTIFICATION

- A. Equipment:
 1. All plumbing equipment shall be identified by nameplates securely fastened in a clearly visible location to the equipment housing or frame. Nameplates shall include the equipment design plan mark and brief description of the area or system served, such as: "Water Softener Building A". Nameplates shall be 2-1/2" x 3/4" minimum, either 1/16" thick Bakelite with engraved white core letters and beveled edge, or aluminum with black enameled background and etched or engraved natural aluminum lettering
 2. Manufacturer's nameplate shall be clean and legible and installed in a clearly visible location.
- B. Piping:

1. Identify piping with symbol identification, direction of flow arrows and specific pressure zones, complying with ANSI A 13.1 color standards.
2. Identify piping at approximately 25' centers where unconcealed. Concealed piping above inaccessible ceilings shall be identified at each access panel. Concealed piping above accessible ceilings shall be identified within 10 feet of each wall penetration (both sides of walls).
3. Where capped piping is provided for future connections, provide legible and durable metal tags indicating symbol identification.
4. Printed labels with colored background and attaching strap: Seton, W. Brady, or equal.
5. Apply in accordance with manufacturer's instructions

C. Buried Utility Warning and Identification Tape

1. Seton, Brady, or equal
2. Polyethylene plastic tape manufactured specifically for warning and identification of buried pipe lines. Code and letter coloring shall be permanent, unaffected by moisture and other substances contained in trench backfill material.
3. Install tape 12" above top of pipe during backfilling of trench.

3.12 LEAKAGE TESTING

- A. Before conducting tests, valve-off or disconnect any equipment and apparatus which may be damaged by the test pressures higher than normal working pressures. All testing shall be witnessed by the Authority Having Jurisdiction.
- B. Sanitary Soil, Waste, and Vent Piping: Hydrostatically test and prove tight, to provide a minimum 10 foot head of water, and in accordance with the governing plumbing code.
- C. Domestic Hot and Cold Water Piping: Test and prove tight under 150 PSI hydrostatic pressure.
- D. Trap Primer Piping: Test and prove tight under 50 PSI hydrostatic pressure.

3.13 TESTING AND ADJUSTING

- A. Adjust all faucets and outlets.
- B. Demonstrate correct operation of all water heating equipment
- C. Adjust temperatures of water heating equipment.
- D. Demonstrate correct operation of thermostatic mixing valves
- E. Demonstrate correct operation of trap priming devices.
- F. Assist in the testing and adjusting of equipment furnished and installed under other Divisions, but served and connected under this section

END OF SECTION

SECTION 230501

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

- A. Work included: Materials, equipment, fabrication, installation, starting, testing and commissioning in conformance with applicable codes and authorities having jurisdiction for Mechanical Work covered by all sections within this Division including, but not limited to
 - 1. Heating, ventilating and air conditioning systems and equipment

- B. Related Sections
 - 1. All work in every Section must also comply with such general conditions of the specifications as are applicable, including, but not limited to
 - a. Instructions to Bidders
 - b. General Conditions
 - c. Special Conditions
 - d. Supplementary Conditions
 - e. Division 1 General Requirements
 - 2. Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation. This section is provided to assist Contractor in coordination of work scope but shall not be construed to limit Contractor's scope of work encompassed by the contract documents.
 - 3. Coordination with other Trades: The following table is intended to assist the Contractors in coordinating the scope of work between Division 23 HVAC (indicated as 23 in table), Division 25 Building Automation Systems (indicated as 25), and other Divisions as indicated. However, the General Contractor is ultimately responsible for coordination among his subcontractors regardless of what is listed in this Section.

INTERFACE / RESPONSIBILITY MATRIX					
System	Division under which the following is specified				Remarks
	Equipment	Installation	Power wiring (remark 1)	Control & interlock wiring (remark 1)	
A. FIRE SPRINKLER SYSTEM					
1. Flow switches	21	21	26	26	
2. Valve monitors	21	21	26	26	
3. Post indicating valves	21	21	26	26	
B. FIRE & LIFE SAFETY SYSTEMS					
1. Fire alarm controls and UUKL atrium smoke controls	28	28	26/ 28	28	
2. Duct mounted & in-duct mounted smoke detectors	28	23	28	28	

INTERFACE / RESPONSIBILITY MATRIX					
System	Division under which the following is specified				Remarks
	Equipment	Installation	Power wiring (remark 1)	Control & interlock wiring (remark 1)	
3. Other smoke detectors	28	28	28	28	
4. Smoke control interlocks to HVAC fans	28	28	28	28	2
5. Smoke dampers with electric actuators	23	23	26	28	
6. Smoke damper end switches	23	23	-	28	
C. MECHANICAL EQUIPMENT					
1. Variable speed drives, field mounted	23	26	26	25 /28	3, 7
2. Motors, 3 phase	23	23	26	-	
3. Motor starters, 3 phase	26	26	26	25 /28	4, 7
4. Motors, 1 phase	23	23	26	26	5, 6, 7
5. Other powered equipment	23	23	26	25	
6. Disconnects/circuit breakers	26/ 23	26/ 23	26	- /28	8, 9
D. BUILDING AUTOMATION SYSTEM (BAS)					
1. Central control workstations & servers	25	25	26	25	
2. Control system network backbone	25	25	25	25	
3. Line voltage control devices to 120V motors	25	26	26	26	6
4. Window switches	25	25	-	25	
5. Control panels	25	25	26	25	10
6. Control devices	25	25	25	25	
E. ELECTRICAL SYSTEMS					
1. Lighting Control BACnet gateway	26	26	26	25	11
2. Lighting relay panels and low voltage switches	26	26	26	26	
3. Lighting occupancy sensors	26	26	26	26	
4. Daylighting sensors and controls	26	26	26	26	
5. Power monitoring sensors and gateway	26	26	26	26/25	12
F. EMERGENCY POWER SUPPORT SYSTEMS					
1. Muffler	26	26	-	-	
2. Exhaust piping	26	26	-	-	
3. Radiator cooling	26	26	-	-	
4. Generator monitoring and alarm points	26	26	-	25	13
5. Generator fuel system	26	26	26	-	
G. IRRIGATION SYSTEM					
1. Controllers	32	32	26	32	
2. Control valves	32	32	32	32	
3. Flow meters	32	32	32	32	
H. PLUMBING SYSTEMS					
1. Condensate drains including traps, primers	22	22	-	-	14
2. Condensate pumps	-	-	-	-	

INTERFACE / RESPONSIBILITY MATRIX					
System	Division under which the following is specified				Remarks
	Equipment	Installation	Power wiring (remark 1)	Control & interlock wiring (remark 1)	
3. Make-up water to hot/chilled/condenser water including backflow prevention	22	22	-	-	15
4. Water flow meters	25	22	25	25	
5. Recirculation pumps	22	22	26	25	
6. Pipe gauges, thermometers, test plugs	22	22	-	-	
7. Self-powered valves, pressure relief valves, liquid level controllers, etc.	22	22	-	-	
8. Sensor wells, meters and other pipe-mounted control devices	25	22	25	25	
I. HVAC HYDRONIC SYSTEMS					
1. Pipe gauges, thermometers, test plugs	23	23	-	-	
2. Self-powered valves, pressure relief valves, liquid level controllers, etc.	23	23	-	-	
3. Automatic isolation and control valves	25	23	25	25	
4. Sensor wells, meters and other pipe-mounted control devices	25	23	25	25	
J. HVAC SHEET METAL					
1. Duct mounted sensors	25	23	25	25	
2. Filter gauges	25	25	-	-	
3. Control dampers	23	23	-	-	16
4. Control damper actuators	25	25	25	25	16
K. HVAC TERMINAL BOXES					
1. Terminal box control transformer panel	25	25	26	25	10, 17
2. Terminal box with damper	23	23	-	-	
3. Digital controller and damper actuator	25	25	25	25	
4. Air-flow measurement pickup	23	23	-	-	
5. Air-flow measurement transducer and piping	25	25	25	25	
6. Wall sensor module	25	25	25	25	
L. MISCELLANEOUS					
1. Plumbing utilities 5 feet beyond building interior wall line	33	33	-	-	
2. CHW and HW utilities outside building interior wall line	33	33	-	-	
3. Roofing, including cant strips and counterflashing at the sides of roof curbs	7	7	-	-	
4. Thermal and acoustical insulation in and on partitions and ceilings	7	7	-	-	
5. Undercutting of doors and door louvers	8	8			
6. Louvers	8	8	-	-	

INTERFACE / RESPONSIBILITY MATRIX					
System	Division under which the following is specified				Remarks
	Equipment	Installation	Power wiring (remark 1)	Control & interlock wiring (remark 1)	
7. Concrete housekeeping pads, piers, pedestals and inertia base fill etc. for equipment.	3	3	-	-	18
8. Equipment, ductwork, and piping steel supports and frames	23	23	-	-	
9. Grates and railings protecting mechanical shaft and other floor openings	5	5	-	-	
10. Curbs at rooftop units, fans, duct/vent penetrations, and piping penetrations	23	23	-	-	19
11. Painting	9/23	9/23	-	-	20
12. Coring or cutting wall and floor openings for ductwork and piping	23	23	-	-	
13. Fire-stopping and acoustic caulking around pipe and duct penetrations in floors and walls	23	23	-	-	
14. Fire rated enclosures where shown around ducts	9	9			
15. Framing of walls and ceilings to accept air outlets, fire dampers, etc.	9	9	-	-	21
16. Ceiling and wall access doors and panels	8	8	-	-	22
NUMBERED REMARKS:					
<ol style="list-style-type: none"> 1. Wiring includes raceway, fittings, wire, boxes and related items, all voltages. 2. Wiring and controls to start and stop fans based on smoke detector status and smoke control logic specified under Division 26 Electrical. 3. Where drive is used for CBC 909 atrium life safety system fan, input to drive to force drive to preset speed specified under Division 23 HVAC; wiring to life safety system specified under Division 26 Electrical. 4. Integral starter control devices such as HOA switches, 120V control transformers specified under Division 26 Electrical. 5. Single phase 120V motors with integral motor overload protection specified under Division 23 HVAC. 6. Line voltage control device such as thermostat or switch specified under Division 25 BAS; wiring and conduit between control device and motor specified under Division 26 Electrical. 7. Fire and life safety control systems, status devices (such as fan status switches and voltage-available relays), start/stop relays and associated wiring and conduit specified under Division 26 Electrical. Identification of mechanical equipment termination contact locations by Division 23 HVAC. 8. Disconnect status where required to be monitored for CBC 909 atrium smoke control systems specified under Division 26 Electrical. 9. Disconnects or circuit breakers are specified under Division 23 HVAC where specifically called for in equipment schedules or specifications to be factory installed with equipment. Otherwise all disconnects are specified under Division 26 Electrical. 10. 120V power to BAS control panels is specified under Division 26 for the panels shown on Drawings. 					

INTERFACE / RESPONSIBILITY MATRIX					
System	Division under which the following is specified				Remarks
	Equipment	Installation	Power wiring (remark 1)	Control & interlock wiring (remark 1)	
<p>Power to all other control panels that may be required is specified under Division 25 BAS, coordinated with Division 26 contractor for available circuits.</p> <p>11. Lighting control vendor to provide all necessary technical assistance to Division 25 BAS Contractor in mapping across lighting control points to the BAS.</p> <p>12. Power measuring sensors, installation and wiring to a single central controller with BACnet/IP interface specified under Division 26 Electrical. BACnet/IP gateway and network connection from gateway to BAS specified under Division 25 BAS. Power monitoring control vendor to provide all necessary technical assistance to Division 25 BAS Contractor in mapping across power monitoring control points to the BAS.</p> <p>13. Generator monitoring sensors and central controller with Modbus gateway specified under Division 26 Electrical. Gateway and network connection from gateway to BAS specified under Division 25 BAS. Generator vendor to provide all necessary technical assistance to Division 25 BAS Contractor in mapping across monitoring control points to the BAS.</p> <p>14. Condensate piping from condensate pans to the sewer system including trap and final connections is specified under Division 22 Plumbing. Piping from auxiliary drain pans where provided at fan-coils is specified under Division 23 HVAC.</p> <p>15. Domestic make-up water, including shut-off valve, backflow prevention, rough-in and final connection to hot water, chilled water, and any other HVAC systems requiring make-up water is specified under Division 22 Plumbing.</p> <p>16. Duct access doors required for access to control devices where required specified under Division 23 HVAC.</p> <p>17. Control transformers for terminal boxes shall be centralized in control panels specified under Division 25 BAS.</p> <p>18. Shop drawings showing dimensions of all curbs, bases, etc. specified under Division 23 HVAC.</p> <p>19. Shims to level curb specified under Division 6. Curb insulation specified under Division 23 HVAC.</p> <p>20. Painting of exposed piping, HVAC equipment, etc. per Paragraph 3.7 specified under Division 23 HVAC. All other painting specified under Division 9.</p> <p>21. Additional T-bar or spline and cut ceiling tile as required to accept air outlets is specified under Division 9.</p> <p>22. Dimensioning of access doors to mechanical equipment and coordination with Architect and Division 8 specified under Division 23.</p>					

1.2 REFERENCE STANDARDS

- A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.

- B. Work shall be performed in accordance with all applicable requirements of the latest edition of all governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not.
- C. Requirements of Regulatory Agencies
1. In accordance with the requirement of Division 1 General Requirements
 2. Nothing in contract documents shall be construed to permit work not conforming to current and applicable laws, ordinances, rules and regulations.
 3. When contract documents exceed requirements of applicable laws, ordinances, rules and regulations, comply with documents establishing the more stringent requirement.
 4. It is not the intent of contract documents to repeat requirements of codes except where necessary for completeness or clarity.
 5. Seismic construction and restraints: In accordance with requirements of Title 17 of California Administrative Code.
 6. Comply with the Safety Orders issued by California Occupational Safety and Health Act, COSHA and any other safety, health or environmental regulations of the State of California and any districts having jurisdictional authority. Where an omission or conflict appears between COSHA requirements and the Drawings and Specifications, COSHA requirements shall take precedence.
 7. Applicable codes as listed below, in addition to others specified in individual sections
 - a. CEC – California Electrical Code
 - b. CBC – California Building Code
 - c. CMC – California Mechanical Code
 - d. CPC – California Plumbing Code
 - e. City and County Codes and Amendments
 - f. California Code of Regulations, including Titles 8, 17, 19, 20, 21, 22 and the California Building Standards Code Part 2, Basic Building Regulations.
- D. Published specifications, standards, tests or recommended method of trade, industry or governmental organizations as listed below apply to all work in Division 23 HVAC, in addition to other standards which may be specified in individual sections.
- E. All base material shall meet ASTM and ANSI standards
- F. All Pressure Vessels, Relief Valves, Safety Relief Valves and Safety Valves: Comply with standards, ASME stamped
- G. All Electrical Devices and Wiring
1. Conform to standards of CEC/NEC
 2. All devices UL or ETL listed and identified
- H. Guidelines and Standards: The latest edition of guidelines and standards published by the following groups will govern the Mechanical Systems and associated support system design. The systems shall be designed to meet or exceed these guidelines and standards.

AABC	Associated Air Balance Council
ADC	Air Diffuser Balance Council
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Air Conditioning, Heating, and Refrigeration Institute
ASC	Adhesive and Sealant Council
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials

AWWA	American Water Works Association
AWS	American Welding Society
COSHA	California Occupational Safety and Health Act
ETL	Intertek Semko (Formerly Electrical Testing Laboratories)
GISO	General Industry Safety Orders
HI	Hydraulic Institute
IEEE	Institute of Electrical and Electronic Engineers
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
OSHPD	Office of Statewide Health Planning and Development
SFA	California State and Local Fire Marshall
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL	Underwriters' Laboratories, Inc.

1.3 QUALITY ASSURANCE

- A. Supply all equipment and accessories in compliance with the applicable standards listed in Paragraph 1.2 and with all applicable national, state and local codes.
- B. All equipment and accessories shall be new and the product of a manufacturer regularly engaged in its manufacture.
- C. All items of a given type shall be the products of same manufacturer.
- D. All work in Division 23 HVAC shall be commissioned. See Section 019100 Commissioning and Section 230800 Mechanical Commissioning.

1.4 DOCUMENT FORMAT

- A. This section applies to all documents specified to be provided by Division 23 specifications except where specifically indicated otherwise.
- B. Electronic copies
 - 1. Provide in word-searchable electronic format; acceptable formats are MS Word, Adobe Acrobat (pdf) and HTML. Scanned paper documents not acceptable even if converted to text with OCR.
 - 2. For Submittals and O&M Manuals, provide separate file for each specification section or provide one file with hyperlinked tabs to each system.
 - 3. For Test & Balance report, provide separate files for each air handling system, hydronic system, primary equipment, etc. or provide one file with hyperlinked tabs to each system.
 - 4. Record drawings shall be in original format per Paragraph 1.6C.3.
- C. Paper copies
 - 1. Only provide where specifically required. In general, only electronic copies are required.
 - 2. Assemble in chronological order following alpha-numeric system used in specification, in heavy three-ring binder.

1.5 SUBMITTALS

- A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformity with the design intent and the Contractor has responded to all comments to the satisfaction of the Owner's Representative.
- B. Submit drawings, product data, samples and certificates of compliance required as hereinafter specified.
1. See also Division 1 Shop Drawings, Product Data and Samples. Conditions in this Section take precedence over conditions in above referenced Section.
 2. Provide submittals promptly in accordance with schedule and in such sequence as to cause no delay in work or in work of any other division.
 3. Submittals for each specification section shall be submitted in a single package. However, it is not required (nor desired) for all products to be submitted concurrently. Rather, submittals may be staggered based on schedule and required equipment release dates.
 4. Allow 15-working days for review, unless the Owner's Representative agrees to accelerated schedule.
 5. For substitutions, list any features or characteristics that are not strictly in compliance with specifications. If none are listed with the submittal, Contractor is guaranteeing that substituted product is functionally equivalent to the specified product in accordance with Paragraph 1.7.
 6. Submittal reviews by the Owner's Representative are intended to assist the Contractor in complying with the design intent and requirements of the drawings and specifications. Reviews do not relieve the Contractor from compliance with these requirements, and comments or lack thereof do not constitute approval of changes in these requirements.
- C. Submission and Resubmission Procedure
1. Each submittal shall have a unique serial number that includes the associated specification section followed by a number for each sub-part of the submittal for that specification section, such as "SUBMITTAL 23xxxx-01".
 2. Each resubmittal shall have the original unique serial number plus unique revision number such as "SUBMITTAL 23xxxx-01 REVISION 1". The cover page of resubmittals shall include a summary of prior comments and how they were resolved in the resubmittal.
 3. Submit in format specified below. Submissions made in the wrong format will be returned without action.
 - a. Product Submittals: One copy in word-searchable electronic format per Paragraph 1.4. Submit each specification section in a separate file named with unique name and number described above.
 - b. Shop Drawings:
 - 1) One copy in word-searchable electronic format per Paragraph 1.4.
 - 2) One paper copy only if requested by Owner
 - c. Samples: As indicated in each specification section
 4. Owner's Representative will return a memo or mark-up of submittal with comments and corrections noted where required.
 5. Make corrections
 - a. Revise initial submittal to resolve review comments and corrections.
 - b. Indicate any changes that have been made other than those requested.
 - c. Clearly identify resubmittal by original submittal number and revision number.
 6. Resubmit revised submittals until no exceptions are taken.
 7. Once submittals are accepted with no exceptions taken, provide
 - a. Complete submittal of all accepted products in a single electronic file for each specification section.
 - b. Photocopies or electronic copies for coordination with other trades, if and as required by the General Contractor or Owner's Representative.

D. Product Data Submittals

1. Contents
 - a. Manufacturer's name and model number
 - b. All information required to completely describe materials and equipment and to indicate compliance with drawings and specifications, including, but not limited to:
 - 1) Schedule when more than one of each item is covered by submittal
 - 2) Physical data, as applicable
 - a) Dimensions
 - b) Weight
 - c) Finishes and colors
 - d) Dimensional shop drawings
 - 3) Performance data, as applicable
 - a) Rated capacities
 - b) Performance curve
 - c) Operating temperature and pressure
 - d) Sound power levels
 - 4) Flow and wiring diagrams as applicable
 - 5) Description of system operation
 - c. All other pertinent information requested in individual sections
2. Format
 - a. See Division 1 Shop Drawings, Product Data and Samples
 - b. Identify clearly if submittal is substitution: Refer to Paragraph 1.7
 - c. Reference specification Division, Section, Title, Paragraph and Page number or drawing number as applicable
 - d. Use same nomenclature, legend, symbols and abbreviations on submittal material as used in contract documents

E. Layout Shop Drawings

1. Drawings shall be developed using 3D software such as CAD-Duct and CAD-Pipe that is compatible with Navisworks to minimum Level of Development 350.
2. Shop fabrication, coordination and installation drawings by the Contractor, are for the Contractor's use and shall be the Contractor's responsibility. These Drawings indicate where the Contractor intends to install the material and equipment as required by the Contract Documents. Do not submit shop fabrication documents unless requested. Use of contract documents or electronic files of contract documents for shop drawings is not sufficient.
3. Prepare and submit Shop Drawings for all Work deviating from that indicated on Contract Drawings. Clearly indicate deviations.
4. Review is not intended to verify dimensions or quantities, or to coordinate items shown on these Drawings. Review is for general conformance with design concept of the Project and general compliance with the information given in the Contract Documents. Contractor is responsible for dimensions, which shall be confirmed and correlated at the Jobsite, for fabrication processes and techniques or construction, for coordination of Work with that of all other trades and the satisfactory performance of Work.
5. Prepare and submit layout drawings, sections and details for following areas:
 - a. Fan rooms
 - b. All duct shafts
 - c. All heating and cooling duct mains up to taps to VAV boxes
6. Drawings shall show work of all trades including but not limited to:
 - a. Ductwork
 - b. Piping: All Trades
 - c. Mechanical Equipment
 - d. Electrical Equipment
 - e. Main Electrical conduits and bus ducts

- f. Equipment supports and suspension devices
- g. Structural and architectural constraints
- h. Show location of
 - 1) Valves: manual and automatic
 - 2) Piping specialties
 - 3) Dampers: fire/smoke, automatic and manual volume, etc.
 - 4) Access doors
 - 5) Control and electrical panels
 - 6) Others as required for clear coordination
- 7. Drawings shall indicate coordination with work specified in other Divisions which must be coordinated with work specified under Division 23 HVAC, including, but not limited to:
 - a. Irrigation equipment and piping
 - b. Elevator equipment
 - c. Building vacuum cleaning systems
 - d. Pneumatic tube systems
 - e. Cable trays
 - f. Computer equipment
 - g. Others as required
- 8. Submission of drawings
 - a. See Division 1 Shop Drawings, Product Data and Samples.
 - b. Submit to other trades for review of space allocated to all trades.
 - c. Revise drawings to compensate for requirements of existing conditions and conditions created by other trades.
 - d. Ensure that each trade has coordinated work with other trades
 - e. Submit with stamps of General and all other applicable Contractors, initialed and signed certifying
 - 1) Review of submittal
 - 2) Verification of products, field measurements and field construction criteria
 - 3) Coordination of information in submittal with requirements of work of this Division and other divisions of Contract Documents
 - f. No layout shop drawing will be reviewed without stamped and signed coordination assurance by the Contractor.

F. Samples

- 1. Submit as required in each specification section.

1.6 COMPLETION REQUIREMENTS

A. Procedure

- 1. Until the documents required in this section are submitted and approved, the system will not be considered "accepted."
- 2. Before requesting acceptance of work, submit one set of Completion Documents for review and approval of Owner's Representative.
- 3. After review, furnish quantity of sets indicated below to Owner.
- 4. Format
 - a. See Paragraph 1.6H for required format of Completion Documents

B. Operating and Maintenance (O&M) Manual

- 1. In accordance with requirements of Division 1 Operating and Maintenance and as follows
- 2. O&M Manual shall include but is not limited to the following
 - a. Complete Product Data Submittals per Paragraph 1.5D so that the details of the device are known. This shall include only final approved submittals; rejected early submittals shall be stripped.

- b. Manufacturer's name, model number, service manual, spare-parts list and descriptive literature for all components
 - c. Operating instructions
 - d. Maintenance and repair requirements
 - e. Wiring diagrams
 - f. Requirements for special tools, test kits and calibration instructions
 - g. Replacement parts list
 - h. Valve tag directory
 - i. Name, address and phone number of contractor's equipment suppliers and service agencies
- C. Record Drawings
- 1. Keep up-to-date during progress of job one set of Mechanical Drawings indicating the Record installation. In addition to changes made during course of Work, show following by dimension from readily obtained base lines
 - a. Fully illustrate all revisions made by all crafts in course of work
 - b. Include all field changes, adjustments, variances, substitutions and deletions, including all Change Orders
 - c. Exact location, type and function of concealed valves, dampers, controllers, piping, air vents and piping drains
 - d. Exact size, invert elevations and location of underground and under floor piping and ducts
 - 2. Progress drawing set shall be available for inspection by Owner's Representative weekly
 - 3. Update shop drawings and record drawings to reflect revisions and additional data listed above at completion of Project
 - a. Original engineering design drawings will be provided to Contactor in electronic format compatible with Revit or AutoCAD version 2013 or later. Update to become record set.
 - b. Drawings required to be updated if revisions were made
 - 1) Floor plans
 - 2) Shop drawings
 - 3) Sections
 - 4) Riser diagrams
- D. Test and Balance Reports
- 1. See Section 230593 Testing, Adjusting and Balancing
- E. Commissioning Reports
- 1. See Section 230800 Mechanical Commissioning and 250000 Building Automation Systems
- F. Training Materials
- 1. See Section 230800 Mechanical Commissioning and 250000 Building Automation Systems
- G. Miscellaneous Certificates
- 1. Pressure and Leakage Test documentation/certificates
 - 2. Training/Instruction completion certificates
 - 3. Fire Marshal and Fire Department approvals of system, as required
 - 4. Final inspection certificate signed by governing authorities
 - 5. Warranty period, including start and end period
 - 6. Field test report, including as applicable
 - a. Startup documents with date and name of technician
 - b. Piping pressure tests

- c. Duct leakage and pressure tests
- d. Drain pan drainage tests
- e. Letters from manufacturers certifying their supervision of equipment installation and start-up procedures
- f. Others as specified herein

H. Format of Completion Documents

- 1. Provide the type and quantity of media listed in table below
- 2. Where indicated in table, the electronic files shall be stored on the BAS systems' Operator Workstation. See Division 25 Building Automation Systems.

	Document	Paper (binder or bound)	Electronic	
			Loaded onto Flash Drive	Loaded onto Operator Workstation
1.	O&M Manuals (including submittals)	3	1	1
2.	Record Drawings	2 Full size 2 Half size	1	1
3.	Test and Balance Report	5	1	–
4.	Commissioning Reports	5	1	–
5.	Miscellaneous Certificates	1	–	–
6.	Warranty documents	1	–	–
7.	Training materials	1 per trainee	1	1

1.7 SUBSTITUTIONS AND PRODUCT OPTIONS

A. Contractor's Options

- 1. For products specified only by functionality and/or reference standard, select product meeting that functionality and/or standard, by any manufacturer.
- 2. For products specified by manufacturer and model number
 - a. Where "Or Equal" lists specific alternative manufacturers including specific model numbers, any of these specific products may be selected and will not be considered a substitution.
 - b. Where "Or Equal" lists specific alternative manufacturers but no specific model numbers
 - 1) Functionally equivalent products by listed alternative manufacturers may be selected.
 - 2) Functionally equivalent products by manufacturers not listed may be selected but may be rejected by Owner's Representative for any reason if there is any question with respect to functional equivalency including unfamiliarity with manufacturer and local representation.
 - 3) Functional equivalent products to the product specified are those that
 - a) Are equal or better in quality, function, capacity, efficiency, serviceability, local support, etc.
 - b) Fully meet the product specifications unless otherwise approved by the Owner's Representative
 - c) Meet site and application constraints including but not limited to size, weight, appearance, and clearance requirements.

B. Substitution Requirements

1. Where substitutions are proposed for products indicated in design documents, the Contractor shall take full responsibility for coordinating with others the requirements of the proposed substitution including but not limited to:
 - a. Adequate space, including service access space
 - b. Power and other electrical connections
 - c. Pads or other equipment supports
 - d. Control devices and interfaces
2. Include all costs for redesign and other work required by all disciplines affected by a substitution.

1.8 DESCRIPTION OF BID DOCUMENTS

A. Specifications

1. Specifications, in general, describe quality and character of materials and equipment
2. Specifications are of simplified form and include incomplete sentences
3. Words or phrases such as "The Contractor shall," "shall be," "furnish," "provide," "a," "an," "the," and "all" have often been omitted for brevity

B. Drawings

1. Drawings in general are diagrammatic. Intention is to show size, capacity, approximate location, direction and general relationship of one work phase to another, but not exact detail or arrangement.
2. Scaled and figured dimensions are approximate and are for estimating purposes only. Indicated dimensions are limiting dimensions where noted. Duct and piping elevations are indicated for initial coordination; final requirements shall be determined by the Contractor after final coordination with other trades.
3. Before proceeding with work check and verify all dimensions in field.
4. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
5. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom and avoid architectural openings, structural members and work of other trades.
6. For exact locations of building elements, refer to dimensional Architectural and Structural drawings.

C. Do not use equipment exceeding dimensions indicated on drawings or equipment or arrangements that reduce required clearances or exceed specified maximum dimensions.

D. If any part of Specifications or Drawings appears unclear or contradictory, apply to Owner's Representative for an interpretation and decision as early as possible.

1. Do not proceed with work without the decision of the Owner's Representative.

1.9 ALTERNATES

A. Refer to Section 01230 Alternates for possible effect on this Section.

1.10 DEFINITIONS

A. Definitions of term used in Division 23 HVAC may differ from those given in general and supplementary conditions and take precedence over them.

- B. "Provide": to furnish, supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically noted.
- C. "Supply": to purchase, procure, acquire and deliver complete with related accessories.
- D. "Work": labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation.
- E. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and related items.
- F. "Wiring": raceway, fittings, wire, boxes and related items.
- G. "Concealed": embedded in masonry or other construction, installed in furred spaces, within double partitions, above hung ceilings, in trenches, in crawl spaces, or in enclosures.
- H. "Exposed": not installed underground or "concealed" as defined above.
- I. "Indicated," "shown" or "noted": as indicated, shown or noted on drawings or specifications.
- J. "Reviewed," "approved," or "directed": as reviewed, approved, or directed by or to Owner's Representative.
- K. "Motor Controllers": starters, variable speed drives, and other devices controlling the operation of motors.
- L. "Control or Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

1.11 PROJECT CONDITIONS

- A. Examine site related work and surfaces before starting work of any Section
 1. In case of conflict, the most stringent takes precedence
 2. For purposes of clarity and legibility, Drawings are essentially diagrammatic to extent that many offsets, bends, unions, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Especially note a number of required duct and pipe offsets to coordinate with structure and not shown. Coordinate dimensioned conditions, including invert elevations, with other trades prior to installation by any trade.
 3. Exact routing of piping, ductwork, etc. shall be governed by structural conditions, obstructions. Not all offsets in ductwork or piping are shown on the Mechanical Drawings. Determine which item to offset or relocate. Maintain required slope in piping. Make use of data in Contract Documents. In addition, Owner's Representative reserves right, at no additional cost to the Owner, to make any reasonable change in location of mechanical items, exposed at ceiling or on walls, to group them into orderly relationships or increase their utility. Verify Owner's Representative's requirements in this regard prior to rough-in.
 4. Take dimensions, location of doors, partitions, similar physical features from Architectural Drawings. Verify at Site under this Division. Consult Architectural Drawings for exact location of outlets to center with Architectural features, panels, etc., at the approximate location shown on mechanical Drawings.
 5. Mounting heights of brackets, outlets, etc., as required
 6. Report to Owner's Representative, in writing, conditions which will prevent proper provision of this work

7. Beginning work of any Section without reporting unsuitable conditions to Owner's Representative constitutes acceptance of conditions by Contractor
8. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to the Owner

B. Coordination

1. Work out all "tight" conditions involving Work specified under this Division and Work in other Divisions in advance of installation. If necessary, and before Work proceeds in these areas, prepare supplementary Drawings under this Division for review showing all Work in congested area. Provide supplementary Drawings, additional Work necessary to overcome congested conditions, at no additional cost to the Owner.
2. Conflicts: Difference or disputes concerning coordination, interference or extent of Work between sections shall be decided as follows
 - a. Install mechanical and electrical systems in the following order of preference (those trades listed below another must reroute to resolve the conflict):
 - 1) Drain piping required by code to be sloped
 - 2) Supply air and exhaust air ductwork connected to fans
 - 3) Electrical conduit 4 inches and larger
 - 4) Hydronic piping connected to pumps
 - 5) Domestic water piping
 - 6) Fire sprinkler piping
 - 7) Electrical conduit smaller than 4 inches
 - 8) Transfer ducts and other ductwork not connected to fans
 - 9) Control system piping and wiring
 - b. Continued disputes shall be decided by Contractor and Contractor's decision, if consistent with Contract Document requirements, shall be final.
3. Supervision: Personally, or through an authorized and competent representative, constantly supervise the work from beginning to completion and, within reason, keep the same foreman and workmen on the Project throughout the Project duration.
4. Provide templates, information and instructions to other Divisions to properly locate holes and openings to be cut or provided.
5. The drawings govern in matters of quantity, and the specifications govern in matters of quality. In the event of conflict within the drawings involving quantities, or within the specifications involving quantities, or within the specifications involving quality, the greater quantity and higher quality shall apply. Such discrepancies shall be noted and clarified in the Bid. No additional allowances will be made because of errors, ambiguities, or omissions that reasonably should have been discovered during the preparation of the Bid.

C. Equipment Rough-In

1. Rough-in locations shown on Mechanical Drawings for equipment furnished by the Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from following sources
 - a. From Shop Drawings for equipment provided under this contract
 - b. From Owner's Representative for Owner-furnished-Contractor installed equipment
 - c. From existing equipment where such equipment is relocated under this Contract
2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on Drawings obtain clarification from Owner's Representative and provide as directed by the Owner's Representative at no additional cost to the Owner.
3. Make final connections

1.12 CLEARANCE FROM ELECTRICAL EQUIPMENT

- A. Piping or ductwork
 - 1. Prohibited, except as noted, in
 - a. Electric rooms and closets over equipment, as restricted by CEC
 - b. Telephone rooms and closets
 - c. Elevator machine rooms
 - d. Electric switchboard room
 - 2. Prohibited, except as noted, over or within 5 feet of
 - a. Transformers
 - b. Substations
 - c. Switchboards
 - d. Motor control centers
 - e. Standby power plant
 - f. Bus ducts
 - g. Electrical panels

- B. Drip pans under piping
 - 1. Where piping is located over any electrical equipment listed above; reroute piping if possible rather than use drip pan
 - 2. 18 gage galvanized steel
 - 3. 18 gage copper
 - 4. Reinforced and supported
 - 5. Watertight
 - 6. With 1-1/4 inch drain outlet piped to floor drain or service sink

1.13 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. See Division 1 Product Requirements

- B. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Provide protective coverings during construction.

- C. Handle and ship in accordance with manufacturer's recommendations

- D. Identify materials and equipment delivered to Site to permit check against approved materials list, reviewed with no exceptions taken Shop Drawings

- E. Protect from loss or damage. Replace lost or damaged materials and equipment with new at no additional cost to the Owner

- F. Where necessary, ship in crated sections of size to permit passing through available space

1.14 PROJECT MANAGEMENT AND COORDINATION SERVICES

- A. See Division 1 Project Coordination

- B. Overview: Provide a project manager/engineer for the duration of the Project to coordinate the Division 23 HVAC work with all other trades. Coordination services, procedures and documentation responsibility shall include, but shall not be limited to the items listed in this section.

- C. Review of shop drawings prepared by other subcontractors
 - 1. Obtain copies of all shop drawings for equipment provided by others that require electrical service connections or interface with Division 23 HVAC work.
 - 2. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 23 HVAC contract documents. Document any discrepancy or deviation as follows:
 - a. Prepare memo summarizing the discrepancy
 - b. Provide a copy of the specific shop drawing, indicating via cloud, the discrepancy
 - 3. Prepare and maintain a shop drawing review log indicating the following information
 - a. Shop drawing number and brief description of the system/material
 - b. Date of your review
 - c. Indication if follow-up coordination is required
- D. Request for information (RFI)
 - 1. See Division 1 Request For Information

1.15 REVIEW OF CONSTRUCTION

- A. Work may be reviewed at any time by the Owner's Representative
- B. Advise Owner's Representative that work is ready for review at following times:
 - 1. Prior to backfilling buried work
 - 2. Prior to concealment of work in walls and above ceilings
 - 3. When all requirements of Contract have been complete
- C. Neither backfill nor conceal work without Owner's Representative's consent.
- D. Maintain on job set of Specifications and Drawings for use by Owner's Representative's
 - 1. Include all change orders.
- E. Contractor is responsible for construction methods, sequences and safety precautions

1.16 SCHEDULE OF WORK

- A. In accordance with Division 1 Contract Schedules and as follows:
 - 1. Arrange work to conform to schedule of construction established or required to comply with Contract Documents
 - 2. In scheduling, anticipate means of installing equipment through available openings in structure
- B. Confirm in writing to Owner's Representative, within 35-days of signing of contract, anticipated number of days required to perform test, balance, acceptance testing and commissioning of mechanical systems. Schedule test, balance and acceptance testing of mechanical systems as follows:
 - 1. Submit for review at this time, names and qualifications of test and balancing agencies to be used
 - 2. Test & Balance and commissioning must occur after completion of mechanical systems, including all control calibration and adjustment, and requires substantial completion of the building, including closure, ceilings, lighting, partitioning, etc.
 - 3. Allow 21-days after test and balance for system commissioning and life safety testing (where applicable)

4. Complete and test all systems early enough to enable completion of commissioning prior to Owner move-in.
5. Provide post construction purge direction immediately before occupancy. See Paragraph 3.8.

1.17 CUTTING AND PATCHING

- A. See Division 1 Cutting, Patching and Patching

1.18 UTILITY CONNECTIONS

- A. Point of connection to on-site chilled water and hot water piping mains shall be just inside the building envelope. Piping outside the envelope and sealing of envelope openings shall be specified under Division 33.

1.19 WARRANTY

- A. In accordance with Division 1 Guarantees, Warranties, Bonds, Service & Maintenance Contracts and as follows.
- B. Warranty all materials, equipment, apparatus and workmanship to be free of defective materials and faulty workmanship for period of one year from date of filing of Notice of Completion or upon beneficial use, at the direction of the Owner's Representative (see Paragraph 3.4A.1).
- C. Provide new materials, equipment, apparatus and labor to replace that determined by Owner's Representative to be defective or faulty.
- D. This guarantee also applies to services including instructions, adjusting, testing, noise, balancing, etc.
- E. Furnish Manufacturers' standard Warranties in excess of one year.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Alternate manufacturers as identified in each section will be considered under conditions specified in Paragraph 1.7 of this section.
- B. Identify materials, equipment by manufacturer's name, nameplate data. Remove unidentified materials, equipment from Site.
- C. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalog as standard with equipment. Furnish optional or additional accessories as specified.

- D. Where no specific make of material or equipment is mentioned, any first class product of reputable manufacturer may be used, provided it conforms to requirements of system and meets with acceptance.
- E. Provide an authorized representative to constantly supervise work of this Division, check all materials prior to installation for conformance with Drawings, Specifications, reviewed Submittals and reviewed Shop Drawings.
- F. Conform to conditions shown and specified. Coordinate with other trades for best possible assembly of combined Work. Relocate equipment when necessitated by failures to coordinate Work or to advise Owner's Representative of conflicts in writing.
- G. Material and Equipment-General Requirements
 - 1. New
 - 2. Approved for use by State Fire Marshal and local building inspection department when applicable
 - 3. Testing agency labeled or with other identification wherever standards have been established
 - 4. Owner's Representative reserves right to reject items not in accordance with Specification either before or after installation
 - 5. Comprised to render complete and operable systems; provide additional items needed to complete installation to realized design
 - 6. Compatible with space allocated; modifications necessary to adjust items to space limitations at Contractor's expense
 - 7. Installed fully operating and without objectionable noise or vibration
 - 8. Design of mechanical systems is generally based on product of the first named manufacturers cited. Where systems for product installed necessitate modification of systems shown on drawings, Contractor is responsible for installation of systems appropriate to product installed.
- H. Electrical Requirements
 - 1. Electrical Work performed under Division 23 HVAC shall conform to requirements of Division 26 Electrical
 - 2. Provide weatherproof devices and installation for out-of-doors work

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that conditions are satisfactory for the installation of materials and equipment. Notify Owner's Representative if conditions are not satisfactory and do not commence work until conditions have been corrected.

3.2 INSTALLATION

- A. Install materials and equipment in compliance with governing codes.
- B. Use printed descriptions, specifications and recommendations of manufacturers as a guide for installation of Work. Follow in all cases where manufacturers' of articles used furnish directions covering points not specified or shown.

- C. Equipment
1. See Division 1 Supporting From Building Structure
 2. Assemble equipment which is required to be field assembled under the direct supervision of the manufacturers' agent
 3. Prior to the final acceptance submit letters from the manufacturers that equipment has been assembled under the direct supervision of the manufacturers' agent
 4. Accurately set and level equipment with supports neatly placed and properly fastened
 5. Properly fasten equipment in place with bolts to prevent movement in earthquake
 6. Coordinate the installation of equipment with openings in structure
 7. Coordinate and fully dimension steel supports for mechanical equipment where shown on drawings with installing contractor
 8. Provide all roof curbs for roof mounted fans, flues, piping and duct penetrations, etc.
 9. Concrete
 - a. Concrete work, include forming, steel bar reinforcing, cast-in-place concrete, finishing and grouting is specified under Division 3 Concrete
 - b. Coordinate and fully dimension concrete housekeeping pads and curbs with installing contractor; dimensions shall be as required for structural and seismic requirements, see Section 230548 Vibration and Seismic Control
 - c. Coordinate inertia base fill with installing contractor
- D. Electrical
1. See Division 26 Electrical
 2. Install electrical devices with code required clearances and access
 3. Assist the electrical contractor in the proper connecting of all electrical wiring and equipment required for mechanical equipment
- E. Sleeves, Chases and Concrete Inserts
1. Provide all required sleeves, chases, concrete inserts, anchor bolts, etc.
 2. Sleeves, chases are prohibited in structural members, except where shown or as directed by Owner's Representative in writing
 3. Embed no piping in concrete or masonry
- F. Waterproof Construction
1. Comply with Division 7 Thermal and Moisture Protection.
 2. Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of mechanical penetrations and sealing penetrations in or through exterior walls, floors, roofs, and foundation walls.
 3. All penetrations through vapor barriers at slabs on grade shall be taped and made vapor tight.
 4. Provide galvanized sheet metal weather protection canopies, hoods or enclosures over all out-of-doors equipment, the operation or maintenance of which would be impaired by rain water; this requirement applies to damper operators and bearing, damper motors, controls and instruments; see other Sections in this Division for application of this requirement to motors, drive, ducts and fans.
- G. Restoration of Damage
1. Repair or replace, as directed by Owner's Representative, materials and parts of premises which become damaged.
 2. Remove replaced parts from premises at no additional cost to the Owner.
- H. Review architectural drawings and coordinate with Architect and other contractors to be sure that all architectural shafts, plenums, rated duct enclosures etc. required for mechanical systems are properly located and dimensioned.

- I. Access Panels and Doors
 - 1. Product specified under Division 8 Openings and Division 5 Metals:
 - a. Coordinate size requirements and exact location with Contractor who will provide and install access doors
 - b. Minimum Sizes: 18 inches by 18 inches unless otherwise shown on Drawings or approved by Owner Representative
 - 2. Provide where shown, or required by Regulatory Agencies, for access of all concealed equipment such as terminal units, valves, fire/smoke dampers, etc., for Mechanical Work:
 - a. Equipment shall be located wherever practical over accessible ceilings or rooms to avoid access doors
 - b. Access doors shall not be used solely for access to balancing dampers; use instead remote control devices specified under Section 233300 Duct Accessories

- J. Openings
 - 1. Coordinate and fully dimension all openings in walls, floors, roofs and structural elements required for mechanical work.
 - 2. Provide all required fire-stopping around pipe, duct and other penetrations required for mechanical work in rated partitions where required by code.
 - 3. Fire damper openings: Contractor shall provide damper UL installation requirements to contractor installing partitions to ensure construction complies with listing.
 - 4. Air outlet openings
 - a. Contractor shall coordinate exact locations of air outlets in floors, walls and ceilings with contractor installing partition.
 - b. Contractor shall coordinate additional T-bar or spline required to accept air outlets with contractor providing and installing ceiling and associated materials.

3.3 PROTECTION OF MATERIALS

- A. See Division 1 Product Requirements.
- B. Completely cover motors and other moving machinery to protect from dirt and water during construction.
- C. During transport to and storage on the construction site, and during rough-in until final connections are made, all ductwork and other related air distribution component openings shall be covered with plastic to prevent contamination from dust, water, and debris.
- D. Cap all openings in pipe and ductwork daily to protect against entry by foreign matter.
- E. Material, equipment or apparatus damaged because of improper storage or protection will be rejected
 - 1. Remove from site and provide new, duplicate, material, equipment or apparatus in replacement of that rejected.
 - 2. Any porous materials, such as duct liner or flexible ductwork that becomes wet; for example, due to rain shall be replaced; drying is not sufficient (due to possible microbial contamination).
- F. Perform Work in manner precluding unnecessary fire hazard.

3.4 ADJUSTMENT

- A. Preliminary Operation
 - 1. Operate any portion of installation for Owner's convenience if so requested by Owner's Representative. Such operation does not constitute acceptance of Work as complete but does constitute beneficial use, see Paragraph 1.19B. Cost of utilities, such as electrical power, will be borne by the Owner if operation is requested by Owner's Representative.

- B. Startup Service
 - 1. Prior to startup, ensure that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrications, venting fan balance, controls and installed and properly set relief and safety valves. See pre-function tests in Division 23 HVAC.
 - 2. Start and operate all systems.
 - 3. Provide services of factory trained technicians for startup of major equipment and systems including boilers, fire pumps, etc.
 - 4. Adjusting: See Section 230593 Testing, Adjusting and Balancing.
 - 5. Functional Testing: See Division 25 Building Automation Systems.
 - 6. Life Safety Testing
 - a. Assist Division 26 Electrical contractor in testing fire alarm controls, including control of smoke dampers and of fan systems.
 - b. Correct any problems related to equipment supplied under Division 23 HVAC.
 - c. Complete the control matrix with details such as fan tags, FSD tags, etc. based on control matrix provided with Life Safety Report.
 - d. Assist Life Safety System commissioning agent in testing and commissioning Life Safety System.
 - e. Provide all tests, air balance and start-up personnel required to start and commissioning the system and for assisting the design/construct team in demonstrating system compliance with the local fire district and building department

- C. Noise
 - 1. Cooperate in reducing any objectionable noise or vibration caused by mechanical systems to the extent of adjustments to specified and installed equipment and appurtenances.
 - 2. Completely correct noise problems caused by failure to make installation in accordance with Contract Documents, including labor and materials required as a result of such failure, at no additional cost to the Owner.

3.5 SPECIAL TOOLS

- A. Furnish to Owner at completion of work one set of any special tools required to operate, adjust, dismantle or repair equipment furnished under any section of this Division.

3.6 CLEANING

- A. See Division 1 Closeout Procedures, Final Cleaning and Extra Material
- B. Thoroughly clean equipment, fans, pumps, motors, piping and other materials under this. Division free from all rust, scale and all other dirt before any covering or painting is done, or the systems put in operation; leave in condition satisfactory to Owner's Representative.
- C. At all times keep the premises free from accumulation of waste material and debris caused by his employees. At the completion of the Project, and at other times as Owner's Representative

may direct, remove refuse from within and around the building. All tools, scaffolding and surplus materials shall also be removed, leaving the Site of his Work clean.

- D. Completely cover all motors and other moving machinery to prevent entry of dirt and water during construction.
- E. Effectively cap all openings into ducts and pipes to keep moisture and foreign matter out during construction

3.7 PAINTING

A. Painting

- 1. Piping exposed to outdoors
 - a. One coat primer
 - b. Two coat alkyd oil paint, UV resistant for PVC piping, color as indicated
 - c. Not required for copper, galvanized steel, or insulated piping
- 2. Steel hangers and supports exposed to outdoors
 - a. One coat primer
 - b. Not required for galvanized steel
- 3. Interior of ductwork and duct accessories, including insulation stick pins, at air outlets as far back as visible from occupied spaces
 - a. Flat black
- 4. Marred surfaces of factory painted equipment
 - a. Spot coat to match adjacent coat
- 5. Insulation exposed to sunlight: See Section 230700 Mechanical Insulation

B. Execution

- 1. Protect flooring and equipment with drip cloths.
- 2. Paint and materials stored in location where directed.
- 3. Oily rags and waste removed from building every night.
- 4. Wire brush and clean off all oil, dirt and grease areas to be painted before paint if applied.
- 5. Workmanship
 - a. No painting or finishing shall be done with
 - 1) Dust laden air
 - 2) Unsuitable weather conditions
 - 3) Space temperature below 60 degrees Fahrenheit
 - b. Pipes painted containing no heat and remain cold until paint is dried.
 - c. Paint spread with uniform and proper film thickness showing no runs, sags, crawls or other defects.
 - d. Finished surfaces shall be uniform in sheen, color and texture.
 - e. All coats thoroughly dry before succeeding coats are applied, minimum 24 hours between coats.
 - f. Primer undercoat of slightly different color for inspection purposes
- 6. Piping continuously painted in all exposed areas

C. Paint

- 1. High gloss medium or long alkyd paint
- 2. Best grade for its purpose
- 3. Deliver in original sealed containers.
- 4. Apply in accordance with manufacturer's instructions.

D. Colors

- 1. Colors as directed by Owner's Representative unless specified herein.

2. Condenser water piping: pale green
 3. Interior of ductwork as far back as visible from outside: flat black
 4. Uncoated hangers, supports, rods and insets: dip in zinc chromate primer
- E. Factory finish
1. Ceiling and wall mounted air outlets in acoustical tile ceilings: Baked white enamel
 2. Aluminum air outlets that are not to be painted: anodized
- F. Marred surfaces of prime coated equipment and piping: spot prime coat to match adjacent coat
- G. Properly prepare Work under this Division to be finish painted under Division 9 Painting
- H. Provide moisture resistant paint for exterior painting and heat resisting paint for hot piping, equipment and materials
- I. Factory Finishes
1. Exposed fan coil units: baked enamel
 2. Unit ventilators and unit heaters: baked enamel
 3. Fans, pumps, compressors, tanks and like items
 4. Air handlers, pumps, water heaters and like items where exposed
- J. For the following, provide factory prime coat. Also, provide factory finish painting on each if not specified in Painting Division
1. Other air outlets
- K. Paint all equipment out-of-doors and equipment supports with two coats of weather resistant enamel
- L. Protect all finished surfaces of fixtures with heavy paper pasted thereon, or by other means, throughout the period of construction
- M. Refinish Work supplied with final finish under this Division if damaged under this Division to satisfaction of Owner's Representative

3.8 OPERATION OF SYSTEMS AND POST-CONSTRUCTION PURGE

- A. This section is provided to
1. Minimize the possibility that ducts and air plenums will be contaminated with construction debris.
 2. Ensure that off-gassing volatile organic compounds (VOCs) are not transferred from one area to another.
 3. Purge VOCs that have off-gassed from construction materials and furnishings prior to occupancy.
- B. Construction Period
1. Fan systems shall not be operated during construction (e.g. to assist in drying walls, space conditioning, etc.) unless approved in writing by Owner's representative.
- C. Test and Balance Period
1. Operation of fan systems for test and balance shall only occur after the area served by air systems and all air plenums have been thoroughly cleaned of dust and debris. No

construction work that generates dirt and particles shall be occurring while fan systems are in operation.

2. Procedure
 - a. Install temporary construction filters (prefilters) on all supply air systems. Do not install high efficiency final filters at this time.
 - b. Adjust systems with economizer capability to supply 100% outdoor air, no recirculated air.
 - c. Perform test and balance work per Section 230593 Testing, Adjusting and Balancing) at zone level.
 - d. Immediately prior to the start of the post-construction purge period (see below), remove and discard construction filters and install high efficiency final filters.
 - e. Conduct test and balance work at supply air system. System may be temporarily converted from 100% outdoor air to minimum outdoor air as required for tests only; return to 100% outdoor air configuration after tests.

D. Post-Construction Purge Period

1. Schedule
 - a. Start after
 - 1) All construction work that produces dust or VOCs is complete, except for minor touch-up painting work and installation of furnishings
 - 2) All test and balance work is complete on all air systems with 100% outdoor air capability
 - 3) Temperature control systems are operational
 - 4) Heating systems are fully operational
 - b. End after a time period determined from the following equation, calculated for each fan system individually, where T is time in days, A is the floor area served by the system in ft² and CFM is the outdoor air capacity of the system in cfm:

$$T = \frac{14000 * A}{CFM * 60 * 24}$$

- c. The space may only be occupied
 - 1) After the purge time period calculated above is complete; or
 - 2) After time T' calculated from the equation below provided the space is ventilated with 100% outdoor air until the total purge time period calculated above is complete.

$$T' = \frac{3500 * A}{CFM * 60 * 24}$$

2. Procedure
 - a. Adjust systems with economizer capability to supply 100% outdoor air, no recirculated air.
 - b. Ensure that high efficiency final filters are in place.
 - c. Run fan systems supplying 100% outdoor air during entire purge period.
 - d. Enable boilers and zone controls and set heating setpoints to 70°F.
 - e. Cooling systems may be enabled or disabled.
3. Because final filters will not be challenged with contaminants in the return air, they do not have to be replaced after the flush-out period.

3.9 FIELD QUALITY CONTROL

- A. See Division 1 Quality Control
- B. Tests

1. Perform as specified in individual sections and as required by authorities having jurisdiction
 2. Perform commissioning work
 - a. Perform pre-function tests as specified in Division 23 HVAC
 - b. Perform functional and post-occupancy tests. See Division 25 Building Automation Systems
 3. Duration as noted
- C. Provide required labor, material, equipment and connections
- D. Furnish written report and certification that tests have been satisfactorily completed
- E. Repair or replace defective work, as directed by Owner's Representative in writing, at no additional cost to the Owner
- F. Restore or replace damaged work due to tests as directed by Owner's Representative in writing, at no additional cost to the Owner
- G. Restore or replace damaged work of others, due to tests, as directed by Owner's Representative in writing, at no additional cost to the Owner
- H. Remedial work shall be performed to the satisfaction of the Owner's Representative, at no additional cost to the Owner, including
1. Work related to all Division 23 HVAC pre-functional tests
 2. Division 23 HVAC work related to Section 019100 Commissioning
 3. Division 23 HVAC work related to Section 230593 Testing, Adjusting and Balancing
 4. Division 23 HVAC work related to Section 230800 Mechanical Commissioning
- I. Remedial work shall include performing any commissioning or other tests related to remedial work an additional time at no additional cost to the Owner

END OF SECTION

SECTION 230513

MOTORS AND CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Motors
 - 2. Variable speed drives
 - 3. Motor controllers where not provided as part of mechanical equipment

1.2 REFERENCE STANDARDS

- A. ABMA 9 Load Ratings and Fatigue Life for Ball Bearings
- B. ABMA 11 Load Ratings and Fatigue Life for Roller Bearings
- C. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators
- D. ANSI/NEMA MG 1 Motors and Generators
- E. ANSI/NFPA 70 National Electrical Code
- F. IEEE Standard 519-1992, IEEE Guide for Harmonic Content and Control
- G. NEC 430.120, Adjustable-Speed Drive Systems.
- H. NEMA ICS 7.0, AC Adjustable Speed Drives
- I. Underwriters Laboratories UL 508 Standard for Industrial Control Equipment
- J. Underwriters Laboratories UL 508A Standard for Industrial Control Panels
- K. Underwriters Laboratories UL 508C Standard for Power Conversion Equipment

1.3 DEFINITIONS

- A. VSD: Variable speed drive
- B. ECM: Electrically Commutated Motor

1.4 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.

- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
1. "R" means required.
 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Motors	R	R		R
Belts and Drives		R		
Variable Speed Drives	R	R		R

- C. Submittals shall include certification from the motor manufacturer certifying compliance with NEMA MG-1, part 31 for motors that are driven by variable speed drives.

1.5 WARRANTY

- A. Special Warranty: VSD warranty shall be 24 months from date of start-up certification including all parts, labor, travel time, and expenses.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Motors
1. US Motors
 2. General Electric
 3. Gould Inc.
 4. Baldor
 5. Ebm-papst
 6. Or equal
- B. Variable speed drives
1. ABB
 2. Danfoss
 3. Yaskawa
 4. Or equal

2.2 MOTORS

- A. General
1. In accordance with NEMA, IEEE, and ANSI C50 standards
 2. Capacity
 - a. Minimum horsepower indicated
 - b. To operate driven devices under all conditions without overload
 3. Squirrel-cage induction type, NEMA Type "B": insulation class, continuous duty
 4. Speed
 - a. 1750 RPM, unless otherwise indicated
 - b. See schedules on drawings for other speeds

5. Minimum NEMA KVA/HP Locked Rotor Code:

HP Range	Code Letter
≤2	M
3	K
5	J
7.5-10	H
>10	G

6. Service factor: 1.15

7. Type unless otherwise scheduled on Drawings

- a. Voltage: As scheduled on Drawings
- b. 1/2 horsepower and smaller
 - 1) Single-phase, 60 hertz
 - 2) With built-in auto-reset thermal overload protection
- c. 3/4 horsepower and larger
 - 1) Three-phase, 60 hertz
 - 2) 50 horsepower and over: Reduced voltage start, suitable for star-delta starting
- d. Electrically Commutated Motor (ECM)
 - 1) Where scheduled on Drawings or equipment Specifications

8. Bearings

- a. Ball type, unless otherwise indicated
- b. Sealed, permanently lubricated, unless otherwise noted or not available in motor size
 - 1) One bearing size on both ends of the motor
 - 2) Minimum bearing life of
 - a) 50,000 hours for belt-drive
 - b) 130,000 hours for direct-drive

B. Enclosure

- 1. Open drip-proof (ODP)
 - a. Provide ODP motors unless otherwise indicated
- 2. Totally enclosed (TEFC)
 - a. Motors outside the building or otherwise exposed to the weather
 - b. Non-ventilated: under 1/2 horsepower
 - c. Fan-cooled: 1/2 horsepower and larger
- 3. See schedules on drawings for other enclosures

C. Belt-connected motors

- 1. Foundation slide base
- 2. Shaft as required for aligning pulleys

D. Motors 1 horsepower and larger shall be NEMA Premium™ labeled and have guaranteed efficiencies equal to or exceeding NEMA Table 12-6D.

E. Motors driven by variable speed drives

- 1. Shall be "inverter ready" motors that meet the requirements of NEMA MG-1 part 31
- 2. Where used for pumps or fans (variable torque), shall have minimum 10:1 turndown and be capable of operating at 10 percent speed indefinitely
- 3. Shall incorporate a design to prevent arcing through the motor bearings, such as: insulated bearings, ceramic bearings, grounded motor shafts such as those manufactured by AEGIS Ground Shafting Systems, or approved equal, for the following applications:
 - a. Motors are larger than 75 HP

- b. The VSD runs near constant speed such as data center air handlers and VSDs used only to adjust for filter loading such as clean room air handlers
- c. Where indicated on Drawings

F. Electrically Commutated Motors (ECMs) ≤1 HP

1. Brushless DC type with electronic commutation from 115 volt, 277 volt, or 480 volt single phase power to a DC signal
2. Speed controllable from a minimum of 15% or less to 100% of full speed
3. Minimum 80% efficiency at all speeds
4. Include time delay relays or other electrical devices as necessary to limit motor in-rush current to 10 times the maximum motor running current.
5. Provide one of the following as indicated on Drawings or Specifications
 - a. Constant speed applications
 - 1) Potentiometer dial mounted on the exterior of the motor housing
 - 2) Programmed with fan-curve for “constant airflow”
 - b. Variable speed applications
 - 1) 0-10 volt DC control signal input
 - 2) Signal configured to be proportional to fan speed, or to torque if speed not available.
 - 3) Where specified in other Sections: Motor shall shut off when speed signal is below 2 Vdc minimum.
 - 4) Where specified in other Sections, include 0-10 volt DC speed feedback output.
6. The motor in-rush current, including transient in-rush currents of less than one 60 Hz cycle (0.016 seconds), shall not exceed 10 times the motor RLA. The manufacture shall include transient in-rush suppression circuit as required to achieve these values. The transient in-rush suppression circuit shall be ETL or UL listed by the manufacturer and shall be designed to be fail safe. The manufacturer shall submit actual factory recorded in-rush values recorded with a meter for the first 10 seconds of the motor starting for the complete assembly, including the current waveform of the initial transient current.
7. Equal to Regal Beloit ECM

2.3 VARIABLE SPEED DRIVES

A. General

1. All variable speed drives other than those that are factory packaged with equipment shall be supplied by one manufacturer.
2. VSDs shall be completely assembled and tested by the manufacturer in an ISO 9001 & 14001 facility.
3. All circuit boards shall be coated to protect against corrosion. Control boards shall be conformal coated to at least IEC 60721-3c2.
4. Include factory installed door interlocked pad-lockable disconnect switch that will disconnect all input power from the drive and all internally mounted options and comply with Lock Out/Tag Out (LOTO) requirements of CEC 430.

B. Performance

1. The VSD shall provide full rated output from a line of ±10% of nominal voltage. The VSD shall continue to operate without faulting from a line of +30% to -35% of nominal voltage.
2. Overload rating of VSD shall be 110% of normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds every minute.
3. VSDs shall be capable of continuous full load operation in the following environmental conditions:

- a. Ambient temperature: 5°F to 104°F. Operation to 120°F shall be possible with a 10% reduction from VSD full load current
- b. Altitude: 0 to 3300 feet above sea level. Operation to 6600 feet shall be possible with a 10% reduction from VSD full load current
- c. Relative humidity: 0 to 95%, non-condensing
- 4. Efficiency shall be not less than 97 percent at rated voltage, current, and frequency and fundamental power factor shall not be less than 98 percent at all speeds and loads.

C. Electrical Characteristics

- 1. Provide as a minimum 5% impedance line reactors. The 5% impedance may be from dual (positive and negative DC bus) reactors or 5% AC line reactors. VSDs with only one DC reactor shall include AC line reactors.
- 2. VSD shall automatically mitigate harmonics throughout the effective load range using Swinging chokes or other devices designed to lower harmonics when VSD is at partial loads.
- 3. Include Ferrite Core EMI/RFI/Common mode filters. The onboard filters shall allow the VSD assembly to be CE Marked and the VSD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2).

D. Equipment Protection and Safeties

- 1. VSD shall:
 - a. Be UL 508 listed for a minimum of 100 kA short circuit current rating (SCCR) without the need for external input fuses or external series rated combination circuit breakers.
 - b. Include built in coordinated AC transient surge protection system consisting of 4 MOVs (phase to phase & phase to ground), capacitor clamp, 1600 PIV Diode Bridge and internal chokes.
 - c. Automatically mitigate harmonics throughout the effective load range using Swinging chokes or other devices designed to lower harmonics when VSD is at partial loads.
 - d. Protect itself against all normal transients and surges in incoming power line, any grounding or disconnecting of its output power, and any interruption or run away of incoming speed signal without time delay considerations. Protection is defined as normal shutdown with no component damage.
 - e. Be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The VSD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under-load condition.
 - f. Protect itself against all phase-to-phase or phase-to-ground faults.
 - g. Be able to start into a rotating load (flying start) at all speeds (forward or reverse) without trip.
 - h. Ride through an input power dip of 3 cycles without trip.
 - i. Operate properly at a -35% +30% voltage fluctuation from rated voltage.
 - j. Operate properly at a 10 percent frequency variation from rated frequency.
 - k. Employ three current limit circuits to provide trip-free operation: slow current regulation, rapid current regulation, and current limit switch-off limit. VSD shall be designed so that overcurrent trip shall be at least 315 percent of the drive's current rating.
 - l. Withstand unlimited switching of the output under full load, without damage to the VSD. Operation of a disconnect switch between the motor and VSD shall not have an adverse effect on the VSD, whether the motor is operating or not. Controls conductors between the disconnect and the VSD shall not be required for the safe and reliable operation of the VSD.

- m. Withstand switching of the input line power up to 20 times per hour without damage to the VSD.
 - 2. Anti-regeneration circuit shall match the deceleration rate of the drive to that of the motor to prevent high bus voltage shutdown common to high inertia loads, such as fans.
- E. Human-Machine Interface
 - 1. Keypad with backlit LCD
 - 2. Removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VSDs.
 - 3. Password protection against parameter changes
 - 4. Hand-Off-Auto selections and manual speed control with “bumpless transfer” of speed reference when switching between “Hand” and “Auto” modes
 - 5. “Help” button with built-in assistance for programming and troubleshooting
 - 6. Complete English words for programming and fault diagnostics; alphanumeric codes only are not acceptable
 - 7. Time stamped fault history with details (amps, volts, type of fault etc.) of drive conditions of at least the last 3 faults with a timestamp and total history of at least 7 of the last faults
 - 8. Displays and meters for the following: Output voltage, output frequency, motor rpm, motor current, motor watts, speed signal input, last three faults
- F. Software Features
 - 1. Adjustable PWM switching carrier frequencies from 1 to 8 kHz.
 - a. Include a PWM switching carrier frequency control circuit that reduces the carrier frequency based on actual VSD temperature that allows the highest PWM switching carrier frequency without derating the VSD or operating at high PWM switching carrier frequency only at low speeds.
 - 2. Ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable for each fault type.
 - 3. Ability to set a maximum current available to the motor with automatic speed reduction to prevent high current trip.
 - 4. Motor flux optimization that automatically reduces applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise.
 - 5. Noise smoothing feature that randomly varies switching frequency to distributes acoustic motor noise over a range of frequencies instead of a single tonal frequency resulting in lower noise intensity.
 - 6. Three programmable critical frequency lockout ranges to prevent the VSD from operating the load continuously at an unstable speed. Each lockout range must be fully adjustable from 0 to full speed.
 - 7. Adjustable acceleration and deceleration ramps, 1 – 1800 seconds adjustable.
 - 8. Fireman’s override logic
 - a. May be applied to any programmable input
 - b. Upon contact closure input, the VSD shall
 - 1) Operate in one of two modes:
 - a) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward).
 - b) Operate using internal PID loop that automatically adjusts motor speed based on programmable analog input and override set point.
 - 2) Ignore all serial communication and keypad commands
 - 3) Capable of being configured to ignore the run permissive contact (used for high static safeties, smoke detector, etc.) This mode shall be capable of being disabled during system testing to avoid damage.

- 4) Capable of being configured to “run to destruct” ignoring all internal safeties that might prevent the VSD from operating at the preset speed. This mode shall be capable of being disabled during system testing to avoid damage.

G. Input/Outputs

1. Minimum Inputs
 - a. Two programmable analog inputs, 0/4-20ma or 0/2-10 Vdc signals, any of which shall be capable of being programmed to the following:
 - 1) Control point feedback signal for internal PID loop
 - 2) Control point setpoint for internal PID loop
 - b. Six programmable digital inputs, 24Vdc, any of which shall be capable of being programmed to the following:
 - 1) Start/stop
 - 2) Run permissive safety interlock
 - 3) Programmable preset speed
 - 4) Forward/reverse direction
2. Minimum Outputs
 - a. Two programmable analog outputs, 0/4-20ma or 0/2-10 Vdc signals, any of which shall be capable of being programmed output proportional to the following:
 - 1) Motor Speed
 - 2) Motor Power (kW)
 - 3) Active PID Reference
 - 4) Active PID Feedback
 - b. Three programmable, digital Form-C relay outputs, ≥8 amps at 24 VDC, any of which shall be capable of being programmed to the following:
 - 1) Open damper or VAV boxes with programmable time delay start
 - 2) Fan status, based on field adjustable motor current that can indicate broken belt or coupling
 - 3) Any fault/alarm
 - 4) Loss of input power to VSD

H. Controls

1. Self-contained controls
 - a. Built-in PID control loop, allowing connection of a pressure or flow signal to a VSD analog input for closed loop control.
 - b. A second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process.
 - c. PID sleep feature to shut off VSD when speed drops below an adjustable value for an adjustable period of time.
 - d. PID set points adjustable from the VSD keypad, analog inputs, or over the communications bus.
 - e. Built-in time clock with a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. VSD programming shall be held in non-volatile memory and is not dependent on battery power
2. Serial Communications
 - a. Built in EIA-485 port with standard protocols
 - 1) BACnet-MS/TP
 - a) Certified BTL listing as B-ASC
 - b) Adjustable to 9.6, 19.2, 38.4, or 76.8 Kbps
 - b. At a minimum, the following points shall be provided:
 - 1) Read only: Speed feedback, output speed, current, % torque, kW power, kilowatt hours (resettable), operating hours (resettable), drive temperature, digital input

status, analog input values, all diagnostic warning and fault information, keypad "Hand" or "Auto" selected, bypass selected, deceleration rate, and acceleration rate

- 2) Read/write: On/off, output speed, digital output status, analog output values, remote fault reset, PID setpoint and gains, maximum speed, and minimum speed

I. Bypass. Not required:

J. Enclosure

1. Enclosure requirements apply to VSD and all specified options and accessories.
2. VSD Enclosures shall be UL rated. Self-certified enclosures or enclosures with only NEMA ratings are not acceptable.
3. Provide enclosure scheduled on Drawings
 - a. NEMA 1/UL Type 1 enclosure for indoor installation
 - b. NEMA 3R/ UL Type 3R enclosure for outdoor installation
 - c. NEMA 12/UL Type 12 for wet or dirty mechanical rooms
 - d. NEMA 4X for outdoor installation in extreme climates
4. VSDs shall be UL listed as plenum rated where located in supply, return, or outdoor air stream.
5. NEMA 4X panel shall be stainless steel cabinet with temperature controlled mechanically cooled air isolated from outside air in the VSD cabinet.
6. Thermostatically controlled cooling fans shall be provided where required to meet ambient operating conditions. Fans shall be designed for replacement without requiring removal of the VSD from wall mount or removal of circuit boards. Fan sound power shall be no greater than local noise sources where VSD is installed. Fans shall operate only when required, based on the temperature and run command to the drive.

2.4 MOTOR CONTROLLERS

- A. See Division 26 Electrical.
- B. Refer to individual equipment sections for factory-provided controllers
 1. Installed on equipment by manufacturer
 2. Supplied with equipment by manufacturer for field installation

PART 3 EXECUTION

3.1 INSTALLATION

- A. See Section 230548 Vibration and Seismic Control.
- B. Coordinate with work of other trades.
- C. Install in accordance with manufacturer's written installation instructions.
- D. See 250000 Building Automation Systems for control wiring, including network interface wiring.
- E. Drives for packaged equipment shall be mounted and wired by equipment manufacturer.

- F. Mounting and power wiring of field mounted variable speed drives and other motor controllers is specified under Division 26 Electrical.
 - 1. Where wall space is not available for mounting VSDs or other motor controllers, provide mounting struts securely mounted to the floor, roof, or adjacent structure
 - 2. Strictly follow VSD manufacturer's recommendations, in particular with respect to grounding.
- G. Set overload devices to suit motors provided in accordance with NEC.

3.2 INSPECTION

- A. Verify that adequate clearance between motor, controllers and adjacent walls or equipment is available to permit maintenance and repairs.
- B. Check that motor and controller are properly supported and allows for proper alignment and tension adjustments as necessary for application.

3.3 PRE-OPERATING CHECKS

- A. Before operating motors and controllers
 - 1. See Section 230800 Mechanical Commissioning.
 - 2. Complete the Pre-Functional Test Data Sheet for each motor and controller.
 - 3. Check for proper and sufficient lubrication.
 - 4. Check for correct rotation.
 - 5. Confirm alignment and re-align if required.
 - 6. Check for proper adjustment of vibration isolation.

3.4 STARTUP, TESTING, AND ADJUSTING

- A. Start and test motors and controllers in accordance with manufacturers written installation instructions.
- B. After starting motors
 - 1. Check for high bearing temperatures.
 - 2. Check for motor overload by taking ampere reading at maximum operating conditions, with all valves open and individual motor running.
 - 3. Check for objectionable noise or vibration; correct as needed at no additional cost to the Owner.
- C. Variable speed drives
 - 1. Certified factory start-up shall be provided. A certified start-up form shall be filled out for each VSD with a copy to the Owner's Representative and a copy kept on file by the manufacturer. Start-up technician shall configure the VSD as follows:
 - a. Set variable speed ramp-up rates on variable air volume systems slow enough to prevent high pressure trips and/or damage to duct systems. Coordinate with Division 25 Building Automation Systems contractor.
 - b. Set minimum speed for all applications in accordance with procedure indicated in Division 25 Building Automation Systems.
 - c. Enable current limit control and set maximum current limit setpoint to the motor to the motor's full load amps.

- d. Enable flying start feature.
 - e. Set voltage to speed ratio (V/f) to “squared”
 - f. Enable Flux Optimization capability.
 - g. Set switching frequency:
 - 1) Set to 4 kHz then check for motor noise in nearby occupiable spaces.
 - 2) If motor noise is audible in occupied space, enable noise smoothing feature.
 - 3) If noise is still a problem, raise switching frequency to 8 kHz. Do not raise switching frequency above 8 kHz.
 - h. Configure status point to only indicate status when the drive detects a current above that which occurs when a belt is broken (fan), the rotor is locked, or a discharge damper or valve is fully closed.
 - i. Set VSD to automatically restart with shortest time period allowed by VSD
 - 1) After power is restored after a power interruption
 - 2) After alarms are cleared
 - j. For fans such as relief fans and cooling tower fans: Run fan through entire speed range and program out speeds that cause fan vibration.
 - k. For VSDs powered by emergency generators, disable Under-volt Control (to cause the Pre-Charge Contactor to open as quickly as possible and prior to transfer of power, avoiding current surge and possible VFD damage).
 - l. For supply air fans for which supply air FSDs are interlocked to shut when the fan is off:
 - 1) Configure one DO contact to close when the VFD has been commanded to start. (This is used to convey to the fire alarm system that the FSDs must be opened. All wiring by Division 26.)
 - 2) Configure the VFD so the drive does not actually start until 15 seconds after the above DO contact has been closed. (This provides sufficient time for the fire alarm system to open the FSDs to avoid a nuisance trip.)
2. For VSDs used for life safety fans:
- a. Configure programmable input(s) per Paragraph 2.3F.8 to speed determined under Section 230593 Testing, Adjusting, and Balancing. This input shall be connected to the Fire Alarm System by Division 26.
 - b. During smoke control system testing, disable safety ignore and run-to-destruct features described under Paragraphs 2.3F.8.b.3) and 2.3F.8.b.4). Once testing is fully complete and just prior to witness testing with AHJ, enable both features.
 - c. Configure one DO contact to open when power is not available per Paragraph 2.3G.2.b.4). This contact shall be connected to the Fire Alarm System by Division 26.
3. After VSD is fully configured and programmed, all settings shall be documented and included with commissioning documentation in electronic format per Section 230501 Basic Mechanical Materials and Methods. The intent is to allow replacement drive electronics to be readily configured.
4. See Section 250000 Building Automation Systems for points to be mapped from the drive controller to the BAS; coordinate information addresses and other information required with the Division 25 Building Automation Systems contractor.
- D. See Section 230593 Testing, Adjusting and Balancing.
- E. See Section 230800 Mechanical Commissioning.

3.5 TRAINING

- A. See Section 230800 Mechanical Commissioning.

- B. VSD manufacturer to provide one of the following:
1. 8-hours of customer training
 2. Interactive Computer based training on VSD installation, start-up, programming, and trouble shooting

END OF SECTION

SECTION 230523

VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included in This Section: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
1. Service valves in hydronic systems
 2. Check valves
 3. Pressure reducing valves
 4. Safety and relief valves
 5. Manual and automatic air vents
 6. Miscellaneous valves

1.2 QUALITY ASSURANCE

- A. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

1.3 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
1. "R" means required.
 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Valves, all types	R	R		R
Manual and automatic air vents	R2	R		

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Ball, butterfly, and check valves
1. Nibco Inc.
 2. Crane Company

3. De Zurik Corporation
 4. Victaulic
 5. Or equal
- C. Silent check valves
1. Nibco, Inc.
 2. Grinnell
 3. Mueller Steam Specialty
 4. Victaulic
 5. Or equal
- D. Combination check and shut-off valves and Triple duty valves: Not allowed
- E. Pressure relief valves
1. ITT Bell and Gossett
 2. Watts
 3. Consolidated
 4. Tour & Anderson
 5. Or equal
- F. Vent and cocks
1. Weiss
 2. Weksler
 3. Crane Company
 4. Lunkenheimer
 5. Or equal
- G. Automatic air vents
1. Amtrol Inc.
 2. Bell and Gossett ITT
 3. Hoffman
 4. Or equal

2.2 GENERAL

- A. Where possible, provide valves of same manufacturer for all Mechanical Sections per products in this Section.
- B. For copper tubing provide solder-joint valves, flare fittings, or IPS-to-copper adaptor, sized for use with tubing and respective valve.
- C. For flanged valves, provide streamline companion flanges, ANSI B16.5, 1988 150 class pounds per square inch
 1. 255 pounds per square inch at 150 degree Fahrenheit
 2. 225 pounds per square inch at 250 degree Fahrenheit unless indicated otherwise
- D. Provide valves rated not less than 125 pounds per square inch steam working pressure, unless indicated otherwise.
- E. Provide valve materials suitable for service and temperature of respective systems, especially with respect to discs, plugs, balls, linings, gaskets, and lubricants of plug cocks, ball valves, etc.

- F. Provide chain-operated hand wheels, rustproof chain and chain guide for following valves
 - 1. Valves 8 feet or more above operating floor or platform
 - 2. As noted

- G. Valves in Insulated Piping: With 2 inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. Nibco Nib-seal handle extension or equal by Conbraco Industries, Inc. or Apollo Div.
 - 2. Butterfly Valves: With extended neck.

2.3 BUTTERFLY VALVES

- A. Flange Type
 - 1. Cast Iron body
 - 2. 316 or 416 stainless steel stem, continuous with pinned disc
 - 3. Disk shall be either
 - a. 304 or 316 stainless steel
 - b. Aluminum bronze
 - c. Nickel encapsulated ductile iron
 - d. EPDM encapsulated ductile iron
 - e. Nylon encapsulated ductile iron
 - 4. EPDM seat and seal
 - 5. Factory tested bubble-tight at 150 pounds per square inch

- B. Type
 - 1. Lug Type
 - a. Equal to Nibco Series LD-2000
 - b. Lugs drilled and tapped to match ANSI 150 flanges
 - c. Recommended by manufacturer or dead-end service at full pressure without the need for downstream flanges
 - d. Use cap screws both sides
 - 2. Wafer Type
 - a. Equal to Nibco Series WD-2000
 - 3. Grooved-end type
 - a. Equal to Victaulic 300 MasterSeal
 - b. Recommended by manufacturer or dead-end service at full pressure without the need for downstream flanges

- C. Operator
 - 1. Throttling handle with memory stops: smaller than 8 inches
 - 2. Gear operators: 8 inches and larger

2.4 BALL VALVES

- A. Materials
 - 1. Two piece body, bronze ASTM B584 C84400
 - 2. 316 stainless steel stem and ball
 - 3. PTFE Seat
 - 4. Full Port 1/2 to 1 inch; Standard Port 1-1/4 and larger
 - 5. 600 pounds per square inch at 100 degree F, 125 pounds per square inch saturated steam

6. Infinite throttling handle with memory stop
 7. Equal to Nibco 580-70-66
- B. Lock guard/shield
1. Where called for on drawings
 2. Equal to Brady Ball Valve Lockout (padlock by Owner)

2.5 MANUAL BALANCING VALVES

- A. Not used

2.6 AUTOMATIC BALANCING VALVES

- A. Not used

2.7 CHECK VALVES

- A. Silent Check Valves
1. For pump discharges:
 - a. Variable speed pumps. Check valve pressure drop shall vary roughly as the square of flow rate to near zero flow. Valves that use hydrodynamic profiles (e.g. Victaulic 716 and 779 check valve) resulting in high or erratic pressure drop at low flow rates are not acceptable.
 2. 2 inches or smaller
 - a. Bronze body
 - b. Center-guided disk, silent check
 - c. Class 125 (125 psi steam, 200 psi water)
 - d. Bronze trim
 - e. Buna-N disk
 - f. Equal to Nibco 480
 3. 2-1/2 inches or larger
 - a. Cast-Iron body
 - b. Center-guided disk, silent check
 - c. Class 125 (125 psi steam, 200 psi water)
 - d. Bronze trim
 - e. Bronze disk with Buna-N seat
 - f. Flanged body or wafer style
 - g. Equal to Nibco F-910 or W-910

2.8 SAFETY AND RELIEF VALVES

- A. General
1. Constructed, rated and stamped in accordance with Section IV of the ASME Boiler and Pressure Vessel
 2. Direct spring-loaded type
 3. Adjustable discharge pressure setting
 4. Brass or bronze body and all wetted parts shall be non-ferrous
 5. Suitable and rated for system pressure and temperature

- B. Set pressures
 - 1. Set pressure as indicated on Drawings; not to exceed pressure rating of protected equipment
 - 2. Valves to open, under test, at set pressure with following tolerance
 - a. Set pressure up to 70 pounds per square inch gage: plus or minus 2 pounds per square inch
 - b. Set pressure, above 70 pounds per square inch gage: plus or minus 3 percent
- C. Capacities
 - 1. Valves shall have capacity to relieve maximum possible generated energy while maintaining pressure in protected equipment at no more than 10 percent above vessel working pressure.
 - 2. Provide multiple valves if required for capacity even though only one valve may be shown on Drawings

2.9 VENT & GAUGE COCKS

- A. Bronze body, 1/4 inch size
- B. Lever handle
- C. 125 pounds per square inch steam working pressure
- D. Equal to Weiss LC-14

2.10 AIR VENTS

- A. Manual Air Vents
 - 1. Vertical
 - 2. Provide 1/4 inch brass needle or ball valve at top of chamber
 - 3. To 3 inch pipe: Line size air chamber, 12 inch long
 - 4. 4 inch to 8 inch: Line size air chamber, 6 inch long
 - 5. 10 inch and larger: Line size pipe cap
- B. Automatic Air Vents
 - 1. Float type
 - a. With isolating valve
 - b. Brass or cast iron body
 - c. Copper or stainless steel float
 - d. Stainless steel valve and valve seat
 - e. Suitable for system operating temperature and pressure
 - f. Non-opening on negative pressure
 - g. Equal to Amtrol No. 747
 - 2. Threaded vent connection for piping vent to drain
 - 3. Upstream valve cock for isolation

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades.
- B. Install valves in accordance with manufacturer's written installation instructions.
- C. Provide valves as shown on drawings.
 - 1. Ball and butterfly valves are considered interchangeable; where one type is shown on drawings, the other type may be used at contractor's option.
- D. Provide all valves (except control valves), strainers, and check valves of same size as the pipes in which they are installed unless otherwise indicated.
- E. Pressure rating of valves same as piping in which installed.
- F. Install valves with stems upright or horizontal, not inverted.
- G. Install valves with cast directional arrows in direction of flow.
- H. Support line valves at the valve in addition to regularly spaced pipe supports shown and specified.
- I. Check valves
 - 1. Provide silent check valves at discharge of pumps. Triple duty valves shall not be used as a substitution for check and shut-off valve.
 - 2. Install swing checks and gravity closing lift checks in horizontal position.
 - 3. Provide straight pipe upstream of valve after pump discharge or elbows as recommended by the valve manufacturer.
- J. Butterfly valves
 - 1. Lug or Grooved-end type at equipment isolation valves and for capped dead head shut off only. Piping adjacent to lug type shall be flange removable while valve is in use.
 - 2. Lug, wafer or Grooved-end type at all other locations
- K. Control valves
 - 1. See Section 250000 Building Automation System for valve specifications.
 - 2. Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where the actuator top and position indicator are below 5 feet above the floor, install with valve stem axis vertical with actuator side up. Otherwise, valves shall be installed with stem horizontal so that the position indicator is visible from the floor. Do not install valves with stem below horizontal or down.
- L. Provide blow-down ball valves and hose adaptors at strainers, air separators, tanks, pipe traps, equipment drains, etc. of same size as strainer blow-off connection.
- M. Provide drain valves at main shut-off valves, low points of piping and apparatus.
- N. Locate wheel handles to clear obstructions with hand.
- O. Install valves only in accessible locations.
- P. Wherever possible, install valves accessible from floor level. Provide guided chain operators on valves over 8 feet above floor in equipment areas. Extend chains to within 6 feet 6 inches of floor.

- Q. Locate equipment shut-off valves to be accessible without climbing over equipment.
- R. Provide operating handles for all valves and cocks without integral operators, unless otherwise noted. Provide adequate clearance for easy operation.
- S. Provide discharge pipe to atmosphere from all relief and safety valves, sized with area equal to sum of outlet areas of all valves connected thereto, unless indicated larger. Extend to over code compliant drain receptacle with air gap.
- T. Provide open-ended line valves with plugs or blind flanges.

3.2 AIR VENTS

- A. Manual air vents
 - 1. Locate
 - a. As shown on drawings
 - b. At all high points in closed piping systems
 - c. At equipment with vents, such as coils
 - 2. 1/4 inch copper tube discharged into nearest drain or with 180 degree bend to discharge into portable container
 - 3. Extend tubing or piping as required to make valve accessible
- B. Automatic air vents
 - 1. Locate as shown on drawings.
 - 2. Provide manual cock at inlet to automatic air vents. Except for vent on air separators, shut valve after system is free of air (to prevent leaks from failed floats).
 - 3. 1/4 inch copper tube discharged into nearest drain

3.3 FIELD QUALITY CONTROL

- A. Test operate valves from closed-to-open-to-closed position while valve is under test pressure.
- B. Test automatic valves including solenoid valves, expansion valves, water regulating valves, pressure reducing valves, pressure relief valves, safety valves and temperature and pressure relief valves for proper operation at settings indicated.
- C. Insure that valves are field checked for packing and lubricant and that disc is for service intended. Replace leaking packing at no additional cost to the Owner. Service valves which do not operate smoothly and properly with suitable lubricant before placing in operation at no additional cost to the Owner.

3.4 INSPECTION & COMPLETION

- A. Verify that adequate clearance between valves and adjacent walls or equipment is available to permit maintenance and repairs.
- B. Verify valve set for normal operation.
- C. Valves tags: See Section 230553 Mechanical Identification.

- D. See Section 230800 Mechanical Commissioning.
- E. See Section 230593 Testing, Adjusting and Balancing.

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Pipe and duct hangers, supports and associated anchors
 - 2. Thermal hanger shields for insulated piping

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers: ASME Section VIII – Boiler and Pressure Vessel Code – Pressure Vessels
- B. Pipe Supports: ANSI B31.9, Facility Services Piping
- C. Duct Hangers: SMACNA Duct Manuals

1.3 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. “R” means required.
 - 2. “R2” means required only for products and equipment differing for the specified manufacturer and model and for “or equals” where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Pipe hangers and supports	R2			R
Structural attachments	R2			R
Pipe protection and thermal hanger shields	R2			
Expansion shields	R2			

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Hangers, Inserts and Supports

1. Midland-Ross Corp.: Superstrut
2. Elcen Metal Products Company
3. Fee and Mason
4. ITT Grinnell Corporation
5. Kin-Line, Inc.
6. Unistrut
7. Superstrut
8. B-Line
9. Tolco
10. Mason Industries
11. Or equal

C. Pipe Protection and Thermal Hanger Shields

1. Pipe Shields, Inc.
2. Elcen Metal Products Company
3. Midland-Ross Corp.: Superstrut
4. Uni-Grip
5. Kin Line
6. Or equal

D. Expansion Shields

1. ITT Phillips Drill Co.: Red Head
2. Hilti Fastening Systems
3. Omark Industries, Inc.
4. Ramset Fastening Systems
5. Or equal

2.2 PIPE HANGERS AND SUPPORTS

- A. Model numbers are Superstrut, unless otherwise indicated. Equal products from all other manufacturers are acceptable.
- B. Provide electro-chromate, galvanized or factory painted finish; no plain "black" hangers allowed
- C. Dielectric Isolators: All uninsulated copper tubing systems; Superstrut isolators or equal, Cush-A-Strip or Cush-A-Clamp on all pipe clamps; for individual hangers, use felt lined hangers
- D. Individual Pipe Hangers
1. Cold pipe all sizes: Clevis hanger, No. C710
 2. Hot pipe sizes up to 4 in: Clevis hanger, No. C710
 3. Hot pipe sizes above 6 in: Adjustable steel yoke and cast iron roll No. C729
- E. Multiple or Trapeze Hangers
1. Factory channel
 - a. 12 gauge thick steel
 - b. Single or double section
 - c. Electro-chromate finish
 - d. Strutnuts: Series A-100 or CM-100
 - e. Straps: Series 702
 - f. Other accessories
 - g. No. A-1200 or A-1202
 2. Hot pipe sizes 6 in and larger: cast iron roll and stand; C728 or CR728

- F. Wall Supports
1. Pipe sizes up to 3 in: Steel bracket No. C738
 2. Pipe sizes 4 in and larger: Welded steel bracket C-735
 3. Hot pipe sizes 6 inches and larger
 - a. Welded steel bracket No. C739
 - b. Adjustable steel yoke and cast iron roller No. C729
- G. Vertical Support
1. General: Riser clamp Series C-720
 2. Chilled water: Either of the following:
 - a. Hydra-Zorb (copper) or Pipe Shield (steel)
 - b. Series C-720 wrapped with insulating tape.
- H. Floor Support:
1. Hot pipe sizes up to 4 in; cold pipe, all sizes
 - a. Adjustable cast iron saddle No. R786
 - b. Locknut nipple
 - c. Floor flange
 2. Hot pipe sizes 6 in and larger: Adjustable cast iron roll and stand No. R-730-C
- I. Thermal Hanger Shields
1. High density insert
 - a. See Section 230700 Mechanical Insulation
 - b. Same thickness as adjoining pipe insulation
 2. Galvanized sheet metal shield
 - a. Shield length and gauges

Pipe Size	Shield Length	Minimum Gauge
1/2-1 1/2	4	26
2 - 6	6	20
8 - 10	9	16
 3. Insert to extend one inch beyond metal shield ends on chilled water piping
 4. Use double layer shield on bearing surface for
 - a. Roller hangers
 - b. Support spacing exceeding 10 feet
 5. Pipe Shields Incorporated or equal
- J. Pipe Isolators
1. Hanger with minimum ¼ inch felt padding
 2. Tolco Fig. 3F felt lined hangers or equal
- K. Insulated Pipe Supports
1. Pipe supported on rod hangers - use Models A1000, A2000, A3000, 4000 and A9000
 2. Pipe supported on flat surfaces - use Models A1000, A2000, A5000, A6000, A7000, A7200 and A7400 Series
 3. Pipe supported on pipe rolls - use Models A3000, A4000, A5000, A6000, A8000, A8200 and A8400 Series
 4. Model designations are Pipe Shields, Inc. or equal; use only models designed for service for which supports are to be used
- L. Anchors and Guides: Provide anchors and guides where indicated on the Drawings and as required. Structural inserts shall be high density calcium silicate compressive strength 600 pounds per square inch. Guide slide pads shall be Teflon. Ensure that slide accommodates pipe

movement over full range of service and out-of-service temperatures. Guides shall be Pipe Shields, Inc. Model #B3000 or equal. Anchors shall be Pipe Shields, Inc. Model #C4000 or equal. See Section 230700 Mechanical Insulation.

- M. Insulated Pipe Strap
 - 1. 1/2 in to 1 in plumbing piping in wood frame construction
 - 2. Felt insulated
 - 3. Nailable pipe straps; In lieu of other hangers and dielectric isolators
 - 4. Koptoy or equal

- N. Escutcheons: See Section 232114 Piping Specialties

- O. Flashing and Sleeves
 - 1. Flashings
 - a. See Division 7 Thermal and Moisture Protection
 - b. Flash and counter flash watertight all pipe and duct penetrations of roofs and exterior walls
 - c. Flash pipes through roofs with ITWBuildex Dektite
 - d. Flash vents through roofs with
 - 1) Minimum 24 gage soldered roof jack for flat surface roofs
 - 2) Minimum 4 pound lead soldered roof jack for roofs other than flat surface roofs
 - 3) Vandal caps
 - 4) Provide counter-flashing sleeves and storm collars
 - 5) Caulk counter-flashing and storm collar weather tight
 - 6) Other flashings shall be minimum 24-gage galvanized sheet metal
 - 2. Sleeves
 - a. Through exterior concrete walls below grade, floor slabs on grade, and through concrete tank walls
 - 1) Schedule 40, galvanized steel pipe sleeves
 - 2) Seal annular space between pipe and sleeve water tight with one of the following
 - a) Thunderline Link-Seals
 - b) Calpico Pipe Linx
 - c) Or equal
 - b. Other concrete walls, floors and roofs
 - 1) Adjustable telescopic metal sleeves
 - 2) Tightly pack annular space between pipe and sleeve with fiberglass. Seal both sides with mastic
 - c. For insulated piping, sleeve diameter shall not be less than diameter of insulation.
 - d. Terminate sleeves flush with walls, and ceiling.
 - e. For flood prevention on vertical pipe, extend sleeves 1 inch above finished floor or use W-rated waterproof fire barrier packing.
 - f. Firestopping at penetrations of fire rated floors and partitions. See Section 232113 HVAC Piping.
 - 3. Separate piping through walls, other than concrete walls, from contact with wall construction materials; use non-hardening caulking.
 - 4. Install insulation on piping in walls which require insulation at time of installation.

2.3 DUCT HANGERS AND SUPPORTS

- A. See Section 233100 Ducts

2.4 STRUCTURAL ATTACHMENTS

- A. Model Numbers are Superstrut, unless otherwise indicated
- B. Anchor Bolts: Size as specified for hanger rods
- C. Concrete Inserts
 - 1. Malleable iron
 - 2. Place reinforcing steel through insert as recommended by manufacturer for recommended loads
 - 3. No. 452 or equal
- D. Beam Clamps
 - 1. All with U-568 safety strap
 - 2. All with locknuts on
 - a. Set Screw
 - b. Hanger rod
 - 3. Bottom flange attachment
 - a. Loading 150 pound and less: U-563
 - b. Loading 150 pound to 300 pound: U-562
 - c. Loading more than 300 pound: U-560
 - 4. Top flange attachment
 - a. Permitted only when bottom flange attachment cannot be used
 - b. Loading 400 pound and less: M-777
 - c. Loading more than 400 pound: M-778
- E. Welded Beam Attachments
 - 1. No. C-780 or equal
- F. Side Beam Brackets
 - 1. No. 542 or equal
- G. Hanger Rods
 - 1. ASTM A575 Hot rolled steel
 - 2. ANSI B1.1 Unified Inch Screw Treads
 - 3. Threaded both ends, threaded one end, or continuous threaded
- H. Hanger Rod Fixtures
 - 1. Turnbuckles: No. F-112 or equal
 - 2. Linked Eye Rod
 - a. Rod swivel
 - b. No. E-131 or equal
 - 3. Clevis: No. F-111 or equal
- I. Powder or Gas Actuated Anchors
 - 1. Hardened steel stud with threaded shank; size of shank to match hanger rod size
 - 2. Use only with non-shock loads
 - 3. Maximum load safety factors:
 - a. Maximum anchor load: 100 pounds
 - b. Static loads - 5
 - c. Vibratory loads - 8-10
 - 4. For concrete and steel; not to be used for light weight concrete, brick or concrete block
 - 5. 10% testing rate required, testing by contractor
 - 6. Omark Drivit or equal
- J. Expansion Shields

1. Carbon-steel anchors, zinc coated
 2. Stainless steel for corrosive atmospheres
 3. For normal concrete use
 - a. Self-drilling anchor
 - b. Sleeve anchor
 - c. Stud anchor
 4. For thin concrete use: wedge anchor
 5. For brick or concrete block use: sleeve anchor
 6. Maximum load safety factors
 - a. Static loads - 4
 - b. Vibratory loads - 8 - 10
 - c. Shock loads - 8 - 10
 7. Size to suit hanger rods
 8. ITT Phillips Red Head or equal
- K. Steel Deck Inserts
1. Factory stud with
 - a. Clip
 - b. Spring
 - c. Coupling
 2. ITT Phillips Red-Head or equal
- L. Miscellaneous Metal
1. Steel plate, shapes and bars: ASTM A36
 2. Steel pipe columns: ASTM A53, Schedule 40, black
 3. Bolts and nuts: regular hexagon-head type, ASTM A307, Grade A
 4. Lag bolts: square head type, Fed. Spec. FF-B-561
 5. Plain washers: round, carbon steel, Fed. Spec. FF-W.92

PART 3 EXECUTION

3.1 PIPE HANGERS, SUPPORTS AND GUIDES

- A. General
1. Assure adequate support for pipe and contents
 2. Provide adjustable hangers for all pipes complete with inserts, adjusters, bolts, nuts, swivels, all-thread rods, etc., except where specified otherwise
 3. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping and do not support piping from other piping.
 4. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping
 5. Install all cast iron piping in accordance with Cast Iron Soil Pipe Industry (CISPI) Standards
 6. Support all piping within 2 feet of each change of direction on both sides of fitting
 7. Thermal hanger shields shall be provided at hangers and supports where piping is insulated
 8. Prevent vibration or swaying
 9. Provide for expansion and contraction

10. Supports of wire, rope, wood, chain, strap perforated bar or any other makeshift device not permitted
11. Comply with applicable requirements at ANSI B31.1 and B31.2 for piping
12. Support piping independently so that equipment is not stressed by piping weight of expansion
13. See Section 230548 Vibration and Seismic Control for mechanical sound, vibration, and seismic control
14. See Section 230548 Vibration and Seismic Control for hangers, guides, anchors and supports requiring vibration isolation units
15. Hangers and supports shall have minimum safety factor of five (5), based on ultimate tensile or compressive strength, as applicable, of material used; base calculations on equipment's heaviest operating weight and pipes full of water
16. Install additional supports or braces if, during normal operation, piping should sway, crawl or vibrate. Piping shall be immobile
17. Install thrust blocks as required to prevent sway

B. Horizontal piping, except as noted

1. Adjustable clevis type and rod; all services at or below 250 degrees F
2. Rollers or slide bases: not required
3. Trapeze hangers; guide individual pipes on trapezes with 1/4 inch U-bolt or Superstrut 702 pipe clamp
 - a. Install thermal hanger shield at each support point
4. Galvanized sheet metal shields between hangers and PVC piping
5. Threaded steel rods
 - a. 2 in vertical adjustment with 2 nuts each end for positioning and locking
 - b. Size to 12 in inside pipe size (IPS)

Pipe, IPS	Rod
to 2 inch	3/8 inch
2-1/2 inch and 3 inch	1/2 inch
4 inch	5/8 inch
6 inch and 8 inch	3/4 inch
10 inch and 12 inch	7/8 inch

- c. Size above 12 inch IPS and multiple pipe standards: safety factor of 5 on ultimate strength on area
- d. For double rod hangers: 1 size smaller than above

C. Vertical piping

1. Base support
 - a. Base elbow or welded equivalent
 - b. Bearing plate on structural support
2. Guides
 - a. At every third floor but not to exceed
 - 1) 25 feet for piping to 2 inch
 - 2) 36 feet for piping 2-1/2 inch to 12 inch
 - 3) 50 feet for piping 14 inch and larger
 - b. Or as otherwise designed by the Vibration Isolation vendor; coordinate with Section 230548 Vibration and Seismic Control
3. Top support
 - a. Special hanger or saddle in horizontal connection
 - b. Provisions for expansion
4. Intermediate supports: steel pipe clamp at floor

- a. Bolted and welded to pipe
 - b. Extension ends bearing on structural steel or bearing plates
- 5. For multiple pipes: coordinate guides, bearing plates and accessory steel
- D. Horizontal insulated piping
 - 1. Install saddles for rollers or slide bases
 - 2. Install thermal hanger shields for all other types of supports
 - 3. See Section 230700 Mechanical Insulation for insulation connection to shields
- E. Vertical insulated piping
 - 1. Install thermal hanger shields at guides
 - 2. Use insulated riser clamps at rigid connections.
 - 3. See Section 230700 Mechanical Insulation for insulation connection to shields
- F. Install Pipe Isolators between hangers and piping for all uninsulated copper tubing.
- G. Spring Supports for Piping
 - 1. See Section 230548 Vibration and Seismic Control
- H. Miscellaneous Steel
 - 1. Provide miscellaneous steel members, beams, brackets, etc., for support of work in this division unless specifically included in other divisions
- I. Fire-stopping
 - 1. At pipe penetrations through rated assemblies
 - 2. Commercial pipe sleeve assemblies that are UL listed and that have been approved by the fire marshal for this purpose.

3.2 PIPE SUPPORT SPACING

A. Maximum spacing for horizontal piping

Type of Pipe	Size	Maximum Spacing
Steel	1-1/2 inch and smaller	7 feet
	2 inch and larger	10 feet
Copper	3/4 inch and smaller	5 feet
	1- 1-1/2 inch	6 feet
	2 - 3 inch	8 feet
	4 inch and larger	10 feet
	Plastic	3/4 inch and smaller	3 feet

- B. Spacing Notes: Additional supports at
 - 1. Changes in direction
 - 2. Branch piping and runouts over 5 feet
 - 3. Concentrated loads due to valves, strainers and other similar items
 - 4. At valves 4 inch and larger in horizontal piping, support piping on each side of valve
- C. Parallel piping on trapezes
 - 1. Maximum spacing to be that of pipe requiring closest spacing

3.3 ATTACHMENT TO STRUCTURE

- A. Concrete
 - 1. Use inserts for suspending hangers from reinforced concrete slabs, walls and sides of reinforced concrete beams wherever practicable
 - 2. Set inserts in position in advance of concrete work
 - 3. Provide reinforcement rod in concrete for inserts carrying
 - a. Pipe over 4 inch
 - b. Ducts over 60 inches wide
 - 4. Where concrete slabs form finished ceiling, finish inserts flush with slab surface
 - 5. Where inserts are omitted, install hangers with expansion shields
 - 6. Through-deck support
 - a. Drill through concrete slab from below
 - b. Provide rod with recessed square steel plate and nut above slab
 - 7. Powder actuated anchors or expansion shields may be used in lieu of inserts
 - a. In bottom of thick slabs
 - b. In thin slab construction, only in sides of beams
 - 8. Pre-Cast Concrete
 - a. Use pre-set inserts
 - b. Where inserts are not available, field drill through beam or joists at locations as directed by Owner's Representative
 - c. Through bolt side beam bracket to beam or joist
 - 9. Poured-In-Place Concrete
 - a. With metal form or underdeck
 - b. Before concrete is poured
 - 1) Field drill hole through metal deck
 - 2) Provide bearing plate, nut and locknut on rod; or install factory-made steel deck inserts specified hereinbefore
 - c. After concrete is poured
 - 1) Install hangers with expansion shields
- B. Steel Beam Anchors
 - 1. Beam or channel clamps
 - 2. Do not cut or weld to structural steel without permission of structural engineer
- C. Steel Deck Anchors
 - 1. Concrete filled: as specified above
 - 2. Decking without concrete
 - a. Through rod Support
 - 1) Weld to square plate, 1/4 in thick
 - 2) Plate to distribute load over minimum of two full cells
 - 3) Coordinate with floor layouts to clear cells with wiring
- D. Side Wall Supports
 - 1. Concrete walls
 - a. As specified for hangers
 - 2. Stud Walls
 - a. Toggle bolts
 - b. Studs welded to structural studs
- E. Support Spreaders
 - 1. Install spreaders spanning between structural members when hangers fall between them, and hanger load is too great for slab or deck attachment
 - 2. Spreaders may be one of methods listed below, or combination of both as required
 - a. Fabricated from structural channel
 - 1) End fittings bolted or welded

- 2) Secure to structural members
 - a) As required by construction
 - b) As reviewed by Structural Engineer
- b. Formed channels with fittings, Superstrut or equal
 - 1) Submit manufacturer's calculations for installation

3.4 DUCT HANGERS AND SUPPORTS

- A. See Section 233100 Ducts

END OF SECTION

SECTION 230548

VIBRATION AND SEISMIC CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included in This Section: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
1. Vibration isolators for equipment
 2. Vibration isolators for piping systems
 3. Equipment bases
 4. Inertia bases
 5. Seismic control for equipment on isolators
 6. Seismic bracing and restraints for piping and ductwork
 7. Seismic bracing and restraints for rigidly mounted equipment
 8. Seismic bracing and restraints for flues

1.2 REFERENCE STANDARDS

- A. ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers
- B. NEMA – National Electrical Manufacturer's Association
- C. Underwriters' Laboratories, Inc.: UL 778 – Motor Operated Water Pumps
- D. American Society of Mechanical Engineers: ASME Section VIII – Boiler and Pressure Vessel Code – Pressure Vessels
- E. Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this section where cited below
1. Mason Industries “Seismic Restraint Guidelines for Suspended Piping, Ductwork, and Electrical Systems”
- F. Publication references below are basic industry standards; however, regulatory requirements may reference, modify or supersede:
1. American Institute of Steel Construction (AISC) publications
 - a. Specification for the Design, Fabrication and Erection of Structural Steel Buildings (Eighth Edition)
 2. American National Standards Institute (ANSI) Standard
 - a. B027.2-965 – Plain Washers
 3. American Society for Testing and Materials (ASTM) Specifications
 - a. A 6 – General Requirements for Delivery and Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
 - b. A 36 – Structural Steel
 - c. A 53 – Welded and Seamless Steel Pipe
 - d. B633 – Electrodeposited Coatings of Zinc on Steel
 - e. A 307 – Carbon Steel Externally and Internally Threaded Standard Fasteners
 - f. A 500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing

- g. A1011 – Hot Rolled Carbon Steel Sheet and Strip
- 4. American Welding Society (AWS) Publication
 - a. D 1.1 – Structural Welding Code

1.3 QUALITY ASSURANCE

- A. Qualifications
 - 1. Manufacturer
 - a. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture for not less than five years
- B. Manufacturer or manufacturer's representative of vibration isolation equipment shall have the following responsibilities
 - 1. Determine vibration isolator sizes and locations
 - 2. Provide piping and equipment isolation systems as scheduled or specified
 - 3. Guarantee specified isolation system static deflection under installed actual load.
 - 4. Provide installation instructions, drawings and field supervision to assure proper installation, adjustment and performance
- C. The installation of all vibration isolation units and associated hangers and bases shall be as directed by the vibration isolation manufacturer's representative.
- D. It is the objective of this Specification to provide the necessary design for the control of excessive noise and vibration in the building due to the operation of machinery or equipment, and due to interconnected piping, ductwork or conduit
 - 1. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
 - 2. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50 percent greater than the design deflection.
 - 3. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than ± 10 percent.
 - 4. All neoprene mountings shall have a Shore hardness of 30 to 50 ± 5 , after minimum aging of 20 days or corresponding oven-aging.
- E. Acoustical Testing
 - 1. The contractor shall cooperate with regard to sound tests (ARI 575, ANSI S1.13) which may be conducted by the Owner's Representative to verify that noise criteria are met.
 - 2. The contractor shall notify the Owner's Representative of any changes which will affect the acoustical performance.
- F. Seismic load calculations for piping, ductwork and equipment
 - 1. F_p , the total design lateral seismic force, shall be calculated by a licensed structural engineer, unless it is explicitly stated in the plans or specifications. This engineer shall be hired by the contractor responsible for this Section of work.
 - 2. Shall meet California Building Code requirements
 - 3. Calculations required for supports and bracing for situations not covered by referenced "Guidelines" and any revisions to seismic load calculations provided in contract documents at time of bid:
 - a. Hired by contractor under this Section or work

- b. Cost of calculations borne by contractor under this Section
- 4. Calculations made and signed by registered civil or structural engineer knowledgeable in seismic design
- 5. Include horizontal and vertical reaction loads at connections to building structures for all seismic restraints, including those covered by referenced Standards
 - a. Coordinate reaction loads and attachment details with structural engineer for building

1.4 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. "R" means required.
 - 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Vibration isolation devices: catalog cuts, static deflections, quantity, load per isolator, mounting details, seismic restraints, mounting details, etc.	R	R		
Concrete and steel details for equipment pads.				R
Welds or anchor bolt locations.				R
Reinforcing and template steel locations and details				R
Seismic calculations for each seismic restraint sized and signed by registered structural or civil engineer.	R	R		
Inertia and equipment bases	R	R		R
Anchors, inserts and fasteners and fastening details	R2	R2		R
Seismic restraints	R2	R2		R
Seismic bracing and restraint mounting details	R	R		
Flexible pipe connectors	R	R		R
Flexible duct connectors	R2	R2		R

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Vibration Isolation
 - 1. Mason Industries, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. M.L. Saussé & Co. (Vibrex)
 - 4. Amber-Booth
 - 5. Or equal.
- C. Flexible Duct Connections
 - 1. Ventfabrics

2. Duro Dyne
3. Or equal

D. Seismic Restraints

1. Hangers and snubbers: Any manufacturer who can verify compliance with SMACNA standards and the California Building Code
2. Strut - Channel Framing: Any manufacturer who can verify compliance with SMACNA standards and the California Building Code
3. Anchors - Drill in, wedge type: Any manufacturer who can verify compliance with the California Building Code
4. Snubbers: Any manufacturer who can verify compliance with the California Building Code

2.2 VIBRATION ISOLATOR TYPES

A. Spring type

1. Spring isolators shall incorporate following
 - a. All springs to be single coil steel with minimum spring coil outer diameter 0.8 of loaded operating height
 - b. Horizontal spring stiffness within 0.8 to 1.25 times rated vertical spring stiffness
 - c. Corrosion resistance
 - 1) Where exposed to corrosive environment including but not limited to:
 - a) Outdoors
 - b) Exposed to outdoor air within 5 feet of outdoor air intake
 - 2) All metal parts hot dip galvanized unless noted otherwise
 - d. Reserve deflection (from loaded to solid height) of 50 percent of rated deflection
 - e. Designed and installed so that ends of springs remain parallel; neoprene cups not acceptable
 - f. Noise pads of ½ inch or 1 inch thickness below the spring base or within the frame to reduce the chance that the springs shall be resonant with equipment forcing frequencies or support structure natural frequencies. For seismic isolators, the pad shall be within the frame. See Table in Paragraph 3.4A.8 for applicability and thickness.
 - g. Leveling device
 - h. Where operating weight differs from installed weight provide built-in adjustable limit stops to prevent equipment rising when weight is removed. Stops shall not be in contact during normal operation.
2. Type "A": Similar to Mason Type SLF
3. Type "B": same as Type "A" except
 - a. Provide built-in resilient vertical limit stops
 - b. Tapped holes in top plate for bolting to equipment
 - c. Capable of supporting equipment at fixed elevation during equipment erection
 - d. Mason Type SLRSO or equal for 1 inch and 2 inch deflection, Type SLR Series 100 for 3 inch to 5 inch deflection
4. Type "C": spring hanger rod isolators shall incorporate the following
 - a. Spring element seated on steel washer within neoprene cup
 - b. Steel retainer box encasing spring and neoprene cup
 - c. Minimum 1/2 inch clearance between retainer box and spring hanger rod
 - d. Minimum 15 degrees angular clearance between rod and retainer box
 - e. Double deflection LDS element
 - f. Mason RW30N or equal

B. Elastomer mounting types

1. Type "D": Double deflecting type incorporating following

- a. Bolt holes for bolting to equipment base
- b. Bottom steel plates for bolting to sub-base as required
- c. Unit type design molded in black oil-resistant neoprene
- d. Neoprene compounded to meet following:
 - 1) Not greater than 50 durometer
 - 2) Minimum tensile strength 2000 pounds per square inch
 - 3) Minimum elongation 300 percent
 - 4) Maximum compression set of 25 percent of the original deflection
- e. Mason Type ND or equal (where seismic restraint not required by CBC)
- f. Mason Type BR or equal (where seismic restraint required by CBC)
- 2. Type "E": Elastomer hanger rod isolators shall incorporate following
 - a. Molded unit type neoprene element
 - b. Compounding described in Type "D" above
 - c. Steel retainer box encasing neoprene mounting.
 - d. Minimum 1/2 inch box
 - e. Mason Type HD or equal
- 3. Type "F": Pad type elastomer mountings to incorporate following
 - a. 5/16 to 3/8 inch minimum thickness per layer
 - b. 50 psi maximum loading
 - c. Ribbed or waffled design
 - d. 1/16 inch galvanized steel plate between multiple layers of pad thickness
 - e. 1/16 inch deflection per pad thickness
 - f. Suitable bearing plate to distribute load
 - g. Bolts through equipment and pad shall be oversized and provided with resilient washers, bushings and lock nuts
 - h. Mason Type Super W Series or equal
- 4. Type "G": Pad type elastomer mountings to incorporate following
 - a. High quality bridge bearing neoprene
 - b. Maximum loading 800 psi
 - c. Suitable bearing plate to distribute load
 - d. Minimum thickness 2 inch
 - e. Mason Type BBP or equal
- 5. Type "H": Combination spring/elastomer hanger rod isolators to incorporate following
 - a. Spring and neoprene isolator elements in steel box retainer
 - b. Characteristics of spring and neoprene as described in Type "C" and Type "E" hanger isolators
 - c. Factory preloading to 75 percent of rated load
 - d. Mason PC30N or equal
- C. Seismic Snubbers
 - 1. Type SS: All-directional seismic snubber
 - 2. Neoprene bushing to be bridge bearing quality
 - 3. Male portion to be smooth round bar; threaded bolts not acceptable
 - 4. Mason Z-1225 or equal

2.3 EQUIPMENT BASES

- A. Integral structural steel bases, Type "B-1"
 - 1. Reinforced as required to prevent base flexure at start-up and misalignment of drive and driven units
 - 2. Fan bases complete with motor slide rails
 - 3. Drilled for drive and driven unit mounting template
 - 4. Mason Type WFSL/WFND or equal

- B. Concrete inertia base, Type "B-2"
 - 1. Formed in structural steel frame
 - 2. Structural base reinforced as required to prevent flexure, misalignment of drive and driven unit or stress transfer into equipment
 - 3. Minimum thickness of the inertia base shall be 6 inches or greater if required to meet weight ratio specified below
 - 4. Fan bases complete with motor slide rails
 - 5. Pump bases shall be large enough to support suction and discharge elbows and suction diffusers
 - 6. Bases complete with
 - a. Height saving brackets
 - b. Reinforcing
 - c. Equipment bolting provisions
 - d. Isolators provided by vibration control supplier, type as scheduled
 - 7. Base ready for concrete pour
 - 8. Inertia Base Weights
 - a. Centrifugal Fans, except as noted: Minimum 1.0 times weight of fan, motor and drive
 - b. Air handling Units, except as noted: Minimum 1.0 times weight of fan and coil cabinet, coils, fan, motor and drive
 - c. Pumps: Minimum 1.5 times weight of pump, motor and base
 - 1) Base to be sized to support suction diffuser when used
 - 9. Mason Type KSL/BMK or equal
- C. Seismic restraint, Type I
 - 1. All directional type
 - 2. Steel and elastomeric
 - 3. Mason Type Z-1225 or equal
- D. Seismic restraint, Type II
 - 1. Criteria
 - a. Designed for seismic force criteria specified in Part 3
 - b. Submit application details for approval

2.4 ANCHORS, INSERTS AND FASTENERS

- A. All anchors and inserts shall be installed according to the California Building Code.
- B. Do not use any anchor or insert in concrete which does not have a signed structurally engineered design value based on its installed application and one of the following
 - 1. California Building Code evaluation report
 - 2. Lab test report verifying compliance
- C. Do not use powder driven and power driven (Shoot-In) fasteners, expansion nails or friction spring clips.
- D. All over-head concrete anchors or inserts shall be selected to comply with the California Building Code table for the anchor or insert.
- E. Torque testing of anchors shall be allowed to verify compliance of anchor installation. However, torque testing shall not justify usability of anchor. Only load or pull testing shall be allowed to justify usability of anchors. Failure of torque shall constitute failure of anchor.
- F. Bolts and nuts

1. Bolts and heavy hexagon nuts: ANSI B18.2.1 and ASTM A307 or A576
2. Bolts, underground: ASTM A325
3. Expansion anchors: Federal Specification A-A-1922

2.5 SEISMIC RESTRAINTS

- A. General
 1. Capable of safely accepting indicated external forces without failure
 2. Maintain equipment, piping and ducts in a captive position
- B. Criteria: Design for seismic forces specified herein
- C. Bracing system: Provide one of the following methods as most applicable for each brace
 1. Material used, except for pipes, shall be structural steel with ASTM A36. Steel pipes shall conform to ASTM A501
 2. Complete system of factory fabricated components
 3. Complete system of job fabricated components
 4. Miscellaneous metal structural shapes

2.6 FLEXIBLE PIPE CONNECTORS

- A. Flexible Piping Couplings for Vibration Isolation
 1. Flexible mechanical joints
 2. Victaulic Style 077/177 or equal
- B. Twin Sphere Connections for Vibration Isolation
 1. Molded twin-sphere type connectors made of peroxide cured EPDM and Kevlar tire cord reinforcement and reinforcing ring
 2. Connectors up to 2 inch diameter may have threaded ends
 3. Connectors 2-1/2 inch diameter and larger to have floating steel flanges recessed to lock the connector's neoprene flanges
 4. Connectors rated a minimum of 150 pounds per square inch at 220 degrees Fahrenheit without control rods or cables; connectors that require control rods are not acceptable.
 5. Mason SAFEFLEX Type SFDEJ (no equal)

2.7 FLEXIBLE DUCT CONNECTORS

- A. General
 1. Conform to NFPA 701 and NFPA 90A
 2. Flame spread rating: 25
 3. Smoke development rating: 50
 4. Airtight and waterproof to plus or minus 10 inches
- B. Construction
 1. Metal collar at each end
 - a. Galvanized steel G60
 - b. Minimum thickness: No. 24 USSG
 - c. Minimum length: 3"
 - d. Double lock joint
 2. Length of fabric

- a. Minimum: 4 inch
- b. Maximum: 10 inch
- 3. Materials
 - a. Coated glass fabric
 - b. 30 ounces per sq yard
 - c. Sewed and cemented seams
 - d. Indoors
 - 1) Neoprene or woven nylon/polyester blend with vinyl coating
 - 2) Ventfabrics, Inc. Ventglas or equal
 - e. Outdoors
 - 1) Woven fiberglass with Hypalon coating
 - 2) Weather-resistant
 - 3) UV, sunlight, and ozone resistant
 - 4) Ventfabrics, Inc. Ventlon or equal

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install isolators and seismic restraints in accordance with manufacturer's written instructions
- B. Vibration isolators must not cause any change of position of equipment or piping resulting in piping stresses or misalignment
- C. Make no rigid connections between equipment and building structure that degrade noise and vibration isolation system herein specified
 - 1. Electrical conduit connections to isolated equipment shall be flexible liquid tight conduit of sufficient length to incorporate a right angle bend, an offset of not less than 8 inches or a loop to allow free motion of isolated equipment
 - 2. The HVAC Sub-contractor shall not install any equipment, piping or conduit which makes rigid contact with the building unless permitted in this Specification; building includes, but is not limited to, slabs, beams, columns, studs and walls
 - 3. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce the vibration isolation
- D. Do not use isolator leveling bolts as jacking screws
- E. Verify that all installed isolators and mounting systems permit equipment motion in all directions

3.2 SEISMIC CONTROL

- A. General
 - 1. Install seismic restraints for pipes, ducts and equipment per applicable code
 - 2. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning or uplift
 - a. Update designs and submit for DSA approval, if required, and include on shop drawings, including arrangements, sizes and model numbers indicated or referenced in applicable standards. Each shop drawing shall bear a Structural or Civil Engineer's stamp and signature registered in the State of California.

- b. Where designs, etc., are neither indicated nor referenced, contractor shall submit such designs, together with supporting calculations prepared by Structural or Civil Engineer registered in State of California. Calculations shall substantiate seismic restraint capability to safely accept external forces without failure and maintain equipment in position.
- c. Capable of safely accepting external forces per CBC without failure.
- 3. Provide resilient restraining devices as required to prevent equipment motion in excess of 1/4 inch
- 4. Coordinate seismic bracing requirements with other sections to result in
 - a. Vertical pipe and duct restraints to coincide with and take place of required hangers
 - b. Longitudinal pipe bracing to coincide with required pipe anchors
- 5. Shall not short circuit vibration isolation systems or transmit objectionable vibration or noise

B. Attachments to Structure: See Section 230529 Hangers and Supports

3.3 FLOOR MOUNTED EQUIPMENT

- A. Concrete housekeeping pads
 - 1. Isolation and seismic restraint supplier to determine dimensions and thickness required
 - a. Minimum thickness: 5.5 inches
 - 2. Support all vibration isolation devices and bases
 - 3. Key with stirrups as required, integral with structural slab
 - 4. Incorporate seismic restraint anchor plates flush with top of housekeeping pad

3.4 EQUIPMENT ISOLATION

- A. General
 - 1. Provide 1 inch operating clearance between equipment or structural bases and housekeeping pad
 - a. 2 inch minimum clearance for inertia bases over 96 inches in any dimension
 - 2. Position equipment, structural base and concrete bases on blocks or wedges at proper operating height
 - 3. Provide operating load conditions prior to transferring base isolator loads to springs and removing wedges
 - 4. Adjust or provide additional resilient restraints to flexibly limit start-up equipment lateral motion to 1/4 inch
 - 5. Prior to start-up, clean out all foreign matter between bases and equipment
 - 6. Verify that there are no isolation short circuits in the base, isolators or seismic restraints or conduit, pipe and duct connections
 - 7. Position all corner or side seismic restraints with equipment in operation for proper operating clearance. Weld or bolt seismic restraints to seismic anchor plates in housekeeping pad
 - 8. Locate spring hanger boxes directly adjacent to the structural support element above, as opposed to down at the location of the supported equipment.
 - 9. Where isolator base pad is called for in Vibration Isolator Schedule, install pad between the isolator base and structure.
 - 10. For isolator pads penetrated by anchors to the structure, to prevent short-circuiting, provide neoprene grommet between the anchor and isolator. Hand-tighten nut to so that grommet is not compressed then secure with lock nut.

B. Vibration Isolator Schedule

Equipment	Base Type	Isolator Type	Isolator Static Deflection	Acoustical Base Pad Thickness
In-line pumps >1 HP	None	C	1 inch	–
Floor-mounted AHUs (internally isolated)	None	F	0.1 inch	–
Suspended fan-coils	None	C	1 inch	–
Floor-mounted fans <10 HP	B-1 if fan is not self-supporting	A	1 inch	1/2 inch
Floor-mounted fans 10 HP and larger				
<300 RPM	B-1 (B-2 if 50 HP or larger)	A	3.5 inch	1/2 inch
300-450 RPM	ditto	A	3 inch	1/2 inch
451-600 RPM	ditto	A	2.5 inch	1/2 inch
601-750 RPM	ditto	A	2 inch	1/2 inch
751-850 RPM	ditto	A	1.5 inch	1/2 inch
>850 RPM	ditto	A	1 inch	1/2 inch
Suspended fans direct drive				
1/3 HP and larger	None	E	0.2 inch	–
<1/3 HP	None	–	–	–

3.5 PIPING ISOLATION

- A. See Section 232113 HVAC Piping
- B. See Section 230529 Hangers and Supports for general support of piping including felt lined hangers for uninsulated piping.
- C. Piping other than risers
 - 1. No vibration isolation required
- D. Vertical Pipe Risers
 - 1. Riser Support 1
 - a. Applies to copper pipe risers and welded steel less than 50 feet in length, and steel pipe risers with flexible mechanical couplings.
 - b. Risers shall be laterally supported with a riser clamp at each floor set on a Type F isolation pad, 0.1 inch deflection.
 - 2. Riser Support 2
 - a. Applies to all pipe risers other than those qualifying for Riser Support 1
 - b. Riser supports shall be engineered by the vibration isolation vendor as follows.
 - c. All vertical risers shall be supported by spring isolators designed to support the riser filled with water. Assigned loads must be within the building design limits at the support points.
 - d. Neutral central resilient anchors close to the center of the run shall direct movement up and down. The anchors shall be capable of holding an upward force equal to the water weight when the system is drained. If one level cannot accommodate this force, anchors can be located on 2 or 3 adjacent floors. Anchors shall be Mason ADA or equal.
 - e. Resilient guides shall be spaced and sized properly depending on the pipe diameter. Guides shall be Mason VSG Vertical Sliding Guides or equal.

- f. Support spring mountings shall be Type A. The initial spring deflection shall be a minimum of 0.75 inches or four times the thermal movement at the isolator location, whichever is greater.
- g. Submittals must include the initial load, initial deflection, change in deflection, final load and change in load at all spring and anchor support locations, as well as guide spacing. Calculations shall include pipe stress at end conditions and branch off locations and the manufacturer must include installation instructions. Submittal must be stamped and signed by a licensed professional engineer in the employ of the vibration isolator vendor.

E. Equipment

- 1. Provide twin-sphere flexible couplings where shown on drawings, such as at pumps. Install per manufacturer's instructions.
- 2. Provide flexible hose connections where shown on drawings, such as at AC units and hydronic heat pumps. Install per manufacturer's instructions.
- 3. For motorized equipment not shown to have flexible connections on drawings, such as chiller, cooling towers, and boilers, provide minimum three flexible style mechanical couplings between the vibrating equipment and the first rigid support to the structure. This can be couplings that are part of elbows and other normally required fittings; it is not necessary to include couplings dedicated to this purpose.
 - a. Not required at:
 - 1) Air handling equipment with internal fan isolation
 - 2) VAV boxes including fan-powered VAV boxes
 - 3) Equipment piped with copper piping

3.6 DUCTWORK ISOLATION

- A. See Section 233100 Ducts.
- B. Ductwork
 - 1. No vibration isolation required other than flexible connections at fans
- C. Flexible Connections
 - 1. Install at all connections to fans and air handling units and as indicated on Drawings
 - a. Not required at suspended direct drive fans <1/3 HP
 - b. Not required at internally isolated air handling units unless shown on drawings
 - 2. 2 inch slack in fabric; install to allow minimum movement of 1 inch in both tension and compression

3.7 WALL AND FLOOR PENETRATIONS

- A. All piping and ductwork to be vibration isolated, and all piping and ductwork passing through acoustically rated partitions, shall freely pass through walls and floors without rigid contacts or connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork, and maintain 0.75 inches to 1.25 inches clearance around the pipe or duct outside surfaces. For installations through air plenum partitions and through acoustically rated partitions, clearance space shall be tightly packed with fiberglass, and caulked airtight after installation of piping or ductwork. Caulk shall be Hilti CP 506 or equal.
- B. For installation in rated walls, see Section 232113 HVAC Piping and Section 233100 Ducts

- C. Provide sleeves and escutcheons as specified in Section 232113 HVAC Piping and Section 233100 Ducts.

3.8 SEISMIC BRACING INSTALLATION

- A. Piping and Ductwork
 1. Bracing system shall meet the seismic load requirements (See Section 1.3F)
 2. Install all bracing and restraints per referenced Guidelines in Paragraph 1.2, where applicable
 3. Where the referenced Guidelines in Paragraph 1.2 are not applicable then submit details of a proposed bracing system. The proposed system shall be stamped by a licensed civil or structural engineer and shall be submitted for approval prior to construction.
 4. Coordinate seismic bracing and restraints so that required expansion provisions will not be restricted
 5. Provide floor support and bracing of pipe connection risers to equipment
 6. Where seismic bracing and restraints are not required refer to Section 230529 Hangers and Supports
- B. Flexibly Supported Piping and Ducts
 1. Provide and locate restraints to allow normal operation of systems without transmitting vibrations to building structure
 2. Location of Restraints: Per referenced Guidelines in Paragraph 1.2
 3. Construction of Restraints: Steel cables, installed slack
- C. Rigidly Mounted Equipment
 1. Secure to floor as required to prevent horizontal motion and overturning
 2. Secure to walls or other equipment to prevent overturning
 - a. Attach to elements capable of taking calculated loads
 - b. Provide steel backing in walls as required to brace equipment and piping from wall

3.9 FIELD QUALITY CONTROL

- A. Inspection by manufacturer's representative of all vibration isolating devices
 1. After installation of all devices
 2. Provide written report by manufacturer regarding
 - a. Installation errors
 - b. Improper selection of devices
 - c. Other fault that could affect performance of system
- B. Submit written report to Owner's Representative
 1. Include manufacturer's report indicating required corrections
 2. Include report on steps to properly complete isolation work
- C. See Section 230800 Mechanical Commissioning

END OF SECTION

SECTION 230553

HVAC SYSTEM IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

- A. Identify piping and equipment components of the mechanical systems to indicate their function and system served

1.2 REFERENCE STANDARDS

- A. Pipe marker shall comply with ANSI/ASME A13.1

1.3 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. "R" means required.
 - 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Pipe markers	R2			
Equipment tags	R2			
Concealed equipment markers	R			

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. W.H. Brady
- C. Seton
- D. Marking Services, Inc. (MSI)
- E. Or equal

2.2 DUCTWORK IDENTIFICATION

- A. Not required

2.3 PIPING IDENTIFICATION

- A. Colors

Pipe Service	Background	Lettering
Chilled water supply	Blue	White
Chilled water return	Blue	White
Heating water supply	Yellow	Black
Heating water return	Yellow	Black

- B. Label Content
 - 1. Pipe service
 - 2. Arrow indicating flow direction
- C. Labels
 - 1. Vinyl duct markers, self-adhesive
 - 2. Able to withstand temperatures up to 160°F
 - 3. Minimum letter size: per ANSI/ASME A13.1
 - 4. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- D. Provide custom marker labels for all piping for which no standard manufactured marker is available. Submit sample for approval
- E. Specialty Gases piping shall be identified with Brady B-60 fiber tags, or equal, with chemical symbol on tag

2.4 VALVE IDENTIFICATION

- A. Valve Tags: Not required

2.5 EQUIPMENT IDENTIFICATION

- A. Nameplates
 - 1. Tag all scheduled and uniquely tagged mechanical equipment with engraved nameplates. Nameplates shall be 1/16-inch thick, 3 x 5 or 2 x 6 laminated 2-ply plastic, center ply white, outer ply black. Form letters by exposing center ply.
 - 2. Identify unit with building number, unit mark as shown on equipment schedules on Drawings, and service. For example: SF-1 SUPPLY FAN

2.6 TERMINAL UNITS

- A. Same as Paragraph 2.5
 - 1. Hand-written or stenciled tag on terminal casing in indelible ink also acceptable

PART 3 EXECUTION

3.1 MANUFACTURER'S IDENTIFICATION

- A. Equipment manufacturer's nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this specification. The nameplates of subcontractor or distributor are not acceptable.
- B. Identify model number, size, capacity, electrical characteristics, serial number, etc.
- C. Leave nameplates clean, legible and with unobstructed view

3.2 PIPING IDENTIFICATION

- A. All piping concealed or exposed shall have identification markers.
- B. Unless the current version of the recommendations of ANSI A13.1, 1981 are more stringent, apply labels or letters after completion of pipe cleaning, insulation, painting, or other similar work, as follows:
 - 1. Every 20 feet along continuous exposed lines
 - 2. Every 10 feet along continuous concealed lines
 - 3. Adjacent to each valve and stubout for future
 - 4. Where pipe passes through a wall, into and out of concealed spaces
 - 5. On each riser
 - 6. On each leg of a "T"
 - 7. Locate where conspicuously visible
- C. Further, apply labels or letters to lower quarters of the pipe on horizontal runs where view is not obstructed or on the upper quarters when pipe is normally viewed from above. Apply arrow labels indicating direction of flow; arrows to be the same color and sizes as identification labels.
- D. Spray a protective coating of clear epoxy over markers and arrows in corrosive atmosphere areas.

3.3 EQUIPMENT IDENTIFICATION

- A. All equipment and apparatus shall have identification nameplates. Cardholders in any form not acceptable.
 - 1. Provide identification nameplate for variable speed drives and starters provided under this Division indicating the equipment that the VFD powers.
- B. Locate where conspicuously visible
- C. Attach either with sheet metal screws, brass chain, or contact cement as applicable
- D. Identify equipment out of view behind access doors, in unfinished rooms on the face of the access door
- E. Place warning signs on machines driven by electric motors which are controlled by fully automatic starters, in accordance with Article 3281, General Industry Safety Orders

- F. Nameplate Directory: Post final copy in Operation and Maintenance Manual

3.4 TERMINAL UNITS

- A. Same as Paragraph 3.3
- B. Identify room sensor/thermostat relating to terminal unit with indelible marker on sensor hidden by cover.

3.5 CONCEALED EQUIPMENT IDENTIFICATION

- A. Where fire/smoke dampers, terminal units, and other equipment requiring routine maintenance are located above accessible ceilings, color-coded markers shall be provided as specified below to make it easier for equipment to be located by maintenance personnel.
 - 1. Marker
 - a. DONN Fineline, narrow tee-bar (tees with flat surface less than 1/2 inch wide), or concealed spine ceilings: 1/8 inch round-head map tack
 - b. Standard tee-bar ceilings: 3/8 inch round sticker made of vinyl, polyester, or PVC (paper not acceptable), equal to EMS Tough-Spots
 - 2. Locate marker on the ceiling tile (tack) or tee (sticker) closest to side of the equipment requiring maintenance (such as damper motor, controls, and valves).
 - 3. Unless otherwise directed, color codes shall be:
 - a. Fire/smoke and smoke dampers: red
 - b. HVAC equipment, such as terminal units, VAV boxes, and heat pumps: blue
 - c. Valves such as at riser taps and riser or branch isolation valves: yellow
- B. Label duct access door to fire and smoke dampers in letters not less than 1/2 inch height reading SMOKE DAMPER, FIRE DAMPER, or FIRE/SMOKE DAMPER. Indelible ink is acceptable.

END OF SECTION

SECTION 230593

TESTING, ADJUSTING AND BALANCING

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Operational testing and adjusting of air handling equipment
 - 2. Balancing of air distribution systems
 - 3. Testing and adjustment of air terminal devices
 - 4. Flow testing, adjusting and balancing of hydronic systems.

1.2 REFERENCE STANDARDS

- A. National Environmental Balancing Bureau Procedural Standards
- B. Associated Air Balance Council National Standards
- C. Testing, Adjusting and Balancing Bureau Standards
- D. ASHRAE Standard 111 Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilating, and Air-Conditioning Systems

1.3 QUALITY ASSURANCE

- A. Contractor shall be member of Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or Testing, Adjusting and Balancing Bureau (TABB)
- B. Contractor shall have satisfactorily balanced at least three systems of comparable type and size
- C. Prior to start of testing, adjusting and balancing, verify that required Project conditions are met
 - 1. Systems installation is complete and in full operation
 - 2. All pre-functional tests have been performed
 - 3. Equipment has been started and tested in accordance with manufacturers' installation instructions
 - 4. Doors and windows are in place and closed or under normal traffic conditions

1.4 SUBMITTALS

- A. All submittals shall follow Submission and Resubmission Procedures outlined in 230501 Basic Mechanical Materials and Methods.
- B. Submit documentation that demonstrates
 - 1. Contractor is a member of AABC, NEBB, or TABB
 - 2. Contractor has satisfactorily balanced at least three systems of comparable type and size

C. Pre-Test Submittal

1. At least 30 days prior to starting field work, submit the following:
 - a. Set of final report forms
 - 1) Complete with design conditions of all equipment and design flow rates for all equipment and devices to be tested.
 - 2) Forms shall include blank entry space for all data requested in this Section. Carefully review requested data; standard balancing forms may not be acceptable.
 - 3) Forms shall be in acceptable word-searchable electronic format per Section 230501 Basic Mechanical Materials and Methods.
 - b. Complete list of instruments proposed to be used
 - 1) Organize in appropriate categories
 - 2) Include data sheets for each
 - 3) Show
 - a) Manufacturer and model number
 - b) Description and use when needed to further identify instrument
 - c) Size or capacity range
 - d) Latest calibration date
 - c. Provide certification that
 - 1) All instruments have been calibrated prior to tests
 - 2) Instruments comply with requirements of AABC, NEBB, or TABB for tests required
 - 3) Contractor is currently certified by AABC, NEBB, or TABB
2. Do not proceed with field work until the above submittal has been approved by Owner's Representative.

D. Final Test & Balance Report

1. At least 15 days prior to Contractor's request for final inspection, submit electronic copy of final reports on approved reporting forms for review and approval by Owner's Representative. Once approved, provide required quantity of paper and electronic copies per 230501 Basic Mechanical Materials and Methods.
2. Form of Final Reports
 - a. Completed forms shall be typed (not hand written) and be in acceptable word-searchable electronic format per Section 230501 Basic Mechanical Materials and Methods.
 - b. Fully completed report forms for all systems specified to be tested and balanced including at a minimum all data specified herein to be recorded
 - c. Each individual final reporting form must bear
 - 1) Signature of person who recorded data
 - 2) Signature of air balance supervisor of reporting organization
 - d. When more than one certified organization performs total air balance services, firm having managerial responsibility shall make submittals.
 - e. Identify instruments of all types that were used and last date of calibration of each.

1.5 PROJECT REVIEW

A. Pre-Construction Review

1. Review following documents
 - a. Contract documents
 - 1) Drawings
 - 2) Specifications
 - 3) Addenda
 - 4) Change orders

- b. Submittal data
 - c. Shop drawings
 - d. Building Automation System drawings
 - e. Pre-functional test reports
 - 2. Identify potential problems from standpoint of total system balance.
 - 3. Review design and shop drawings and specifications for
 - a. Potential problems for total system balance
 - 1) Location of balancing devices
 - 2) Lack of balancing devices
 - 3) General System layout
 - 4) Architectural features
 - 5) Accessibility
 - b. Most effective system balance procedures
 - c. Scheduling and coordination requirements
 - 4. Review submittal data for
 - a. Completeness of data
 - b. Conformity with contract documents
 - c. Special instructions for use of balancing devices
 - d. Factors for flow meters
 - e. Limitations affecting accuracy of measurements
 - f. Balancing forms shall show design data and submittal data where different
 - g. Equipment performance data and curves
 - 5. Review BAS drawings and specifications for:
 - a. Calibration and setpoint adjustment requirements by this Section
 - b. Determining most effective total system balance procedure for minimum control manipulation
 - c. Coordinate required control manipulation with BAS installer
 - 6. Submit report recommending addition and/or relocation of balancing devices, including, but not limited to
 - a. Volume dampers
 - b. Balancing valves (including ball and butterfly valves with memory-stops, which are used in the design for balancing)
 - c. Pressure and temperature measuring points
- B. Construction Review
- 1. Make on-site visits during progress of construction: Number of visits to be as required to perform the functions specified below.
 - 2. Purpose of review
 - a. Identify potential problem for performing total system balance
 - b. Identify modifications that will affect air total system balance
 - c. Schedule and coordinate total system balance with other work
 - d. Identify conditions that could create hazardous environment for building occupants
 - 3. Typical activities
 - a. Check that necessary balancing and measuring hardware is
 - 1) In place
 - 2) Located properly and accessibly
 - 3) Installed correctly
 - b. Identify and evaluate variations from system design
 - c. Record data from equipment nameplates
 - d. Identify and report possible restrictions in systems; such as
 - 1) Poorly designed duct fittings
 - 2) Questionable piping connections
 - 3) Others as may arise or based on contractor's experience
 - e. Verify that construction progress will not delay total system balance

- f. Identify best location for duct traverses
- g. Identify scaffolding needs

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

- A. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified herein. If not otherwise noted, the following minimum requirements apply
 - 1. Volt-meter: plus or minus 1 percent scale
 - 2. Ammeter: plus or minus 1 percent scale
 - 3. Ohmmeter: plus or minus 0.1 percent scale for calibrating plus or minus 0.4 degrees Fahrenheit resistance temperature sensors, plus or minus 0.25 percent scale for calibrating plus or minus 1 degrees Fahrenheit temperature sensors, plus or minus 1 percent scale for measuring motor current
 - 4. Ultrasonic time-of-travel strap-on flow sensor: plus or minus 5 percent of reading
 - 5. Other flow sensors: plus or minus 2 percent of reading
 - 6. Water pressure gauge: plus or minus 1/2 percent scale, ASME Grade 2A
 - 7. Watt meter, plus or minus 1/2 percent scale: 3 phase split core current transducers
 - 8. Temperature: plus or minus 0.4 degrees Fahrenheit
- B. All equipment shall be calibrated within 6 months of use, or according to the manufacturer's recommended interval, whichever is shorter, and when dropped or damaged. Calibration tags shall be affixed or certificates readily available and proof of calibration shall be included reports.

PART 3 EXECUTION

3.1 GENERAL

- A. Coordinate with work of other trades.
- B. Coordinate all work with Commissioning Coordinator
 - 1. See Section 019100 Commissioning
 - 2. See Section 230800 Mechanical Commissioning
- C. Report to Owner's Representative any discrepancies or items not installed in accordance with the Contract Drawings pertaining to proper balance and operation of air and water distribution systems.
- D. Perform testing, adjusting and balancing in accordance with AABC, NEBB, or TABB standards.
- E. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to Section 230700 Mechanical Insulation.

- F. Mark equipment settings with paint or other suitable, permanent identification material, including damper control positions, valve indicators, and similar controls and devices, to show final settings.
- G. Assist in performance testing where specified in Section 230800 Mechanical System Commissioning.

3.2 CONTROL SYSTEM COORDINATION

- A. See Division 25 Building Automation Systems
- B. System balance techniques in this Section rely on the operation of the BAS. Test and balance contractor shall coordinate schedule of work with BAS installer to ensure test and balance work can be executed and completed in a timely manner.
- C. Cooperate with BAS installer in determining operating conditions and setpoints, as indicated in this Section.
- D. Cooperate with BAS installer in calibrating all airflow measuring devices.
- E. Obtain and receive training for required software from BAS installer for setting calibration constants in terminal devices.

3.3 WATER SYSTEMS BALANCING

- A. Prepare water systems for balancing in following manner
 1. Verify the following conditions
 - a. Piping systems have been flushed and treated in accordance with Section 232113 HVAC Piping
 - b. Strainers have been cleaned
 - c. Piping systems are completely full of water, all air properly vented
 - d. All coil and heat exchanger shut-off, balance, and control valves are fully open
 2. Check pump
 - a. Rotation
 - b. Pump factory impeller trimming by comparing shut-off heads with pump curves from approved submittals
 - 1) Note that impellers on variable speed pumps should not be trimmed to design flow and head conditions. See Section 232123 Pumps.
 - 2) Report discrepancy in shut-off head to Owner's Representative and if impeller does not appear to be properly trimmed. Wait for direction before proceeding with pump test and balance.
 3. BAS and Central Plant Operability
 - a. Do not proceed with any of the following balancing procedures until the BAS is capable of operating equipment such as fans, pumps, VAV boxes, control valves, etc. in manual and automatic modes and capable of reading sensors such as differential pressure, flow rates, temperatures, etc. of air and hydronic systems to be tested and adjusted.
 - b. Do not proceed with air handler testing until chilled and hot water at design temperatures are available from the central plant.
- B. Pumps

1. Test and report for each pump at test conditions indicated in Paragraphs below.
 - a. Tag
 - b. Manufacturer and model of pump and motor
 - c. Motor horsepower, volts, phase, full load amps
 - d. Pump shut-off head from curves, measured shut-off head, and resulting impeller diameter from pump curve
 - e. At test condition specified
 - 1) Volts and amps
 - 2) Calculated brake horsepower
 - 3) Entering and leaving gage pressure and difference in feet
 - 4) Flow rate deduced from pump curve
 - 5) For pump with variable speed drive
 - a) Speed (Hz)
 - b) Kilowatts
 2. Include pump curve from approved submittals in final report.
- C. Chilled Water and Hot Water Distribution System
1. Coil Test & Balance
 - a. System is self-balancing. Two-way control valves at coils prevent each coil from being over-supplied with water, other than minor excursions during transients such as cool-down or warm-up. Conventional balancing (throttling of balancing valves) will increase pump energy use by not allowing aggressive differential pressure setpoint reset. Hence, do not adjust any valves on any coil or pump, except temporary adjustments where noted. All manual valves at coils and pumps shall be wide open when test and balance work is complete.
 - b. Report with all control valves open to coil and all pumps (except standby pumps, where applicable) operating at full speed
 - 1) See Air Balance below for coil temperature data where required
 - 2) See Pump test data above for pump data
 - 3) Coils with modulating two-way
 - a) Terminal tag
 - b) Control valve model number and serial number
 - c) Pressure drop across coil
 - d) Flow as measured by calibrated balancing valve (where applicable).
Determine flow by either of the following:
 1. Use test plugs to measure pressure drop across the coil and estimate flow using coil manufacturer's submittal data of flow vs. pressure drop. This option shall only be used when design coil pressure exceeds 5 feet.
 2. Use test plugs to measure pressure drop across the control valve and calculate flow using valve manufacturer's submitted Cv.
 2. HW Pump Variable Speed Drive Setpoint Determination
 - a. For systems with variable speed drives, determine maximum differential pressure setpoint (DPmax) in conjunction with the BAS installer as follows.
 - 1) Fully open all control valves serving coils that are located downstream of the differential pressure sensor.
 - 2) Fully close all control valves serving coils that are located upstream of the differential pressure sensor.
 - 3) Start pump(s). Manually adjust speed slowly until design flow (or design pressure drop, for coils without calibrated balance valves) is just achieved through all open coils without modulating any balance valves. One coil should be just at design flow, while others should be at or above design flow.
 - 4) Once flow condition in previous step is achieved, note the BAS system differential pressure reading at the differential pressure sensor. This reading becomes the differential pressure setpoint. Using pressure taps at differential

- pressure sensor and handheld digital pressure sensor, verify accuracy of BAS reading.
 - 5) If there are multiple differential pressure sensors, repeat steps above for each sensor.
 - b. Convey to the BAS installer
 - 1) Differential pressure setpoint
 - 2) Any discrepancy between BAS differential pressure reading and handheld measurement
 - c. Report at condition described above
 - 1) Differential pressure setpoint and concurrent reading of handheld measurement: Initials of BAS installer to indicate that the information was transmitted to them.
 - 2) Tag of coils downstream of differential pressure sensor, along with the following for each
 - a) Design flow rate and pressure drop
 - b) Tested flow rate and pressure drop with differential pressure at setpoint determined above
 - 3) Water flow rate through flow meter (where applicable), through BAS
 - 4) See Pump test data above for pump data
3. Control Valve Shut-off Test
 - a. Close all control valves in the system through the BAS. Run all pumps at full speed.
 - 1) Verify that all control valves remain shut with no measurable flow, as indicated by pump differential pressure and any temperature rise across coils.
 - 2) Do not run pumps deadheaded for more than 5-minutes at any one time.
 - 3) After test, release control valves to automatic operation through the BAS.
 - b. Report at condition described above
 - 1) Tag of coils where flow is detected: Initials of BAS installer to indicate that this information was transmitted to them.
 - 2) Measured pump inlet and outlet pressures, and difference converted to feet
 - 3) Differential pressure reading at all differential pressure sensors, through BAS

3.4 AIR SYSTEM BALANCING

A. General

1. Do not operate fan systems for test or balance until spaces served have been cleaned of dust and debris, to avoid contamination of supply air or return air paths and equipment.
2. Filters
 - a. Check that filters of the type specified are installed, oriented in the proper airflow direction, free of bypass, and clean.
 - b. Make no adjustment for dirty filters; fans were selected for clean filters at design airflow.
 - c. For systems with construction prefilters and high efficiency final filters
 - 1) Perform all zone level balancing with only pre-filter installed, no final filter, and system operating on 100 percent outdoor air.
 - 2) Immediately prior to pre-occupancy 100 percent outdoor air purge (see procedure specified under Section 230501 Basic Mechanical Materials and Methods), remove and discard prefilters and install clean final filters. With final filters in place, perform tests of air handling unit as described for appropriate AHU type below. After system testing and balancing is complete, conduct 100 percent outdoor air purge per Section 230501 Basic Mechanical Materials and Methods.
3. In cooperation with BAS installer, set adjustments of automatically operated dampers and valves to operate as indicated.

4. Balance hydronic systems prior to air balance and have operational during air balance for air temperature measurements where specified.

B. Air Outlets

1. Adjust diffusers' throw pattern prior to balance as indicated below unless otherwise indicated on Drawings. Review manufacturer's instructions for proper diffuser blade or weir gate positions to provide this throw pattern as it is not always intuitive. It is TAB contractor's responsibility to adjust throw patterns for all adjustable throw diffusers. If diffuser has a fixed throw pattern and is incorrectly installed, HVAC contractor shall correct pattern prior to balance.
 - a. Ceiling diffusers: As indicated on the Drawings.
 - 1) Star pattern diffuser deflectors shall be adjusted for corner blow pattern unless otherwise indicated on Drawings.
 - b. Slot diffusers supplying cooling-only, or heating and cooling with ceilings 15 feet and lower: Adjust to throw away from adjacent walls along the ceiling toward the center of the room served.
 - c. Slot diffusers supplying heating-only, or heating and cooling with ceiling above 15 feet: Adjust to throw downward and slightly toward adjacent wall.
 - d. Double-deflection grilles: Adjust rear blades horizontal 22 degree upward and splay front blades in 45 degree pattern at each end gradually rotating to be almost straight at blades in center of grille.
 - e. Thermafusers: Install directional baffles (or verify factory installation) to achieve the blow pattern shown on plans and schedules.
2. Test and adjust each diffuser, grille and register to within plus or minus 10 percent of design requirements
 - a. Start with all dampers wide open.
 - b. Adjust dampers, starting with nearest to terminal unit or fan. Make adjustments using duct mounted volume dampers rather than dampers at diffuser face (if any) unless absolutely required.
 - c. At least one damper shall remain wide open at end of balance.
3. Thermafusers
 - a. See manufacturer's instructions.
 - b. All measurements shall be made with all appearance panels in place.
 - c. Design flow
 - 1) Fully open the damper using the balancing lever
 - 2) Balance Thermafusers to design flow just like any other diffuser per Paragraph 3.4B.2 adjusting the VAV box damper through the BAS as needed so at least one balancing damper is wide open.
 - 3) Once all Thermafusers are at design flow and at least one balancing damper wide open, the VAV box discharge static pressure reading becomes the design setpoint, (DPmax). Coordinate with the BAS system and installer to record this value. No field measurement of static pressure is required, only the BAS sensor reading.
 - d. Minimum flow
 - 1) Set minimum flow adjustment dial to 10% (the factory setting)
4. Plenum return air grilles or slots in lights: No balance required
5. Report
 - a. Tag each grille, diffuser and register and mark tag on copy of floor plan.
 - b. For each grille, diffuser and register, indicate tag, size, type, and effective area (where applicable).
 - c. Required velocity/cubic feet per minute
 - d. Initially tested velocity/cubic feet per minute
 - e. Finally tested cubic feet per minute after adjustments
 - f. Thermafuser VAV box static pressure setpoint; also convey to BAS contractor.

C. Terminal Boxes

1. Balancing contractor shall provide laptop computer or other device for communicating with BAS system, using software provided by BAS installer. Cooperate with BAS installer to learn how to use software to calibrate BAS zone controller.
2. Terminal box calibration procedure listed below may be modified based on specific features or limitations of digital controller and recommendations of the controller manufacturer. Submit revised procedure for approval by Owner's Representative along with pre-test submittal per Paragraph 1.4C.
3. Use BAS terminal "commissioning" software where available and record all calibration and test data through the BAS.
4. Zero transmitter prior to each test.
5. Adjust BAS calibration constants so that the VAV box controller and measured air flow rate at air outlets matches BAS reading within range listed at all of the following conditions at a minimum:
 - a. Maximum airflow setpoint, $\pm 5\%$
 - b. Controllable minimum airflow setpoint, $\pm 10\%$. The controllable minimum value shall be that determined by the BAS contractor per Section 250000.
 - c. Zero flow
6. Terminal fans (fan-powered boxes)
 - a. Adjust speed to achieve design cfm within 10 percent
 - b. For series-flow boxes, adjust BAS setpoint to allow VAV damper to operate at maximum airflow rate: Increase fan speed until there is no backflow through plenum opening.
 - c. For ECMs with speed controlled by BAS, set maximum speed via BAS interface and note speed setpoint in air balance report.
7. Report
 - a. Tag, manufacturer, and model
 - b. VAV maximum cooling flow rate, design and measured
 - c. VAV minimum flow rate, design and measured
 - d. BAS calibration coefficients at all calibration points

D. BAS airflow measuring stations (AFMS)

1. For cooling AHU AFMS
 - a. Test Conditions
 - 1) Command all VAV boxes to full open.
 - 2) Override the economizer to 100% outdoor air, i.e. configure the outdoor air damper to be 100% open and the return air damper to be 0% open.
 - 3) Start supply fan and run it slowly from 10% speed up to 100% speed, in 10% increments with a pause at each step to allow time for the VAV boxes to communicate. At each 10% increment, measure and report:
 - a) Sum of VAV box airflows (should be displayed on BAS AHU graphic)
 - b) Airflow measurement station airflow reading
 - c) Traverse across supply air duct, filter bank, or other location where the most accurate airflow reading is possible
 - b. Plot the speed vs. all three measured airflows. They should be linear and the three readings should be within 10% of each other.
2. For factory calibrated AFMS: If measured airflow and BAS readings differ by more than 10%, consult with Owner's Representative for recalibration instructions. Do not change factory calibration without written direction.
3. For field calibrated AFMS: Coordinate with BAS installer to adjust calibration coefficients. Report coefficients in air balance report.

E. Air Handling Unit and Fan-coil Airflow Rate Readings

1. Total supply air quantities shall be determined at all of the following where applicable

- a. Pitot traverse in the supply duct downstream, positive pressure side of the fan
 - b. Pitot traverse at coil or filter bank
 - c. Totaling the readings of individual air outlets
 - d. Totaling the readings of individual terminals as read through the BAS
 - e. Supply fan airflow sensor reading as read through the BAS
 - 2. Total return air quantities shall be determined at all of the following where applicable
 - a. Pitot traverse in the return air duct or damper entering air handler
 - b. Totaling the readings of individual air outlets, if ducted return system
 - c. Totaling reading of each return air shaft inlet, if multi-story plenum return system
 - d. Return fan airflow sensor reading as read through the BAS
 - 3. Outside air quantities shall be determined by all of the following where applicable
 - a. Subtracting pitot traverses of supply and return ducts
 - b. Pitot traverse of outdoor air intake duct
 - c. Outdoor airflow sensor reading as read through the BAS
 - d. Note: Balance by measurement of return air, outside air, and mixed air temperatures shall not be used due to inherent inaccuracy.
- F. Variable Air Volume Air Handlers
- 1. Adjust fan speed using manual adjustment of variable speed drive for testing only. Do not change or adjust sheaves.
 - 2. Supply fan DP Setpoint.
 - a. Establish maximum static pressure setpoint (DPmax) in conjunction with the BAS installer as follows. All adjustments made via the BAS, not field measurements except as noted.
 - b. Test Conditions
 - 1) Set all boxes to operate at maximum airflow setpoints; allow controls to stabilize.
 - 2) For cooling systems only to account for diversity: Shut off boxes, starting with boxes whose dampers are the most closed, as indicated by the BAS, and upstream of the DP sensor, until the airflow equals scheduled design airflow rate.
 - c. Procedure
 - 1) Manually lower fan speed slowly while observing VAV box airflow rates downstream of the static pressure sensor. Stop lowering speed when one or more VAV box airflow rates drops 10 percent below maximum airflow rate setpoint.
 - 2) Once flow condition in previous step is achieved, note the BAS system static pressure reading at the duct static pressure sensor.
 - a) This reading becomes the maximum static pressure setpoint.
 - b) Using pressure taps at differential pressure sensor and handheld digital pressure sensor, verify accuracy of BAS reading.
 - d. If there are multiple static pressure sensors, repeat steps above for each sensor. Each sensor will have its own setpoint.
 - e. Convey to the BAS installer
 - 1) Static pressure setpoints
 - 2) Any discrepancy between BAS differential pressure reading and handheld measurement
 - f. Report
 - 1) Static pressure setpoint and concurrent reading of handheld measurement: Initials of BAS installer to indicate that the information was transmitted to them.
 - 2) Tag of VAV boxes that dropped below design maximum airflow rate in tests above. These are the critical boxes, those requiring the largest static pressure.
 - 3) Concurrent fan data
 - a) Volts and amps
 - b) Amps and kilowatts from variable speed drive
 - c) Variable speed drive speed in hertz

- d) Entering and leaving fan static pressure
 - e) Flow rate, summed from BAS terminals
 - f) Fan airflow sensor reading from BAS, where applicable
- 3. Minimum outside air flow
 - a. Supply air fan and return air fan (if any) shall first be operating at design airflow. For VAV systems with diversity, close enough boxes close to fan to reduce supply airflow to scheduled design condition.
 - b. For systems with outdoor airflow measuring stations, see Paragraph 3.4D. Adjust dampers to achieve minimum design outdoor air flow rate via the BAS.
- 4. Test with system operating at design fan and minimum outside air flow conditions described above and report the following on a schematic of the system:
 - a. Tags of all equipment
 - b. Manufacturer and model of all fans and motors
 - c. Motor horsepower, rpm, volts, phase, full load amps
 - d. Sheave data at motor and fan; belt data
 - e. Fan airflow rate at all locations measured, as listed above
 - f. Final measured fan speed and amps
 - g. Amps and kilowatts from variable speed drives
 - h. Variable speed drive speed in hertz
 - i. Static pressures measured at
 - 1) Return air plenum
 - 2) Mixed air plenum
 - 3) Downstream of relief fan (where applicable)
 - 4) Downstream of filter
 - 5) Downstream of coil
 - 6) Discharge of supply fans
 - 7) At static pressure sensor
 - j. Concurrent airflow rate readings from BAS airflow sensors, including sum of VAV box airflow rates
 - k. Minimum BAS outdoor air control setpoints and signals as applicable
 - l. Coil Performance
 - 1) Test with
 - a) Associated pumps running in automatic maintaining differential pressure setpoint determined above
 - b) Central plant cooling (heating) equipment operational
 - c) Controls adjusted to provide coil design water temperature entering coil
 - d) Fan is running at design airflow
 - e) Fully open control valve, allow steady-state to be reached, and measure
 - 2) Measure and report on a schematic of the system
 - a) Entering water temperature
 - b) Leaving water temperature
 - c) Coil differential pressure drop
 - d) Coil flow rate, deduced from manufacturer's coil flow vs. pressure drop data, see submittals
 - e) Coil entering drybulb and wetbulb to cooling coils, drybulb only for heating coils
 - f) Leaving supply air drybulb and wetbulb from cooling coils, drybulb only for heating coils
- 5. Relief Fans
 - a. Test Conditions
 - 1) Economizer in 100% outdoor air position
 - 2) Supply fan at design supply air rate
 - 3) All doors and windows closed in area served by air handler
 - 4) All exhaust fans on in area served by air handler

- b. Procedure
 - 1) Measure building pressure using BAS sensor.
 - 2) Manually adjust fan speed at variable speed drive to achieve than 0.05" building pressure.
 - a) Fan speed may exceed 60 Hz if necessary. Do not change or adjust sheaves.
 - b) If required fan speed exceeds 60 Hz, convey maximum speed to BAS contractor.
 - 3) At the above design conditions, measure fan inlet and outlet pressures and measure total relief air quantities with pitot tube traverse of main ducts near the fan inlet or outlet where possible.
 - c. Report
 - 1) Amps and kilowatts from variable speed drive
 - 2) Variable speed drive required speed in hertz
 - 3) Inlet and outlet static pressure
 - 4) Building static pressure
- G. Drain Pan Testing
- 1. This test shall be performed for all drain pans including
 - a. Primary condensate drain pans on all air handling units and fan-coils
 - b. Humidifier and evaporative cooler sump pans that include a drain-down cycle
 - 2. This test does not apply to:
 - a. Auxiliary drain pans under fan-coils
 - b. Other drain pans for emergency use not expected to be wet during normal operation
 - 3. Procedure
 - a. Pan Slope Test
 - 1) Turn AHU off.
 - 2) Plug the drain at the discharge air gap.
 - 3) Fill the drain pan with water until standing water covers all of the pan.
 - 4) Remove the test plug and verify all of the water drains, leaving puddles no larger than 2" in diameter and 1/8" deep anywhere in the pan.
 - b. Trap Sizing Test – Blow-Through Fans
 - 1) Plug the drain at the discharge air gap.
 - 2) Open the air handler/fan-coil coil access panel and fill the drain pan until all areas of the pan are covered with at least 1/2" of water. Close the access panel.
 - 3) Configure and operate the air handler/fan-coil at design operating conditions as defined above herein. The intent is that the coil section will be at the highest expected operating pressure.
 - 4) Remove drain and observe condensate flow at drain pipe discharge air gap. Within a few minutes, there should be little to no flow.
 - 5) Use theatrical smoke or other flow indicator near the drain vent/cleanout and verify that air is not being blown out of the trap. If airflow is detected, the trap is dry and the trap depth, as measured from the centerline of the drain connection to the centerline of the bottom of the trap, is too shallow.
 - c. Trap Sizing Test – Draw-Through Fans
 - 1) Plug the drain at the discharge air gap.
 - 2) Open the air handler/fan-coil coil access panel and fill the drain pan until all areas of the pan are covered with at least 1/2" of water. Close the access panel.
 - 3) Configure and operate the air handler/fan-coil at design operating conditions as defined above herein. The intent is that the coil section will be at the lowest expected operating pressure.
 - 4) Remove drain and observe condensate flow at drain pipe discharge air gap. Within a few minutes, there should be little to no flow.

- 5) Use theatrical smoke or other flow indicator near the drain vent/cleanout and verify that air is not being drawn into the trap. If airflow is detected, the trap is dry and the trap depth, as measured from the centerline of the drain connection to the centerline of the bottom of the trap, is too shallow.
 - 6) Place a bucket or other receptacle at the drain discharge to capture condensate runoff.
 - 7) Turn off air handler/fan-coil fan. Additional runoff will occur from the P-trap, and possibly from the AHU if the drain pan is still partially full. The vertical distance from the centerline of the unit connection to the drain connection is "A". If the amount of water in the receptacle after runoff stops exceeds the condensate pipe volume determined based on the nominal pipe diameter and "A", then moisture was still standing in the pan at the end of the test, indicating future water retention problems are likely. If so, the distance "A" needs to be extended. Otherwise, the pan was dry, and the install is acceptable.
- H. Constant Volume & Variable Volume Exhaust Fans and Recirculating Fan-Coils
1. See Paragraph 3.4B for air outlet balancing
 2. Total air quantities for fan shall be determined by both
 - a. Pitot tube traverse of main ducts near the fan inlet, and
 - b. Totaling the readings of individual air outlets
 3. Total air quantities shall be obtained within 10 percent of design by adjustment of fan speed
 - a. Constant speed fans
 - 1) Adjust sheaves on fans with adjustable sheaves.
 - 2) Change sheaves on fans with fixed sheaves.
 - 3) Adjust speed potentiometer for ECMs
 - b. Variable speed fans
 - 1) Adjust maximum fan speed at ECM or VFD
 4. Report
 - a. Tag
 - b. Manufacturer and model of fan and motor
 - c. Sheave data at motor and fan; belt data
 - d. Motor horsepower, rpm, volts, phase, full load amps
 - e. Fan airflow rate at all locations measured, as listed above
 - f. Final measured amps
 - g. Inlet and outlet static pressure
- I. Life Safety Systems
1. Review Smoke Control Report provided by Owner's representative for required airflow and pressure differential requirements, where applicable.
 2. All work shall be done under direction of Owner's life safety commissioning agent and in coordination with fire alarm/smoke control system installer.
 3. Atrium Exhaust
 - a. Configure smoke dampers and make-up operable openings for atrium smoke control mode. Verify dampers/makeup openings are in the required position indicated in Smoke Control Report via the feedback lights provided at the fire alarm/smoke control panel.
 - b. Release (close) all smoke doors to atrium.
 - c. Measure atrium exhaust rate at air openings from atrium to the relief fan mechanical plenum.
 - d. Adjust exhaust fan speed until desired atrium exhaust rate and differential pressure is achieved relative to adjacent smoke zones.
 4. For variable speed driven fans, adjust preset speed setpoint in variable speed drive so that desired speed is achieved when life safety system contact closes. Only after final

tests are complete, configure variable speed drive so that contact closure results in “run to destruct” operation (no safeties) as required by code.

5. Report
 - a. Tag
 - b. Manufacturer and model of fan and motor
 - c. Sheave data at motor and fan; belt data
 - d. Motor HP, rpm, volts, phase, FLA
 - e. Fan airflow rate at all locations measured, as listed above
 - f. Final measured fan speed and amps
 - g. Inlet and outlet static pressure
 - h. Variable speed drive fan preset speed signal

3.5 ADDITIONAL COSTS

- A. Fans: If drives are not capable of being adjusted to meet required performance, inform Owner’s Representative and indicate added price to supply and install required sheaves. Do not include sheave changes in initial bid.
- B. Pumps: If impeller must be trimmed, inform Owner’s Representative and indicate added price to trim impeller and replace. Do not include impeller trim in initial bid.
- C. Do not proceed until work is approved by Owner’s Representative.

3.6 SPOT CHECKING

- A. Spot checks shall take place after test and balance work is complete and reports have been prepared and approved.
- B. Spot checks shall be witnessed by an Owner’s Representative. Schedule spot checks with Owner’s Representative at least 1 week prior to proposed test date.
- C. Owner’s Representative shall select subsets of any tested and balanced air or hydronic system to be spot-checked on the day of tests without prior notice to the Contractor.
 1. Spot-checking will not require more than one working day.
 2. If additional spot checks are requested by the Owner’s Representative causing the time limit above to be exceeded, inform Owner’s Representative and indicate added price to perform the additional tests. Do not include additional tests in initial bid.
- D. Discrepancies
 1. If any of the spot-check measurements differ more than 15 percent from those documented in test and balance reports, the Contractor shall completely rebalance the associated system. For balance discrepancies at or downstream of a VAV box, rebalance only is required at or downstream of that box.
 2. If discrepancies as described above are found on more than 25 percent of the spot-checks for air systems, all air systems shall be rebalanced.
 3. If discrepancies as described above are found on more than 25 percent of the spot-checks for hydronic systems, all hydronic systems shall be rebalanced.
 4. Rebalance work shall be witnessed by an Owner’s Representative at the option of the Owner’s Representative.
 5. All rebalance work shall be documented and documentation shall be resubmitted as specified above.
 6. All rebalance work shall be provided at no additional cost to the Owner.

3.7 TRAINING OWNER PERSONNEL

- A. See Section 230800 Mechanical Commissioning.
- B. Go over the final Testing, Adjusting and Balancing Report, explaining the layout and the meanings of each data type.
- C. Discuss any outstanding deficient items in control, ducting, piping or design that may affect the delivery of air or water.
- D. Identify and discuss any systems or system components that are not meeting their design capacities.
- E. Discuss any temporary settings and steps to finalize them for any areas that are not finished or fully occupied.
- F. Any other appropriate points that may be helpful for facilities operations, relative to testing, adjusting and balancing or the mechanical systems.

END OF SECTION

SECTION 230700

HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included in This Section: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Piping insulation
 - 2. Pipe insulation jacket
 - 3. Equipment insulation
 - 4. Ducts and plenums, thermal insulation
 - 5. Duct and plenums, acoustic insulation

1.2 REFERENCE STANDARDS

- A. ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate
- B. ASTM C177 – Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- C. ASTM C335 – Steady-State Heat Transfer Properties of Horizontal Pipe Insulation
- D. ASTM C585 – Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe
- E. ASTM C921 – Properties of Jacketing Materials for Thermal Insulation
- F. ASTM E84 – Surface Burning Characteristics of Building Materials
- G. ASTM E96 – Water Vapor Transmission of Materials
- H. ASTM E1222 – Standard Test Method for Laboratory Measurement of the Insertion Loss of Pipe Lagging Systems
- I. ASTM D 5590 - Standard Test Method for Determining the Resistance of Coatings to Fungal Defacement
- J. ASTM F 1249 -- Standard Test Method for Water Vapor Transmission Rate Through Plastic Film Using a Modulated Infrared Sensor
- K. NFPA 255 – Surface Burning Characteristics of Building Materials
- L. SMACNA – HVAC Duct Construction Standards - Metal and Flexible
- M. UL 723 – Surface Burning Characteristics of Building Materials

1.3 DEFINITIONS Duct Dimensions

1. Where acoustical liner is indicated on the Drawings the duct sizes indicated shall be clear inside dimensions unless duct size is specifically indicated as outside dimensions (OD)

1.4 QUALITY ASSURANCE

- A. Source Quality Control
 1. Service: Use insulation specifically manufactured for service specified
 2. Labeling: Insulation labeled or stamped with brand name and number
- B. Applicator: Company specializing in performing the work of this section with minimum three years experience

1.5 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 1. "R" means required.
 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Equipment insulation	R			
Piping insulation	R			
Jackets	R			
Duct insulation, wrap and liner	R			
Adhesives and coatings	R2			
Mechanical fasteners	R2			

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Insulation: Fiberglass
 1. Owens-Corning Fiberglass Corporation
 2. Manville
 3. Certainteed Corporation
 4. Knauf
 5. Or equal
- C. Insulation: Elastomeric Closed Cell
 1. Armacell, Inc.
 2. Rubatex Corporation
 3. Or equal

- D. Weatherproof Aluminum Jacket
 - 1. Childers Products Company
 - 2. Insul-Coustic/Birma Corporation
 - 3. Or equal

- E. Pre-molded pipe fitting covers and Jacketing
 - 1. Manville: Zeston
 - 2. Childers Products Company
 - 3. Proto Corporation
 - 4. Insul-Coustic/Birma Corporation
 - 5. Or equal

- F. Adhesives, Coatings, and Sealants
 - 1. Foster
 - 2. Childers
 - 3. Epolux Mfg. Corporation
 - 4. Insul-Coustic/Birma Corporation
 - 5. Armacell
 - 6. Or equal

- G. Mechanical Fasteners
 - 1. AGM Industries, Inc.
 - 2. Miracle Adhesives Corporation
 - 3. Grip-Nail
 - 4. Or equal

2.2 GENERAL

- A. Energy Codes: The current versions of California Title 24 and California Building Code shall govern where requirements for thickness exceeds thickness specified

- B. All insulation materials, including jackets, facings, adhesives, coatings, and accessories are to be fire hazard rated and listed by Underwriters' Laboratories, Inc., using Standard UL 723 (ASTM E-84), (NFPA-255), (ASA A2.5-1963)
 - 1. Flamespread: maximum 25
 - 2. Fuel contributed and smoke developed: maximum 50
 - 3. Flameproofing treatments subject to deterioration from moisture or humidity are not acceptable

- C. Insulation and accessories shall not provide any nutritional or bodily use to fungi, bacteria, insects, rats, mice, or other vermin, shall not react corrosively with equipment, piping or ductwork, and shall be asbestos free: Duct lining shall meet ASTM C1136 and ASTM C665 for biological growth in insulation

- D. Products shall not contain or be coated with any PBDEs.

2.3 INSULATION MATERIALS

- A. Pipe Insulation
 - 1. Fiberglass

- a. Molded: one piece, maximum 0.26 K factor at 75 degrees Fahrenheit mean temperature: Owens-Corning ASJ/SSL-II Pipe Insulation or equal
- b. Blanket: minimum 1 lb. density, maximum 0.28 K factor at 75 degrees Fahrenheit mean temperature: Owens-Corning Faced Duct Wrap or equal
- c. Board: Density as noted, maximum 0.26 K factor at 75 degrees Fahrenheit mean temperature: Owens-Corning 700 Series with face or equal
- 2. Flexible, closed cell elastomeric thermal insulation
 - a. Insulation ASTM C534
 - b. Service rating of 220 degrees Fahrenheit
 - c. Density 3 to 6 pounds per cubic foot
 - d. Closed cell foam: Vapor permeability ASTM E96 0.2 perm
 - e. Max moisture absorption: 1.0 percent by volume, 10 percent by weight
 - f. Molded pipe insulation
 - 1) Maximum 0.27 K factor at 75 degrees Fahrenheit mean temperature
 - 2) Maximum water vapor transmission rating of 0.17 perm-inches
 - g. Sheet insulation
 - 1) Maximum 0.28 K factor at 75 degrees Fahrenheit mean temperature
 - 2) Maximum water vapor transmission rating of 0.17 perm-inches
 - h. Seal with Rubatex adhesive or equal
 - i. Armacell Armaflex or equal
- 3. Calcium Silicate
 - a. Insulation ASTM C 533, Type I
 - 1) ESLIN Industrial Insulation also acceptable
 - b. Sectional with 14 pounds per cubic foot nominal density
 - c. 0.45 maximum K-factor at 300 degrees Fahrenheit mean temperature and 1200 degrees Fahrenheit maximum service rating
 - d. Waterproofed
 - e. Flexural Strength 100 pounds per square inch
 - f. JM Thermo-12 Gold or equal
- 4. Underground pipe insulation: See Section 232113 HVAC Piping

B. Jackets

- 1. Factory Applied Vapor Barrier All Service Jacket (ASJ)
 - a. ASTM C921, White kraft paper bonded to aluminum foil
 - b. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches
 - c. Secure with self sealing longitudinal laps and butt strips.
 - d. Seal all seams with vapor barrier coating.
 - e. Coat all insulated fittings, elbows, and valves with vapor barrier coating and reinforcing mesh.
 - f. Tie Wire: See Paragraph E.1, with twisted ends on maximum 12 inch centers
 - g. Vapor Barrier Lap Adhesive: Compatible with insulation
- 2. Aluminum Jacket: ASTM B209
 - a. Use for weatherproof jacket
 - b. Thickness: 0.016 inch sheet
 - c. Finish: Embossed
 - d. Joining: Longitudinal slip joints and 2 inch laps
 - e. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner
 - f. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel
- 3. Preformed PVC
 - a. Polyvinylchloride covers similar to Manville Zeston.
 - b. Color: white

4. Equipment insulation facings: Foil-scrim-kraft laminate of aluminum foil facing, glass scrim reinforcing, kraft paper backing
- C. Preformed Pipe Fitting Covers
1. Aluminum
 - a. Factory fabricated formed covers
 - b. General Aluminum Supply Corporation GASCO or equal
 2. PVC
 - a. Factory fabricated formed covers
 - b. Manville Zeston or equal
 - c. Grooved end piping: Proto Corporation Losmoke or equal
- D. Adhesives and coatings
1. Foster and Childers product names and figure numbers or approved equal
 - a. Lagging adhesive: Foster 30-36; Childers CP-50AMV1
 - b. Vapor barrier coating:
 - 1) Foster Vapor Safe 30-80
 - 2) UP Label, comply with MIL-C-19565C, Type II; fire and water resistant
 - 3) Permeance no greater than 0.08 perms at 37 mil dry film thickness as test by ASTM F 1249
 - c. Vapor-seal adhesive (lap adhesive): Foster 85-60
 - d. Fiberglass adhesive (duct liner and duct wrap adhesive): Meets ASTM C916 Type II. Foster 85-60; Childers CP-127
 - e. Cellular glass bedding and sealing compound adhesive: Foster Foamseal 30-45; Childers CP-70
 - f. Outdoor vapor barrier coating: Foster 30-90. Permeance no greater than 0.08 perms at 37 mil dry film thickness as test by ASTM F 1249.
 - g. Elastomeric insulation: 520 contact adhesive
- E. Wire, banding and fastening devices
1. Wire: minimum 16 gauge copper clad annealed steel wire
 2. Bands: 3/4 inches nominal width with wing seals, of minimum thickness as follows:
 - a. Aluminum: 0.007 inches. Except where exposed to weather, 0.020 inches
 - b. Galvanized steel: 0.005 inches
 - c. Stainless steel: 0.010 inches
 3. Staples: outward clinching type of corrosion resistant steel
- F. Mechanical Fasteners
1. Mild steel, copper plated
 2. AGM Industries Power Base insulation pins or equal
 3. Insulation washers
 - a. Galvanized steel
 - b. 1- 1/2 inch diameter
 - c. AGM Industries SLW-1 or equal
- G. Provide a continuous vapor seal for any service piping that carries liquid below 60 degrees Fahrenheit. Coat all ASJ vapor retarder seams with vapor barrier coating to prevent moisture ingress. Coat all ASJ seams with vapor barrier coating.
- H. Pre-insulated pipe support and shields
1. Provide insulated pipe supports for all insulated pipe and tubing.
 2. Hangers and supports shall fit outside of all pipe insulation and insulation inserts. See Section 230529 Hangers and Supports
 3. Insulated pipe supports

- a. Pipe Shields, Inc. or equal
 - b. Waterproof calcium silicate or polyurethane insulation insert
 - c. Galvanized steel or aluminum shield
 - d. Minimum temperature rating equal to maximum design fluid temperature plus 25°F
 - e. Load rated, based upon testing and analysis in conformance with the latest edition of the following codes: ASME B31.9, MSS SP-58, MSS SP-69 and MSS SP-89
4. Pipe supports for use on flat surfaces shall have integral load distribution plates coated with zinc primer minimum 3 mils thick.
 5. Install pre-insulated pipe supports per manufacturer's installation instructions. Shield lengths and gauges shall also be per manufacturer's recommendations.
 6. Tape all butt joints where pipe insulation butts up against hanger shield
 - a. On hot pipe, apply three inch wide vapor barrier tape or band over the butt joint
 - b. On cold pipe, apply a wet coat vapor barrier lap cement on all butt joints and seal the joints with a minimum of three inch wide vapor tape or band and vapor barrier coating.
- I. Fire-stopping
1. At pipe penetrations through rated assemblies
 2. Commercial pipe sleeve assemblies that are UL listed and that have been approved by the fire marshal for this purpose
 3. Insulation shall be continuous through penetration.
- J. Accessories
1. Insulation Protection Saddles: 12-inch long, 16 gauge steel
 2. Paint: Ultraviolet resistant latex paint with special adherence capabilities to the fitting covers, elastomeric, aluminum facing, Kraft paper, tapes and adhesives
- K. Equipment Insulation
1. Glass fiber, semi-rigid
 - a. Insulation: ASTM C612; rigid, noncombustible
 - 1) 'K' ('ksi') value: ASTM C335, 0.24 at 75 degrees Fahrenheit
 - 2) Maximum service temperature: 450 degrees Fahrenheit
 - 3) Maximum moisture absorption: 0.1 percent by volume
 - 4) Density: 3.0 pounds per cubic foot density
 - b. Vapor Barrier Jacket
 - 1) Kraft paper bonded to aluminized film
 - 2) Moisture vapor transmission: ASTM E96; 0.04 perm
 - 3) Secure with self sealing longitudinal laps and butt strips. Minimum lap 2 inches
 - 4) Secure with bands, adhesive or ties
 - c. Facing: 1 inch galvanized or stainless steel hexagonal wire mesh stitched on one face of insulation
 - d. Vapor Barrier Lap Adhesive: Compatible with insulation
 - e. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool
 2. Jackets
 - a. Aluminum
 - b. Use for weatherproof jacket
 - c. Thickness: 0.016 inch sheet
 - d. Finish: Embossed
 - e. Joining: Longitudinal slip joints and 2 inch laps
 - f. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner
 - g. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel

3. Equipment insulation facings: Foil-scrim-kraft laminate of aluminum foil facing, glass scrim reinforcing, kraft paper backing
4. Wires, bands and fastening devices
 - a. Wires: Minimum 16 gage galvanized steel wire
 - b. Bands: 3/4 inch nominal width wing seals, of minimum thickness as follows
 - 1) Aluminum: 0.007 inches indoors. Where exposed to weather 0.020 inches
 - 2) Stainless Steel: 0.010 inches

L. Duct Insulation

1. Duct Wrap with Vapor Barrier; Type DW-V
 - a. Insulation
 - 1) ASTM C553
 - 2) Flexible, noncombustible blanket
 - 3) K-value: ASTM C518, 0.3 at 75 degrees Fahrenheit
 - 4) Maximum service temperature: 250 degrees Fahrenheit
 - 5) Maximum moisture absorption: 0.20 percent by volume
 - 6) Minimum density: 0.75 pounds per cubic foot
 - b. Vapor Barrier Jacket
 - 1) Factory installed Foil Scrim Kraft (FSK)
 - 2) Kraft paper reinforced bonded to aluminized film
 - 3) Moisture vapor transmission: ASTM E96 Procedure E; 0.02 perm
 - c. Vapor Barrier Tape: Kraft paper reinforced bonded to aluminized film, with pressure sensitive rubber based adhesive
 - d. Owens-Corning All Service Faced Duct-Wrap or equal
2. Duct Board without Vapor Barrier; Type DB
 - a. Insulation
 - 1) ASTM C612
 - 2) Rigid, noncombustible blanket
 - 3) K-value: ASTM C518, 0.25 at 75 degrees Fahrenheit
 - 4) Maximum service temperature: 250 degrees Fahrenheit
 - 5) Maximum moisture absorption: 0.20 percent by volume
 - b. Owens-Corning Type 703 or equal
3. Duct Board with Vapor Barrier; Type DB-V
 - a. Insulation
 - 1) ASTM C612
 - 2) Rigid, noncombustible blanket
 - 3) K-value: ASTM C518, 0.25 at 75 degrees Fahrenheit
 - 4) Maximum service temperature: 250 degrees Fahrenheit
 - 5) Maximum moisture absorption: 0.20 percent by volume
 - b. Vapor Barrier Jacket
 - 1) Factory installed Foil Scrim Kraft (FSK)
 - 2) Moisture vapor transmission: ASTM E96 Procedure E; 0.02 perm
 - c. Vapor Barrier Tape: Kraft paper reinforced bonded to aluminized film, with pressure sensitive rubber based adhesive
4. Tie Wire: Annealed steel, 16 gage

M. Duct and Plenum Lining

1. Rectangular Duct Lining; Type AL
 - a. Material
 - 1) Insulation: ASTM C423
 - 2) K-value: ASTM C518, 0.23 at 75 degrees Fahrenheit
 - 3) Maximum service temperature: 250 degrees Fahrenheit
 - 4) Maximum moisture absorption: 0.20 percent by volume

- 5) 1-1/2 pounds per cubic foot unless shown otherwise to be 3 pounds per cubic foot
- 6) Minimum noise reduction coefficient (NRC) rating of 0.7 at 1 inch, 0.9 at 2 inch
- b. Interior air-side surface
 - 1) Smooth black neoprene or matte facing overlay on air side. Coating shall conform to NFPA 90A, ASTM C665, ASTM G21
 - 2) Suitable for velocity up to 4000 feet per minute
 - 3) Meet erosion test method described in UL publication No. 181
 - 4) Durable and mechanically cleanable
 - 5) EPA registered anti-microbial agent
 - 6) Certainteed Toughgard R Duct Liner or equal
 - 7) Adhesives
 - a) Duct Insulation, Internal: Foster 85-60 or equal
 - b) Weld Pins: Duro-Dyne CP or equal
- 2. Round Duct Lining; Type RAL
 - a. Material same as Paragraph 2.3M.1.a
 - b. Interior air-side surfaces same as Paragraph 2.3M.1.b
 - c. Self-supporting, slide-in installation
 - d. JM Permacote Spiracoustic or equal
 - e. Small diameter ducts which cannot be insulated internally using duct lining materials shall be pre-fabricated. Insulation material shall be fixed between outer duct metal and a perforated metal liner. United McGill k27 series or equal. Fittings shall be insulated to same standard and shall be by same manufacturer.
- 3. Plenum Lining; Type PL
 - a. Material same as Paragraph 2.3M.1.a
 - b. Interior air-side surfaces same as Paragraph 2.3M.1.b

PART 3 EXECUTION

3.1 PIPE & EQUIPMENT INSULATION SCHEDULE

- A. Insulation Application Types
 - 1. Type P-1
 - a. Molded fiberglass
 - b. All-service jacket
 - c. Vapor-sealed
 - 2. Type P-2
 - a. Molded fiberglass
 - b. All-service jacket
 - 3. Type P-3: Flexible elastomeric insulation
 - 4. Type P-4
 - a. Calcium silicate insulation
 - b. Aluminum preformed jacket
 - 5. Type E-1
 - a. Fiberglass board
 - b. Minimum 3 pounds per cubic foot density
 - c. Foil-scrim-kraft facing
 - d. Vapor-sealed
 - 6. Type E-2
 - a. Fiberglass board
 - b. Minimum 3 pounds per cubic foot density
 - c. Segmented or scored for curved surfaces

7. Type E-3: Flexible cellular foam insulation

B. Application Schedule

Service	Location	Type	Pipe Size	Thickness
Chilled water piping	General	P-1	All	Per Title 24, 1 inch minimum
Hot water piping	General	P-2	All	Per Title 24, 1.5 inches minimum
Hot water pumps	General	E-2 or E-3		Per Title 24, 2 inches minimum
Hot water coil frame and tube bends	Outdoors, ceiling return air plenum, and unconditioned spaces	E-2 or E-3 or DW-V duct wrap		1/2 inch E-2/3 1.5 inch DW-V

C. Non-insulated piping and equipment

1. Pneumatic tubing
2. Pot feeders and piping to them other than the first 2 feet from the point of connection at piping mains
3. Vent, overflow, drain and relief, except as noted otherwise

3.2 PIPING INSULATION INSTALLATION

- A. Install materials in accordance with manufacturer's instructions
- B. Coordinate with work of other trades
- C. Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness
- D. Install insulation where it cannot become wet. If insulation becomes wet, remove and dispose of properly and replace with new, dry insulation. Wetted insulation is not acceptable. Ensure insulation is dry before and during installation.
- E. Insulate all piping, valves, fittings, flanges and accessories
- F. On piping exposed to public view, locate insulation and cover seams in least visible locations
- G. Insulate fittings, joints and valves with insulation of same material and thickness as adjoining pipe. Use pre-molded fiberglass fitting covers or radial mitered segments of pipe insulation. For strainers, expansion joints, fittings and accessories requiring servicing or inspection insulation shall be removable and replaceable without damage.
- H. Insulate flanges with insulation sleeve of same material as pipe insulation to cover flange and overlap insulation on adjacent piping
- I. Continue insulation through walls, sleeves, pipe hangers and other pipe penetrations
- J. Finish insulation at supports, protrusions and interruptions. No hangers or supports shall be embedded in insulation. Do not insulate expansion bellows.
- K. Fiberglass insulation
 1. Provide insulation with factory applied vapor barrier jackets

2. Butt edges neatly. ASJ with 3 inch minimum butt strips
 3. Longitudinal overlaps: Minimum 2 inch self sealing, double adhesive
 4. Apply additional jacket as specified
 5. For piping conveying fluids below ambient temperature finish with vapor barrier adhesive
- L. For all pipe systems exposed in the mechanical equipment rooms, finish with an all service jacket
- M. For insulation exposed to weather
1. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement.
 2. Cover with weatherproof aluminum jacket with seams located on bottom side of horizontal piping. For mechanical joints (such as Victaulic) only, 30 mil UV-resistant PVC fitting covers are acceptable in lieu of aluminum.
- N. Perform work at ambient and equipment temperatures as recommended by adhesive manufacture
- O. Protection: Protect against dirt, water, chemical, or mechanical damage before, during, and after installation. Repair or replace damaged insulation at no additional cost
- P. All vapor barriers shall be continuous. Tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape.
- Q. Joints between insulation and access shall be sealed with vapor barrier mastic

3.3 PIPE INSULATION APPLICATION

- A. General
1. Before applying insulation
 - a. Test piping for tightness and obtain approval
 - b. Clean surfaces to be insulated of dust, grease and foreign matter
 2. Butt edges neatly
 3. Fill voids with insulating cement
 4. Longitudinal overlaps
 - a. 2 inches minimum
 - b. For exposed work: toward ceiling or wall
 - c. For weatherproof aluminum jackets: on side to shed water
 5. Circumferential overlaps on weatherproof aluminum jackets: 2 inches minimum
 6. Continuous insulation passing through sleeves or other openings
 7. Oversize insulation to accommodate heat tracing on piping
- B. Valves, fittings, flanges and accessory insulation
1. Unless otherwise noted, insulate
 - a. Valves including bonnets
 - b. Flanges
 - c. Fittings
 - d. Strainers
 - e. Expansion joints
 - f. Specialties
 2. Insulation for strainers, expansion joints, fittings and accessories requiring servicing or inspection
 - a. Insulation removable and replaceable without damage

- b. Enclosed within two piece, No. 18 gauge aluminum covers fastened with cadmium plated bolts and nuts
 - 3. Insulation of same thickness as adjacent piping insulation
 - 4. For piping systems insulated with fiberglass
 - a. Wire on pre-molded fiberglass fitting covers or mitered segments of pipe insulation
 - b. For pipe sizes under 3 inches, hydraulic setting insulating cement may be used
 - c. Vapor barrier for vapor-sealed insulation only
 - 1) Apply uniform layer of vapor barrier coating to cover entire surface of fitting insulation
 - 2) Embed layer of fiberglass tape into wet coating, extending 2 inches over adjoining pipe covering
 - 3) Apply finish layer of vapor barrier coating over entire surface
 - d. Finish for exposed locations only
 - 1) Apply skim coat of insulating cement to smooth out surface of fitting insulation
 - 2) Embed layer of fiberglass tape into uniform coat of wet mastic, extending 2 inches over adjoining pipe covering
 - 3) Apply finish coat of same mastic over entire surface of fitting insulation
 - 5. For piping systems insulated with calcium silicate
 - a. Wire on pre-molded sections of calcium silicate fitting covers or mitered segments of pipe insulation
 - b. Under 3 inches pipe size, built up coating of insulating and finishing cement to match thickness of adjoining pipe insulation, may be used
 - c. For exposed locations only, apply skim coat of finishing cement to smooth out surface of fitting insulation
 - 6. Flanges
 - a. Insulation sleeve of same material as pipe insulation, to cover flange and overlap insulation on adjacent piping
 - b. For calcium silicate insulation provide calcium silicate rings between sleeve and pipe insulation
- C. At pipe hangers
 - 1. Insulation protection shields specified in Section 230529 Hangers and Supports
 - 2. Butt insulation to shields
 - 3. Cold piping: Wet coat of vapor barrier lap cement on all butt joints
- D. Jackets and facings
 - 1. Vapor-sealed types: continuous; staples not permitted
 - 2. Adhere longitudinal laps: Adhere 3 inches wide joint strip, of same material as facing, at center of each butt joint
 - 3. Adhesives
 - a. Vapor-sealed insulation: vapor-seal adhesive
 - b. Heating service insulation: vapor-seal adhesive
 - c. Weatherproof aluminum jacket: sealing compound
 - d. Underground asphalt felt jacket: asphalt mastic
- E. Wiring, banding and fastening devices: Secure insulation to piping and equipment in accordance with following minimum requirements
 - 1. Piping insulation section 3 foot long
 - a. Concealed vapor-sealed insulation banded at ends and center
 - b. Other concealed insulation banded at ends and center or stapled on 2 inches centers
 - 2. Pipe fitting insulation
 - a. Loops of wire to secure mitered segments of insulation
 - b. Wire spiraled on from end to end on blanket insulation

3. Outdoor piping weatherproof aluminum jackets banded at circumferential joints and center of each section: Lap joint at bottom

3.4 EQUIPMENT INSULATION

- A. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Secure insulation to equipment with bands, welded-on anchors, ties or adhesive. Where access to equipment is required for testing or maintenance the insulation shall be installed so that it is removable and so that the vapor barrier can be remade after access.
- B. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- C. For cold equipment or equipment containing fluids below ambient temperature
 1. Insulate entire system
 2. Provide vapor barrier jackets, factory applied or field applied
 3. Finish with glass cloth and vapor barrier adhesive
 4. Cover with aluminum jacket where specified
- D. For equipment containing fluids above ambient temperature
 1. Insulate entire system
 2. Provide standard jackets, with or without vapor barrier, factory applied or field applied
 3. Finish with glass cloth and adhesive
 4. Cover with aluminum jacket where specified
 5. For hot equipment containing fluids 140 degrees Fahrenheit or less, do not insulate flanges and unions, but bevel and seal ends of insulation
 6. For hot equipment containing fluids over 140 degrees Fahrenheit, insulate flanges and unions with removable sections and jackets
- E. Finish insulation at supports, protrusions, and interruptions
- F. For equipment in mechanical equipment rooms or in finished spaces, finish with aluminum jacket
- G. Do not insulate over nameplate or ASME stamps; bevel and seal insulation around such
- H. General
 1. Apply insulation with edges tightly butted
 - a. Joints staggered and secured in place by steel bands
 - b. Where necessary weld on suitable anchors
 2. Seal with 520 adhesive
- I. Special considerations
 1. Strainers and suction diffusers: removable and replaceable covers to allow strainer removal
 2. Pumps: removable and replaceable covers to allow impeller replacement
 3. Provide sufficient clearance around openings for normal operation of equipment

3.5 DUCT & PLENUM INSULATION

- A. Duct Insulation Type and Thickness Schedule

<u>Location</u>	<u>Cooling or Heat/Cool Supply</u>	<u>Heating-only Supply</u>	<u>Return</u>	<u>Exhaust</u>
Outdoors	2 inches 1.5 pounds per cubic foot AL or RAL	2 inches 1.5 pounds per cubic foot AL or RAL	2 inches 1.5 pounds per cubic foot AL or RAL	-
Concealed in ceiling or return air plenum	1.5 inches DW-V	1.5 inches DW-V	-	-
In unconditioned spaces	1.5 inches DW-V	1.5 inches DW-V	1.5 inches DW-V	-
Exposed within conditioned space	-	-	-	-
In mechanical rooms below 7'0" from floor or otherwise exposed to damage	1.5 inches DB-V	1.5 inches DB	-	-
Lined duct on drawings indicated to have 2 inch liner	2 inches 1.5 pounds per cubic foot AL	2 inches 1.5 pounds per cubic foot AL	2 inches 1.5 pounds per cubic foot AL	2 inches 1.5 pounds per cubic foot AL
Lined duct on drawings (unless otherwise noted)	1 inch 1.5 pounds per cubic foot AL or RAL	1 inch 1.5 pounds per cubic foot AL or RAL	1 inch 1.5 pounds per cubic foot AL or RAL	1 inch 1.5 pounds per cubic foot AL or RAL
Terminal cans	0.5 inches 1.5 pounds per cubic foot AL	0.5 inches 1.5 pounds per cubic foot AL	0.5 inches 1.5 pounds per cubic foot AL	-
Flex duct	By manufacturer	By manufacturer	By manufacturer	-

- B. Non-Insulated Ductwork
1. No insulation required for ducts so indicated in Duct Insulation Type and Thickness Schedule, plus
 - a. Exhaust ducts, unless shown to be lined
 - b. Return air ducts in conditioned spaces, unless shown to be lined
 - c. Outside air ducts
 2. Do not line ducts
 - a. Where prohibited by codes

3.6 DUCT INSULATION INSTALLATION

- A. General
1. Ensure that insulation is continuous through inside walls: See 230548 Vibration and Seismic Control for packing openings through walls
 2. Finish insulation neatly at hangers, supports and other protrusions
 3. Locate insulation joints or cover seams in least visible locations
 4. Where ducts run in groups too close to be individually insulated and finished
 - a. Completely fill all spaces between ducts with rigid or flexible insulating material
 - b. Insulate and finish exterior surfaces of group as specified for particular service
 5. Where ducts cannot be insulated after erection, insulate prior to installation

6. Where specified thickness of insulation and/or lining exceeds available thickness in single layer, provide insulation and/or lining in 2 or more layers with joints staggered
7. Preparation
 - a. Do not install covering before ductwork and equipment has been tested and reviewed
 - b. Ensure surface is clean and dry prior to installation
 - c. Ensure insulation is dry before and during application
8. Mechanical fasteners
 - a. Use spot weld anchors in all shop fabricated internally lined ducts
 - b. Adhered anchors
 - c. Clip off pin penetrations flush with insulation surface or facing
 - d. Seal pins and washers where pins penetrate vapor barriers
 - 1) With 4 inch square pieces of vapor barrier material to match facing
 - 2) Adhere with vaporseal adhesive
 - e. Spacing on rectangular ducts
 - 1) Typical of horizontal and vertical, unless otherwise specified
 - 2) Duct board
 - a) 3 inches in from edges
 - b) Intermediate fasteners: 12 inches on counter maximum spacing all directions
 - c) Not less than four pins per surface
 - 3) Duct wrap

<u>Side Dimension</u>	<u>Maximum Spacing</u>
24 inches and under	None required.
25 to 32 inches	Horizontal - none. Vertical: 1 row centered, 12 inches on center
33 to 48 inches	2 rows, 12 inches on center.
49 to 60 inches	3 rows, 12 inches on center.
61 inches and over	16 inches on center, all directions.

- 4) Duct wrap spacing applicable to flat surfaces of flat oval ducts
9. Provide 24 gauge sheet metal Z section frames over edges of duct and plenum lining
 - a. At access openings and doors
 - b. Along edges exposed to air flow

B. Rectangular Duct Wrap

1. Without vapor barrier
 - a. Comply with published recommendations of manufacturer and with following
 - b. Secure with 4 inch strips of adhesive, 8 inches on center
 - c. For rectangular ducts 24 inches and wider, secure to bottom of duct with mechanical fasteners 18 inches on center
 - d. Wrap with 18 gauge galvanized wire, 16 inches on center
2. With Vapor Barrier
 - a. Vapor barrier and sealing continuous without breaks. Vapor proof seal around supports and bracing
 - b. 2 inches lap strip at one end
 - c. Peel insulation for 2 inch lap strip along longitudinal joints
 - d. Seal lap strips with vaporseal adhesive; Foster's 85-60 or equal

C. Round Duct Wrap

1. General
 - a. Adhere flexible insulation to ductwork with adhesive applied in 6 inch wide strips on 16 inch centers
 - b. Provide 16 gauge annealed tie wire tied, spiral wound or half hitched at 16 inch centers

- c. Overlap insulation 2 inches and seal joints and breaks with 2 inch lap of foil adhered over joint
 - 2. Apply duct wrap with vapor barrier as specified above for rectangular ducts
- D. Duct Board
 - 1. Comply with published recommendations of manufacturer
 - 2. Secure on top, sides and bottom of duct with mechanical fasteners, spacing as scheduled
 - 3. Secure with 4 inch strips of adhesive, 8 inch on center
- E. Rectangular Duct and Plenum Lining
 - 1. Comply with SMACNA Duct Liner Application Standard, published recommendations of manufacturer, and following:
 - 2. Apply adhesive over 100 percent of surfaces to be lined
 - 3. The coated surface shall face air stream
 - 4. Surface adjacent to air flow, including at joints, to be uniformly flat
 - 5. Insulation on floors of plenums and large ducts where access is required shall be protected by wire mesh so that lining is not damaged when walked or crawled on.
 - 6. Blank-Off Panels: Insulation, enclosed with sheet metal on all sides; all joints with vapor barrier mastic and taped
 - 7. Volume Dampers: Where volume dampers do not allow for continuous insulation, terminate insulation clear of handle sweep and finish edges to maintain vapor barrier and to prevent damage to the insulation
 - 8. Seal butt joints and exposed edges of liner to prevent erosion
 - 9. Edges at terminal points shall be provided with metal beading and heavily coated with adhesive
 - 10. Damaged areas replaced or heavily coated with adhesive
 - 11. Mechanical fasteners
 - a. Use weld pins
 - b. Install mechanical fasteners
 - 1) Weld pins flush with liner surface. Weld pins spaced maximum of 12-inch on center in both directions and within 2 inches of all corners and joints, except where SMACNA Standard requires closer spacing
 - 2) Within 2 inches of all edges
 - 3) Minimum 4 pins per side
 - 4) For field alterations of lined ducts, install adhesive and glued pins with washers. Clip-off pins after washers installed. Field installed pins shall be used for unusual conditions only and shall not exceed 1 percent of total pins.

3.7 PENETRATIONS THROUGH RATED WALLS

- A. Refer to drawings for penetrations of rated assemblies.
- B. Install per manufacturer's installation and listing requirements.

3.8 FIELD QUALITY CONTROL

- A. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship
- B. All vapor barriers shall be continuous; tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape

C. See Section 233100 Ducts for protection of lined duct during construction

END OF SECTION

SECTION 232113

HVAC PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Hot water heating system piping
 - 2. Chilled water system piping

1.2 REFERENCE STANDARDS

- A. ANSI/ARI 710 – Liquid Line Dryers
- B. ASTM A53 / A53M - 07 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- C. ASTM F2014-00 Standard Specification for Non-Reinforced Extruded Tee Connections for Piping Applications
- D. ASTM A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- E. ASTM D638 – Tensile Properties of Plastics
- F. ASTM D2105 – Longitudinal Tensile Properties of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Tube
- G. ASTM D2143 – Cyclic Pressure Strength of Reinforced, Thermosetting Plastic Pipe
- H. ASTM D2412 – Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- I. ASTM D2992 – Obtaining Hydrostatic or Pressure Design Basis for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
- J. ASTM D3517 – “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe
- K. ASTM D3567 – Determining Dimensions of Reinforced Thermosetting Resin Pipe (RTRP) and Fittings
- L. ASTM D3681 – Chemical Resistance of Reinforced Thermosetting Resin Pipe in a Deflected Condition
- M. ASTM G53 – Weathering of Non-Metallic Materials
- N. ANSI/ASME SEC 9 – Welding and Brazing Qualifications

- O. ANSI/ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- P. ANSI/ASME B16.26 – Cast Copper Alloy Fittings For Flared Copper Tubes
- Q. ANSI/ASME B31.9 – Building Services Piping
- R. ANSI/ASTM B32 – Solder Metal
- S. ANSI/ASTM B88 – Seamless Copper Water Tube
- T. ASTM B280 – Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- U. ANSI/AWS A5.8 – Brazing Filler Metal
- V. ANSI/AWS D1.1 – Structural Welding Code
- W. AWWA C950 – Fiberglass Pressure Pipe

1.3 QUALITY ASSURANCE

- A. Welding materials and labor to conform to ASME Code and applicable state Labor Regulations
- B. Use welders fully qualified and licensed by state authorities
- C. Welders Certification: In accordance with ANSI/ASME SEC 9 and ANSI/AWS D1.1
- D. Each length of pipe, fitting, trap, fixture or device used in any piping system shall be stamped or indelibly marked with
 - 1. Weight or quality
 - 2. Maker's name or mark
- E. Examine piping layouts and determine requirements for piping offsets, loops or expansion joints to adequately protect systems.
 - 1. Determine locations and design of anchors and pipe guides to maintain proper piping alignment.
 - 2. Determine anchor reaction forces and coordinate locations of anchors with Owner's Representative.
- F. Coordinate expansion and flexibility requirements of this Section with seismic bracing requirements of Section 230548 Vibration and Seismic Control.
- G. Conform to ANSI/ASME B31.9

1.4 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. "R" means required.

2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Piping materials	R			
Pipe fittings	R			R
Solder	R2			

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Welding Fittings
1. Babcock and Wilcox Tubular Products Division
 2. Bonney Forge Foundry, Inc.
 3. Landish Company
 4. Taylor Company
 5. Tube Turns Division Allegheny International Inc.
 6. Or equal
- C. Mechanical Couplings and Fittings
1. Victaulic Company of America
 2. Grinnell
 3. Viega
 4. Or equal
- D. Flange Gaskets
1. John Crane Company
 2. Garlock Mechanical Packing Division
 3. Goodrich
 4. Manville
 5. Or equal
- E. Solder
1. Westinghouse
 2. J.W. Harris Co., Inc.
 3. Handy & Harman
 4. Engelhard
 5. Lucas Milhaupt
 6. Or equal
- F. Pipe Joint Compound
1. Rectorseal
 2. Permatest
 3. John Crane
 4. Or equal

2.2 PIPING AND FITTINGS

A. General

1. Piping shall
 - a. Be commercially round and straight
 - b. Be of uniform quality and workmanship
 - c. Be free from all defects
 - d. Be identified

B. Pressure Piping

1. Pressure piping shall conform to requirements of ANSI Safety Code for Pressure Piping, B31.9
2. Type PP-1: Black Steel
 - a. Schedule 40 or Standard Weight, ASTM A53 Type E Grade B (electric resistance welded)
 - b. 2-1/2 inches and larger
 - c. Welded joints
 - 1) Steel welding-neck fittings, ANSI B16.9-93
 - 2) Steel welding-neck flanges and flanged fittings, ANSI B16.5-88, 150 pounds per square inch
 - d. Mechanical joints
 - 1) Machined groove or rolled
 - 2) Fittings as hereinafter specified
 - e. 0.375 inch wall for sizes 12 inch and larger
3. Type PP-2: Galvanized Steel
 - a. Not used
4. Type PP-3: Copper Tubing
 - a. ASTM B88; Type M, L or K
 - b. Hard temper unless indicated otherwise
 - c. Wrought-copper, solder joint fittings, ANSI B16.22, in sizes available
 - d. Cast-bronze solder-joint fittings, ANSI B16.18, only in sizes not available in wrought copper
 - e. Cast-bronze, threaded, ground-joint unions, ANSI B16.15, 2 inches and smaller
 - f. Cast bronze, flanged unions, ANSI B16.24, 150 pounds per square inch class, 2-1/2 inches and larger
 - g. Copper tubing flared fittings: bronze castings for flared type joints, ANSI B-16.26
 - h. Mechanical joints
 - 1) Press-fit
 - 2) Fittings as hereinafter specified

C. Fittings and Flanges: Standard products of respective manufacturer of piping as hereinbefore specified.

D. Flange Gaskets

1. Full faced or flat ring type to suit flange facings, selected from one of following materials
2. Gaskets for flanged joints shall comply with ANSI B16.21
3. Full faced for cast iron flanges
4. Raised face for steel flanges
5. SBR or EPDM, 1/16 inch thick
6. Gaskets coated with thread lubricant when being installed

E. Flange Bolts: Open-hearth bolt steel

F. Unions

1. Steel Piping 2 inches and smaller
 - a. 250 pounds per square inch: ground joint
 - b. Equal to Grinnell Fig. 554
2. Steel Piping Larger than 2 inches: Welding flanges
3. Copper Piping: Equal to Nibco No. 633

G. Dielectric Connections

1. Unions
 - a. Only allowed where union is required elsewhere in specifications or on drawings. Use nipple specified below otherwise.
 - b. 2 inches and smaller
 - 1) 250 pounds per square inch
 - 2) Standard gaskets for plumbing
 - 3) High temperature gaskets for heating
 - 4) Equal to EPCO Model FX
 - c. 2-1/2 inches and larger
 - 1) Brass
 - a) Brass half-union, ANSI B16.1, 1989, 175 pounds per square inch
 - b) To welding flange as hereinbefore specified
 - c) Equal to EPCO Model X
 - 2) Copper
 - a) Half union with EPDM insulator gasket
 - b) 150 pounds per square inch
 - c) The Copper component of the flange adapter shall be Third Party Classified by Underwriters Laboratories Inc.
2. Nipples
 - a. For open circuit hydronic systems:
 - 1) Minimum 4 inch long galvanized steel, stainless steel, brass, or copper nipple with non-conducting thermo-plastic internal lining
 - 2) ASTM Standard F-492 for continuous use at temperatures up to 225°F
 - 3) ClearFlow, Victaulic Style 47 Dielectric Waterway, or equal
 - b. For closed-circuit hydronic systems: minimum 6 inch long brass nipple

H. Grooved End Fittings and Couplings

1. Fittings
 - a. Designed for use with grooved- or rolled-end pipe and couplings
 - b. Materials
 - 1) Steel: ASTM A53 or A106, Grade B
 - 2) Malleable Iron: ASTM A47
 - 3) Ductile Iron: ASTM A536
2. Couplings
 - a. Mechanical type designed to
 - 1) Engage and lock grooved pipe or fitting ends
 - 2) Form leak-proof joint
 - 3) Allow angular deflection, expansion, contraction, and vibration isolation (flexible type, Victaulic Style 77, Style 177, or equal)
 - a) Exception: At contractor's option and risk, rigid couplings (Victaulic Style 107 or equal) may be used except at the following locations:
 1. Mechanical equipment connections where the couplings are being used in lieu of flexible coupling for vibration isolation
 2. Risers, for which we use flexible couplings for expansion and contraction
 3. Straight horizontal runs over 20 feet long, for which we use flexible couplings for expansion and contraction
 - b. Housings

- 1) Malleable Iron: ASTM A47
 - 2) Ductile or Nodular Iron
 - c. Gaskets
 - 1) EPDM
 - 2) Materials required for specific service, minimum 230°F operating temperature
 - 3) Product of coupling manufacturer
 - d. Bolts and Nuts
 - 1) Track-head or oval neck type bolts
 - 2) Standard hexagon nuts
 - 3) Heat treated carbon steel conforming to ASTM A183
 - 4) Minimum tensile strength: 110,000 pounds per square inch
 - 3. Pressure Ratings
 - a. 3/4 inch to 6 inches: 1000 pounds per square inch
 - b. 8 to 12 inches: 800 pounds per square inch
 - c. 14 to 24 inches: 300 pounds per square inch
 - 4. Finish
 - a. Painted
 - 5. Equal to Victaulic Company of America
- I. Press-Fit Fittings and Couplings
- 1. For ½" to 4" copper piping
 - 2. Smart Connect feature to provide clear visual indication of which connections have not been pressed prior to putting the system into operation
 - 3. EPDM sealing element suitable for application
 - 4. Listings and certifications
 - a. NSF-61-372
 - b. IAPMO PS 117
 - c. UL 213
 - d. FM Class 1920
 - e. ABS 1.1.2
 - 5. Compliant with:
 - a. California Mechanical Code
 - b. California Plumbing Code
 - c. NFPA 13, 13D and 13R
 - 6. Operating ranges
 - a. 0°F to 250°F
 - b. 200 psi
 - 7. Equal to Viega ProPress

2.3 PIPING SPECIALTIES

- A. See Section 232114 Piping Specialties

2.4 SOLDER

- A. S-1: Silfos or Silvaloy 15 silver solder (brazing) with 15 percent silver, 80 percent copper and 5 percent phosphorous
- B. S-1A: Safety Silv 56 cadmium-free silver solder (brazing) with 55 to 57 percent silver, 21 -23 percent copper, 15 to 19 percent zinc, 4 to 6 percent tin, and 0.15 percent other metals.
- C. S-2: 95 percent tin 5 percent antimony solder, lead free, or

- D. S-2A: 95.6 percent tin, 4 percent copper, 0.4 percent silver, lead free

PART 3 EXECUTION

3.1 PIPE SERVICES

- A. Piping type shall be in accordance with the table below. Where multiple types are listed, any may be used at Contractor's option.

Service	Location	Type of Pipe	Remarks
Hot water Chilled water	Above ground	PP-1; PP-3 Type L	

3.2 INSTALLATION

- A. Coordinate with work of other trades.
- B. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leak resistant piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes where indicated by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.
- C. Arrangement
 1. Except for large scale details piping is diagrammatically indicated. Install generally as shown.
 2. Do not scale drawings for exact location of piping.
 3. Install piping to best suit field conditions, in coordination with other trades.
 4. Piping Arrangement
 - a. Arrange piping neatly along walls
 - b. In neat, horizontal groups
 - c. Each group to be in one plane, insofar as possible
 - d. Maintain required slope
 5. Do not sleeve structural members without consent of Owner's Representative.
 6. Maintain minimum 1 inch clearance from adjacent work, including insulation, except as noted.
 7. Install piping concealed above ceilings or in walls unless otherwise indicated.
 8. Installation of piping shall be made with use of appropriate fittings. Bending of piping will not be allowed.
 9. Unions installed shall be accessible.
 10. Locate piping runs vertically and horizontally; avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. In finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction, or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.
 11. Electrical equipment spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless the piping serves equipment in the room.
 12. Use tapered reducers where any change in pipe size occurs. Bushings shall not be used.

13. Conceal piping in finished portions of building, above the floor line. Cutting of walls and floors shall be held to the minimum possible to secure the proper installation.
14. Provide concealed high points with air chambers with 1/4-inch copper tube vent line and stop cock carried to accessible point.
15. Install piping subject to expansion or contraction in a manner permitting strains to be evenly distributed and alleviated.
16. Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.
17. Pipe coils with inlet at bottom, outlet from top, unless otherwise directed by coil manufacturer.

D. Penetrations

1. Escutcheons
 - a. Provide stainless steel escutcheons at piping penetrations of walls that are exposed public view and required for proper appearance. Provide galvanized steel escutcheons at penetrations of masonry walls elsewhere.
 - 1) Clearance from duct to opening shall not exceed 1 inch.
 - 2) Escutcheons shall overlap wall, floor, or ceiling surface by ½ inch minimum.
 - b. Escutcheons are not required at drywall penetrations where not exposed to public view.
2. Caulk and seal all piping penetrations through acoustical walls and partitions. See Section 230548 Vibration and Seismic Control.
1. Firestopping at penetrations of fire rated floors and partitions
 - a. The fire-resistance rating of penetrations and fire-resistant joint systems shall be firestopped with a UL listed firestop system that will maintain the fire rating of the assembly. Through-penetrations and membrane penetrations shall be protected by an approved system installed as required by the system listing or as otherwise permitted by CBC Section 714. Listed through-penetration firestop systems and membrane penetrations shall be installed in accordance with the installation details for the listed system to be installed. Fire protection system installation details and listings shall be submitted for approval prior to the start of system installation.
 - b. Manufacturer
 - 1) 3M Penetration Sealing Systems (PSS 7909) and 3M Fire Barrier Caulk and Putty
 - 2) Dow-Corning LTV Silicone foam
 - 3) Or equal
2. At all below-grade penetrations, provide mechanical seal complete with wall sleeve with wall anchor, and water stop plate. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill the annular space between pipe and sleeve, complete with pressure plates and cadmium plated nuts and bolts.

E. Sloping, Air Venting and Draining

1. Slope piping as indicated, true to line and grade, and free of traps and air pockets.
2. Reducers/increasers
 - a. Eccentric
 - 1) At pump suction where reducer is required
 - 2) Top side flat
 - b. Concentric: All other locations
3. Connect branch piping to bottom of mains in closed systems.
4. Provide drain valves and hose adapters as indicated on drawings and at the bottom of all risers.
5. Vents: See Section 230523 Valves.

F. Piping Specialties: See Section 232114 Piping Specialties.

- G. Pipe Hanging and Supports: See Section 230529 Hangers and Supports.
- H. Flashing and Sleeves: See Section 230529 Hangers and Supports.
- I. Painting: See Section 230501 Basic Mechanical Materials and Methods.
- J. Pipe Identification: See Section 230553 Mechanical Identification
- K. Copper
 - 1. Crimping of copper tubing prohibited.
 - 2. Isolate copper tubing from ferrous materials and hangers with two thicknesses of 1 inch wide 10 mil polyvinyl tape, spiral-wrapped around pipe. Total width shall be a minimum of 3 inches.
- L. Coatings: Reapply coal-tar coating on buried piping, after installation, to surfaces from which coating has been removed or scraped.
- M. Care of Floors
 - 1. Do not set pipe vises or threading machines on unprotected concrete floors.
 - 2. Cover floor when making plumbing connections to avoid staining floors with oil, white or red lead or other substances.
 - 3. Remove any stains at no additional cost to the Owner.

3.3 COPPER AND STEEL WATER PIPING

- A. Fittings
 - 1. Provide standard, manufacturing fittings in all cases.
 - 2. Prohibited fittings
 - a. Field fabricated
 - b. Bushings on pressure piping
 - c. Clamp-on branch connections
 - 3. Provide insulating couplings or dielectric unions at all connections of ferrous piping to non-ferrous piping.
 - 4. Branch connections, steel piping
 - a. Equal to main and to two pipe sizes smaller: Weld tees, same weight as piping
 - b. Three or more pipe sizes smaller than main, but 2-1/2 inches and larger: Bonney Weld-o-lets
 - c. Two inches and smaller: Bonney Weld-o-lets, or steel couplings
 - 5. Branch connections, copper piping
 - a. Seamless tee or
 - b. Press-fit tee or
 - c. Mechanically formed tee connection
 - 1) ASTM Designation F2014-00
 - 2) Per ASME B31.9 Section 930.2
 - 3) Equal to T-Drill T-D35
- B. Provide unions or flanges to render all items in systems easily removable, including
 - 1. Control valves
 - 2. Both sides of pumps and equipment
 - 3. Where indicated on drawings
 - 4. Use mechanical (Victaulic) couplings at all connections on tube-pull side of chiller to allow for temporary removal of piping to provide full access to the water box for tube pull.
 - 5. Exceptions

- a. Copper water piping 1-inch or less, at Contractor's options, since the copper can be easily cut and the union is a less secure joint than a soldered joint
 - b. Unions not allowed:
 - 1) Where not allowed by code

- C. Pipe Ends
 - 1. Perform pipe cutting and end preparation to result in clean ends with full inside diameter
 - 2. Grind and ream as necessary

- D. Nipples
 - 1. Close nipples not permitted.
 - 2. Provide extra heavy pipe for nipples where unthreaded portion is less than 1-1/2 inch long.

- E. Threaded Joints: Not allowed other than unions and accessories (e.g. gauges, test plugs)

- F. Welded Joints
 - 1. Welded joints shall not be substituted for mechanical (Victaulic) joints where mechanical joints are specifically called out in specifications or on Drawings (for example to provide expansion/contraction or chiller tube pull access).
 - 2. Weld pipe joints in accordance with recognized industry practice and as follows
 - a. Welding shall be done by qualified welders in a first-class, workmanlike manner, conforming to the American Standard Code for Pressure Piping USA B-31.1 and B-31.1A.
 - b. Bevel pipe ends at a 37.5 degree angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
 - c. Do not weld-out piping system imperfections by tack-welding procedures; re-fabricate to comply with requirements.
 - d. Standards: Conform to Section UI, Chapter 4, "Welding of Pipe Joints", ANSI B31.9 and applicable portion of ASME Boiler and Pressure Vessel Code, Section IX.
 - e. Operator's qualifications: All welders engaged in work under this Section shall be qualified in accordance with State requirements. Each operator's certificate shall be on file at site and made available to State upon request. Welding of pressure piping shall be done by-welders who have been qualified by recognized agency within 6 months prior to date of Contract.
 - f. Preparation for welding: Bevel piping on both ends before welding; both ends shall have 1-1/6 inch land at bottom of bevel. Pipe with a 3/4 inch wall thickness or less shall be beveled to a standard 37.5 degrees.
 - g. Use backing rings on all butt-welding joints 6-inches and larger.
 - h. State employed Inspector will visually inspect welds. Any weld judged defective by visual inspection shall be cut out and tested in presence of Inspector. If percentage of defective coupons is deemed excessive, contractor shall cut additional coupons as directed by the Owner's Representative or the State Inspector. Removal and replacement of test coupons and samplings shall be done at no additional cost to the Owner. At the option of the State Inspector or the Owner's Representative, certain welds may be required to be radiographed.
 - 3. Where required, peen and wheel-grind welds.
 - 4. Ends of pipe may be burned for welding
 - a. Grind bevel and remove scale between welding joint.
 - b. Ragged edges with metal beads, poor alignment other inferior work will be rejected.
 - 5. Perform welding with oxyacetylene or electric arc process.

- G. Grooved and Rolled-End Joints
 - 1. Perform following in accordance with manufacturer's instructions

- a. Cut or roll pipe
- b. Install couplings and fittings
2. Determine that gasket material and lubricant are compatible with service of pipe.

H. Press-Fit Joints

1. Use only on above-ground applications.
2. Strictly comply with manufacturer's instructions and recommendations.
3. Pressure test with water
 - a. First test for any unpressed fittings using a pressure range of 15 psig to 85 psig.
 - b. Once all fittings are confirmed to be pressed, pressure test as required herein and per code.

I. Soldered and Brazed Joints

1. Solder
 - a. Use Solder S-1 for
 - 1) Mechanically formed tee connection (T-drill)
 - b. Use Solder S-1 or S-2A for
 - 1) Piping 3 inch and larger
 - c. Use Solder S-2 or S-2A other than above.
2. Clean surfaces to be jointed, of oil, grease, rust and oxides
 - a. Remove grease from fittings by washing in solution of 1/16 sodium carbonate and three gallons hot water (except as otherwise specified for medical gas piping)
 - b. Clean socket of fitting and end of pipe thoroughly with emery cloth to remove rust and oxides.
 - c. Wipe excess solder from joint before it hardens.
3. When soldering or brazing materials that could be damaged by heat, remove sensitive parts and protect parts from heat. Joints shall be cool before reassembling.
4. Cut tubing square, reamed, and burrs removed.
5. Prevent annealing of fittings and tubing when making connections.

3.4 EXPANSION CONTROL

A. General

1. Install piping to permit free expansion and contraction without damaging piping or construction.
2. Provide offsets, expansion loops, anchors, guides and supports to permit expansion, within stress limits of ANSI 31.1 Pressure Piping for temperature ranges specified.
3. Where pipe loops or changes in direction of piping cannot be employed to absorb expansion and contraction, provide expansion joints.
4. Install pipe guides so that movement takes place along axis of pipe only. Pipe moves laterally at expansion elbows.
5. Make riser offsets in manner to avoid pocket forming due to expansion.

B. Expansion Calculations

1. Thermal Expansion
 - a. Determine thermal linear expansion of each segment of piping systems.
 - b. Base expansion calculations on following temperatures, plus 30 percent safety factor
 - 1) Hot Water Heating
 - a) Idle temperature: 50 degrees Fahrenheit
 - b) Maximum temperature: 210 degrees Fahrenheit
 - 2) Chilled Water
 - a) Operating temperature: 40 degrees Fahrenheit
 - b) Maximum temperature: 100 degrees Fahrenheit

- c. Determine effect of linear expansion upon piping layout in building
 - 1) If resulting stresses exceed maximum allowable limits introduce additional loops and/or offsets.
 - 2) Where space limitations preclude installation of loops and/or offsets provide expansion joints.
 - 2. Structural Considerations
 - a. Install pipe anchors to provide required restraints on expanding piping systems.
 - b. Install pipe guides to provide required restraints against lateral action of expanding piping systems
 - 1) Spacing for expansion joints: per manufacturer's recommendations.
 - 2) Spacing for pipe loops and/or offsets: as required to maintain alignment within allowable stress limits.
 - c. Locate anchors and guides only at building structural members capable of taking imposed reaction loads.
 - d. Determine horizontal and vertical reaction loads of anchors and guides to building structure
 - 1) Coordinate details and reaction loads with structural engineer for building.
 - 2) If necessary, revise location and number of anchors and guides as recommended by structural engineer to result in allowable reaction loads to building.
- C. Provision for Expansion
 - 1. Loops, bends, offsets
 - a. As indicated or because of job required relocation of piping and equipment.
 - b. Design as follows
 - 1) Use spring type loop U-bend or offset U-bend.
 - 2) Corner radii five to six times pipe diameters.
 - 3) Join bends only by welding
 - a) Welding-steel piping
 - b) Brazing-copper or bronze piping
 - 2. Mechanical Joint System
 - a. Grooved- or rolled-joint piping systems with provisions for expansion control methods incorporating inherent flexibility of couplings and fittings may be provided, under conditions specified below
 - 1) Submit design considerations published by manufacturer of couplings and fittings.
 - 2) Conditions specified below must comply with published design considerations.
 - 3) Rolled-joint piping expansion accommodation is generally less than for grooved-joint systems. Verify sufficient joints are provided.
 - b. Perform calculations as specified elsewhere in this section, along with determining any other data required to assure that longitudinal motion, angular deflection and resultant forces do not exceed recommendations in manufacturer's design considerations.
 - c. Provide required anchors and guides spaced per manufacturer's design considerations.
 - d. Install with gap settings of all couplings and fittings to permit full range of expansion, contraction and/or angular deflection as recommended by manufacturer to take place without excessive displacement and forces.
 - 3. See Section 230548 Vibration and Seismic Control

3.5 TESTING

A. Test of Water Piping

1. Test water piping at completion of roughing in, in accordance with the following schedule and show no loss in pressure or visible leaks after a minimum duration of four hours, or time as indicated, at the test pressures indicated.
2. Make connections to existing CUP systems with flanged connection. During testing of the new work, provide a slip-in plate to restrict test pressure to new systems only. Remove plate and complete connection to existing system at completion of testing.
3. Inspect pressure piping in accordance with procedures of ANSI B31.
4. Hydrostatic test pressure
 - a. Less than 100 psi operating pressure: 150 psi
 - b. Over 100 psi operating pressure: 1-1/2 times operating pressure
 - c. Never exceed test pressure ANSI B16.1 basis
5. Duration: 2 hours
6. With system valves capped and pressure apparatus disconnected
 - a. Pressure change: none
 - b. Compensate for temperature change
7. Leaks and defects
 - a. Repair or replace as directed by the Owner's Representative
 - b. At no additional cost to the Owner
8. Notify Owner's Representative in writing one week before test.
9. Furnish written report and certification that tests have been satisfactorily completed to the Owner's Representative.

3.6 WATER PIPING SYSTEM CLEANING

- A. During Construction
 1. Keep openings in piping closed to prevent entrance of foreign matter
 2. Clean pipe, fittings and valves internally
 3. Hammer welds to remove slag and weld beads
- B. Cleaning Procedure
 1. Cleaning shall be supervised by water treatment supplier. See Section 232500 Water Treatment. When approved, procedure below may be modified based on recommendations of supplier.
 2. Clean system immediately after pressure test.
 3. Protect against damage from freeze up or discharge of water.
 4. Closed Circuit Piping Systems
 - a. Open all valves (including control valves) in all legs so circulation goes through all sections.
 - 1) For 3-way valves, either set to 50% open position or begin procedure with valves full open to coil and change to full open to bypass halfway through cleaning period.
 - b. Install temporary filter bags or fine-mesh start-up strainer screen in all line strainers during cleaning.
 - c. Fill with clean water.
 - d. Keep return isolation valve separating the building from the campus loop closed to prevent startup debris from migrating back to the central plant; crack open supply isolation valve to provide a thermal expansion/contraction path for the mass of water in the building loop (applies after each loop filling). Bypass startup valve shall be open throughout cleaning procedure and closed immediately thereafter.
 - e. Start pumps and operate at design flow rate or greater. On chilled water system without pumps, provide a temporary pump at taps provided; flow rate per water treatment specialist's recommendations.
 - f. Simultaneously drain at low points and fill the loop until effluent is clear.

- g. Shut off makeup water.
 - h. Circulate for a minimum of two 48-hour periods. For each period:
 - 1) Add alkaline detergent via pot feeder. See Section 232500 Water Treatment.
 - 2) At end of period
 - a) Shut the supply isolation valve.
 - b) Remove and clean strainers.
 - c) Drain at low points.
 - i. After last circulation period
 - 1) Shut off pumps.
 - 2) Shut the supply isolation valve.
 - 3) Completely drain out entire system of cleaning solution.
 - 4) Remove filters at strainers, or replace start-up screen with final strainer screen.
 - 5) Fill system with clean water.
 - 6) Start pumps, and simultaneously drain at low points for 8 hours.
 - 7) Test
 - a) Alkalinity not more than 200 parts per million in excess of alkalinity of rinsing water
 - b) Effluent visually clear; no visible particles or color
 - 8) Repeat flushing of water until tests are met.
 - j. Should any pipe be plugged, disconnect piping, clean again, and reconnect at no additional cost to the Owner.
 - k. Connect the building to the campus distribution network.
 - 1) Open both the supply and return isolation valves to place the building into service.
 - 2) Start building pumps at 60 Hz and circulate water for a duration coordinated with the campus' water treatment provider to ensure that treated water from the central plant is distributed throughout the building. Thereafter, release the control valves and building pumps to automatic control.
 - 3) Coordinate start of service with campus engineering so that central plant chemical dosing can be adjusted, if needed, to account for the fluid volume added by the building.
 - 4) Do NOT leave the system filled with untreated water for more than 4 hours.
5. All open circuit systems shall be flushed until water runs clean.

3.7 COMPLETION REQUIREMENTS

- A. Complete Pre-Functional Test Data Sheet for each hydronic system. See Section 230800 Mechanical Commissioning.

END OF SECTION

SECTION 232114
PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Escutcheons
 - 2. Bypass chemical feeders
 - 3. Strainers
 - 4. Thermometers
 - 5. Pressure gauges
 - 6. Test plugs

1.2 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. "R" means required.
 - 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Escutcheons	R2			
Bypass chemical feeders	R			R
Strainers	R			
Thermometers	R	R		
Pressure gages	R	R		
Test plugs	R			

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Bypass chemical feeders
 - 1. J. L. Wingert Co.
 - 2. Industrial Chemical Corporation
 - 3. Or equal

- C. Strainers
 - 1. C.M. Bailey
 - 2. Mueller
 - 3. Keckley
 - 4. Victaulic
 - 5. Or equal

- D. Thermometers
 - 1. Weksler
 - 2. Weiss Instruments, Inc.
 - 3. Ashcroft
 - 4. Trevice
 - 5. Marsh
 - 6. Or equal

- E. Pressure gauges
 - 1. Weksler
 - 2. Weiss Instruments, Inc.
 - 3. Dresser Industries, Ashcroft
 - 4. H. O. Trevice Company
 - 5. Or equal

- F. Pressure-temperature test plugs
 - 1. Peterson Engineering Company
 - 2. Taco, Inc.
 - 3. Or equal

2.2 ESCUTCHEONS

- A. Provide escutcheons with inside diameter closely fitting pipe outside diameter or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, ceilings, or pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish and screw or spring clamping device with concealed hinge.
 - 1. Pipe escutcheons for moist areas: For water resistant floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged. Split hinged type shall not be used in areas with security requirements.
 - 2. Pipe escutcheons for dry areas: Provide sheet steel escutcheons, solid or split hinged. Split hinged type shall not be used in areas with security requirements.

2.3 BYPASS CHEMICAL FEEDER

- A. Batch feeder for closed circulating water systems
- B. Capacity: 5 gallons
- C. Steel shell and heads
- D. Cap: Cast iron with Buna N "O" ring: Quarter-turn to open

- E. 3/4 inch tapings for water in and out and drain
- F. Operating pressure and temperature
 - 1. Minimum rated operating pressure up to 125 pounds per square inch
 - 2. Minimum rated operating temperature up to 250°F
 - 3. Design and installation as indicated
- G. Wingert Model HD or equal

2.4 STRAINERS

- A. Pressure rating: minimum 150 psi at 200°F
- B. Screen
 - 1. 304 or 316 stainless steel or Monel, reinforced
 - 2. Free area not less than 3 times inlet area
 - 3. Perforations
 - a. To 2 inch: 20 mesh
 - b. To 4 inch: 1/16 inch
 - c. 5 inch and larger: 1/8 inch
- C. Y-Type
 - 1. 2 inches and less
 - a. Cast Bronze
 - b. Solder joint
 - c. Bronze cap and plug, straight thread with composition gasket
 - d. Keckley E-150 or equal
 - 2. Larger than 2 inches
 - a. Cast iron
 - b. Flanged connection
 - c. Bolted cast iron cover with composition gasket and threaded hose connection
 - d. Keckley Style A or equal
- D. Basket type
 - 1. Cast iron
 - 2. Flanged connection
 - 3. Bolted cover, bottom or side drain connection
 - 4. Keckley Style GFV or equal
- E. Provide Hubbell, Refrigerant Specialties, or equal on refrigeration systems.

2.5 THERMOMETERS

- A. Digital, self-powered
 - 1. Display: Minimum 3/8" LCD digits, swivel mount for 360° viewing adjustment
 - 2. Range: 0 to 300°F
 - 3. Sensor: Glass passivated thermistor
 - 4. Accuracy: 1% of reading or 1°F, whichever is greater
 - 5. Resolution: 0.1 °F between 0 and 200°F
 - 6. Recalibration: Internal potentiometer
 - 7. Lux Rating: 10 Lux (one foot-candle)

8. Waterproof cover for outdoor installations
9. Ambient Operating Range:
 - a. Temperature: -30/140°F
 - b. Humidity: 0% RH to non-condensing
10. Power: Self-powered via integral photovoltaic cells
11. Weiss DVU, Weksler AD, or equal

- B. Stem Length for Nominal Pipe Sizes
 1. Below 4 inch: 3-1/2 inch stem, elbow mounted
 2. 4-8 inch: 3-1/2 inch stem
 3. 10-14 inch: 6 inch stem

2.6 PRESSURE GAUGES

- A. Pipe or equipment mounted type
 1. Diameter: 4 1/2 inch, except as noted
 2. Case: black finished cast aluminum with flangeless back
 3. Threaded black cast aluminum ring with gasketed glass face
 4. Type 316 stainless steel spring tube
 5. Stainless steel precision movement: Micrometer adjustment on needle
 6. Accuracy: 0.5 percent full scale range
 7. With calibration adjustment
 8. Quarter turn stop cock: Materials compatible with service
 9. Pressure snubbers
 - a. Filter type
 - b. For liquid, air and gas
 10. Weksler Type AA44 or equal
- B. Pressure gauge ranges in pounds per square inch gauge
 1. Heating water pump: 0-100
 2. Pressure gauges indicated on drawings or in specifications not indicated above to be submitted with appropriate range for review

2.7 PRESSURE/TEMPERATURE TEST PLUG

- A. Solid brass with valve core
- B. Valve core: Nordel or EPDM
- C. Fitted with a color coded and marked cap with gasket
- D. Suitable for 500 pounds per square inch gage and 275°F for water systems
- E. Pete's Plug: No. 110 with yellow cap or equal

2.8 FLANGES

- A. Convolute
- B. Carbon steel, cold-formed

- C. Weld-neck and blind flanges in conformance with the design criteria of Section VIII, Division I of the ASME Pressure Valve Code
- D. Flanges drilled and tapped to match ANSI 150
- E. All material to comply with requirements of ASTM A516
- F. Gaskets: Teflon or as recommended by the flange manufacturer and suitable for the service involved
- G. Slip-on flanges will not be permitted
- H. 150-pound and 300-pound weld-neck and screwed steel flanges on steel lines to conform to ANSI Standard B16.5 for dimensions and ASTM A 181 Material Standard

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with manufacturer's instructions.

3.2 ESCUTCHEONS

- A. Install at piping penetrations of walls, floors and ceilings
 - 1. Where exposed to public view
 - 2. At penetrations of exterior walls
- B. Where piping is insulated, escutcheons shall fit insulation outside diameter.

3.3 BYPASS CHEMICAL FEEDERS

- A. Install feeder in convenient location where it may be easily refilled, maximum 4 feet above floor.
- B. Install as indicated on drawings
 - 1. Support from floor
 - 2. Valves on inlet, outlet and drain

3.4 STRAINERS

- A. Wye-type: Where shown on drawings and ahead of all automatic balancing valves and pressure regulating valves
- B. Basket-type strainers: Where shown on drawings
- C. Install strainers in horizontal or vertical-down position

3.5 INSTRUMENTATION

- A. Install sensors and sensor wells to piping using thread-o-lets welded or soldered to pipe, or other approved means. For piping smaller than 1.5 times well depth, wells shall be installed in the end of an elbow, or tee used in place of an elbow, to minimize obstruction.
- B. Thermometers
 - 1. Install thermometers for easy readability (height, distance, view angle) from floor wherever possible.
 - 2. Install in brass or stainless steel thermowell.
 - 3. Locate where shown on drawings.
- C. Pressure Gauges
 - 1. Provide gauges where shown on drawings.
 - 2. Install gauges on non-vibrating backing.
 - 3. Provide instrument cocks for isolation and removal of gauge at each pressure connection point.
 - 4. Install gauges for easy readability (height, distance, view angle) from floor, except gauges at ceiling coils
 - 5. At pumps, install a single pressure gauge only piped to pump taps at the inlet and outlet of pump. Using two gauges or connecting to piping rather than pump taps is not acceptable.
- D. Pressure-Temperature Test Plugs
 - 1. Provide pressure/temperature test plugs where shown on drawings.
 - 2. Also locate at all temperature and pressure sensors for calibration, see Section 250000 Building Automation Systems.
 - 3. Mount using threadolet welded or braised to pipe.

3.6 INSPECTION

- A. Verify that adequate clearance between piping specialties and adjacent walls or equipment is available to permit maintenance and repairs.

3.7 TESTING AND ADJUSTING

- A. Test thermometers, pressure gauges and water meters for accurate indication with known calibrated master; calibrate or replace if not within 5 percent of reading.
- B. Test air vent points to insure all air has been vented.
- C. Test other piping specialties for proper operation.
- D. See Section 230800 Mechanical Commissioning.

END OF SECTION

SECTION 232123

PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for all water pumps except
 1. Where integral with manufactured piece of equipment
 2. Where specialty pumps applicable to specific systems are specified under the relevant Section

1.2 REFERENCE STANDARDS

- A. Underwriters' Laboratories, Inc.: UL 778 – Motor Operated Water Pumps
- B. American Society of Mechanical Engineers: ASME Section VIII – Boiler and Pressure Vessel Code – Pressure Vessels
- C. ANSI/HI Pump Standards

1.3 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 1. "R" means required.
 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Pump data	R	R		R
Mounting details				R

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Bell and Gossett

- C. PACO
- D. Patterson
- E. Or equal

2.2 GENERAL

- A. Centrifugal, single stage, unless otherwise noted
- B. Bronze fitted (impeller and wear rings)
- C. Statically and dynamically balance rotating parts
- D. Construction to permit complete servicing without breaking piping connections
- E. Pumps to operate at 1750 rpm unless specified otherwise
- F. Bearings: Grease lubricated roller or ball bearings
- G. Shaft seals
 1. Mechanical, internally flushed
 2. Single, inside mounted, end face rubber bellows type
 3. Springs: stainless steel
 4. Seal head: brass or stainless steel
 5. Carbon face rotating against a stationary ceramic face
 6. Elastomer: Buna or EPDM
- H. Substitutions
 1. Brake horsepower rating at design conditions shall be no more than 10 percent above that scheduled.
 2. Motor horsepower shall be no larger than that scheduled, or compensate Division 26 contractor for any associated cost to increasing motor size.
- I. Motors: See pump schedule and Section 230513 Motors and Controllers
- J. Pump characteristics
 1. Pump curve shall rise continuously from maximum capacity to shutoff
 2. Shutoff head approximately 10 percent greater than design head
 3. Operation between 65% and 115% of GPM at best efficiency point (BEP) for the indicated impeller size, ideally between 85% and 105% of GPM at BEP
 4. For pumps serving variable flow (2-way valve) systems; or where multiple pumps operate in parallel other than lead/standby applications
 - a. Pump shall be capable of operating at 40 percent beyond design flow rate without exceeding break off point
 - b. Motors shall be selected for non-overloading operation at a flow rate 40 percent beyond design flow rate
 5. Impeller diameter
 - a. Minimum tip to cutwater clearance: 4%
 - b. Constant speed pumps: Trim to duty
 - c. Variable speed pumps: Trim to the maximum impeller size that does not cause an increase in motor size (so that maximum efficiency is achieved).

- K. Pumps and flanges tested and rated to withstand 1-1/2 times specified working pressures based on both inlet pressures scheduled and pump shut-off head or 175 pounds per square inch working pressure at 250 degrees Fahrenheit, whichever is greater.
- L. Pumps to be suitable for handling fluids at scheduled temperatures
- M. Pressure taps on both inlet and outlet for gauge connection mounted in the pump casing (not in external piping)
- N. Factory tested
- O. Painted with at least one coat of high-grade machinery enamel

2.3 IN-LINE

- A. Type as scheduled
 - 1. Close coupled
 - 2. Suitable for vertical or horizontal operation
 - 3. Back pullout design
- B. Shaft: Stainless or Carbon Steel
- C. Wearing rings: renewable bronze
- D. Shaft sleeves: bronze
- E. Casing with suction and discharge gauge ports, vent and plugged drain ports
- F. Capable of being serviced without disturbing piping connections
- G. Pump volute base ring tapped for 1-1/2 inch 125 pound ANSI flange to support pump
- H. Pump flanges to have 125 pound ANSI flange drilling

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades
- B. Install pump in accordance with manufacturer's written installation instructions
- C. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer
- D. Decrease to pump suction from line size with flat-top eccentric reducers on horizontal inlet piping (or suction diffuser where indicated on drawings), concentric reducers elsewhere
- E. Support piping adjacent to pump such that no weight is carried on pump casings

- F. Allow at least 5 pipe diameters between pump suction entry and closest elbow or strainer, unless a pump suction diffuser is installed
- G. Inlet and discharge valves and other piping specialties shall be pipe size, not pump inlet or discharge connection size
- H. See Section 232114 Piping Specialties
- I. See Section 250000 Building Automation Systems
- J. See Section 230800 Mechanical Commissioning

3.2 MOUNTING AND ALIGNMENT

- A. See Section 230548 Vibration and Seismic Control
- B. Recheck alignment after operation when the pump and the driver are at operating temperature.

3.3 INSPECTION

- A. Verify that adequate clearance between pump and adjacent walls or equipment is available to permit maintenance and repairs.
- B. Check that pump is suspended from building structure and not supported by piping.

3.4 PRE-OPERATING CHECKS

- A. Before operating pumps
 1. See Section 019100 Commissioning
 2. Complete the Pre-Functional Test Data Sheet for each pump; see Commissioning specs.
 3. Assure that piping is clear of debris which might clog pump
 4. Vent air from pump system to assure water in pump and piping system
 5. Check for proper and sufficient lubrication
 6. Check for correct operation of check valve
 7. Check for correct rotation
 8. Confirm alignment again after grouting has properly set and re-align if required
 9. Check packing nut adjustment for proper leakage rate and packing lubrication
 10. Assure that strainer is clean before commencing testing
 11. Check for proper adjustment of vibration isolation

3.5 TESTING AND ADJUSTING

- A. Before starting pump: See Section 019100 Commissioning
- B. After starting pumps
 1. Check for high bearing temperatures
 2. Check temperature of packing gland or mechanical seal for proper cooling operation
 3. Check for motor overload by taking ampere reading at maximum operating conditions, i.e. all valves open and individual pump running

- 4. Check shut-off head to ensure impellers properly trimmed
- C. See Section 230593 Testing, Adjusting, and Balancing
- D. See Section 230800 Mechanical Commissioning

3.6 TRAINING

- A. See Section 230800 Mechanical Commissioning
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel on:
 - 1. Procedures for starting and stopping and troubleshooting pumps
 - 2. Procedures and schedules for maintaining and servicing pumps
 - 3. Organization and content of Operations & Maintenance Manuals

END OF SECTION

SECTION 233100

DUCTS

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Ductwork
 - 2. Single wall plenum walls and casings
 - 3. Fasteners and Sealants
 - 4. Exceptions: Where integral with manufactured piece of equipment

1.2 REFERENCE STANDARDS

- A. SMACNA HVAC Duct Construction Standards, latest edition

1.3 DEFINITIONS

- A. Seam: locks or weld applied longitudinally to close section of duct, for example longitudinal seam, spiral seam.
- B. Joint: abutting connection between duct sections for continuity of air passage, for example cross joint, transverse joint, coupling.
- C. Reinforcement: hardware applied to strengthen duct, for example girth angles, tie rods, fasteners (not connectors), and the like.
- D. Stiffening: folding, bending, beading, cross-breaking or corrugating of sheets to achieve strength through shape, for example pocket lock secures joint and is transverse stiffener, with girth angle and fasteners applied (not connectors), joint or stiffener is reinforced.
- E. Duct Classification
 - 1. Terms used in this specification are defined as follows:
 - a. Low Pressure: less than 2 inches pressure class and less than 2000 feet per minute air velocity
 - b. Medium Pressure: 2 inches to 6 inches pressure class or higher than 2000 feet per minute air velocity
 - c. High Pressure: above 6 inches pressure class

1.4 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Ductwork materials and fittings	R			R
Flexible ducts	R			R
Duct sealants	R			
Duct pressure testing reports		R		

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Spiral oval and round ducts
 1. United Sheet Metal Division, United McGill
 2. Semco Manufacturing, Inc.
 3. Metco
 4. Contractor fabricated
 5. Or equal
- C. Duct Connection Systems
 1. Ductmate Industries, Inc.
 2. Fabriduct Transverse Duct Connection system
 3. Ward Industries, Inc.
 4. Or equal
- D. Flexible Ducts
 1. Thermaflex
 2. Flexmaster
 3. Or equal
- E. Duct Sealants
 1. Minnesota Mining and Manufacturing Company
 2. Foster
 3. Childers
 4. Miracle Adhesive Corporation
 5. United Sheet Metal Division United McGill Corporation
 6. Hardcast Products Group
 7. Mon Eco Industries
 8. Nashua
 9. 3M
 10. Or equal
- F. Flexible Duct Clamps
 1. Panduit

2. Aeroquip Corporation
3. Ideal Division Parker Hannifin Corporation
4. Tridon Corporation
5. Young Regulator Company
6. Or equal

- G. Duct Support Systems
1. CEAS Wedgy Support Systems
 2. Gripple
 3. Or equal

2.2 MATERIALS

- A. Galvanized Steel Sheet Metal
1. Cold rolled soft steel sheets
 2. ASTM A653 and A924
 3. Galvanizing:
 - a. General: minimum G-60
 - b. Exposed to weather or outdoor air, or as indicated herein or on Drawings: minimum G-90
 - c. Plenum walls and blank-offs where in contact with cooling coil: minimum G-90
 4. Lock-forming quality
- B. Miscellaneous Products
1. Screws and rivets
 - a. Same material as sheet, except as indicated on the Drawings
 - b. On aluminum sheets, provide cadmium plated or stainless steel
 - c. Zinc or cadmium plated, permitted on galvanized sheets
 - d. Minimum screw size: No. 10
 - e. Minimum rivet size: 4 pound
 2. Duct Sealants
 - a. Duct Sealing Compound. UL-181 listed, water-based
 - 1) Foster Safetee Duct Sealant 32-19
 - 2) Childers CP-146
 - 3) Design Polymerics DP-1010
 - 4) Hardcast Products Group Flex-Grip 550 or 601
 - 5) Or equal
 - b. Rolled Elastomeric Duct Sealant: Hardcast Products Group Foil-Grip 1403-181BFX, Aluma-Grip AFT-701 or equal, UL-181 listed
 - c. Gaskets
 - 1) Continuous, reinforced, inert self-conforming type
 - 2) 1/8 inch thick
 - 3) Width: to match angle connection.
 - 4) 3M Weatherban Ribbon Sealant PF5422 or equal
 - d. Two-Part Hard-Setting Joint Tape
 - 1) Two part process includes tape and hard setting sealant
 - 2) Mineral impregnated woven fiber tape
 - 3) Impregnated with activator/adhesive of polyvinyl acetate type
 - 4) UL Listed
 - 5) Flame spread: 10
 - 6) Smoke contributed: 0
 - 7) Equal to Hardcast 550 or 601 sealant and Aluma-Grip AFT-701 tape
 3. Spring Fasteners

- a. Oval head stud and receptacle
 - b. Screwdriver slot
 - c. Self-ejecting
 - d. Dzus or equal
 - 4. Angles, tie rod and shapes for reinforcing ducts: In accordance with SMACNA HVAC Duct Construction Standards
 - 5. Duct connection system
 - a. Transverse bolted duct joints
 - b. Flanges with permanent, non-hardening sealant
 - c. Ductmate Industries Ductmate 25 and 35, Fabriduct TDC, or equal
- C. Turning vanes
- 1. Galvanized steel ductwork: galvanized steel or painted black steel, except as indicated on the Drawings
 - 2. Other ductwork: same material as ductwork
 - 3. Construction per SMACNA HVAC Duct Construction Standards for
 - a. Single wall vanes with 3/4 inch trailing edge
 - b. Double wall vanes: Not acceptable
 - c. Vane length: Provide separate equal size sections for vane length greater than those indicated in referenced Standards.
 - d. Vane runners: Type 1 or 2 acceptable
 - 4. Vane radius
 - a. 2 inch radius: duct width up to 36 inches
 - b. 4 inch radius: duct width 36 inches or larger
 - 5. Vanes shall be at the correct angle for airflow (leading edge in line with the entering duct section; leaving edge in line with exiting duct section). If only 45° angles are available, turning vanes shall only be used in 90° elbows where the entering width equals the exiting width; all other elbows shall be full radius type unless otherwise indicated on the drawings.
- D. Low pressure round duct take-off fittings in rectangular duct
- 1. Factory-fabricated spin-in fitting
 - 2. Die-formed galvanized steel
 - 3. Balancing damper
 - a. Spring loaded
 - b. Locking regulator
 - c. Sealed at both ends to prevent leakage
 - 4. No scoop allowed for any application
 - 5. Noll Manufacturing, Young Manufacturing or equal

2.3 ROUND AND OVAL DUCTWORK

- A. General
- 1. Construction
 - a. Factory- or shop-fabricated spiral lock seam duct; no snap lock
 - b. Factory-fabricated longitudinal seam
 - 1) Acceptable for ducts larger than standard factory sizes
 - 2) Welded duct
 - 2. Fittings
 - a. Same material and construction as duct in which installed
 - b. For ductwork exposed to occupant view, do not use fabricated fitting at taps to VAV boxes and outlets. Instead use saddle tap cut into continuous spiral duct. Intent is for

spiral duct to be continuous for aesthetic reasons. Saddle tap flange width shall be 0.5 inches or less.

- c. Tees and taps
 - 1) 45 degree conical or shoe tap
 - 2) 90 degree conical tap
 - a) Inlet diameter shall be minimum 2 inches wider than the round duct diameter
 - b) Maximum 14° taper angle
 - 3) 90 degree straight tap
- d. Elbows
 - 1) Seams
 - a) Spot welded with bonded seams or spiral seam except as indicated below
 - b) Continuous welded seams for the following applications
 - 1. 4 inch and higher pressure class
 - 2. Product conveying ducts such as those for grease exhaust and laboratory fume hood exhaust
 - 3. Dishwasher exhaust for horizontal ducts
 - 4. Where exposed to occupant view
 - c) Adjustable elbows with sealed gores are acceptable on low pressure ducts where concealed from occupant view
 - 2) Minimum gores as follows:
 - a) 2 gores - less than or equal to 30 degrees
 - b) 3 gores - 31 degrees through 45 degrees
 - c) 4 gores - 46 degrees through 60 degrees
 - d) 5 gores (or solid full radius) - over 61 degrees
 - 3) Throat radius to diameter ratio shall not be less than 1.0 except:
 - a) Where shown otherwise on Drawings
 - b) Short radius adjustable elbows with sealed gores are acceptable on low pressure ducts where concealed from occupant view

2.4 FLEXIBLE DUCTS

- A. Flexible ducts
 - 1. UL 181, Class I Air Duct
 - a. Products categorized as only Flexible Air Connectors under UL 181 are prohibited.
 - 2. Labeled for compliance with CMC
 - 3. Minimum working pressure
 - a. 2 to 4 inch positive static pressure class: 4 inches
 - b. 0 to 1 inch negative static pressure class: 1 inch
 - 4. Insulated Flexible Duct
 - a. Chlorinated polyethylene (CPE) inner liner duct permanently bonded to a vinyl or zinc coated spring steel wire helix
 - b. Fiberglass insulating blanket; minimum R-value
 - 1) Ducts outside the conditioned space and in conditioned envelope: 4.2
 - 2) Ducts outside conditioned space and conditioned envelope: 8.0
 - c. Low permeability outer vapor barrier of fiberglass bi-directional reinforced metallized film laminate
 - d. Inner and outer liners shall provide a double air seal
 - e. Minimum Insertion Loss, 10 feet straight duct, 2500 fpm

Duct ID (in.)	Frequency (Hz)						
	125	250	500	1000	2000	4000	8000
6	11	33	37	39	37	19	14
8	13	35	34	39	29	17	14

≥12	10	26	26	35	24	11	9
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- f. Warranty: free of defects in material and factory workmanship for a period of 10 years from the date of manufacture
- g. Thermaflex M-KE or equal
- 5. Uninsulated Flexible Duct
 - a. Woven fiberglass fabric with flame retardant coating permanently bonded to a vinyl or zinc coated spring steel wire helix
 - b. Thermaflex S-LP-10 or equal
- B. Flexible ductwork clamps
 - 1. Straps listed for use with flexible ductwork
 - 2. 2 inches and greater SP Class: Galvanized steel strap
 - a. Adjustable toggle type
 - b. Young Quick-Clamps or equal
 - 3. Less than 2 inches SP class: Adjustable nylon strap
 - a. With factory furnished installed tool
 - b. Panduit PAN-TY Cable Ties, Heat Stabilized Nylon 6/6

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades
- B. See Division 25 Building Automation Systems
- C. See Section 230800 Mechanical Commissioning

3.2 MOUNTING AND ALIGNMENT

- A. See Section 230548 Vibration and Seismic Control

3.3 DUCT CLASSIFICATION

- A. Minimum operating pressure for each duct system, general
 - 1. Scheduled static pressure for each fan or unit, positive or negative, unless otherwise indicated on the Drawings
 - 2. Adjust upward to nearest pressure class tabulated in SMACNA HVAC Duct Construction Standards
- B. Static pressure class, unless otherwise indicated on the Drawings

Application	SMACNA Pressure Class
VAV supply air duct and risers from AHU thru shaft fire/smoke damper	3 inches
Other VAV supply air duct upstream of VAV boxes	2 inches
Downstream of VAV boxes, fan-coils, heat pumps, SZ VAV etc.	1 inch

Application	SMACNA Pressure Class
Outdoor air	-2 inches
Toilet exhaust	-2 inches
Other fans systems	Per fan static
Return air transfers	1/2 inch

3.4 DUCTWORK INSTALLATION

A. General

1. Install ducts in accordance with manufacturer's written installation instructions
2. Construct with gages, joints, bracing, reinforcing, and other details per current CMC and SMACNA, unless specified otherwise
 - a. Comply with most stringent
 - b. Provide ducts with CMC gages or thicker when traversing rated corridors
 - c. Combustion air ducts: Minimum 24 gage
3. Construct of galvanized sheet metal, except where otherwise indicated herein or on Drawings
4. Provide for duct rigidity by either of these methods
 - a. Beading at 12 inches on center, maximum
 - b. Crossbreak outward in ducts having positive internal pressure
 - c. Crossbreak inward in ducts having negative internal pressure
 - 1) Exception: All ducts exposed to rain shall outward crossbreak on top of the duct.
5. Duct dimensions indicated are outside duct dimensions (OD) unless indicated on the Drawings as inside dimension (ID or net, clear dimension).
6. Alter duct sizes on basis of equal friction where required to facilitate installation. Reflect changes in shop drawings for review by Owner's Representative.
7. At duct penetrations of walls, floors and ceilings where exposed to occupant view, provide sheet metal angle type escutcheons with no sharp corners or edges.
 - a. Clearance from duct to opening shall not exceed 2 inches.
 - b. Escutcheons shall overlap wall, floor, or ceiling surface by ½ inch minimum.
8. Frame, trim, caulk and seal all duct penetrations through acoustical walls and partitions. See Section 230548 Vibration and Seismic Control.
9. Firestopping at penetrations of fire rated floors and partitions
 - a. The fire-resistance rating of penetrations and fire-resistant joint systems shall be firestopped with a UL listed firestop system that will maintain the fire rating of the assembly. Through-penetrations and membrane penetrations shall be protected by an approved system installed as required by the system listing or as otherwise permitted by CBC Section 714. Listed through-penetration firestop systems and membrane penetrations shall be installed in accordance with the installation details for the listed system to be installed. Fire protection system installation details and listings shall be submitted for approval prior to the start of system installation.
 - b. Manufacturer
 - 1) 3M Penetration Sealing Systems (PSS 7909) and 3M Fire Barrier Caulk and Putty
 - 2) Dow-Corning LTV Silicone foam
 - 3) Or equal
10. Tapers
 - a. Pitch sides of duct in diverging or converging airflow maximum of 1 to 4 taper
 - b. Abrupt, bushing type fitting not allowed
11. Duct openings

- a. Provide openings where required to accommodate thermometers, smoke detectors, controllers, and the like. Insert through airtight rubber grommets.
- b. Where openings are provided in insulated ductwork for insertion of instruments, install insulation material inside metal ring for use as plug.
- c. At fire dampers allow adequate length of duct to install access door.
- 12. Avoid penetration of ducts; provide airtight seal at unavoidable penetrations of hanger rods and tie rods.
- 13. No exposed sharp metal allowed
 - a. All exposed pins, screws and sharp objects shall be covered with hardening silicon
 - b. All exposed sheet metal edges shall be hemmed with exposed corners rounded smooth
 - c. Remove all sheet metal fish hooks
 - d. Dryer ducts shall have no screws or other elements protruding into ducts that might catch lint.
- 14. Install lining in ducts and plenums as specified in Section 230700 Mechanical Insulation.
- 15. Volume dampers: Install dampers as specified in Section 233300 Duct Accessories
- 16. Ducts exposed to occupant view
 - a. Use only spiral round or oval ducts; no rectangular duct or flex duct unless specifically shown on Drawings.
 - b. Use Grippler hangers.
 - c. Duct sealant shall be clear and concealed in the joint, invisible to occupants.
 - d. Run ducts parallel to the structure unless specifically shown on Drawings.
 - e. Ducts shall not intersect wall corners or run parallel to and within a full height wall.
 - f. Where painting is shown on architectural drawings, materials shall be de-greased or otherwise ready to paint (paint by others).
 - g. Ducts shall have no external markings or tags.
 - h. Saddle taps and other taps to grilles, tees, wyes, etc.:
 - 1) Have flanges at duct connection inside the duct concealed from view
 - 2) Do not break the duct, i.e. use taps cut into a continuous spiral duct, not factory constructed tees.

B. Rectangular Elbows

- 1. Use radius elbows in rectangular ducts unless otherwise indicated on the Drawings based on ratio of inner throat radius (R) to duct width in plane of radius (W):
 - a. Low pressure: R/W shall not be less than 0.5
 - b. Medium pressure: R/W shall not be less than 1.0
 - c. Where space does not permit radius specified above, install short radius splitter vanes per SMACNA HVAC Duct Construction Standard with number of splitter vanes determined by R/W ratio
 - 1) One vane: R/W above 0.3
 - 2) Two vanes: R/W between 0.1 to 0.3
 - 3) Three vanes: R/W 0.1 and smaller
- 2. Square turns with turning vanes in rectangular ductwork may only be used as follows:
 - a. Where shown on drawings. Note: turning vanes are not required on return air transfer boots unless shown on Drawings.
 - b. Where radius elbow specified above cannot fit.
 - c. Where close to inlets at fans (to minimize system effect).

C. Rectangular ductwork

- 1. Transverse Joints
 - a. Standard: Fabriduct TDC or Ductmate or equal. Low pressure ductwork may be slip & drive (S&D) per SMACNA.
 - b. Welded. Where indicated herein or on plans.
- 2. Longitudinal Joints

- a. Standard: Pittsburgh. Snap lock not allowed.
 - b. Welded. Where indicated herein or on plans.
 - 3. Branch take-offs
 - a. Medium pressure riser taps: double 45 degree (upstream and downstream)
 - b. Other medium pressure: 45 degree upstream
 - c. Low pressure: straight 90 degrees

- D. Plenum walls, blank-offs, and casings
 - 1. Constructed per SMACNA HVAC Duct Construction Standard, Casings and Plenums.
 - 2. Static pressure class
 - a. Upstream of fan: -2 inches
 - b. Downstream of fan: fan static pressure or greater
 - 3. Seal all joints, edges, and penetrations as per HVAC ducts as specified herein.

- E. Round and oval ductwork
 - 1. Joints
 - a. Standard: Beaded sleeve joints mechanically fastened with sheet metal screws or pop rivets
 - b. Welded. Where indicated herein or on plans.
 - 2. Longitudinal
 - a. Standard: Spiral lock
 - b. Welded. Where indicated herein or on plans.
 - 3. Branch take-offs
 - a. Medium pressure: 45 degrees or conical 90 degrees
 - b. Low pressure: straight 90 degrees. Branch connections may be made with spin-in fittings
 - c. Center-line take-off, unless otherwise indicated on the Drawings

- F. Flexible ductwork
 - 1. Use only where shown on drawings.
 - 2. Type:
 - a. Insulated acoustical type shall be used for all:
 - 1) Supply air
 - 2) Return air
 - 3) Exhaust air (for acoustical dampening) except rooms with showers or other high moisture sources
 - b. Uninsulated type shall be used for all:
 - 1) Exhaust air from rooms with showers or other high moisture sources
 - 3. Not allowed for:
 - a. Product conveying systems such as kitchen exhaust and laboratory exhaust
 - b. Dishwasher exhaust
 - c. Dryer exhaust (other than final exposed connection at dryer)
 - d. Medium pressure ducts upstream of VAV boxes
 - 4. Continuous, single pieces
 - 5. Length
 - a. Maximum: 5 feet
 - b. Minimum:
 - 1) Insulated acoustical type: 5 feet
 - 2) Uninsulated type: 3 feet
 - 6. End Connections
 - a. Connect to duct collars, terminal unit connections and round air outlets per manufacturer's instructions.
 - b. Secure with strap clamps and seal as specified herein.
 - 7. Installation

- a. Support adequately to avoid excessive droop
 - b. Minimum inside bending radius not less than one duct diameter
 - c. Install as straight as possible except as shown on drawings for sound attenuation
 - d. Cut ducts to lengths required rather than create bends to take up excess lengths except as shown on drawings for sound attenuation
- G. Grille connections
- 1. Provide at entry to diffuser collar either
 - a. Straight duct for 1 duct diameters or greater
 - b. Full radius elbow
 - c. Side inlet plenum
 - 1) Height: 4 inches minimum taller than top of grille to provide room for uniform airflow to grille
 - 2) Width/length: 2 inches wider than duct or round diffuser collar, whichever is larger
 - 3) For supply air grilles, internal surfaces lined with minimum 1/2 inch thick Type AL duct liner as specified under Section 230700 Mechanical Insulation
 - 4) At contractor's option, where plenum is required at round neck diffuser, square neck diffuser with length and width equal to diffuser diameter may be substituted
 - d. Thermaflex FlexFlow Elbow or equal
 - 2. Connections at grilles shall be insulated to the extent the duct is insulated including the final register box.
 - 3. Seal connections at grilles per seal class of upstream ductwork.
- H. Duct hangers and supports
- 1. General
 - a. Support horizontal ducts with hangers of size and spacing as indicated in pertinent SMACNA HVAC Duct Construction Standards
 - b. Attachment to structure: See Section 230529 Hangers and Supports
 - c. Seismic restraints: See Section 230548 Vibration and Seismic Control
 - 2. Horizontal Duct Supports
 - a. Install hangers at each change in direction of duct
 - b. Strap hangers
 - 1) Extend strap down both sides of ducts
 - 2) Turn under bottom one inch minimum
 - 3) Metal screw hangers to
 - a) Bottom of duct
 - b) Upper and lower sides of ducts
 - c) Not more than 12 inches on center
 - c. Angle hangers
 - 1) Provide angle hangers formed by extended vertical bracing angles
 - 2) Or by rods connecting to bottom angles if size or bracing angles conform to hanger schedule
 - 3. Vertical duct supports
 - a. Support vertical ducts at every floor
 - b. Use angles or channels mechanically fastened to ducts with screws or pop rivets.
 - c. Set angles or channels on floor slab or structural steel members placed in opening, unless otherwise indicated on the Drawings
- I. General ductwork
- 1. Applies to ductwork not specifically listed in Paragraphs below
 - 2. Standard galvanized construction
 - 3. Standard seams and joints

- J. Ducts exposed to weather
1. Galvanized steel G-90, 304 stainless steel, or aluminum
 2. Make ducts subject to rain watertight.
 3. Construct as follows to assure water run-off
 - a. Arrange standing seams to not act as dams
 - b. Longitudinal seams at bottom of duct
 - c. Construct all ducts subject to rain watertight and to insure water runoff by one or more of following techniques
 - 1) Slope entire top of duct down toward side
 - 2) Vertical struts within duct to bow top panels of duct into convex shape
 - 3) Sheet metal cap where shown on Drawings
- K. Sound-rated duct packing
1. Wherever possible avoid duct penetrations through sound-rated walls, floors and ceilings.
 2. Provide packing for unavoidable duct penetrations per Section 230548 Vibration and Seismic Control.
- L. Joint Sealing
1. Seal ducts per the Seal Levels tables below
 - a. Seal factory fabricated ducts and plenums, including terminal boxes, if not factory sealed to Seal Level listed
 - b. Provide more stringent sealing if required to meet requirements of Paragraph 3.5.

Seal Level Requirement				
Duct Location	Duct Type			
	Supply		Exhaust/ outdoor air	Return
	<2 in. water column ^b	≥2 in. water column ^b		
Outdoors	A	A	C	A
Unconditioned Spaces	A	A	C	A
Return Air Plenums	A	A	A	C
Conditioned Spaces	C	A	A	C
^b Duct design static pressure classification.				
Seal Level Definitions				
Seal Level	Sealing Requirements			
A	All transverse joints, longitudinal seams, and duct wall penetrations			
B	All transverse joints and longitudinal seams			
C	Transverse joints only			
Longitudinal seams are joints oriented in the direction of airflow. Transverse joints are connections of two duct sections oriented perpendicular to airflow. Duct wall penetrations are openings made by any screw fastener, pipe, rod or wire. Spiral lock seams in round and flat oval duct need not be sealed. All other connections are considered transverse joints, including but not limited to spin-ins, taps and other branch connections, access door frames and jambs, duct connections to equipment, gores of elbows, etc.				

2. Ducts not exposed to weather
 - a. General: Seal using one of the following:
 - 1) Duct Sealing Compound
 - 2) Gasketed TDC or Duct-Mate
 - 3) Two-Part Hard-Setting Joint Tape
 - 4) Rolled Elastomeric Duct Sealant if and only if
 - a) Joint is not exposed to occupant view
 - b) Pressure class is less than 2 inches

- c) Surface is clean, dry, and grease/oil-free
 - d) Extensive pressure is applied, working the tape into the duct surface using an application tool recommended by the Rolled Elastomeric Duct Sealant manufacturer.
 - b. Flexible duct
 - 1) Secure with straps or clamps as specified herein.
 - 2) Supplement with Rolled Elastomeric Duct Sealant, both inner and outer liner.
 - c. Indoor duct where exposed to occupant view: Sealant shall be within joint only and not visible.
 - d. Fire and fire/smoke dampers: Sealant shall be listed as SFM approved on manufacturer's UL installation sheet.
 - e. Continuous welded ducts: Additional sealing not required.
- 3. Duct exposed to weather
 - a. TDC or Duct-Mate joints: Utilize interior joint gasket material plus a bead of butyl rubber sealant at the joint and continuous metal clip or cleat over the top of all four joints (top bottom and sides).
 - b. Continuous welded ducts: Additional sealing not required.
 - c. Other joints: Apply Two-Part Hard-Setting Joint Tape to
 - 1) Longitudinal joints
 - 2) Transverse joints
 - 3) Duct penetrations
 - 4) Screws through duct
 - 5) Gores of elbows
- 4. After installation and testing reseal joints found to be leaking at no additional cost to the Owner.

3.5 DUCT PRESSURE/LEAKAGE TESTING

- A. Scope of Testing
 - 1. HVAC Ductwork and Plenums
 - a. Supply
 - 1) 3-inch pressure class and greater: Test entire duct section.
 - 2) 2-inch pressure class:
 - a) Required only if duct area required to be tested by other sections herein do not total 10% of the total installed duct area for the project.
 - b) Test 2-inch class duct sections starting with those that are directly connected to 3-inch pressure class ducts until 10% of the total installed duct area for the project. Provide a drawing showing proposed sections to be tested for approval prior to testing.
 - 3) Ductwork outside the building envelope: Test entire duct section.
 - 4) Other: Not required
 - b. Return:
 - 1) Ductwork outside the building envelope: Test entire duct section
 - 2) Other: Not required
 - c. Exhaust:
 - 1) General: Not required
 - d. Outdoor air: Not required
 - 2. Life Safety Ductwork
 - a. Since smoke exhaust will be balanced at the atrium exhaust per Section 230593 Testing, Adjusting and Balancing, leakage in the mechanical room is not relevant. Relief fans have been oversized to account for some mechanical room leakage.

B. General

1. Tests conducted in presence of Owner's Representative
2. Use portable high pressure blower and necessary instruments to indicate amount of leakage
3. See Section 230593 Testing, Adjusting and Balancing for testing procedures and accuracy of test instruments
4. Conduct tests as prescribed in SMACNA HVAC Air Duct Leakage Test Manual, and make test before duct sections are concealed
5. Procedure
 - a. Seal openings in ducts and plenums to be tested.
 - b. Connect test apparatus to test section using flexible duct connection or hose.
 - c. Close damper on blower suction side, to prevent excessive buildup of pressure.
 - d. Start blower and gradually open damper on suction side of blower.
 - e. Build up pressure in test section equal to static pressure class.
 - f. Noise generated from duct leakage not acceptable. Seal as required.
 - g. Determine amount of air leakage by makeup air flow measurements:
 - 1) Maximum permitted leakage for HVAC ductwork shall be:

$$CFM_{max} = (A/100) C_L P^{0.65}$$

where

CFM_{max} = the maximum permitted leakage, cubic feet per minute (cfm).

A = surface area of the tested duct sections, square feet.

CL = duct leakage class, cfm/100 square feet at 1 inch water column.
 = 6 for rectangular sheet metal, rectangular fibrous ducts, and round flexible ducts

= 3 for round/flat oval sheet metal or fibrous glass ducts

P = test pressure which shall be equal to the design duct pressure class rating, inches water column.

2) Maximum permitted leakage for life safety ductwork shall be per CBC 909.

3) If leakage exceeds allowable limit, and only a portion of the ductwork was tested per Paragraph 3.5A.1.a.2), repair leaks and retest duct sections until permitted leakage limits are obtained, then expand testing to include 40% of duct system area at no additional cost to the Owner. If failures continue, expand to 100% of duct system area at no additional cost to the Owner.

6. Visually mark tested sections with certification sticker and initials of field test inspector.

C. Documentation

1. Submit certification of test results of compliance to Commissioning Authority.
2. Include certified test results showing compliance per Section 230501 Basic Mechanical Materials and Methods.

3.6 PROTECTION

- A. Adhere to SMACNA Duct Cleanliness for New Construction Guidelines for Intermediate Level Duct Cleanliness unless more stringent requirements are indicated herein.
- B. Storage: Porous materials, such as lined and flexible duct, shall be stored where they will not be exposed to rain or other moisture sources.
- C. Temporary closure: Provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris at the following conditions:
 1. Exposed ends of unlined installed ducts at the end of each day
 2. Exposed ends of lined ducts or plenums whether in storage or installed

- D. Duct cleaning
 - 1. Using the connected fan(s) force air at high velocity through duct to remove accumulated dust
 - 2. Protect equipment and spaces, which may be harmed by excessive dirt with filters, or bypass during cleaning
 - 3. In areas, which must be kept dust free, seal all outlets duct tight. When closures are removed avoid spilling dust in room

3.7 INSPECTION

- A. Verify that adequate clearance between ducts and adjacent walls or equipment is available to permit proper sealing, maintenance and repairs.

3.8 PRE-OPERATING CHECKS

- A. Before operating the duct systems: Set all manual dampers in full open position
- B. Complete the Pre-Functional Test Data Sheet (Section 230800 HVAC Commissioning) for each duct system.

3.9 TESTING AND ADJUSTING

- A. Before starting the duct systems
 - 1. Clean the duct system. See Paragraph 3.6D
 - 2. See Section 019100 Commissioning
- B. After starting the duct systems: Check for noise and leakage. Repair as required at no additional cost to the Owner.
- C. See Section 230593 Testing, Adjusting, and Balancing: Coordination with Balance Agency:
 - 1. Provide services of a sheet metal installer familiar with the system ductwork to provide assistance to the balancing agency during the initial phases of air balancing in locating all sheet metal dampers
 - 2. Install missing dampers
- D. See Section 230800 Mechanical Commissioning

END OF SECTION

SECTION 233300
DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Access Doors
 - 2. Balancing Dampers
 - 3. Automatic Dampers
 - 4. Backdraft Dampers
 - 5. Fire Dampers
 - 6. Smoke Dampers
 - 7. Fire/Smoke Dampers
 - 8. Sound Attenuators
 - 9. All duct accessories except, where integral with manufactured piece of equipment.

1.2 QUALITY ASSURANCE

- A. Fire, smoke, and fire/smoke dampers shall be UL listed and constructed in accordance with UL Standard 555 Fire Dampers and UL Standard 555S.
- B. Demonstrate operation of smoke dampers to authorities having jurisdiction and Owner's representative as part of life safety testing.
- C. Access doors shall be UL labeled.
- D. Damper pressure drop and leakage ratings shall be based on tests and procedures performed in accordance with AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

1.3 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. "R" means required.
 - 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Access doors	R2			R
Balancing dampers	R2			R
Automatic dampers	R	R		R
Backdraft dampers	R2			R
Fire dampers	R	R		R

Item	Product Data	O&M Manual	Samples	Shop Drawing
Smoke dampers	R	R		R
Fire/Smoke dampers	R	R		R
Sound attenuators	R			R

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Access Doors, Ducts
1. Ventfabrics, Inc.
 2. Duo Dyne, Corporation
 3. Ruskin Mfg. Company
 4. PCI Industries – Pottorff
 5. Ductmate
 6. Or equal
- C. Access Doors, Plenum
1. Ventfabrics, Inc.
 2. Duo Dyne, Corporation
 3. Elgen Manufacturing Company
 4. Or equal
- D. Balancing and Automatic Dampers
1. Ruskin Manufacturing Company
 2. Greenheck
 3. Air Balance Inc.
 4. American Warming and Ventilating Inc.
 5. Johnson Controls
 6. PCI Industries - Pottorff
 7. Or equal
- E. Backdraft Dampers
1. Greenheck Fan Corp
 2. Ruskin Manufacturing Company
 3. Air Balance, Inc.
 4. American Warming and Ventilating Inc.
 5. Or equal
- F. Damper Hardware
1. Ventfabrics, Inc.
 2. Duo Dyne, Corporation
 3. Young Regulator Company
 4. Or equal
- G. Fire Dampers, Smoke Dampers, and Combination Smoke and Fire Dampers

1. Ruskin Manufacturing Company
2. Greenheck
3. Air Balance Inc.
4. PCI Industries - Pottorff
5. Or equal

H. Sound Attenuators

1. Vibro-Acoustics
2. Dynasonics
3. Industrial Acoustics, Inc.
4. Or equal

2.2 DUCT ACCESS DOORS

A. In accordance with SMACNA Duct Construction Manuals, except as indicated in the Drawings

B. In Ductwork

1. Construction

- a. Same material as duct
- b. Rating same as duct pressure class
- c. Where duct is insulated
 - 1) Fiberglass insulation, thickness to match duct insulation installed R-value, see 230700 Mechanical Insulation
 - 2) Double wall
- d. Positive seal polyethylene gasket
- e. Paired progressive cam-locks, quantity as required for tight, low leakage fit
- f. No tools required for opening and closing

2. Size

- a. 20 inches x 14 inches unless otherwise indicated in the Drawings
- b. Ducts less than 16 inches: one dimension 20 inches; other dimension 2 inch less than duct width
- c. Larger sizes where required for access

C. In Grease and Lab Exhaust Ductwork

1. Factory fabricated access doors listed for application
2. Size as shown on drawings and per code

2.3 DAMPERS

- A. Volume Dampers
1. Conform to requirements of SMACNA HVAC Duct Construction Standards.
 2. General
 - a. Blades of same material as duct where damper is located
 - b. Damper Hardware
 - 1) Ventlok 400 and 4000 series or equal; for low pressure systems 2 inch SMACNA pressure class and less
 - 2) Ventlok HiVel hardware or equal; for greater than 2 inch SMACNA pressure class
 - c. Actuating quadrants typical for single and multi-blade dampers; provide closed bearing on opposite end from quadrant to prevent air leakage: Ventlok No. 609 or equal
 - d. Bearing at one end of damper rod: Ventlok No. 609 or equal
 - e. Sealed bushings installed at both ends to avoid duct leakage
 - f. Accessible quadrant at other end of damper rod
 - 1) With lever and lock screw: Ventlok No. 635 or equal
 - 2) Insulated ducts
 - a) Quadrants mounted on collar to clear insulation
 - b) Ventlok Nos. 637, 638, or 639 or equal
 - c) Selection based on insulation thickness
 - g. For volume dampers above non-removable (inaccessible) ceilings
 - 1) Use ceiling access panels if provided for another purpose and located within reach of the damper; do not provide access panels whose sole purpose is for damper access.
 - 2) Otherwise provide either:
 - a) Ventlok No. 677, MAT Roto-Twist 200, or equal mechanical concealed damper regulator with
 1. Required interconnecting hardware and cable
 - b) Greenheck RBDR-50, MAT Electro-Balance 200 or equal electrically actuated balancing damper assembly (position feedback not required) with
 1. Required interconnecting hardware and cable
 2. Battery powered controller
 - c) With either device, controller connection shall be located in a concealed location as follows:
 1. In the diffuser/grille backpan or plenum where accessible through the diffuser/grille
 2. Above the ceiling at the terminal box that serves the damper. This may be a ganged connector for multiple dampers served by the terminal box.
 3. Above the ceiling at the nearest accessible location, such as next to a fire/smoke damper ceiling access panel
 3. Single blade dampers
 - a. Galvanized steel ductwork: galvanized steel, except as indicated in the Drawings
 - b. Blade: Two gages heavier than duct gage, or 18 gage, whichever is lighter
 4. Multi-blade Dampers
 - a. Low Pressure/Low Velocity Systems (2 inch water column or less static pressure class and 1500 fpm or less face velocity)
 - 1) Opposed blade damper
 - 2) Ruskin Model CD35 or equal
 - b. High Pressure/High Velocity Systems (greater than 2 inch water column static pressure class or greater than 1500 fpm face velocity):
 - 1) Rectangular
 - a) Opposed blade damper
 - b) Ruskin Model CD60 or equal
 - 2) Round and Oval
 - a) Oval: Ruskin Model CDR25 and DO25 or equal

- b) Round: Up to 20 inch diameter: Ruskin Model MDRS25 or equal
- c) Round: Larger than 20 inch diameter: Ruskin Model CDRS25 or equal

B. Automatic Dampers

1. Refer to Section 237300 Air Handling Units for dampers provided with factory packaged air handling equipment.
2. Field installed dampers
 - a. Blade Action
 - 1) Throttling duty: opposed
 - 2) Mixing duty: parallel
 - 3) Two-position: parallel or opposed
 - b. Bearings: Molded synthetic or stainless steel sleeve, turning in extruded hole in frame.
 - c. Seals:
 - 1) Blade: Inflatable PVC coated fiberglass material, silicone, or neoprene mechanically attached to blade edge.
 - 2) Jamb: Flexible metal compression type.
 - d. Linkage: concealed in frame. External linkage, jump-over brackets, jackshafts and any other elements in the airstream will not be accepted.
 - e. Axles: Minimum 1/2 inch diameter plated steel, hex-shaped, mechanically attached to blade. Side access for direct-coupled actuator.
 - f. Finish: Mill galvanized
 - g. Where stainless steel dampers are indicated on drawings, dampers shall have stainless steel blades, stainless steel bearings, stainless steel jamb seals.
 - h. Where aluminum dampers are indicated on drawings, dampers shall have aluminum blades, aluminum frame, synthetic or stainless steel bearings, stainless steel jamb seals.
3. Actuators: Direct coupled type specified under Division 25 Building Automation Systems
4. Damper area: See Drawings.
5. Damper type: See Drawings.

C. Backdraft Dampers

1. Required locations
 - a. Where indicated on the Drawings
 - b. In suction or discharge of all exhaust fans as listed in equipment schedule
 - 1) Integral, heavy-duty factory-installed type acceptable unless otherwise scheduled
2. General Applications
 - a. Construction
 - 1) Extruded aluminum construction, minimum 4 inch 12 gage frame
 - 2) Extruded vinyl locked into blade edge.
 - 3) Blade ends overlapping frame
 - b. Performance
 - 1) Start to open: .02 inches w.g. or less
 - 2) Fully open: .05 inches w.g. or less
 - 3) Leakage for 24 inch wide damper: 25 cfm per ft² or less
 - c. Ruskin Series CBD4 or equal
3. High Velocity Applications
 - a. Applies to discharge of air handlers and where velocity exceeds 1500 fpm. Damper shall be specifically designed for location at turbulent fan discharge.
 - b. Frame
 - 1) Minimum 12 gage galvanized steel channel
 - 2) Bolt Holes: Both flanges
 - c. Blades

- 1) Airfoil-shaped with integral structural reinforcing tube running full length of each blade
- 2) Material: 7 inches x minimum 0.080 inch Alloy 6063-T5 extruded aluminum
- 3) For multiple section dampers, provide galvanized steel or aluminum bracket to link dampers so they operate together.
- d. Axles: Minimum 3/4 inch (19 mm) diameter plated steel
- e. Bearings: Bolt-on bearings with re-lube ball bearings
- f. Linkage
 - 1) 3/16 inch thick x 3/4 inch plated steel tie bar with minimum 16 gage plated steel linkage arms; stainless steel pivot pins
 - 2) Located out of airstream (side or external linkage)
- g. Counterbalance: Located out of airstream
- h. Seals
 - 1) Blade
 - a) Mechanically attach blade seals to blade
 - b) Silicone rubber, rated for 300 degrees Fahrenheit
 - 2) Jamb: Vinyl
- i. Ruskin CBS92 or equal
- j. For Fume Hood Exhaust Fans only
 - 1) As above except stainless steel blades, stainless steel bearings, stainless steel linkage and axles, silicone blade edge seals, and no jamb seals.
 - 2) Greenheck HB-230 or equal

2.4 FIRE DAMPERS

- A. Ratings (test conditions and label) per UL Standard 555
 1. 250 degrees Fahrenheit minimum
 2. 1-1/2 hour fire rating, unless otherwise indicated in the Drawings
 3. Dynamic (closes against air flow) where required by code or where scheduled
- B. Factory sleeve
- C. Damper
 1. Multi-bladed, equipped with fusible link, spring loaded type
- D. Fusible link
 1. UL listed
 2. Fusible links on fire dampers shall be constructed to UL Standard 33 – Fusible Links for Fire Protection Service
 3. Temperature rating: Per code
- E. Type: as indicated on the Drawings

2.5 SMOKE DAMPERS

- A. Factory sleeve
- B. Damper
 1. Leakage class as scheduled, minimum Class 2, rated per UL 555S
- C. Actuator

1. UL 555S listed
 - a. 120 volt two position unless otherwise indicated on drawings
 - b. Spring return normally closed unless otherwise indicated on drawings
 - c. Electronic cut-out at full-open so that actuator creates no noise holding open
 - d. Permanently lubricated gears
 - e. Direct coupled with cold-weld steel clamp; aluminum clamp and external linkage and jackshafts are not acceptable for single section dampers.
 - f. For multiple damper sections using one actuator, jackshafts between sections shall be welded, not bolted or screwed.

D. Controls

1. Status end switches
 - a. Only where scheduled on Drawings
 - b. Built into the direct-coupled actuator; blade mounted end switch packages are not acceptable.
 - c. For dampers with multiple actuators, status switches are required for each independent damper section; sections that have multiple actuators and that also have jackshafts connecting the dampers in each section together shall have actuator end switches on only one actuator.
 - d. UL 555S listed
 - e. California State Fire Marshal approved

E. Type: as indicated on the Drawings

2.6 COMBINATION FIRE AND SMOKE DAMPERS

A. Fire ratings (test conditions and label) per UL Standard 555S

1. 250 degrees Fahrenheit minimum
2. 1-1/2 hour fire rating, unless otherwise indicated in the Drawings

B. Factory sleeve

C. Damper

1. Either parallel blade or opposed blade
2. Leakage class as scheduled, minimum Class 2, rated per UL 555S
3. Locate damper in sleeve starting at approximately 3" from end of the sleeve opposite the damper actuator end. (Damper shall be installed with this end protruding 3 inches out from inside surface of wall.)
4. Horizontal dampers shown on Drawings to be supported by a drywall rated enclosure (rather than a framed concrete opening) shall be listed for this application.

D. Actuator

1. UL 555S listed
 - a. 120 volt two position unless otherwise indicated on drawings
2. Spring return normally closed unless otherwise indicated on drawings
3. Electronic cut-out at full-open so that actuator creates no noise holding open
4. Permanently lubricated gears
5. Direct coupled with cold-weld steel clamp; aluminum clamp and external linkage not acceptable
6. For multiple damper sections using one actuator, jackshafts between sections shall be welded, not bolted or screwed.

E. Controls

1. Heat-actuated electric release
 - a. Controlled closure to prevent duct and HVAC component damage
 - b. Damper to automatically reopen after a test, smoke detection or power failure condition. In the event of heat activated closure, the damper must be manually reset at the damper.
 - c. Release temperature: as scheduled on drawings.
 - d. Ruskin EFL or equal
 2. Status end switches
 - a. Only where scheduled on Drawings
 - a. Built into the direct-coupled actuator; blade mounted end switch packages are not acceptable.
 - b. For dampers with multiple actuators, status switches are required for each independent damper section; sections that have multiple actuators and that also have jackshafts connecting the dampers in each section together shall have actuator end switches on only one actuator.
 - c. UL 555S listed
 - d. California State Fire Marshal approved
- F. Type: as indicated on the Drawings

2.7 SOUND ATTENUATORS

- A. Factory prefabricated
- B. Shell
 1. Galvanized steel: minimum 22 gage
 2. Leakproof at pressure differential of 8 inches water gage
- C. Media:
 1. Flamespread: maximum 25
 2. Fuel contributed and smoke developed: maximum 50
 3. Minimum 4.5 pounds per cubic foot density glass or mineral fiber packed under 5 percent compression
 4. Media shall meet erosion test method described in UP Publication No. 181
 5. Filler to be inert, vermin and moisture proof
- D. Internal construction: Galvanized perforated steel baffles: minimum 24 gauge
- E. Attenuator Performance
 1. See schedule on the Drawings for
 - a. Net insertion ratings
 - b. Maximum allowable air pressure drop
 - c. Model number
- F. Certified tests
 1. Submit a laboratory certified test data for pressure drop and insertion loss ratings
 - a. For square or rectangular attenuators: 24 inch x 24 inch cross-section attenuator
 - b. For round attenuators: 24 inch diameter conical attenuator
 - c. Certification data for pressure drop and net insertion loss: based on tests of same attenuator
 - d. Attenuators and tests: subject to inspection upon request
- G. Industrial Acoustics, Inc. Quiet-Duct or equal

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades
- B. Install duct accessories in accordance with manufacturer's written installation instructions
- C. See Section 233100 Ducts
- D. Provide access doors in following locations:
 - 1. Coils in ducts (including at VAV boxes)
 - a. Entering and leaving side for cooling coils
 - b. Entering side for heating coils
 - 2. Automatic dampers: linkage side
 - 3. Smoke dampers
 - 4. Fire dampers
 - 5. Smoke detection heads enclosed in ducts
 - 6. At the top of each lined duct riser accessible from the fan room floor (for inspection of duct liner)
 - 7. Fan bearings enclosed in ducts
 - 8. Sprinkler heads in ducts
 - 9. Motors, actuators or other accessories that require access or service inside ducts
 - 10. Outdoor air plenums as required to clean plenum from dirt and debris.
 - 11. Where otherwise indicated on the Drawings
- E. Volume dampers
 - 1. Provide at locations indicated on the Drawings
 - a. Volume dampers shall be installed as far away from air outlets as functionally reasonable to avoid noise in the occupied space.
 - b. Provide also in wyes and tap-ins to outlets whether indicated on the Drawings or not, except
 - 1) Where dampers are not indicated on the Drawings above inaccessible ceilings
 - 2) To sidewall outlets in exposed ducts (opposed blade dampers in outlets shall be provided where scheduled)
 - 2. Additional locations where dampers appear to be required for balancing, place request for information with Engineer prior to construction.
 - 3. For ductwork exposed to occupant view, volume damper handles shall be on top of duct or otherwise concealed from occupant view.
 - 4. For dampers above non-removable ceilings that are not accessible from ceiling access panels or removable diffusers, provide concealed damper regulator as specified herein or detailed on Drawings.
- F. Fire and smoke dampers
 - 1. Provide in ducts and openings as indicated in the Drawings
 - 2. Provide access door in duct adjacent to each in location where damper may be inspected and internal fusible link or fire-stat may be replaced
 - 3. Install duct smoke detector provided by Division 26 if required; see Division 26 drawings
 - 4. Smoke and fire dampers installed in tunnel corridors shall have weight of damper supported from structure above.
- G. Control dampers

1. Field mounted control dampers installed with concealed linkage shaft accessible on side of damper with space for direct-coupled actuator
2. Actuator installation: See Division 25 Building Automation Systems

H. Install belt guards at all exposed belts

3.2 MOUNTING AND ALIGNMENT

- A. Install all accessories to prevent air leakage.
- B. Install closed bearing end on all damper blades that penetrate duct to prevent air leakage.
- C. Support extra weight of duct accessories. See Section 230548 Vibration and Seismic Control

3.3 INSPECTION

- A. Verify that adequate clearance between duct accessories and adjacent walls or equipment is available to permit maintenance and repairs.

3.4 PRE-OPERATING CHECKS

- A. Before operating duct accessories: Set all components in normal operating condition

3.5 TESTING AND ADJUSTING

- A. Before operating duct accessories see Section 019100 Commissioning
- B. After starting duct accessories
 1. Check for noise and leakage; repair as required at no additional cost to the Owner
 2. Operation test: Test each piece of equipment to show that it will operate in accordance with requirements.
- C. See Section 230593 Testing, Adjusting, and Balancing
- D. See Section 230800 Mechanical Commissioning

END OF SECTION

SECTION 233400

FANS

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. All fans except where integral with manufactured piece of equipment
 - 2. Roof type gravity hoods and ventilators

1.2 REFERENCE STANDARDS

- A. ANSI/ABMA Standard 9 – Load Rating and Fatigue Life for Ball Bearings
- B. AMCA 99 – Standards Handbook
- C. AMCA 210 – Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
- D. AMCA 300 – Reverberant Room Method for Sound Testing of Fans
- E. AMCA 301 – Methods for Calculating Fan Sound
- F. ANSI/ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings

1.3 QUALITY ASSURANCE

- A. AMCA certified ratings per applicable AMCA standard based on the testing conducted in an independent laboratory
- B. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal
- C. Sound Ratings: AMCA 301; tested to AMCA 300 and bear the AMCA Certified Sound Rating Seal
- D. Fabrication: Conform the AMCA 99
- E. Conform to AMCA Bulletins regarding construction and testing
 - 1. Fans shall bear AMCA certified rating seal
- F. Scheduled equipment performance is minimum capacity required.
- G. Scheduled electrical capacity shall be considered as maximum available.
- H. Scheduled static pressure is external to the fan and does not include the pressure drop of accessories specified to be provided with the fan, such as backdraft dampers, inlet screens, belt

tubes, etc. The manufacturer shall include these pressure drops in the fan total pressure such that the scheduled airflow can be achieved at the scheduled external static pressure.

1.4 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. "R" means required.
 - 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Fans	R	R		R
Fan & Hood accessories	R	R		

- C. Include
 - 1. Complete graph of fan curves, not just curve for design conditions
 - 2. Sound power levels
 - a. Fans 1 horsepower and larger: dB by octave bands
 - b. Fans less than 1 horsepower: sones

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Loren Cook
- C. Greenheck
- D. Twin City
- E. Or equal

2.2 GENERAL

- A. Fans shall bear the AMCA certified ratings seal for sound and air performance and be certified in accordance with ARI Standard 210 and 211, and AMCA Standard 2408 for centrifugal fans
- B. Fans used shall not increase motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria.
- C. Performance
 - 1. See fan schedule on the Drawings

2. Capacities: minimum as scheduled on the Drawings
 3. Brake horsepower rating: Maximum 10 percent above that scheduled on the Drawings
 4. Fans and drives shall be capable of accommodating static pressure variations of plus or minus 10 percent
 5. Motor horsepower: No larger than that scheduled on the Drawings, or compensate Division 26 contractor for any associated cost to increasing motor size
 6. Sound power: No greater than that scheduled on the drawings
- D. Wheels
1. Class as indicated on the Drawings or as required for duty
 2. Formed steel or extruded aluminum
 3. Statically and dynamically balanced in accordance with AMCA Standard 204-96 Balance Quality and Vibration Levels for Fans
 4. Exposed fan wheels protected by finger proof screen where scheduled
- E. Shafts
1. AISI C-1045 hot rolled and accurately turned, ground, and polished
 2. Sized for a critical speed of at least 125% of maximum RPM
- F. Motors
1. Comply with Section 230513 Motors and Controllers.
 2. Provide electrically commutated motor (ECM) where scheduled
- G. Housing
1. Bolted and welded construction utilizing corrosion resistant fasteners
 2. Scroll wrapper and scroll side panels shall be a minimum 12 gauge steel
 3. The entire fan housing shall have continuously welded seams
 4. Spun inlet bell and shaped cut-off for centrifugal fans
 5. Weatherproof drive covers at utility sets shall have access doors
- H. Belt Drive
1. Matched, multiple V-belt
 2. Capacity: minimum 1.5 times motor horsepower
 3. Pulleys
 - a. Cast iron
 - b. Variable pitch diameter
 - 1) Except motors with variable speed drives
 - 2) Fans up to 7-1/2 hp motor
 - 3) Fans from 10 hp to 25 hp, under 1000 rpm
 - c. Fixed pitch diameter
 - 1) All motors with variable speed drives
 - 2) Fans 10 hp and over 1000 rpm
 - d. Select at mid-point of range
 4. Automatic belt tensioner to maintain proper belt tension and provide quick belt removal and replacement, where scheduled. Equal to Loren Cook.
 5. Companion sheaves to maintain belts parallel
 6. Drive guards
 - a. Comply with requirements of State COSHA
 - b. Provide holes in belt guards for tachometer readings
 - c. Indoor Belt Drives: 16 gage expanded metal or wire screen enclosure with 70 percent free area and steel frame
 - d. Outdoor Belt Drives: Provide enclosure over entire motor and drive assembly.
- I. Bearings

1. Designed and tested specifically for use in air handling applications
2. Heavy duty regreasable ball or roller type in a cast iron pillow block housing
3. Bearing shaft mounting mechanism shall be concentric mount, not set screw mount.
4. Grease fittings extended to accessible locations outside housing
5. Life rating: minimum 200,000 hours per ABMA Standard 9 or 11 L₅₀ rating, at maximum catalog speed

J. Painting

1. Electrostatically applied, baked polyester powder coating, minimum 2 mil thick
2. Paint must exceed 1,000 hour salt spray under ASTM B117 test method

K. Discharge: As indicated on the Drawings

2.3 SMOKE EXHAUST FANS

- A. Fans indicated on drawings as being exhaust fans provided to comply with CBC 909 requirements shall meet all CBC 909 requirements including:
 - B. Rated for duty up to 165°F (or temperature listed in schedule) for 20 minutes
 - C. 150% belt safety factor with minimum two belts on belt driven fans

2.4 HIGH VOLUME CEILING FANS

A. Warranty schedule:

1. Mechanical components: 10 years
2. Electrical components: 5 years (no factory install); 10 years (factory install)
3. Labor: 1 year

B. General

1. The entire fan assembly shall be Intertek/ETL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standard 22.2. No. 113.
2. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 40 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.

C. LED Light Kit

1. The fan shall be equipped with a hollow shaft in which electrical wiring can be routed to below the fan. The LED light kit shall operate independently from the fan at an operating voltage of 120–277VAC, 50–60 Hz. The standard color of the LED light kit components shall be white or silver.
2. The LED light kit shall have a standard LED color temperature and lumen option as scheduled.

D. Controls

1. The fan controller shall be incorporated into the fan assembly and housed in an enclosure independent of the motor to prevent overheating or electrical interference. The fan controller shall be factory programmed to minimize starting and braking torques and shall be equipped with a simple diagnostic program and an LED light to identify and relay faults in the system.
2. The controller shall include the following I/O points:

- a. Start stop
 - b. Status output
 - c. Speed input
 - d. Life safety lockout
3. Wall control module is specified under Division 25.
 4. Lighting dimmer/switch is specified under Division 26.
- E. Airfoil System
1. The fan shall be equipped with eight (8) high volume, low speed airfoils of precision extruded, anodized aluminum alloy. Each airfoil shall be of the high-performance Mini-Elipto design. The airfoils shall be connected to the hub and interlocked with eight (8) stainless steel retainers and two (2) sets of stainless steel bolts and lock washers per airfoil.
 2. The fan shall be equipped with eight (8) upswept winglets designed to redirect outward airflow downward, thereby enhancing efficiency. The winglets shall be molded of high strength polymer and shall be attached at the tip of each airfoil with a stainless steel screw. The standard color of the winglets shall be silver or black.
 3. The fan hub shall be constructed of zinc plated steel for high strength and durability. The hub shall be precision machined to achieve a well-balanced and solid rotating assembly.
- F. Motor
1. The motor shall be an IP43 rated permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0–100% without the use of a gearbox or other mechanical means of control.
- G. Mounting System
1. All components in the mounting system shall be of formed metal design using low-carbon steel no less than 3/16" (0.5 cm) thick and containing no critical welds. The mounting system shall be powder coated for appearance and resistance to corrosion. All mounting bolts shall be metric stainless steel or equivalent. No mounting hardware substitutions, including cast aluminum, are acceptable.
 2. The fan extension tube shall be a round, extruded aluminum tube. The extension tube shall include a chrome plate with forward and reverse controls and a fan status indicator light that is visible from the floor.
 3. The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be Ø3/16" (0.5 cm) diameter and fabricated out of 7 x 19 stranded galvanized steel, pre-loaded and tested to 3,200 lbf (13,345 N).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades
- B. Install fans in accordance with manufacturer's written installation instructions.
- C. See Section 233100 Ducts for duct connections
- D. See Division 25 Building Automation Systems

- E. See Section 230800 Mechanical Commissioning
- F. Flexible duct connection at inlet and outlet: See Section 230548 Vibration and Seismic Control.
- G. Backdraft Dampers
 - 1. Comply with Title 24 Energy Standards and CMC
 - 2. Provide backdraft or shutoff dampers for suction or discharge of every exhaust fan as scheduled on the Drawings
 - 3. See schedules on the Drawings and Section 233300 Duct Accessories for where fan manufacturer may provide dampers and when specialty damper manufacturer must provide them.
- H. Roof Mounted Fans and Ventilators
 - 1. Install on factory fabricated curbs
 - a. Exception: Install Utility fans as indicated on the Drawings
 - b. Secured to structure with hold down methods as detailed
 - c. Made fully weatherproof. See Division 7 Thermal and Moisture Protection for waterproofing and roofing.
- I. High Volume Ceiling Fans
 - 1. Minimum Distances
 - a. Airfoils shall be at least 10 ft above the floor.
 - b. Installation area shall be free of obstructions such as lights, cables, sprinklers, or other building structures with the airfoils at least 2 ft (0.61 m) clear of all obstructions.
 - c. The structure the fan is attached to shall be capable of supporting a torque load of up to 40 ft-lb of torque.
 - 2. Wall control module installation and low voltage wiring are specified under Division 25.
 - 3. Lighting dimmer/switch installation and wiring are specified under Division 26.
 - 4. In buildings equipped with sprinklers, including ESFR sprinklers, fan installation shall comply with all of the following:
 - a. The maximum fan diameter shall be 24 ft.
 - b. The fan shall be centered approximately between four adjacent sprinklers.
 - c. The vertical clearance from the fan to the sprinkler deflector shall be a minimum of 3 ft.
 - d. Fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72—National Fire Alarm and Signaling Code. See Division 28.

3.2 MOUNTING AND ALIGNMENT

- A. See Section 230548 Vibration and Seismic Control

3.3 INSPECTION

- A. Verify that adequate clearance between fans and adjacent walls or equipment is available to permit maintenance and repairs.

3.4 PRE-OPERATING CHECKS

- A. Before operating fans

1. See Section 230800 Mechanical Commissioning.
- B. Do not operate fans for any purpose, temporary or permanent, until
1. Ductwork is clean
 2. Filters in place
 3. Bearings lubricated

3.5 TESTING AND ADJUSTING

- A. Before starting fans
1. See Paragraph 3.4B
 2. See Section 019100 Commissioning
 3. Install belt and motor guards
- B. Start and test fans in accordance with manufacturers written installation instructions.
- C. Start up and adjust fans to insure proper operation.
- D. The submitted sound power level shall be verified through actual measurements and calculations in accordance with AMCA standards 300 and 301.
1. In the event the sound power level data measured or being submitted exceeds the designed level, provide additional sound traps or other sound attenuating devices to supplement the design in order to comply with sound power level specifications. Perform this work, including the additional noise control and any increase in motors Hp and increase in electrical service at no additional cost to the Owner. Submit calculations or measurement results to the Owner's Representative, which substantiate that sound power level produced by the submitted equipment and any required sound attenuating devices do not exceed the specified sound power levels.
- E. After starting fans: Check for objectionable noise or vibration. Correct as needed at no additional cost to the Owner.
- F. Balancing: See Section 230593 Testing, Adjusting and Balancing
- G. Commissioning: See Section 230800 Mechanical Commissioning

3.6 TRAINING

- A. See Section 230800 Mechanical Commissioning

END OF SECTION

SECTION 233600
AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following: All air terminal units including
 - 1. Variable air volume boxes

1.2 REFERENCE STANDARDS

- A. ARI Standard 885 – Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminal and Air Outlets
- B. UL Standard 1995 – Standard for Safety Heating and Cooling Equipment
- C. ASHRAE Standard 130 – Methods of Testing for Rating Ducted Air Terminal Units

1.3 QUALITY ASSURANCE

- A. Terminal units rated and certified in accordance with ARI Standard 880-98 Certification Program
- B. All electrical components shall be UL listed and installed in accordance with the UL Standard 1995.

1.4 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. “R” means required.
 - 2. “R2” means required only for products and equipment differing for the specified manufacturer and model and for “or equals” where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
VAV boxes	R	R		R

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. VAV Boxes
 - 1. Price
 - 2. Titus
 - 3. Envirotech
 - 4. Or equal

2.2 VAV BOXES

- A. General
 - 1. Ship as a complete assembly requiring no field assembly (including accessories)
 - 2. Casings
 - a. Minimum 22-gage, galvanized steel
 - b. Leakage rating: 10 cubic feet per minute maximum leakage at 1 inch water column, when tested per ASHRAE Standard 130
 - c. Acoustic lining
 - 1) Material: Fiberglass with high density facing
 - 2) Minimum thickness:
 - a) Terminals located in conditioned space or return air plenum: 1/2 inch
 - b) Terminals located in unconditioned spaces: 1 inch
 - 3) Minimum 1.5 pound per cubic foot density
 - 4) Maximum thermal conductivity: 0.28 Btu-in per hour per foot squared per degree Fahrenheit (BTU-inch/h-ft²·°F) measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 75 degrees Fahrenheit
 - 5) Meet erosion test method described in UL publication No. 181
 - 6) Meet smoke developed and flame spread rating requirements of NFPA-90A
 - 7) Meet ASTM C1136 and ASTM C665 for biological growth in insulation
 - d. Discharge duct connection
 - 3. Controls unit mounted by manufacturer
 - a. Multi-point, double axis cross-flow, center averaging sensor
 - 1) The minimum amplification factor for even sizes 6 to 16 inch shall be greater than 2.0. Provide documentation with submittal that substantiates compliance with this requirement.
 - 2) Be rated for inlet or discharge duty, as indicated on the Drawings
 - 3) Provide accurate flow sensing regardless of inlet duct configuration
 - 4) Brass balancing taps and unit mounted airflow versus flow sensor pressure signal charts for field airflow measurements
 - 5) Be removable for cleaning when box is used for return or exhaust applications
 - b. Control panel:
 - 1) For VAV boxes exposed to public view, include control panel with cover to fully enclose VAV box controller
 - 2) Otherwise provide flat mounting bracket for controller
 - c. For Direct Digital Controls, see Division 25 Building Automation Systems
 - 4. Radiated and discharge sound power
 - a. Equal or less in each octave band than terminal selections scheduled on the Drawings at noted capacities assuming 1.0 inch inlet static pressure, with a tolerance of + 2 dB in any band.
 - b. Due to added space and pressure drop, providing additional plenums or attenuators to meet sound power ratings is not acceptable.
 - 5. Total pressure drop

- a. Equal or less than terminal selections scheduled on the Drawings at noted capacities, with a tolerance of 0.02 inches of water
- b. This limitation is in total, not static, pressure. Where total pressure is not listed on certified performance documents, provide a table of manual adjustments of static pressure with velocity pressure calculated from inlet and outlet velocities.
- 6. Dampers
 - a. Heavy gage steel
 - b. Single blade damper; opposed blade dampers are not acceptable
 - c. Shaft rotating in self-lubricating Delrin or equal bearings; nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position.
 - d. Damper shall have durable synthetic seal. Foam seals are not acceptable.
 - e. Close-off leakage rating: 5 cubic feet per minute maximum leakage at 1.50 inches water column.
- 7. Hot water heating coils
 - a. Not used

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate work and access with respective trades
- B. Install terminal units in accordance with manufacturer's written installation instructions.
- C. Duct connections
 - 1. See Section 233100 Ducts
 - 2. Provide sheet metal duct connections at VAV box inlet; flexible duct not acceptable
 - 3. No flexible connection required on duct outlet
- D. See Division 25 Building Automation Systems
- E. See Section 230800 Mechanical Commissioning

3.2 MOUNTING AND ALIGNMENT

- A. Support VAV boxes at four corners with minimum, 1" x 18 gage sheet metal straps or 3/8 inch all-thread rod. Secure lower end of strap to the side of unit casing with minimum two #10 sheet metal screws, or bolt through casing with washers to prevent leakage. Bend end of strap and secure to bottom of casing with one #10 sheet metal screws.
- B. See Section 230548 – Vibration and Seismic Control for vibration isolation requirements.

3.3 INSPECTION

- A. Verify that adequate clearance between air terminal units and adjacent walls or equipment is available to permit maintenance and repairs.

3.4 TESTING AND ADJUSTING

- A. Before operating air terminal units, complete the attached Pre-Functional Test Data Sheet for each air terminal unit. See Section 019100 Commissioning
- B. Start and test fans in accordance with manufacturers written installation instructions.
- C. Start up and adjust fans to insure proper operation.
- D. After starting air terminal units: Check for objectionable noise or vibration. Correct as needed at no additional cost to the Owner.
- E. See Section 230593 Testing, Adjusting, and Balancing
- F. See Section 230800 Mechanical Commissioning

3.5 TRAINING

- A. See Section 230800 Mechanical Commissioning

END OF SECTION

SECTION 233700

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following: All air outlets, inlets, grilles, registers and diffusers except where integral with manufactured piece of equipment

1.2 REFERENCE STANDARDS

- A. ARI Standard 650 – Air Outlets and Inlets
- B. ASHRAE Standard 70 – Methods of Testing for Rating the Airflow Performance of Outlets and Inlets
- C. AMCA Standard 500 – Laboratory Methods of Testing dampers for Rating
- D. NFPA Standard 90A – Installation of Air Conditioning and Ventilating Systems
- E. NFPA Standard 90B – Standard for the Installation of Warm Air Heating and Air Conditioning Systems

1.3 QUALITY ASSURANCE

- A. Comply with ARI Standard 650, ASHRAE Standard 70, AMCA Standard 500, NFPA Standard 90A, and NFPA Standard 90B.
- B. Provide outlets and inlets that have, as minimum, throw and noise criteria ratings for each size device as listed in manufacturer's current data, rated as required by the above standards.

1.4 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. "R" means required.
 - 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Grilles, registers, and diffusers	R			R
Accessories	R			

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Price
- C. Titus
- D. Krueger
- E. Nailor
- F. Or equal

2.2 GENERAL

- A. Manufacturer shall examine and approve of application of each outlet.
- B. Noise level at design capacities: no larger than diffuser selection indicated on the drawings.
- C. Diffuser frame and other options shall be as indicated herein unless otherwise indicated on Drawings.
- D. Volume dampers
 - 1. Do not provide dampers built into grille or directly attached to the grille unless specifically called out on Drawings or in this Section.
 - 2. Volume damper key-operated adjustable from face of diffuser on register except as noted
 - 3. Opposed blade
- E. Diffuser frame
 - 1. Frame type shall be coordinated with ceiling type. Refer to architectural reflected ceiling Drawings.
 - a. At plaster or drywall ceilings, use lay-in diffuser with drywall frame (Price SPF or APF to match diffuser material). Drywall frame to match diffuser color.
 - 2. No visible screw allowed on diffusers or frames, unless otherwise indicated on Drawings or in this Section.
 - 3. Linear and bar diffusers shown as one collinear piece on plans shall be constructed as one piece within manufacturing limitations and to appear as one section if manufacturing limitations require multiple pieces.
- F. Outlets may be steel or aluminum unless otherwise indicated on the Drawings.

- G. Color
 - 1. Face and frame: Unless otherwise indicated on the Drawings:
 - a. General: Factory-baked #26 white enamel
 - b. Mounted in exposed unpainted galvanized steel ducts: aluminum
 - 2. Internal parts of grille visible from occupied space, including all visible parts behind the diffuser face such as pattern controllers, back pans of perforated diffusers, and visible parts of plenums: flat black

2.3 STYLES

- A. General
 - 1. See diffuser schedule on the Drawings for outlet style and size
 - 2. Throw pattern per the Drawings
 - 3. Specific frame, border, and other product references refer to Price
- B. Perforated diffusers and grilles - Steel
 - 1. Supply: Star-pattern diffuser, Price PDSP
 - a. Deflectors factory adjusted for corner blow pattern unless otherwise indicated on Drawings.
 - 2. Ducted return/exhaust: Price PDDR
 - 3. Plenum return:
 - a. Price PDDR
 - b. Light shield
- C. Flow Bar
 - 1. Price AS or JS; slot width as scheduled
 - 2. Integral plenum. For supply air, include minimum 1/2 inch thick insulation equal to Type AL duct liner as specified under Section 230700 Mechanical Insulation
 - 3. Border
 - a. Drywall ceilings or walls: Equal to Price Border 22
 - b. Other: Equal to Price Border 61 with mitered corners, concealed fasteners
 - 4. Controls
 - a. Supply: Adjusta Slot weir gate unless Jet Slot is indicated in schedules
 - b. Return or exhaust:
 - 1) As scheduled, either:
 - a) Adjusta Slot with weir gate removed
 - b) Jet Slot with blade set vertical for full free area
 - 2) With light shield
- D. Sidewall
 - 1. Price 500 series as scheduled
 - 2. Supply air
 - a. Double deflection: vertical blades on room side
 - b. For grilles or diffusers less than 7 feet above the floor, the maximum centerline blade spacing shall be 1/2 inch.
 - 3. Return/exhaust
 - a. Parallel fixed blades set at a deflection of 45 degrees or 0 degrees from horizontal as scheduled
 - 4. Drywall frame with recessed screw holes, face mounting allowed
 - 5. Register (WSR, WER, etc.) to have opposed blade damper unless otherwise indicated on the Drawings
- E. Spiral Duct

1. Price SDGE
2. Double deflection, vertical blades on room side
3. Extruded aluminum with clear anodized finish
4. No scoops or dampers
 - a. Exception: Provide opposed blade dampers for exhaust grilles where indicated on plans

F. Thermally powered diffusers

1. Cooling only:
 - a. Acutherm ST-C
 - b. Adjustable cooling setpoint via knob/wheel behind diffuser face
2. Cooling and Heating:
 - a. Acutherm ST-HC
 - b. Independently adjustable cooling and heating setpoints via knob/wheel behind diffuser face
 - c. Automatic heating/cooling changeover based on supply air temperature
3. Adjustable minimum flow position stop via knob/wheel behind diffuser face
4. Plaque face

2.4 SCREENED OPENINGS

A. Mesh

1. 3/4 in. square pattern
2. No. 16 galvanized wire
3. Interwoven
4. Welded or secured to frame

B. Frames: Optional

1. 1 inch by 1 inch by 1/8 inch galvanized steel angles
2. Continuous around perimeter of screen

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades.
- B. Install air outlets and inlets in accordance with manufacturer's written installation instructions and Section 233100 Ducts.
- C. Return and exhaust registers: Install with blades oriented to prevent sight through outlets.
- D. Grille backs or plenums visible through grilles painted flat black
- E. Transfer grilles
 1. See indications on the Drawings
 2. Wall installations, unless otherwise indicated, provide two grilles
 - a. One on each side of wall, except where open to return air plenum
 - b. Connecting sheet metal collar with 18 inch elevation offset for sound and light attenuation

- F. Provide duct screens at termination ducts as indicated on the Drawings

3.2 MOUNTING AND ALIGNMENT

- A. See Section 230548 Vibration and Seismic Control
- B. All air outlets and inlets shall be secured to building
 1. Ceiling grilles shall be secured to prevent falling from ceiling during construction or service with minimum of two 16-gage ceiling wires, two 22-gage by 1 inch galvanized sheet metal strap or two #10 sheet metal screws.
 2. Comply with CBC.
- C. Mount directional grilles as indicated on the Drawings.
- D. Adjust grille throw patterns prior to test and balance. See Section 230593 Testing, Adjusting and Balancing.

3.3 INSPECTION

- A. Verify mounting, direction and adjustments are installed as indicated on the Drawings.

3.4 TESTING AND ADJUSTING

- A. See Section 019100 Commissioning
- B. See Section 230593 Testing, Adjusting and Balancing
- C. See Section 230800 Mechanical Commissioning

END OF SECTION

SECTION 234000

AIR CLEANING DEVICES

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Filter media

1.2 REFERENCE STANDARDS

- A. ASHRAE Standard 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
- B. ANSI/UL 900 – Test Performance of Air Filter Units

1.3 QUALITY ASSURANCE

- A. Filters shall have MERV and dust loading ratings in accordance with ASHRAE Standard 52.2 with preconditioning as specified in Appendix J of that Standard.

1.4 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. “R” means required.
 - 2. “R2” means required only for products and equipment differing from the specified manufacturer and model and for “or equals” where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Filters	R	R		R
Built up system filter rack and housing	R	R		R
Filter gages	R2	R		

1.5 Spare Filters

- A. Furnish one new complete set of filters (excluding construction filters) for each filter bank on completion and acceptance of the Work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Filter Media and Frames
 - 1. Camfil Filtration Group
 - 2. Flanders/Precisionaire
 - 3. American Air Filter
 - 4. Filtration Group
 - 5. Or equal

2.2 FILTERS

- A. General
 - 1. UL 900 listed
 - 2. Disposable type
 - 3. Each filter shall consist of media, media support grid and enclosing frame.
 - 4. Each filter shall have flow direction and MERV rating permanently affixed to frame.
- B. Type 1: Pleated Filter
 - 1. 2 inch or 4 inch pleat as scheduled
 - 2. Media: Cotton & synthetic media (no polyester)
 - 3. Minimum performance:
 - a. MERV 8
 - 4. Maximum initial pressure drop at 500 feet per minute face velocity shall not to exceed 0.3 inches water column. Final pressure drop shall be no less than 1.0 inch water column.
 - 5. Equal to Camfil 30/30
- C. Type 2: Not used
- D. Type 3: Bag Filters
 - 1. Deep pleated replaceable element
 - 2. Minimum depth: 22 inch
 - 3. Enclosing frame
 - a. Galvanized steel frame and galvanized steel pocket retainers
 - b. Header bonded to the media to prevent air bypass
 - 4. Media
 - a. Lofted microfine glass (no polyester)
 - b. Chemically bonded to permeable media support backing
 - 5. Minimum performance
 - a. MERV 15
 - 6. Maximum initial pressure drop at 500 feet per minute face velocity shall not to exceed 0.62 inches water column. Final pressure drop shall be no less than 1.0 inch water column.
 - 7. Equal to Camfil Hi-Flo ES

2.3 FRAMES

- A. For air handlers and fan-coils, see individual specifications Sections.

2.4 FILTER GAUGE

- A. See Division 25 Building Automation Systems (DP sensors with LCD display).

PART 3 EXECUTION

3.1 FILTER MEDIA

- A. Media as selected in equipment schedules on the Drawings
- B. Construction filters
 1. Type 1 for all equipment; roll media not acceptable

3.2 INSTALLATION

- A. Factory installed in air handling equipment
- B. Coordinate with work of other trades
- C. Install Air Cleaning Devices in accordance with manufacturer's written installation instructions.
- D. See Division 25 Building Automation Systems
- E. See Section 230593 Testing, Adjusting and Balancing
- F. See Section 230800 Mechanical Commissioning

3.3 START-UP PROCEDURES

- A. Do not operate air handling unit fan systems for any reason until spaces served have been cleaned of dust and debris, to avoid contamination of supply air or return air paths and equipment.
- B. Supply fans shall not be operated unless filters are installed, including temporary filters for use during test and balance.
- C. If the final pressure drop of the temporary filters is reached during test and balance, replace them with a spare set.
- D. Before final air balancing, and immediately before post-construction outdoor air purge if required by Section 230501 Basic Mechanical Materials and Methods remove temporary construction filters and install clean final filters:
 1. Remove prefilters in front of cartridge and bag filters after construction and do not replace. Prefilters shall not be used during for normal operation.

2. See Section 230593 Testing, Adjusting and Balancing and Section 230501 Basic Mechanical Materials and Methods for media installation during test and balance period.

3.4 INSPECTION

- A. Verify that adequate clearance between Air Cleaning Devices and adjacent walls or equipment is available to permit maintenance and replacement of filters.
- B. Verify that filters are firmly seated in frame to minimize bypass.

3.5 TRAINING

- A. See Section 230800 Mechanical Commissioning

END OF SECTION

SECTION 237300

AIR HANDLING UNITS & COILS

PART 1 GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Air handling units

1.2 SUBMITTALS

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. "R" means required.
 - 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Air handling units	R	R		R

- C. Air-Handling Units
 - 1. List of exceptions to the specifications including section number and a detailed description of alternative materials and methods. If there are no exceptions, so state in precise language.
 - 2. List of proposed manufactures for fans, filters, coils, motors, drives, dampers and other components
 - 3. Complete dimensional data including exterior dimensions and dimensions of internal components such as plenum dividers.
 - 4. Weight
 - 5. Fans
 - a. Complete graph of certified fan curves (not just curve for design conditions) indicating efficiency, BHP, and RPM
 - b. Certified fan-sound power ratings
 - c. Fan construction and accessories
 - d. Motor ratings, electrical characteristics, and motor accessories
 - 6. Cabinet material, metal thickness, finishes, insulation, and accessories including construction details for panel sealing, thermal break, door seal and hardware, shipping split and field treatment of panel penetration (sleeve) details.
 - 7. Certified coil-performance ratings with system operating conditions indicated.
 - 8. Dampers, including housings and linkage
 - 9. Filters and filter frame product data with performance characteristics
 - 10. Sound power levels by octave bands; radiated and at inlet and discharge
 - 11. Wiring diagram
 - 12. Control panel location, including elevation indicating height above the ground
 - 13. Internal static pressure drop of all components at design conditions

14. The number of shipping sections requiring field reassembly and weight and dimensions of each

1.3 QUALITY ASSURANCE

- A. Unit shall have the approval of one of the following agencies: Underwriters' Laboratories (UL), Electrical Testing Laboratories (ETL) or Canadian Standards Association (CSA). If the manufacturer cannot provide an ETL/UL sticker on the air handler from the factory, it will be the sole responsibility of the manufacturer to arrange for local ETL or UL approval and labeling.
- B. Electrical Components, Devices, and Accessories: Built, listed and labeled in strict accordance to the CEC and NFPA 70, and shall bear an appropriate label certifying compliance with UL Standard 508A by a qualified testing agency, and marked for intended location and application.
- C. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- D. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- E. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- F. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- G. Water Coils: Factory tested to 350 psig according to ARI 410 and ASHRAE 33.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Nortek Companies
- B. Energy Labs
- C. Gouvernaire
- D. Equal

2.2 ACOUSTICAL PERFORMANCE

- A. All sound power level measurements and calculations shall be in complete accordance with the latest version of AMCA Standard 300 Reverberant Room Method for Sound Testing of Fans and AMCA Standard 301 Method for Calculating Fan Sound Ratings from Laboratory Test Data. Test and calculation procedures based on sound intensity measurements may be substituted for the above procedures, if directed in advance by the Owner's Representative.

B. Maximum sound power levels

1. The air handling unit components (e.g. fans, coils, panels) shall be selected and constructed to provide no more than the follow sound power levels under all operating conditions:

		Maximum Sound Power Level, dB						
Frequency		63	125	250	500	1000	2000	4000
AH-C	Supply air opening	94	90	98	93	92	87	82
	Return air opening	81	81	94	86	83	76	70
	Radiated	82	78	80	69	67	63	58
AH-H	Supply air opening	90	85	94	89	88	83	78
	Return air opening	83	82	97	85	82	75	70
	Radiated	78	74	79	65	63	59	55

2.3 CONSTRUCTION

A. Cabinet

1. Walls and roof shall be double wall panels
 - a. Indoor location: 2 inch thick
2. Outer panel shall be: 16-gauge solid G90 galvanized
3. Inner panel shall be:
 - a. Minimum 20-gauge solid 304 stainless steel in the coil and humidifier sections, minimum 1 foot upstream and 3 feet downstream of coil/media.
 - b. Minimum 22-gauge G90 perforated bright galvanized steel liner in all other sections
4. Construction shall comply with one of the following options:
 - a. Option 1: All exterior panel seams shall be stitch welded and continuously sealed with a urethane sealant.
 - b. Option 2: Exterior panels shall be mechanically connected with thermal break and sealed with an industrial EPDM gasket to form a water and airtight seal. Gasket seal shall not be exposed to UV light or the weather. Fasteners used to attach the panels shall be stainless steel, bolt-type construction that can be removed and refastened and shall not penetrate the air tunnel. Sheet metal screws are not acceptable.
 - c. Option 3: Panels shall be of standing seam construction with seams turned inward to provide a smooth flush exterior. Panels shall be screwed together on maximum 8" centers with minimum 5/16" zinc plated screws sealed with a continuous bead of silicone caulking applied between the matching panel seams prior to assembly, and with a final bead following assembly on both the exterior and interior panel seams to produce an air tight unit. Wall to base skin and wall to roof panel seams shall be sealed with 1/2" x 1/8" Poron-Rubber strips and all exterior seams shall be continuously caulked to assure leak-proof integrity of the unit housing.
5. Insulation:
 - a. Wall and roof panels shall be insulated with 3 pound density pre-molded rigid board fire-resistant with scrim-Kraft - PSK faced insulation or polyisocyanurate foam.
 - b. All panels shall feature a Class A thermal break.
 - c. Thickness to match panel wall thickness specified herein with the following minimum R-values including the impact of thermal short-circuits:
 - 1) 2 inch panel: R-8
 - d. Insulation to meet NFPA 90A, NFPA 90B and ASTM E 84 requirements for Flame Spread of 25 or less and Smoke Development of 50 or less.

- e. Insulation shall have a thermal conductivity K factor of .23 Btu/hr/Sq. ft/degree F @ 75 F
 - 6. Roof panels
 - a. Indoor units: shall be flat with smooth exteriors the same as the side panels.
 - 7. Stiffeners of angle steel shall be supplied as required to maintain a casing deflection criteria of 1/100 at 1.5 times the working pressure.
 - 8. Access Doors
 - a. Access doors shall be double wall construction using materials, thickness, and insulation matching those of the associated section. All doors installed downstream of the cooling coil shall include a Class A thermal break. Door-jam & frame shall be constructed of extruded aluminum with continuously welded corners for rigidity. Door panels shall be insulated with expandable foam insulation completely encapsulated and sealed between the door panels and frame. Provide doors located and sized to allow for routine maintenance including motor replacement and filter replacement, electrical components and any other sections or components requiring access or maintenance.
 - b. Doors shall be provided with a minimum (2) dual acting heavy duty key locking composite latches through 48" high, (3) latches through 72" high. Latches shall be operable from both the interior and exterior of the unit. Door latches on doors into fan sections shall be provided with a hasp or other mechanism to facilitate locking of the doors. Door hinge shall be heavy duty Stainless Steel.
 - c. Doors shall be provided with double high performance closed cell replaceable neoprene bulb type gasket seals around the entire perimeter of the door / frame.
 - d. Doors shall open against static pressure unless obstructed by internal components. If obstructed by internal components on the positive sections requiring access, the doors shall open with pressure and shall be provided with a safety restraining mechanism. Doors used to access rotating equipment shall be provided with an OSHA approved safety latching mechanism requiring a tool to open and shall also have a highly visible, permanently fixed, caution sign on the exterior of the door. Doors with access to moving parts must also have locking hardware and meet current UL mechanical protection guidelines. Standard door size shall be 24" wide by 60" high unless restricted by height or section width.
 - e. Viewing Window
 - 1) Located in access doors to these sections plus those shown in other sections on drawings:
 - a) Supply Fan
 - b) Return/relief Fan
 - 2) Thermal pane wire glass
 - 3) Minimum window size shall be 8 inches by 12 inches.
- B. Internal walls and plenum dividers
- 1. Walls separating return air/access vestibule from coil sections, supply discharge plenum, and mixed air plenum shall be 2 inch double wall panel constructed and insulated as specified for 2 inch exterior panels except with both panels as specified for inside panel. Return air/access side of all plenum walls shall be perforated.
 - 2. Other plenum walls and blank-off plates shall be single wall, fabricated of formed 16 gage solid galvanized steel panels except cooling coil blank-off plates which shall be constructed of 16 gage solid stainless steel.
 - 3. Provide access panels in wall sections where components cannot be easily accessed or removed through the exterior access doors.
- C. Bases
- 1. Unit bases shall be constructed from structural steel channel iron around the entire perimeter of the unit and provided with intermediate structural tubing, channel and angle

iron as required to support all internal components. All tubing, channel and angle joints shall be solid welded. Bolted or formed channel bases are not acceptable.

2. Floor Construction
 - a. The entire section base (component sections and service vestibule) shall have a floor of minimum 16 gauge G90 galvanized steel or aluminum tread plate.
 - b. Include a minimum 2 inch upturned lip around the section perimeter and all floor openings. No lips or flanges allowed in walking areas to prevent a trip hazard.
 - c. Floor shall be capable of supporting a 300 lb. live load with maximum L/200 deflection at any floor seam.
 - d. Base shall be insulated with water impervious foam under the base skin and covered with a minimum 20 gauge galvanized steel liner. Insulation R-value (including effect of thermal short circuits) shall meet same criteria as cabinet casing requirements specified herein.
 - e. All floor openings greater than 8 inches in either dimension, including dampers openings, shall be covered with a removable galvanized steel or aluminum grating bolted in place suitable for walking on which will prevent any personnel and large objects from falling through into the space below. Grating shall be capable of supporting minimum 100 pounds/ft².
3. Drain pans
 - a. Under cooling coil and humidifier sections and extending under blank plenum section downstream and extending under all headers and return bends. To aid in coil cleaning, drain pans shall be installed under all coils, including all heating coils.
 - b. Type 304 Stainless steel, minimum 16-gage
 - c. Corners soldered, welded or brazed
 - d. Pitched to drain flange to fully drain. Double broken, double sloped to ensure no standing water.
 - e. Fully accessible for cleaning
 - f. Drain connection
 - 1) Minimum size per code
 - 2) Extended to the exterior of the air handler
 - 3) Stainless steel or brass
 - 4) Welded or soldered into bottom of pan
 - 5) Intermediate pans shall drain to the bottom main pan
 - g. Insulation on bottom drain pan: minimum 1 in. thick, coated fiber glass board or injected foam insulation, NFPA-90 or UL listed. (Intermediate drain pans need not be insulated.)

2.4 FAN ARRAY

- A. The fan array shall include multiple, direct driven, arrangement 4 plenum fans constructed per AMCA requirements for the duty specified, minimum Class II or class III as required. Fans shall be rated in accordance with and certified by AMCA for performance.
- B. Each fan/motor cell shall include a 12-gauge, G90 Galvanized steel intake wall, 14 gauge spun steel fan inlet funnel, and a 10-gauge G90 Galvanized steel motor support plate rail and structure. Inlet plate, inlet cone and motor base support shall be powder coated. Fan cell structure shall be heavy gauge, anodized aluminum, interior perforated panels and exterior panels shall be aluminum.
- C. The fan array shall consist of multiple fan and motor cells, spaced in the airway tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein. In order to assure uniform velocity profile in the

AHU cross section, the fan cell dimensions must be variable, such that each fan rests in an identically sized cell, and in a spacing that must be such that the submitted array dimensions fill a minimum of 90% of the cross sectional area of the AHU air way tunnel. There shall be no blank off plates or "spacers" between adjacent fan columns or rows to position the fans across the air way tunnel. The array shall produce a uniform air flow profile and velocity profile within the airway tunnel of the air handling unit to equal the specified cooling coil and/or filter bank face velocity by $\pm 10\%$ when measured at a point 36 inches from the intake side of the fan array intake plenum wall, and at a distance of 72 inches from the discharge side of the fan array intake plenum wall. Submittals for units providing less than the scheduled quantity of fans and/or spacing of the fans for multiple fan arrays shall submit CFD modeling of the air flow profile for pre-bid approval that indicates uniform velocity and flow across all internal components without increasing the length of the AHU unit or changing the aspect ratio of the unit casing as designed.

- D. Fan housing shall include sound absorbing acoustic baffles as required to meet specified sound power levels.
- E. Back flow prevention. Each individual cell in the multiple fan arrays shall be provided with an integral backflow prevention device that prohibits recirculation of air in the event a fan or multiple fans become disabled. The system effects for the backflow prevention device(s) shall be included in the criteria for TSP determination for fan selection purposes, and shall be indicated as a separate line item SP loss in the submittals. Back-flow device blades and frame shall be constructed of aluminum.
- F. Vibration Control
 - 1. Option 1. Each individual fan assembly shall be free-floating at all four corners on minimum 2" deflection spring type isolators with seismic restraints. The spring isolators shall be mounted to structural steel members and shall be rated for a minimum of 1G. The fan discharge shall be isolated from the cabinet by means of a neoprene-coated flexible connection.
 - 2. Option 2. Each fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, exceeding category BV-5, to meet or exceed an equivalent Grade G.55, producing a maximum rotational imbalance of 0.022" per second peak, filter in (0.55mm per second peak, filter in). All fan and motor assemblies with 27" dia. and less shall be balanced to meet or exceed the G.55 residual unbalance. Fan and motor assemblies submitted for approval incorporating larger than 10 HP motors shall be balanced in three orthogonal planes to demonstrate compliance with the G.55 requirement with a maximum rotational imbalance of 0.022" per second peak filter in (0.55 mm per second peak, filter in).
- G. Each fan & motor assembly shall be removable through the access door located on the discharge side of the fan wall array.
- H. Filter Rating
 - 1. Where the unit has both prefilters and final filters, select fan using clean filter pressure drops for both the pre-filters and final filters.
 - 2. Where the unit has only final filters, select fan for mean air pressure drop (midway from clean to maximum).

2.5 HOT AND CHILLED WATER COILS

- A. Extended surface type coils

1. Copper Tubes
 - a. Brazed or welded joints
 - b. Minimum thickness: 0.020 inches
 - c. Outside diameter: 1/2 inch or 5/8 inch
 - d. The use of internal restrictive devices such as turbolater springs or ribbons to obtain turbulent construction is not acceptable.
 2. Plate fins
 - a. Aluminum
 - b. Minimum thickness 0.0075 inches
- B. Rows and fin spacing
1. To meet performance scheduled at similar pressure drop; no fewer rows than that scheduled
 2. Selected with tube fouling factor of 0.0001
 3. Maximum fin spacing: Meet Standard 62.1 maximum pressure drop requirement (≤ 0.75 in.w.c. at 500 fpm, dry coil)
 4. Select to avoid moisture carryover
- C. Circuiting: full row, single circuit, fully overall counterflow
- D. Headers
1. Steel or Copper with red brass piping connections
- E. Certified by AHRI per current Standard 410
- F. For field installed coils, coil frame designed for bolting to other sections or ductwork:
- G. Coil Casing
1. Minimum 16-gage
 2. Fan-coils: galvanized steel casing and tube sheet
 3. Air handling units: Type 304 stainless steel casing and tube sheet
 4. Intermediate supports of same material as casing
- H. Design for 200 pounds per square inch, 250 degrees Fahrenheit unless otherwise indicated on the Drawings
- I. Factory tested to
1. 300 pounds per square inch for water coils
 2. 450 pounds per square inch for refrigeration condenser coils
 3. 300 pounds per square inch for refrigeration evaporator coils
- J. Factory cleaned, degreased, and flushed. Piping connections shall be capped with removable caps.
- K. All coils shall be removable from either side of the unit by easily removable end panels. Individual end panels shall be supplied for each coil on the supply and return side of the cabinet to allow single coil piping breakdown for coil removal.
- L. Coil supply and return piping connections extending through the cabinet wall shall be sealed by rubber grommets with caulking on the exterior of the casing. The escutcheon plate shall have a rolled collar around the pipe opening to protect the pipe and be equipped with an "O" ring rubber gasket between the collar and the pipe to prevent chaffing and provide an air tight seal around the opening.

2.6 FILTERS

- A. Filters shall be arranged for Face, Rear or side loading as indicated on the detail drawings. Face loading is preferred where space allows. Face or rear loading shall be in gasketed universal holding frames. The filter rack assemblies shall be blanked off to the sides, roof and floor and properly sealed to minimize filter bypass
- B. Filter Gauge – see Section 250000 BAS.
- C. Filter banks shall be sized so maximum filter face velocity does not exceed 500 fpm unless otherwise shown on drawings.
- D. Filter rack: 304 or 316 SS
- E. Filter type
 - 1. As scheduled
 - 2. In accordance with Section 234000 Air Cleaning Devices.

2.7 ELECTRICAL

- A. Provide separate panels, each with an externally operated non-fused main disconnect switch, for separate field power connections for the following:
 - 1. Supply fan motors
 - 2. Lighting
- B. Each air handling unit shall contain electrical control panels consisting of a surface mounted or fully recessed NEMA rated enclosure.
- C. All motors in the fan array shall be provided with individual disconnects and thermal overload protection. All motor circuit protectors shall be located in main enclosure. Include the following for AHUs used for life safety smoke control: Disconnects shall have auxiliary contacts for monitoring position status by the Fire Alarm System.
- D. Motors
 - 1. Comply with Section 230513 Motors and Controllers.
 - 2. Motors shall be standard foot mounted type, TEFC or TEAO, premium efficiency.
 - 3. Motors, and shall be “off-the-shelf”, available from local motor suppliers, either 1800 or 3600 nominal RPM.
 - 4. Motors shall include permanently sealed bearings
 - 5. The weight of any individual motor shall not exceed 200-lbs.
 - 6. Motors shall meet the requirements of NEMA MG-1 Part 30 and 31, section 4.4.2. (invertor-duty).
 - 7. Where recommended by VFD manufacturer, include shaft grounding system equal to AEGIS SGR unless motor has ceramic bearings
 - 8. Each motor shall be provided with individual disconnects and thermal overload protection, located in main electrical enclosure.
- E. Variable speed drives
 - 1. VSDs are field installed and provided by others.
- F. Lights

1. Provide vapor proof marine type mini-fluorescent light fixtures in each accessible section complete with a protective metal cage and sealed glass enclosure. Cabinets greater than 14 feet in width shall have two fixtures per section.
2. Lights shall be wired to a common switch mounted in a weatherproof box adjacent to the fan access door complete with a GFCI convenience outlet and indicator light.
3. All wiring to lights shall be in conduit and internal to the unit. No external conduit runs for the lights are allowed.
4. If the unit requires splitting, junction boxes shall be furnished at each section to allow the electrical contractor to make final connections in the field. Wiring shall be clearly labeled at junction points to facilitate reconnection.

G. Controls

1. All controls provided under Division 25 Building Automation Systems.

2.8 DAMPERS

A. Dampers shall comply with 233300 Duct Accessories. Construction and performance shall match that of Ruskin models specified below.

B. Type and Size

1. Return air
 - a. UL listed smoke damper with direct coupled actuator with end switches (due to atrium makeup duty)
 - b. Equal to Ruskin SD-60
 - c. Parallel blade
 - d. 1000 fpm sized for supply fan design airflow less design minimum outdoor airflow
2. Economizer Outdoor air
 - a. Equal to Ruskin CD-50
 - b. Parallel blade
 - c. 400 to 1000 fpm sized for supply fan design airflow
3. Minimum outdoor air "dump" damper (AH-C)
 - a. Equal to Ruskin CD-60
 - b. Opposed blade
 - c. Size per plans

C. Actuators are specified under Section 250000 BAS, except for smoke dampers.

D. Damper configuration

1. Each section shall be designed to be operated by a separate direct coupled actuator. Jackshafts and external linkage shall not be used. Provide space between damper sections (or between damper and roof/floor for vertical blade dampers) to allow for side-mounted direct-coupled actuator.
2. Do not interlink economizer outdoor air and return air dampers. Each shall operate independently.
3. Economizer outdoor air and return airflow shall be directed into each other. Provide vertical blades if required.

1.1 AIR OPENINGS

A. Size

1. Supply Air: ≤ 1500 fpm face area

2. Return Air: \leq 1000 fpm face area
- B. Protection
1. For floor openings, provide minimum 80% free area walking grate where opening is in an accessible section.
 2. For all other openings, cover opening with a heavy-duty screen.

2.9 UNIT TESTING AND QUALITY CONTROL

- A. Equipment Qualification
1. Prior to unit shipment, the following qualifications shall be performed and documented:
 - a. All fans shall be balanced and factory run tested to ensure design integrity.
 - b. All bearings shall be provided with a full complement of grease.
 - c. All factory piping shall be leak tested to ensure integrity.
 - d. All electrical circuits shall be tested to ensure correct operation.
 - e. Drain pans shall be tested to ensure positive slope to drain. (See also post-installation tests performed under Section 230593 Testing, Adjusting and Balancing.)

PART 3 EXECUTION

3.1 INSTALLATION

- A. Units shall ship with all openings securely covered and watertight. Protection shall be retained until completion of construction or until opening is field connected to ductwork.
- B. Coordinate with work of other trades.
- C. Vibration isolation and mounting: See Section 230548 Vibration and Seismic Control.
- D. Install in accordance with manufacturer's written installation instructions.
- E. Mount units sufficiently high to allow for proper condensate trapping and drainage.
- F. Piping
1. See Section 232113 HVAC Piping
 2. See piping diagrams
 3. Do not block access doors with piping. Access doors shall be capable of opening 90 degrees.
 4. Pipe condensate to nearest appropriate drain. See Division 220000 Plumbing.
- G. See Division 25 Building Automation Systems

3.2 INSPECTION

- A. Verify that adequate clearance between air handling units and adjacent walls or equipment is available to permit maintenance and repairs.

3.3 PRE-OPERATING CHECKS

- A. Before operating air handling units:
 - 1. See Section 230800 HVAC Commissioning.
 - 2. Complete Pre-Functional Test Data Sheet for each unit.

3.4 CLEANING

- A. After completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean all components including fan wheels, cabinets, dampers, coils, and filter housings.
- B. Install new, clean filters in accordance with Section 234000 Air Cleaning Devices.

3.5 TESTING AND ADJUSTING

- A. Do not operate fans for any purpose, temporary or permanent until
 - 1. Ductwork is clean
 - 2. Filters are in place
 - 3. Bearings are lubricated
 - 4. Fan has been run under observation
- B. Start and test fans in accordance with manufacturer's written installation instructions.
- C. Test cooling coil drain pans. See Section 233300 Duct Accessories
- D. Start-up and adjust completed air handling units to ensure proper operation
- E. See Section 230593 Testing, Adjusting, and Balancing
- F. After starting fans: Check for objectionable noise or vibration. Correct as needed at no additional cost to the Owner.
- G. Commissioning: See Section 230800 Mechanical Commissioning.
- H. Training: See Section 230800 Mechanical Commissioning.

END OF SECTION

SECTION 250000

BUILDING AUTOMATION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Furnish and install a digital Building Automation System (BAS) as specified herein.
- B. Coordination with other Divisions: See coordination matrix in Section 230501 Basic Mechanical Materials and Methods.

1.2 INTEGRATION WITH EXISTING SYSTEM

- A. Include all services required to integrate this building into existing BAS for a fully operational system.
- B. Procedure
 1. Obtain a copy of the campus database with access privileges.
 2. Perform a database review with the Owner's Representative to ensure uniformity of point naming, graphic layout and style, BACnet device instance numbering scheme, IP addresses, BACnet Distribution Tables and BACnet Broadcast Management Devices.
 3. BACnet devices
 - a. Create new building database following the BACnet device instance numbering scheme specified under Paragraph 3.12B.4.
 - b. Double check existing database to ensure there are no duplicate BACnet device instance numbers. This includes 3rd party equipment such as VFDs.
 4. Graphics
 - a. For standard applications, such as VAV boxes and VAV box summary pages, use the campus standard graphics file template, including using the same file template name.
 - b. For new or modified graphics custom to the new building, ensure file template name do not duplicate any existing file names.
 5. Programming
 - a. For standard sequences covered by ASHRAE Guideline 36, use the programming provided by the BAS manufacturer, first ensuring they have been updated by the manufacturer to reflect the latest issue and all addenda published when programming work is initiated.
 - b. For other typical applications, first review those used for similar applications in other campus buildings to use as a starting point, then edit to reflect sequences specified herein. The intent is to have standard programming throughout the campus to the extent possible.
 - c. Double check existing database to ensure program file names do not duplicate any existing file names.
 6. If a BACnet/IP Broadcast Management Device (BBMD) router is required, check the existing Broadcast Distribution Tables (BDT) to ensure that a BBMD router is not already assigned to the relevant network before adding a new one.
 7. Install building database and control programming on a temporary portable operator's terminal provided by the Contractor. The POT shall be used for start-up, testing, and commissioning. The POT shall remain the property of the Contractor after final completion of the project.

8. Once the building BAS has been fully commissioned and accepted by the Owner:
 - a. Create a new backup of the existing campus database.
 - b. Merge the new building database with the existing campus database.
 - c. Confirm that no communication issues (in the building and across the campus) have resulted from the merge.
 - d. Confirm that all new controllers have successfully bound to the server and that alarms and trends are being sent to the server.
 - e. Configure alarm page-out notifications (e.g. e-mail, SMS, etc.) per Paragraph 3.12F.
 - f. Make another backup of the merged database.
 - g. Load the merged database onto the campus Control System Server.
 - h. Integrate graphic screens into the Central Plant graphics including adding appropriate hyperlinks so that the system operates as one integrated system.
 - i. Confirm that the merge was successful by sample testing points and sequences
 - j. Perform a post-merge review 4 to 8 weeks following the merge. Review general system operation, problematic areas, alarms and trend histories. Identify and remediate any issues.
 - k. Receive Owner approve of the final installation in writing.
9. Provide high level password for Owner operator access to the system only at this point; Owner will not have access to the system prior to system acceptance and integration.

1.3 CONTRACTOR PROPOSALS

- A. The system requirements described in this specification are generally performance based. Where requirements are prescriptive, the intent is to provide minimum quality, not to give unfair advantage to any given manufacturer or product. If a contractor finds that a certain requirement is unduly difficult or expensive to meet, contact the Engineer prior to bid due date and an addendum modifying the requirement will be considered.
- B. Where requirements are unclear, the contractor shall clarify the requirements with the Engineer before the bid due date. Where requirements continue to be unclear, the contractor's proposal must accurately describe what is included and excluded.
- C. By submitting a proposal, contractor guarantees that their proposal is in full compliance with these specifications except as specifically excluded in their proposal.

1.4 REFERENCE STANDARDS

- A. Nothing in Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, and regulations. When Contract Documents differ from requirements of applicable laws, ordinances, rules and regulations, comply with documents establishing the more stringent requirement.
- B. The latest published or effective editions, including approved addenda or amendments, of the following codes and standard shall apply to the BAS design and installation as applicable.
- C. State, Local, and City Codes
 1. CBC – California Building Code
 2. CMC – California Mechanical Code
 3. CEC – California Electrical Code
 4. Local City and County Codes
- D. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

1. ANSI/ASHRAE 135 – BACnet - A Data Communication Protocol for Building Automation and Control Networks.
2. ANSI/ASHRAE Standard 15 – Safety Standard for Refrigeration Systems.

E. Electronics Industries Alliance

1. EIA-232 – Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
2. EIA-458 – Standard Optical Fiber Material Classes and Preferred Sizes.
3. EIA-485 – Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
4. EIA-472 – General and Sectional Specifications for Fiber Optic Cable.
5. EIA-475 – Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications.
6. EIA-573 – Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications.
7. EIA-590 – Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications.

F. Underwriters Laboratories

1. UL 916 – Energy Management Systems.

G. National Electrical Manufacturers Association

1. NEMA 250 – Enclosure for Electrical Equipment.

H. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems.
2. IEEE 802.3 – CSMA/CD (Ethernet – Based) LAN.
3. IEEE 802.4 – Token Bus Working Group (ARCNET – Based) LAN.

1.5 DEFINITIONS

A. Acronyms

AAC	Advanced Application Controller
AH	Air Handler
AHU	Air Handling Unit
AI	Analog Input
ANSI	American National Standards Institute
AO	Analog Output
ASC	Application Specific Controllers
ASCII	American Standard Code for Information Interchange
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
A-to-D	Analog-to-Digital
BACnet	Data Communications Protocol for Building Automation and Control Systems
BC	Building Controller
BIBB	BACnet Interoperability Building Blocks

BTL	BACnet Testing Laboratory
CAD	Computer Aided Drafting
CHW	Chilled Water
CHWR	Chilled Water Return
CHWS	Chilled Water Supply
COV	Change of Value
CSS	Control Systems Server
CU	Controller or Control Unit
CV	Constant Volume
CW	Condenser Water
CWR	Condenser Water Return
CWS	Condenser Water Supply
DBMS	Database Management System
DDC	Direct Digital Control
DHW	Domestic Hot Water
DI	Digital Input
DO	Digital Output
D-to-A	Digital-to-Analog
BAS	Building Automation System
EMT	Electrical Metallic Tubing
EP	Electro-Pneumatic
ETL	Edison Testing Laboratories
GUI	Graphical User Interface
HHD	Hand Held Device
HOA	Hand-Off-Automatic
HVAC	Heating, Ventilating and Air-Conditioning
HTTP	Hyper-Text Transfer Protocol
I/O	Input/output
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
LAN	Local Area Network
LANID	LAN Interface Device
MAC	Medium Access Control
MHz	Megahertz
MS/TP	Master-Slave/Token-Passing
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
ODBC	Open Database Connectivity
OI	Operator Interface
OWS	Operator Workstation
P	Proportional
PC	Personal Computer
PI	Proportional-Integral
PICS	Protocol Implementation Conformance Statement
PID	Proportional-Integral-Derivative
POT	Portable Operators Terminal
PTP	Point-to-Point
RAM	Random Access Memory

SOO	Sequence of Operation
SQL	Standardized Query Language
SSL	Secure Socket Layers
TAB	Test, Adjust, and Balance
TDR	Time Delay Relay
UFT	Underfloor Fan Terminal Box
UL	Underwriters' Laboratories, Inc.
XML	Extensible Markup Language

B. Terms

Term	Definition
Accessible	Locations that can be reached with no more than a ladder to assist access and without having to remove permanent partitions or materials. Examples include inside mechanical rooms, mechanical equipment enclosures, instrument panels, and above suspended ceilings with removable tiles.
BACnet Interoperability Building Blocks	A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device in a specification.
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.
Change of Value	An event that occurs when a digital point changes value or an analog value changes by a predefined amount.
Client	A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.
Concealed	Embedded in masonry or other construction, installed in furred spaces, within double partitions, above hung ceilings, in trenches, in crawl spaces, or in enclosures.
Continuous Monitoring	A sampling and recording of a variable based on time or change of state (such as trending an analog value, monitoring a binary change of state).
Contract Documents	Specifications, drawings, and other materials provided with request for bids.
Control Systems Server	A computer(s) that maintain(s) the systems configuration and programming database.
Controller	Intelligent stand-alone control device. Controller is a generic reference to BCs, AACs, and ASCs.
Direct Digital Control	Microprocessor-based control including Analog/Digital conversion and program logic.
Building Automation System	The entire integrated management and control system.
Equal	Approximately equal in material types, weight, size, design, quality, and efficiency of specified product.
Exposed	Not installed underground or concealed.

Term	Definition
Furnish	To purchase, procure, acquire and deliver complete with related accessories.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Hand Held Device	Manufacturer's microprocessor based portable device for direct connection to a field Controller.
Inaccessible	Locations that do not meet the definition of accessible. Examples include inside furred walls, pipe chases and shafts, or above ceilings without removable tiles.
Indicated, shown or noted	As indicated, shown or noted on drawings or specifications.
Install	To erect, mount and connect complete with related accessories.
Instrumentation	Gauges, thermometers and other devices mounted in ductwork or piping that are not a part of the BAS.
IT LAN	Reference to the facility's Information Technology network, used for normal business-related e-mail and Internet communication.
LAN Interface Device	Device or function used to facilitate communication and sharing of data throughout the BAS.
Local Area Network	Computer or control system communications network limited to local building or campus.
Master-Slave/Token Passing	Data link protocol as defined by the BACnet standard.
Motor Controllers	Starters, variable speed drives, and other devices controlling the operation of motors.
Native BACnet Device	A device that uses BACnet for communication. A device may also provide gateway functionality and still be described as a Native BACnet device.
Native BACnet System	A network composed only of Native BACnet Devices without gateways.
Open Database Connectivity	An open standard application-programming interface for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system is handling the data.
Open Connectivity	OPC is an interoperability standard developed for industrial applications. OPC compliant systems make it possible to access or exchange data from any application, regardless of which database management system is handling the data.
Operator Interface	A device used by the operator to manage the BAS including OWSs, POTs, and HDDs.

Term	Definition
Operator Workstation	The user's interface with the BAS system. As the BAS network devices are stand-alone, the OWS is not required for communications to occur.
Owner	The Owner or their designated representatives.
Piping	Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and related items.
Points	All physical I/O points, virtual points, and all application program parameters.
Point-to-Point	Serial communication as defined in the BACnet standard.
Portable Operators Terminal	Laptop PC used both for direct connection to a controller and for remote dial up connection.
Primary Controlling LAN	High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs.
Protocol Implementation Conformance Statement	A written document that identifies the particular options specified by BACnet that are implemented in a device.
Provide	Furnish, supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically noted.
Reviewed, approved, or directed	Reviewed, approved, or directed by or to Owner's Representative.
Router	A device that connects two or more networks at the network layer.
Secondary Controlling LAN	LAN connecting AACs and ASCs.
Server	A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.
Standardized Query Language	SQL - A standardized means for requesting information from a database.
Supervisory LAN	Ethernet-based LAN connecting Primary Controller LANs with each other and OWSs, CSS, and THS. See System Architecture below.
Supply	Purchase, procure, acquire and deliver complete with related accessories.
Wiring	Raceway, fittings, wire, boxes and related items.
Work	Labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation.

1.6 QUALITY ASSURANCE

A. Materials and Equipment

1. Manufacturer's Qualifications: See 2.1 for approved manufacturers.

B. Installer

1. BAS Contractor's Project Manager Qualifications: Individual shall specialize in and be experienced with direct digital control system installation for not less than 3 years. Project Manager shall have experience with the installation of the proposed direct digital control equipment product line for not less than 2 projects of similar size and complexity. Project Manager must have proof of having successfully completed the most advanced training offered by the manufacturer of the proposed product line.
2. BAS Contractor's Programmer Qualifications: Individual(s) shall specialize in and be experienced with direct digital control system programming for not less than 3 years and with the proposed direct digital control equipment product line for not less than 1.5 years. Programmers must show proof of having successfully completed the most advanced programming training offered by the vendor of the programming application on the proposed product line.
3. BAS Contractor's Lead Installation Technician Qualifications: Individual(s) shall specialize in and be experienced with direct digital control system installation for not less than 3 years and with the proposed direct digital control equipment product line for not less than 1.5 years. Installers must show proof of having successfully completed the installation certification training offered by the vendor of the proposed product line.
4. BAS Contractor's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. BAS Contractor must document a minimum 5-year history of servicing installations of similar size and complexity. Installer must also document at least a 1-year history of servicing the proposed product line.
5. Installer's Response Time and Proximity
 - a. Installer must maintain a fully capable service facility within 50 miles of the subject Project. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.
 - b. Installer must demonstrate the ability to meet the emergency response times listed in Paragraph 1.12B.1.
6. Electrical installation shall be by manufacturer-trained electricians
 - a. Exception: Roughing in wiring and conduit and mounting panels may be subcontracted to any licensed electrician.

1.7 SUBMITTALS

- A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformity with the design intent and the Contractor has responded to all comments to the satisfaction of the Owner's Representative.
- B. Submit drawings and product data as hereinafter specified. Conditions in this Section take precedence over conditions in Division 1 or Section 230501 Basic Mechanical Materials and Methods.
- C. Submittal Schedule: Submittal schedule shall be as follows unless otherwise directed by the Owner's Representative:
 1. Allow 10 working days for approval, unless Owner's Representative agrees to accelerated schedule.
 2. Submittal Package 0 (Qualifications) shall be submitted with bid.
 3. Submittal Package 1 (Hardware and Shop Drawings) shall be submitted in accordance with schedule established by the Owner in bid documents.
 4. Submittal Package 2 (Programming and Graphics) and shall be submitted no less than 30 days before software is to be installed in field devices.
 5. Submittal Package 3 (Pre-Functional Test Forms) shall be submitted no less than 30 days prior to conducting tests.

6. Submittal Package 4 (Pre-Functional Test Report) shall be submitted no less than 14 after conducting tests.
7. Submittal Package 5 (Post-Construction Trend Points List) shall be submitted 14 days prior to the start of the trend collection period.
8. Submittal Package 6 (Functional Test Report) shall be submitted no more than 7 days after conducting tests.
9. Submittal Package 7 (Training Materials) shall be submitted no less than 14 days prior to conducting first training class.
10. Submittal Package 8 (Post-Construction Trend Logs) shall be submitted after demonstration tests are accepted and systems are in full automatic operation.
11. Submittal Package 9 (End-of-Warranty Trend Logs) shall be submitted 30 days prior to the end of the warranty period.

D. Submission and Resubmission Procedure

1. Optional Pre-Submittals. At Contractor's option, electronic submittals indicated below may be submitted unofficially via email directly to the Engineer for review and comment prior to formal submission. Comments provided by the Engineer are not official and may be changed or additional comments may be provided on the formal submittal. The intent of pre-submittals is to reduce paperwork and review time.
2. Each submittal shall have a unique serial number that includes the associated specification section followed by a number for each sub-part of the submittal for that specification section, such as SUBMITTAL 250000-01.
3. Each resubmittal shall have the original unique serial number plus unique revision number such as SUBMITTAL 250000-01 REVISION 1. The cover page of resubmittals shall include a summary of prior comments and how they were resolved in the resubmittal.
4. Submit one copy of submittal in electronic format specified under each submittal package below. Submissions made in the wrong format will be returned without action.
5. Submittals shall have bookmarks for each subsection (e.g. Materials, Drawings) and each for each drawing including drawing number and name.
6. Owner's Representative will return a memo or mark-up of submittal with comments and corrections noted where required.
7. Make corrections
 - a. Revise initial submittal to resolve review comments and corrections.
 - b. Indicate any changes that have been made other than those requested.
 - c. Clearly identify resubmittal by original submittal number and revision number.
8. Resubmit revised submittals until no exceptions are taken.
9. Once submittals are accepted with no exceptions taken, provide
 - a. Complete submittal of all accepted drawings and products in a single electronic file.
 - b. Photocopies or electronic copies for coordination with other trades, if and as required by the General Contractor or Owner's Representative.

E. Submittals Packages

1. Submittal Package 0 (Qualifications)
 - a. Provide Installer and Key personnel qualifications as specified in Paragraph 1.6B.
 - b. Format: Word-searchable format per Paragraph 1.8C.3.
2. Submittal Package 1 (Hardware and Shop Drawings)
 - a. Hardware
 - 1) Organize by specification section and device tags as tagged in these specifications.
 - 2) Do not submit products that are not used even if included in specifications.
 - 3) Include a summary table of contents listing for every submitted device:
 - a) Tab of submittal file/binder where submittal is located
 - b) Device tag as tagged in these specifications (such as TS-1A, FM-1)

- c) Specification section number (down to the lowest applicable heading number)
 - d) Whether device is per specifications and a listed product or a substitution
 - e) Manufacturer
 - f) Model number
 - g) Device accuracy (where applicable)
 - h) Accuracy as installed including wiring and A/D conversion effects (where applicable)
- 4) Submittal shall include manufacturer's description and technical data, such as performance data and accuracy, product specification sheets, and installation instructions for all control devices and software.
- 5) When manufacturer's cut-sheets apply to a product series rather than a specific product, the data specifically applicable to the Project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.
- 6) Format: Word-searchable format per Paragraph 1.8C.3.
- b. Shop Drawings
- 1) System architecture one-line diagram indicating schematic location of all control units, workstations, LAN interface devices, gateways, etc. Indicate address and type for each control unit. Indicate media, protocol, baud rate, and type of each LAN.
 - 2) Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. The schematics provided on Drawings shall be the basis of the schematics with respect to layout and location of control points.
 - 3) All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
 - 4) Label each input and output with the appropriate range.
 - 5) Device table (Bill of Materials). With each schematic, provide a table of all materials and equipment including:
 - a) Device tag as indicated in the schematic and actual field labeling (use tag as indicated in these specifications where applicable and practical)
 - b) Device tag as indicated in these specifications where applicable and if it differs from schematic device tag
 - c) Description
 - d) Proposed manufacturer and model number
 - e) Range
 - f) Quantity
 - 6) With each schematic or on separate valve sheet, provide valve and actuator information including pipe size, valve size, C_v , design flow, target pressure drop, actual design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of fail-safe valves and dampers.
 - 7) Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
 - 8) Details of control panels, including controllers, instruments, and labeling shown in plan or elevation indicating the installed locations.
 - 9) Floor plans: None required.

- 10) Format
 - a) Sheets shall be consecutively numbered.
 - b) Each sheet shall have a title indicating the type of information included and the mechanical/electrical system controlled.
 - c) Table of Contents listing sheet titles and sheet numbers.
 - d) Legend and list of abbreviations.
 - e) Schematics
 1. Word searchable pdf format.
 2. 21 inch x 15 inch or 17 inch x 11 inch.
 - f) Floor plans: None required
- c. Do not include sequence of controls on shop drawings or equipment submittals; they are included in Submittal Package 2.
3. Submittal Package 2 (Programming and Graphics)
 - a. A detailed description of point naming convention conforming to Paragraph 3.12B to be used for all software and hardware points, integrated with existing database convention.
 - b. A list of all hardware and software points identifying their full text names, device addresses and descriptions.
 - c. Control Logic Documentation
 - 1) Submit control logic program listings (graphical programming) consistent with specified English-language Sequences of Operation for all control units.
 - 2) Control logic shall be annotated to describe how it accomplishes the sequence of operation. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.
 - 3) Include specified English-language Sequences of Operation of each control sequence updated to reflect any suggested changes made by the Contractor to clarify or improve the sequences. Changes shall be clearly marked. SOO shall be fully consistent with the graphical programming. (An electronic version of the sequences of controls in Paragraph 3.12 will be provided to the Contractor upon request.)
 - 4) Include control settings, setpoints, throttling ranges, reset schedules, adjustable parameters and limits.
 - 5) Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation.
 - d. Graphic screens of all required graphics, provided in final colors.
 - e. Format
 - 1) Points list: Word-searchable format per Paragraph 1.8C.3.
 - 2) Programming: Native Delta GCL+.
 - 3) Programming and operating manual: Word-searchable format per Paragraph 1.8C.3.
 - 4) Graphics: Graphical electronic format (pdf, png, etc.).
4. Submittal Package 3 (Pre-Functional Test Forms)
 - a. Provide pre-functional test forms as required by Paragraph 3.14D.23.14D.2.a.
 - b. Format: Word-searchable format per Paragraph 1.8C.3.
5. Submittal Package 4 (Pre-Functional Test Report)
 - a. Provide Pre-Functional Test Report as required by Paragraph 3.14D.2.
 - b. Format: Word-searchable format per Paragraph 1.8C.3.
6. Submittal Package 5 (Post-Construction Trend Points List)
 - a. Provide a list of points being trended along with trend interval or change-of-value per Paragraph 3.14H.2.d.
 - b. Format: See Paragraph 2.11C.3.
7. Submittal Package 6 (Functional Test Report)
 - a. Provide completed functional test forms as required by Paragraph 3.14F.4.

- b. Format: Word-searchable format per Paragraph 1.8C.3.
- 8. Submittal Package 7 (Training Materials)
 - a. Provide training materials as required by Paragraph 3.15.
 - b. Format: Word-searchable format per Paragraph 1.8C.3.
- 9. Submittal Package 8 (Post-Construction Trend Logs)
 - a. Provide trend logs as required by Paragraph 3.14H.
 - b. Format: See Paragraph 2.11C.3.
- 10. Submittal Package 9 (End-of-Warranty Trend Logs)
 - a. Provide trend logs as required by Paragraph 3.14H.
 - b. Format: See Paragraph 2.11C.3.

1.8 COMPLETION REQUIREMENTS

A. Procedure

1. Until the documents required in this Section are submitted and approved, the system will not be considered accepted and final payment to Contractor will not be made.
2. Before requesting acceptance of Work, submit one set of completion documents for review and approval of Owner.
3. After review, furnish quantity of sets indicated below to Owner.

B. Completion Documents

1. Operation and Maintenance (O & M) Manuals. Provide in both paper and electronic format per Paragraph 1.8C.
 - a. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual.
 - b. As-built versions of the submittal product data. Submittal data shall be located in tabs along with associated maintenance information.
 - c. Engineering, Installation, and Maintenance Manual(s) that explain how to design and install new points, panels, and other hardware; preventive maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
 - d. Complete original issue documentation, installation, and maintenance information for all third-party hardware and software provided, including computer equipment and sensors.
 - e. A list of recommended spare parts with part numbers and suppliers.
 - f. Operators Manual with procedures for operating the control systems, including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
 - g. Programming Manuals with a description of the programming language, control block descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the programming editor.
 - h. Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.
 - i. A listing and documentation of all custom software for the Project created using the programming language, including the set points, tuning parameters, and point and object database.
 - j. English language control sequences updated to reflect final programming installed in the BAS at the time of system acceptance.
 - k. A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface.

2. Complete original issue electronic copy for all software provided, including operating systems, programming language, operator workstation software, and graphics software.
3. Complete electronic copy of BAS database, user screens, setpoints and all configuration settings necessary to allow re-installation of system after crash or replacement of server, and resume operations with the BAS in the same configuration as during owner sign-off.
4. Project Record Drawings
 - a. As-built versions of the submittal drawings in reproducible paper and electronic format per Paragraph 1.8C.
 - b. As-built network architecture drawings showing all BACnet nodes including a description field with specific controller and device identification, description and location information.
5. Commissioning Reports. Completed versions of all Pre-functional, Functional, and Demonstration Commissioning Test reports, calibration logs, etc., per Paragraph 3.14A.9.
6. Copy of inspection certificates provided by the local code authorities.
7. Written guarantee and warranty documents for all equipment and systems, including the start and end date for each.
8. Training materials as required by Paragraph **3.15D**.
9. Contact information. Names, addresses, and 24-hour telephone numbers of contractors installing equipment, and the control systems and service representatives of each.

C. Format of Completion Documents

1. Provide the type and quantity of media listed in table below.
2. Project database, programming source files, and all other files required to modify, maintain, or enhance the installed system shall be provided in their source format and compiled format (where applicable).
3. Where electronic copies are specified, comply with the following:
 - a. Provide in word-searchable electronic format; acceptable formats are MS Word, Adobe Acrobat (pdf), and HTML; submit other formats for review and approval prior to submission; scanned paper documents not acceptable.
 - b. For submittals, provide separate file for each type of equipment.
 - c. Control sequences shall be in MS Word.

	Document	Paper (binder or bound)	Electronic	
			Loaded onto Flash Drive	Loaded onto CSS
1.	O&M Manual	2	1	1
2.	Original issue software	–	1 per workstation	1
3.	Project database including all source files	–	1 per workstation	1
4.	Project Record Drawings	2	1	1
5.	Control sequences	1	1	1
6.	Commissioning Reports	2	1	1
7.	Inspection Certificates	1	–	–
8.	Warranty documents	1	–	–
9.	Training materials	1 per trainee	1	1
10.	Contact information	1	–	1

D. Permanent On-site Documentation

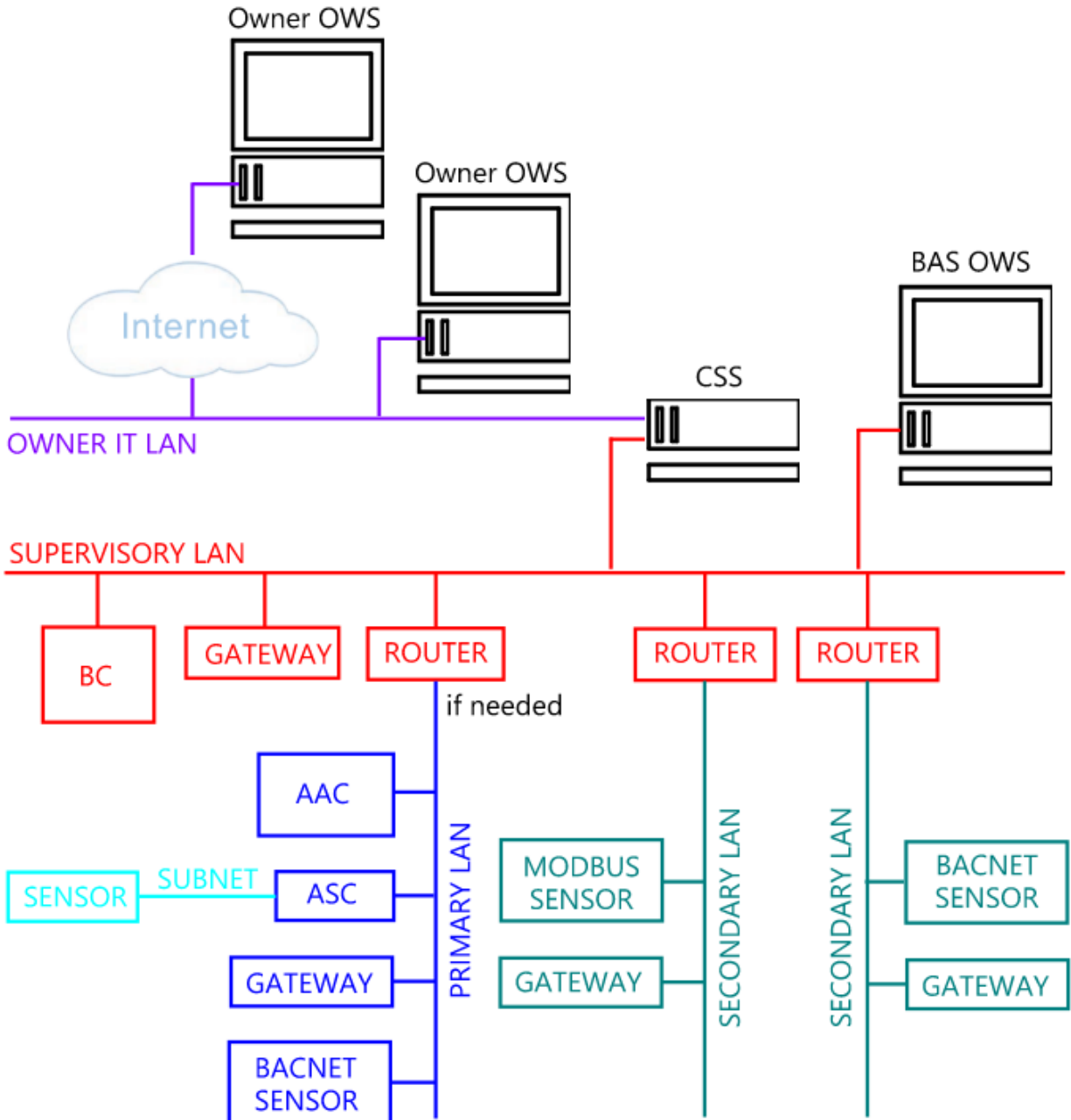
1. In panels, provide the following in a sufficiently permanent manner such that documentation cannot be easily removed (and lost):
 - a. Point list of all points in panel.
 - b. Shop drawings for devices in panel.

1.9 BAS DESIGN

A. System Architecture

1. General
 - a. The system provided shall incorporate hardware resources sufficient to meet the functional requirements specified in this Section. Include all items not specifically itemized in this Section that are necessary to implement, maintain, and operate the system in compliance with the functional intent of this Section.
 - b. The system shall be configured as a distributed processing network(s) capable of expansion as specified herein.
 - c. The existing Campus BAS consists of a control system server interconnected by a high speed Supervisory LAN to each campus building and facility. This project includes integrating building level BCs and other control devices into the campus system.
 - 1) Within the building, the BAS shall be standalone and not rely on any 3rd party networks, such as the Campus IT LAN.
 - 2) To communicate with the central CSS (and internet via VPN), the building Supervisory LAN shall connect via a managed firewall/router or managed switch, provided under Division 27, to the College IT LAN, provided by the College's IT group. Locate in building BDF.
 - d. All control products provided for this Project shall comprise an interoperable Native BACnet System. All control products provided for this Project shall conform to ANSI/ASHRAE Standard 135.
 - e. Power-line carrier systems are not acceptable for BAS communication
2. BAS Network Architecture
 - a. Owner IT LAN. Ethernet-based, 100 or 1000 Mbps network with VPN dedicated to BAS specified under Division 27 Communications.
 - b. Supervisory LAN: Ethernet-based, 100 or 1000 Mbps BACnet/IP network interconnecting BCs and certain gateways and possibly the CSS and OWS(s) as specified herein. LAN shall be IEEE 802.3 Ethernet with switches and routers that support 100 Mbps minimum throughput. This network shall be BACnet/IP as defined in the BACnet standard, and shall share a common network number for the Ethernet backbone, as defined in BACnet.
 - c. Primary LAN: High-speed, peer-to-peer communicating LAN used to connect BCs, AACs, and certain gateways where specified herein. The Primary LAN communicates exclusively control information. Acceptable technologies include and are limited to Ethernet (IEEE802.3)
 - d. Secondary LAN: Network used only to connect certain gateways and sensors where specified herein. It shall not be used to interconnect BCs, AACs, and ASCs. Network speed versus the number of devices on the LAN shall be dictated by the response time and trending requirements. Acceptable technologies include but are not limited to:
 - 1) BACnet over Master Slave/Token Passing (MS/TP)
 - 2) Modbus RTU over RS-485
 - e. Subnets: Networks used to connect sensors and thermostats to AACs and ASCs. This network may as above for Secondary LANs or may be proprietary the manufacturer.

3. Operator Interfaces and Servers. The Control Systems Server (CSS) and Operator interface devices are existing. No additional CSS, OWS, or POT shall be provided as a part of this project. See Paragraph **Error! Reference source not found.** for temporary CSS requirements.
4. The figure below shows an example of the desired network architecture. Note:
 - a. Not all devices shown will exist for this project.
 - b. Ethernet network installer shall be responsible for assigning IP addresses to all devices on the network.



5. Controllers. The BCs, AACs, and ASCs shall monitor, control, and provide the field interface for all points specified.
6. Gateways

- a. See Paragraph 2.4C for a list of gateways and routers.
- b. Where gateways are used, critical points shall be hardwired from the BAS to the controlled device, rather than using the gateway, to avoid problems with gateway failures, currently a common problem. Critical points are those that are essential for proper operation and are listed in points list as separate points. Where listed, these points shall be hardwired even when available through gateway.

B. System Performance

1. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. This includes when system is collecting trend data for commissioning and for long term monitoring. (See Paragraph 3.14H.) In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein, assuming no other simultaneous operator activity. Reconfigure LAN as necessary to accomplish these performance requirements. This does not apply to gateways and their interaction with non-BAS-vendor equipment.
 - a. Object Command: The maximum time between an operator command via the operator interface to change an analog or binary point and the subsequent change in the controller shall be less than 5 seconds.
 - b. Object Scan: All changes of state and change of analog values will be transmitted over the network such that any data used or displayed at a controller or workstation will have been current within the previous 10 seconds.
 - c. Graphics Scan: The maximum time between an operator's selection of a graphic and it completely painting the screen and updating at least 10 points shall be less than 10 seconds.
 - d. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation or broadcast (where so programmed) shall not exceed 10 seconds for a Level 1 alarm, 20 seconds for alarm levels 2 and 3, and 30 seconds for alarm levels 4 and 5. All workstations on the onsite network must receive alarms within 5 seconds of each other.
 - e. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
 - f. Control Loop Performance: Programmable controllers shall be able to execute DDC PID control loops at a selectable frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
2. Sensor selection, wiring method, use of transmitters, A-to-D conversion bits, etc. shall be selected and adjusted to provide end-to-end (fluid to display) accuracy at or better than those listed in the following table.

Measured Variable	Reported Accuracy
Space drybulb temperature	±1°F
Ducted Air drybulb temperature	±0.5°F
Mixed Air drybulb temperature	±1°F
Outside Air drybulb temperature	±0.5°F
Chilled and Condenser Water Temperature	±0.2°F
Hot Water Temperature	±0.5°F
Relative Humidity – general	±5% RH
Relative Humidity – outdoor air	±3% RH
Water and Gas Flow	±1% of reading
Airflow (terminal)	±10% of reading
Airflow (measuring stations)	±5% of reading

Measured Variable	Reported Accuracy
Air Pressure (ducts)	±0.05 inches
Air Pressure (space)	±0.01 inches
Water Pressure	±2% of reading
Electrical power	1% of reading
Carbon Dioxide (CO ₂)	±75 ppm

1.10 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project-developed software and documentation shall become the property of the Owner. These include, but are not limited to:
1. Project graphic images
 2. Record drawings
 3. Project database
 4. Project-specific application programming code
 5. All documentation

1.11 WARRANTY

- A. At the successful completion of the final testing, commissioning, and demonstration phase in accordance with the terms of this specification, if equipment and systems are operating satisfactorily to the Owner and if all completion requirements per Paragraph 1.8B have been fulfilled, the Owner shall certify in writing that the control system has been accepted. The date of acceptance shall be the start of the warranty period.
- B. Guarantee all materials, equipment, apparatus and workmanship (including programming) to be free of defective materials and faulty workmanship for the following periods from date of acceptance:
1. BCs, AACs, and ASCs: two years
 2. Valve and damper actuators: five years
 3. All else: one year
- C. Provide new materials, equipment, apparatus and labor to replace that determined by Owner to be defective or faulty.
- D. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. Contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.
- E. Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies shall be provided at no cost to the Owner during the warranty period.
- F. Sequence of operation programming bugs (both due to programming misinterpretations and sequence errors) shall be corrected and any reasonable control sequence changes required to provide proper system operation shall be provided at no additional cost to the Owner during this period.

1.12 WARRANTY MAINTENANCE

- A. The Owner reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the Owner, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.
- B. At no cost to the Owner, provide maintenance services for software and hardware components during the warranty period as specified below:
 - 1. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the Owner to the Contractor.
 - a. Response by telephone or via internet connection to the BAS to any request for service shall be provided within two hours of the Owner's initial request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected, at least one technician, trained in the system to be serviced, shall be dispatched to the Owner's site within eight hours of the Owner's initial request for such services.
 - 2. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following notification by the Owner to the Contractor.
 - a. Response by telephone to any request for service shall be provided within eight working hours (contractor specified 40 hr. per week normal working period) of the Owner's initial request for service.
 - b. In the event that the malfunction, failure, or defect is not, at least one technician, trained in the system to be serviced, shall be dispatched to the Owner's site within three working days of the Owner's initial request for such services, as specified.
 - 3. Owner's Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for Owner to call in the event of a need for service. At least one of the lines shall be attended continuously (24/7). Alternatively, pagers/SMS can be used for technicians trained in system to be serviced. One of the three paged/texted technicians shall respond to every call within 15 minutes.
 - 4. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.
 - 5. Documentation: Record drawings and software documentation shall be updated as required to reflect any and all changes made to the system or programming during the warranty period.

PART 2 PRODUCTS

2.1 PRIMARY BAS MANUFACTURER

- A. Delta Controls (to match campus standard)

2.2 GENERAL

- A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way.
- B. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

- C. All controllers, associated hardware (repeaters, routers, etc.), sensors, and control devices shall be fully operational and maintain specified accuracy at the anticipated ambient conditions of the installed location as follows:
 1. Outdoors or in harsh ambient conditions: -20°C to 55°C (-4°F to 130°F), 10% RH to 90% RH noncondensing.
 2. Conditioned spaces or mechanical rooms: 0°C to 40°C (32°F to 104°F), 10% RH to 80% RH noncondensing.

2.3 CONTROLLERS

- A. Building Controller (BC)
 1. Delta eBMGR
- B. Advanced Application Specific Controller (AAC)
 1. Delta Red5
- C. Application Specific Controller (ASC)
 1. Delta Red5

2.4 COMMUNICATION DEVICES

- A. Supervisory LAN Routers
 1. Delta eBMGR
- B. BACnet Gateways & Routers
 1. Gateways shall be provided to link non-BACnet control products to the BACnet inter-network. All of the functionality described in this Paragraph is to be provided by using the BACnet capabilities. Each Gateway shall have the ability to expand the number of BACnet objects of each type supported by 20% to accommodate future system changes.
 2. Each Gateway shall provide values for all points on the non-BACnet side of the Gateway to BACnet devices as if the values were originating from BACnet objects. The Gateway shall also provide a way for BACnet devices to modify (write) all points specified by the Points List using standard BACnet services.
- C. Gateway and Routers

Equipment/System	Interface			
	Type	Specified Under Division:	Location	Connect to this Network:
Variable Speed Drives	BACnet/MSTP	23	Each VFD	Secondary
Lighting Controls	BACnet/IP	26	BDF Room	Supervisory
Power Monitoring	BACnet/IP	26	BDF Room	Supervisory
BTU meters	BACnet/MSTP	25	Each BTU meter	Secondary
Emergency Generator	Modbus RS-485	26	Generator yard	Secondary

2.5 BAS INTERFACE HARDWARE

- A. Control System Server (CSS) and all other interface hardware is provided under Laney Central Utility Plant scope. No work in this section other than integration of database per Paragraph **Error! Reference source not found.**

2.6 AIR TUBING

- A. Seamless copper tubing, Type L-ACR, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder-joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder.
- B. Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, and with flame-retardant harness for multiple tubing. Use compression or push-on brass fittings.

2.7 ELECTRIC WIRING AND DEVICES

- A. All electrical work shall comply with Division 26.
- B. Communication Wiring
 1. Provide all communication wiring between Building Controllers, Routers, Gateways, AACs, ASCs and local and remote peripherals (such as operator workstations and printers).
 2. Ethernet LAN: Use Fiber or Category 5e or 6 of standard TIA/EIA 68 (10baseT). Network shall be run with no splices and separate from any wiring over 30 volts.
 3. ARCnet and MS/TP LAN: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over 30 volts. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.
- C. Analog Signal Wiring
 1. Input and output signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, current or voltage analog outputs, etc. shall be twisted pair, 100% shielded if recommended or required by controller manufacturer, with PVC cover. Gauge shall be as recommended by controller manufacturer.

2.8 CONTROL CABINETS

- A. All control cabinets shall be fully enclosed with hinged door.
 1. For panels in mechanical rooms and other spaces that are secure and accessible only to BAS/MEP operators, provide quarter-turn slotted latch.
 2. For panels located in electrical rooms, IDF rooms, and other spaces that may be accessible by persons other than BAS/MEP operators, provide key-lock latch. A single key shall be common to all panels within each building. Provide 3 keys.
- B. Construction
 1. Indoor: NEMA 1
 2. Outdoor: NEMA 3R

- C. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs or tie-wrapped. Terminals for field connections shall be UL Listed for service, individually identified per control-interlock drawings, with adequate clearance for field wiring. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover. Control terminations for field connection shall be individually identified per control Shop Drawings.
- D. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.
- E. Provide with
 - 1. Framed, plastic-encased point list for all points in cabinet.
 - 2. Nameplates for all devices on face.

2.9 SENSORS AND MISCELLANEOUS FIELD DEVICES

- A. The listing of several sensors or devices in this section does not imply that any may be used. Refer to points list in Paragraph 2.12 Points List for device specification. Only where two or more devices are specifically listed in points list (such as "FM-1 or FM-4") may the Contractor choose among listed products.
- B. Control Valves
 - 1. Manufacturers
 - a. Belimo
 - b. Siemens
 - c. Invensys
 - d. Delta
 - e. Bray
 - f. Or equal
 - 2. Butterfly Valves
 - a. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class bolt pattern to match specified flanges.
 - b. Seat: EPDM replaceable, non-collapsible, phenolic backed.
 - c. Disc: Polished aluminum bronze or stainless steel, pinned or mechanically locked to shaft. Sanded castings are not acceptable.
 - d. Bearings: Bronze or stainless steel.
 - e. Shaft: 416 stainless steel supported at three locations with PTFE bushings for positive shaft alignment.
 - f. Close off rating: Bubble-tight shutoff greater or equal to 125% of pump shut-off head.
 - g. Manufacturers (In Addition to Paragraph 2.9B.1.)
 - 1) Jamesbury
 - 2) Keystone
 - 3) Dezurik
 - 4) Or equal
 - 3. Two Position Ball Valves
 - a. Valves shall be specifically designed for two-position duty in control application with guaranteed average leak-free life span over 200,000 full stroke cycles.
 - b. Industrial quality with nickel plated forged brass body and female NPT threads.
 - c. Blowout proof stem design, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 600 psi rating (1 inch and smaller) or 400 psi rating (larger than 1 inch). The stem packing shall consist of 2 lubricated O-rings designed for on-off service and requiring no maintenance.

- d. Valves suitable for water or low-pressure steam shall incorporate an anti-condensation cap thermal break in stem design.
- e. No characterization disks
- f. Close off rating: Bubble-tight shutoff greater or equal to 125% of pump shut-off head.
- g. Ball: Chrome plated brass
- h. Stem: Chrome plated brass
- 4. Modulating Characterized Ball Valves
 - a. Valves shall be specifically designed for modulating duty in control application with guaranteed average leak-free life span over 200,000 full stroke cycles.
 - b. Industrial quality with nickel plated forged brass body and female NPT threads.
 - c. Blowout proof stem design, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 600 psi rating (2-way valves) or 400 psi rating (3-way valves). The stem packing shall consist of 2 lubricated O-rings designed for modulating service and requiring no maintenance.
 - d. Valves suitable for water or low-pressure steam shall incorporate an anti-condensation cap thermal break in stem design.
 - e. Close off rating: Bubble-tight shutoff greater or equal to 125% of pump shut-off head.
 - f. Ball: stainless steel
 - g. Stem: stainless steel
 - h. Characterizing disk held securely by a keyed ring providing equal percentage characteristic
- 5. Minimum valve assembly pressure ratings
 - a. Chilled water: 125 psi at 60°F
 - b. Hot water: 125 psi at 200°F
 - c. Condenser water: 125 psi at 100°F
- 6. Valve Selection
 - a. Valve type
 - 1) Modulating 2-way or 3-way valves: characterized ball type
 - 2) Two-position isolation: butterfly or non-characterized ball type
 - b. Valve Characteristic
 - 1) 2-way valves: equal percentage or modified equal percentage.
 - 2) 3-way valves controlling cooling coils and condenser water heat exchangers: linear.
 - 3) 3-way valves controlling heating coils: equal percentage or modified equal percentage.
 - 4) Two-position valves: not applicable. For ball valves used for two-position duty, do not include characterizing disk.
 - c. Valve Sizing
 - 1) Modulating Water: Size valve to achieve the following full-open pressure drop
 - a) Minimum pressure drop: equal to half the pressure drop of coil or exchanger.
 - b) Maximum pressure drop
 - 1. Hot water at coils: 2 psi
 - 2. Chilled water at coils: 5 psi
 - c) 3-way valves shall be selected for near minimum pressure drop. 2-way and 6-way valves shall be selected near maximum pressure drop.
 - d) Flow coefficient (C_v) shall not be less than 1.0 (to avoid clogging) unless protected by strainer. Verify from piping schematics that a strainer is being provided.
 - e) Valve size shall match as close as possible the pipe size where C_v is available in that size.
 - 2) Two-position valves: Line size unless otherwise indicated on Drawings.

C. Control Dampers

- 1. See Section 233300 Duct Accessories and Section 237300 Air Handling Units & Coils.

D. Actuators

1. Manufacturers
 - a. Belimo
 - b. No equal
2. Warranty: Valve and damper actuators shall carry a manufacturer's 5-year warranty.
3. Electric Actuators
 - a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.
 - b. Enclosure shall meet NEMA 4X weatherproof requirements for outdoor applications.
 - c. Dampers. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The clamp shall be steel of a V-bolt design with associated V-shaped, toothed cradle attaching to the shaft for maximum strength and eliminating slippage via cold weld attachment. Single bolt or set screw type fasteners are not acceptable. Aluminum clamps are unacceptable.
 - d. Valves. Actuators shall be specifically designed for integral mounting to valves without external couplings.
 - e. Actuator shall have microprocessor based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible.
 - f. Noise from actuator while it is moving shall be inaudible through a tee-bar ceiling.
 - g. Actuators shall provide protection against actuator burnout using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation or use of magnetic clutches are not acceptable.
 - h. Modulating Actuators. Actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. Actuators shall have positive positioning circuit so that controlled device is at same position for a given signal regardless of operating differential pressure. Actuators that internally use a floating actuator with an analog signal converter are not acceptable.
 - i. Where indicated on Drawings or Points List, actuators shall include
 - 1) 2 to 10 VDC position feedback signal
 - 2) Limit (end) position switches
 - j. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.
 - k. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
 - l. Actuators shall be provided with a conduit fitting an a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
 - m. Where fail-open or fail-closed (fail-safe) position is required by Paragraph 2.9D.5, an internal mechanical, spring return mechanism shall be built into the actuator housing. Electrical capacitor type fail-safe are also acceptable. All fail-safe actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
 - n. Actuators shall be capable of being mechanically and electrically paralleled to increase torque where required.
 - o. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 inch-pound torque capacity shall have a manual crank for this purpose.

- p. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed.
- q. Actuators shall provide clear visual indication of damper/valve position.
- 4. Electric Actuators for Large Butterfly Valves
 - a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.
 - b. The valve actuator shall consist of a capacitor-type reversible electric motor, gear train, limit switches and terminal block, all contained in a die cast aluminum enclosure.
 - c. Enclosure shall meet NEMA 4X weatherproof requirements for outdoor applications.
 - d. Output shaft shall be electroless nickel plated to prevent corrosion.
 - e. Actuator shall have a motor rated for minimum 75% duty cycle. Duty cycle shall be defined as running time divided by installed time at maximum torque.
 - f. Actuator shall be suitable for operation in ambient temperature ranging from -22°F to +150°F.
 - g. A pre-wired cable shall bring wiring outside enclosure to avoid necessity of opening cover.
 - h. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.
 - i. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator. When in manual operation electrical power to the actuator will be permanently interrupted.
 - j. The hand wheel will not rotate while the actuator is electrically driven.
 - k. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.
 - l. Provide limit (end) position switches where indicated on schematics.
 - m. Actuators shall provide clear visual indication of valve position.
- 5. Normal and Fail-Safe Position
 - a. Except as specified otherwise herein, the normal position (that with zero control signal) and the fail-safe position (that with no power to the actuator) of control devices and actuators shall be as indicated in table below. "Last" means last position. Actuators with a fail-safe position other than "Last" must have spring or electronic fail-safe capability.

Device	Normal Position	Fail-Safe Position
Outside air damper	CLOSED	OPEN (for life safety)
Return air damper (Note 1)	OPEN	CLOSED (for life safety)
Minimum outside air "dump" damper (Note 1)	CLOSED	CLOSED (for life safety)
Exhaust/relief air damper (Note 2)	CLOSED	OPEN (for life safety)
AHU heating coil valves	OPEN	LAST
AHU cooling coil valves	CLOSED	LAST
HW/CHW valves for changeover coils	Same as fail-safe	See Schematics
VAV box dampers	OPEN	LAST

Device	Normal Position	Fail-Safe Position
Notes: 1. Actuators shall be provided with damper as a UL listed smoke damper assembly under Section 237300 Air Handling Units & Coils. 2. Actuators shall be rated for 200°F ambient temperature minimum, e.g. Belimo FSAF series for smoke exhaust operation		

- 6. Valve Actuator Selection
 - a. Modulating actuators for valves shall have minimum rangeability of 50 to 1.
 - b. Water
 - 1) 2-way, 6-way, and two-position valves
 - a) Tight closing against 125% of system pump shut-off head.
 - b) Modulating duty against 90% of system pump shut-off head.
 - 2) 3-way shall be tight closing against twice the full open differential pressure for which they are sized.
- 7. Damper Actuator Selection
 - a. Actuators shall be direct coupled. For multiple sections, provide one actuator for each section; linking or jack-shafting damper sections shall not be allowed.
 - b. Provide sufficient torque as velocity, static, or side seals require per damper manufacturer's recommendations and the following:
 - 1) Torque shall be a minimum 5 inch-pound per square foot for opposed blade dampers and 7 inch-pound per square foot for parallel blade dampers.
 - 2) The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating.

E. General Field Devices

- 1. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.
- 2. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.
- 3. Field devices specified herein are generally two-wire type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with two-wire type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, provide a transmitter and necessary regulated DC power supply, as required.
- 4. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.
- 5. Accuracy: As used in this Section, accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis. Sensor accuracy shall be at or better than both that specifically listed for a device and as required by Paragraph 1.9B.2.

F. Temperature Sensors (TS)

- 1. General
 - a. Unless otherwise noted, sensors may be platinum RTD, thermistor, or other device that is commonly used for temperature sensing and that meets accuracy, stability, and resolution requirements.
 - b. When matched with A/D converter of BC, AAC, or ASC, sensor range shall provide a resolution of no worse than 0.3°F (0.16 °C) (unless noted otherwise herein).

- c. Sensors shall drift no more than 0.3°F and shall not require calibration over a five-year period.
- d. Manufacturers
 - 1) Mamac
 - 2) Kele Associates
 - 3) Building Automation Products Inc.
 - 4) Delta Controls
 - 5) Or equal
- 2. Duct temperature sensors: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise.
 - a. TS-1A: Single point (use where not specifically called out to be averaging in points list). Sensor probe shall be 304 stainless steel.
 - b. TS-1B: Averaging. Sensor length shall be at least 1 linear foot for each 2 square feet of face area up to 25 feet maximum. Sensor probe shall be bendable aluminum.
- 3. Water Temperature Sensors
 - a. TS-2A: Well mounted immersion sensor, ¼" stainless steel probe, double encapsulated sensor, with enclosure suitable for location.
 - b. TS-2B: Same as TS-2A except provide extra precision (XP) temperature sensors to meet accuracy specified Paragraph 1.9B.2.
 - c. TS-2C. See BTU-1.
 - d. All piping immersion sensors shall be in one-piece machined brass or stainless steel wells that allow removal from operating system, with lagging extension equal to insulation thickness where installed in insulated piping. Wells shall be rated for maximum system operating pressure, temperature and fluid velocity. The well shall penetrate the pipe by the lesser of approximately half the pipe diameter or eight inches. The use of direct immersion or strap-on type sensors is not acceptable.
- 4. Room Sensors
 - a. Thermostat tags refer to the following:

Type:	Tag	
Delta model	eZTS	eZNS
Display	Blank	LCD
Temperature only	TS-3A	TS-3C
With humidity	TS-3AH	TS-3CH
With CO ₂	TS-3AC	TS-3CC
With CO ₂ and humidity	TS-3AHC	TS-3CHC

- 1) Display
 - a) Blank: Blank cover (or LCD display with display configured to be shut off and touchpad or keypad disabled)
 - b) LCD: LCD display of all sensors, temperature setpoint adjustment buttons, and schedule override button
- 2) Humidity Sensor
 - a) 10% to 90%/±2% accuracy
 - b) Where humidity sensor is not specified but included as standard, it shall be configured to not be displayed on the LCD or any graphics and not included in points list, as if it did not exist. (The purpose is to avoid the expense of having to keep the sensor in calibration.)
- 3) CO₂ Sensor
 - a) 400 to 1250 PPM/ ±30PPM or 3% of reading, whichever is greater.
 - b) The sensor shall include automatic background calibration (ABC) logic to compensate for the aging of the infrared source and shall not require recalibration for a minimum of 5 years, guaranteed. If sensor is found to be out of calibration, supplier shall recalibrate at no additional cost to the Owner within 5 years of purchase date.

- c) Meet Title 24 requirements including calibration interval
 - 4) For room sensors connected to terminal box controllers (such as at VAV boxes) that require calibration: Include a USB port or some other means for connection of POT for terminal box calibration. Alternative means of terminal calibration are acceptable provided they result in no cost to Work performed under Section 230593 Testing, Adjusting, and Balancing.
 - b. See equipment schedules for thermostat type.
 - 5. TS-4: Outdoor Air Sensor
 - a. Outdoor air sensors shall have a sun shield, utility box, and watertight gasket to prevent water seepage.
 - 6. Temperature Transmitters: Where required by the Controller or to meet specified end-to-end accuracy requirements, sensors as specified above shall be matched with transmitters outputting 4-20 mA linearly across the specified temperature range. Transmitters shall have zero and span adjustments, an accuracy of 0.1°F when applied to the sensor range.
- G. BTU Meter (BTU-1)
- 1. Matched RTD or solid state temperature sensors with a differential temperature accuracy of +/-0.15°F.
 - 2. Flow meter: FM-1
 - 3. Unit accuracy shall be +/- 1% factory calibrated, traceable to NIST with certification.
 - 4. NEMA 1 enclosure.
 - 5. UL listed.
 - 6. Provide BACnet/MSTP network connection that will allow all point data to be transmitted to BAS network.
 - a. BACnet Points:
 - 1) Supply Temperature
 - 2) Return Temperature
 - 3) Flow
 - 4) Energy Rate (Btu/hr.)
 - 7. Manufacturers
 - a. Onicon System 20
 - b. Siemens Sitrans
 - c. Or Equal
- H. Differential Pressure Transmitters (DPT)
- 1. DPT-1: Water, General Purpose
 - a. Fast-response capacitance sensor
 - b. Two-wire transmitter, 4-20 mA output with zero and span adjustments
 - c. Accuracy
 - 1) Overall Accuracy (at constant temp) $\pm 0.25\%$ full scale (FS).
 - 2) Non-Linearity, BFSL $\pm 0.22\%$ FS.
 - 3) Hysteresis 0.10% FS.
 - 4) Non-Repeatability 0.05% FS.
 - d. Long Term Stability 0.5% FS per year
 - e. Only 316 stainless steel in contact with fluid
 - f. Pressure Limits
 - 1) 0 to 100 psid range: 250 psig maximum static pressure rating, 250 psig maximum overpressure rating.
 - 2) 100 to 300 psid range: 450 psig maximum static pressure rating, 450 psig maximum overpressure rating.
 - g. Include brass 5-valve assembly for single sensor devices. See Paragraph 3.11E.7.
 - h. Manufacturers
 - 1) Setra 209 or 230

- 2) Modus W30
- 3) Or equal
- 2. DPT-2: Not used
- 3. DPT-3: Air, Duct Pressure:
 - a. General: Loop powered two-wire differential capacitance cell-type transmitter.
 - b. Output: two wire 4-20 mA output with zero adjustment.
 - c. Overall Accuracy: $\pm 1\%$ of range (not of maximum range/scale)
 - d. Switch selectable range:
 - 1) ≥ 0.5 inches water column
 - 2) ≤ 10 inches water column
 - 3) Select range as specified in points list or, if not listed for specified setpoint to be between 25% and 75% full-scale.
 - e. Housing: Polymer housing suitable for surface mounting.
 - f. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301, Davis Instruments, or equal, with connecting tubing.
 - g. DPT-3A: Include LCD display of reading.
 - h. Manufacturers.
 - 1) Setra
 - 2) Modus
 - 3) Invensys
 - 4) Dwyer
 - 5) Or equal
- 4. DPT-4: Air, Low Differential Pressure
 - a. General: Loop powered, two-wire differential capacitance cell type transmitter.
 - b. Output: Two-wire 4-20 mA output with zero adjustment.
 - c. Overall Accuracy
 - 1) General: $\pm 1\%$ FS
 - d. Range
 - 1) Fixed (non-switch selectable)
 - 2) Minimum Range: 0, -0.1, -0.25, -0.5, or -1.0 inches water column
 - 3) Maximum Range: +0.1, 0.25, 0.5, or 1.0 inches water column
 - 4) Range shall be as specified in points list or, if not listed, selected such that specified setpoint is between 25% and 75% full-scale.
 - e. Housing: Polymer housing suitable for surface mounting
 - f. Static Sensing Element
 - 1) Ambient sensor: Dwyer A-306 or 420, BAPI ZPS-ACC-10, or equal
 - 2) Space sensor: Kele RPS-W, BAPI ZPS-ACC-01, Dwyer A-417 or 465, Veris AA05 or equal wall plate sensor
 - 3) Filter or duct pressure sensor: Dwyer A-301 or equal
 - 4) Plenum pressure sensor: Dwyer A-421 or equal
 - g. DPT-4A: Include LCD display of reading
 - h. Manufacturers
 - 1) Setra 267
 - 2) Modus
 - 3) Air Monitor
 - 4) Paragon
 - 5) Or equal
- 5. DPT-5: VAV Velocity Pressure
 - a. General: Loop powered two-wire differential capacitance cell type transmitter.
 - b. Output: Two-wire, 4-20 mA output with zero adjustment.
 - c. Flow transducer (including impact of A-to-D conversion) shall be capable of stably controlling to a setpoint of 0.004 inches differential pressure or lower, shall be capable of sensing 0.002 inches differential pressure or lower, and shall have a ± 0.001 inches or lower resolution across the entire scale.

- d. Calibration software shall use a minimum of two field measured points, minimum and maximum airflow, with curve fitting airflow interpolation in between.
- e. Range: 0 to 1.5 in.w.c.
- f. Housing: Polymer housing suitable for surface mounting.
- g. Manufacturer
 - 1) Automated Logic or Distech
 - 2) No equal

I. Differential Pressure Switches (DPS)

- 1. DPS-1: Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential, and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range. 0°F to 160°F operating temperature range.
- 2. DPS-2: Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Automatic reset. Provide manufacturer's recommended static pressure sensing tips and connecting tubing.

J. Current Switches (CS-1)

- 1. Clamp-on or solid-core
- 2. Range: as required by application
- 3. Trip Point: Automatic or adjustable
 - a. Exception: Fixed setpoint (Veris H-300 or equal) may be used on direct drive constant speed fans that do not have backdraft or motorized shutoff dampers.
- 4. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage
- 5. Lower Frequency Limit: 6 Hz
- 6. Trip Indication: LED
- 7. Approvals: UL, CSA
- 8. May be combined with relay for start/stop
- 9. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing with override switch. Kele RIBX, Veris H500, or equal
- 10. Manufacturers
 - a. Veris Industries H-608/708/808/908, and H6ECM05 for ECMs
 - b. Senva C-2320L
 - c. RE Technologies SCS1150A-LED
 - d. Or equal

K. Current Transformers (CT-1)

- 1. Clamp-On Design Current Transformer (for Motor Current Sensing)
- 2. Range: 1-10 amps minimum, 20-200 amps maximum
- 3. Trip Point: Adjustable
- 4. Output: 0-5 Vdc or 0-10 Vdc,
- 5. Accuracy: $\pm 0.2\%$ from 20 to 100 Hz.
- 6. Amperage range sizing and switch settings in accordance with the following and per manufacturer's instructions:

Motor HP	120V	277V	480V
$\leq 1/2$	0-10A	0-10A	-
3/4 – 1.5	-	0-10A	0-10A
2 – 5	-	-	0-10A
7.5 – 10	-	-	0-20A
15 – 20	-	-	0-30A
25 – 30	-	-	0-40A

- 7. Manufacturers
 - a. Veris Hx22 series

- b. Kele SC100
 - c. Or equal
- L. Flow Meter (FM)
1. FM-1: Magnetic Flow Tube Flow Meters
 - a. General Requirements
 - 1) Sensor shall be a magnetic flow meter, which utilizes Faraday's Law to measure volumetric fluid flow through a pipe. The flow meter shall consist of 2 elements, the sensor and the electronics. The sensor shall generate a measuring signal proportional to the flow velocity in the pipe. The electronics shall convert this EMF into a standard current output.
 - 2) Electronic replacement shall not affect meter accuracy (electronic units are not matched with specific sensors).
 - 3) Provide a four-wire, externally powered, magnetic type flow transmitter with adjustable span and zero, integrally mounted to flow tube. Output signal shall be a digital pulse proportional to the flow rate (to provide maximum accuracy and to handle abrupt changes in flow). Standard 4-20 mA or 0-10 Vdc outputs may be used on HVAC applications provided accuracy is as specified.
 - 4) Flow Tube
 - a) ANSI class 150 psig steel
 - b) ANSI flanges
 - c) Lined with
 1. Heating hot water, glycol: PTFE, PFA, or ETFE liner rated for $\leq -4^{\circ}\text{F}$ to $\geq 212^{\circ}\text{F}$ fluid temperature
 2. Chilled, condenser, domestic hot and cold water: Polypropylene, Ebonite, PTFE, PFA, or ETFE liner rated for $\leq 32^{\circ}\text{F}$ to $\geq 140^{\circ}\text{F}$ fluid temperature
 - 5) Electrode and grounding material
 - a) 316L Stainless steel or Hastelloy C
 - b) Electrodes shall be fused to ceramic liner and not require O-rings.
 - 6) Electrical Enclosure: NEMA 4
 - 7) Approvals
 - a) UL or CSA
 - b) NSF Drinking Water approval for domestic water applications
 - 8) Performance
 - a) Accuracy shall be $\pm 0.5\%$ of actual reading from 3 to 30 feet per second flow velocities, and ± 0.015 fps from 0.04 fps to 3 fps.
 - b) Stability: 0.1% of rate over six months.
 - c) Meter repeatability shall be $\pm 0.1\%$ of rate at velocities > 3 feet per second.
 - d) Calibration: The sensor must be factory calibrated on an internationally accredited (such as NAMAS) water flow rig with accuracy better than 0.1%. Calibration shall be NIST traceable.
 - b. Manufacturers
 - 1) Onicon F-3100 series
 - 2) Siemens/Danfoss Magflo 3100
 - 3) Krohne Optiflux 4000
 - 4) Sparling TigermagEP FM656
 - 5) Or equal
 2. FM-2: Not used
 3. FM-3: Not used
 4. FM-4: Not used
 5. FM-5: Not used
 6. FM-6: Domestic and makeup water meters
 - a. 2 inches and smaller: Multi-jet water meter

- 1) Multi-jet velocity type meter
 - 2) Magnetic drive – no gearing exposed to water
 - 3) 125 psi cast bronze body with integral strainer
 - 4) Meet all requirements of AWWA C-708 Multi-Jet Meter
 - 5) Accuracy: $\pm 1.5\%$ of reading
 - 6) Low voltage pulse output, with configurable volume per pulse.
 - 7) pulse output
 - 8) Odometer-type gallons totalizer display with weather cover
 - 9) Designed for vertical or horizontal piping
 - 10) For potable water: NSF-61 certified and in compliance with California Proposition 65
 - 11) Manufacturers:
 - a) SeaMetrics MJE, MJR, or WTS
 - b) Elster Amco M700
 - c) Master Meter
 - d) Equal
- b. 2.5 inches and larger: Compound-type water meter
- 1) Shall consist of a combination of a turbine-type, mainline meter for measuring high rates of flow and a bypass meter of an appropriate size for measuring low rates of flow. The compound meter shall have an automatic valve mechanism for diverting low rates of flow through the bypass meter.
 - 2) Comply with ANSI and AWWA C702 standards.
 - 3) Comply with NSF/ANSI Standard 61, ANNEX G.
 - 4) Maximum operating pressure of 150 psi and maximum operating temperature of 120°F continuous (220°F peak).
 - 5) Low voltage pulse output, with configurable volume per pulse.
 - 6) Manufacturers:
 - a) Badger Recordall Series Meter
 - b) Neptune
 - c) Or equal

M. Airflow Measuring Stations (AFMS)

1. General. AFMS provided under this Section shall be licensed to bear the AMCA Certified Rating Seal for Airflow Measuring Stations. Ratings shall be based on tests and procedures performed in accordance with AMCA Publication 611 and comply with requirements of the AMCA Certified Ratings Program.
2. AFMS-1
 - a. Differential pressure type with uniframe DP sensor
 - 1) Provide quantity of DP sensors per manufacturer's recommendations
 - b. Station mounted with expanded metal screen
 - c. Analog outputs for airflow and temperature
 - d. Manufacturers
 - 1) Air Monitor OAM-II-AFS
 - 2) No equal

N. Electric Control Components

1. Line-Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT contacts rated for 120V and current as required for application, temperature setpoint range of 50 to 90°F.
2. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.
 - a. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:

- 1) AC coil pull-in voltage range of +10%, -15% or nominal voltage.
- 2) Coil sealed volt-amperes (VA) not greater than 4 VA.
- 3) Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
- 4) Pilot light indication of power-to-coil and coil retainer clips.
- b. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load.
- c. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.
3. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1 enclosure. Manufacturer shall be Square D, Cutler-Hammer, or equal.
4. Control Transformers and Power Supplies
 - a. Control transformers shall be UL Listed. Furnish Class 2 current-limiting type, or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Mount in minimum NEMA-1 enclosure.
 - b. Transformer shall be proper size for application. Limit connected loads to 80% of rated capacity.
 - c. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection, and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.
 - d. Separate power transformer shall be used for controllers and for actuators and other end devices that use half wave rectification.
 - e. Unit shall operate between 0°C and 50°C [32°F and 120°F]. EM/RF shall meet FCC Class B and VDE 0871 for Class B, and MIL-STD 810C for shock and vibration.
 - f. Line voltage units shall be UL Recognized and CSA Approved.
5. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley, Kele, or equal.
6. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley, Kele, or equal.
7. Ceiling Fan Override
 - a. Mechanical Timer Switch: Switch shall be mechanically spring wound with a N.O. contact or N.C. contacts as required. Timer shall be 0-120 minutes and shall not include a "hold" feature, which allows switch contacts to remain closed. Intermatic FF2H or equal.
 - b. Potentiometer. Wall box mounted single turn with knob numbered 0 to 100. Wall plate cover to match electrical. Kele SPA or equal.
 - c. Mount in one-gang box if possible.
 - d. Label: see Drawings

2.10 CALIBRATION & TESTING INSTRUMENTATION

- A. Provide instrumentation required to verify readings, calibrate sensors, and test the system and equipment performance.

- B. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6-month period. Certificates of calibration shall be submitted.
- C. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (for example if field device is $\pm 0.5\%$ accurate, test equipment shall be $\pm 0.25\%$ accurate over same range).

2.11 SOFTWARE

A. General

- 1. System software shall be the latest version of Delta enteliWEB.

B. Licensing

- 1. Include licensing and hardware keys for all software packages at all workstations (OWSs and POTs) and servers.
- 2. Within the limitations of the server, provide licenses for any number of users to have web access to the CSS at any given time.
- 3. All operator interface, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the Owner.
- 4. All operator software, including that for programming and configuration, shall be available on all workstations. Hardware and software keys to provide all rights shall be installed on all workstations.

C. Graphical User Interface Software

1. Graphics

- a. The GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated graphics and active setpoint graphic controls shall be used to enhance usability.
- b. Graphics tools used to create Web Browser graphics shall be non-proprietary and provided and installed on each OWS.
- c. Graphical display shall be 1280 x 1024 pixels or denser, 256 color minimum.
- d. Links
 - 1) Graphics shall include hyperlinks which when selected (clicked on with mouse button) launch applications, initiate other graphics, etc.
 - 2) Screen Penetration: Links shall be provided to allow user to navigate graphics logically without having to navigate back to the home graphic. See additional discussion in Paragraph 3.12E.
 - 3) Information Links
 - a) On each MEP system and subsystem graphic, provide links to display in a new window the information listed below.
 - 1. English-language as-built control sequence associated with the system. See Paragraph 1.8B.
 - 2. O&M and submittal information for the devices on the graphic. See Paragraph 1.8B. This includes links to electronic O&M and submittal information for mechanical equipment supplied under Section 230501 Basic Mechanical Materials and Methods.
 - b) The display shall identify the target of the link by file name/address.
 - c) Information shall be displayed in electronic format that is text searchable.
 - d) Window shall include software tools so that text, model numbers, or point names may be found. Source documents shall be read-only (not be editable) with this software.

e. Point Override Feature

- 1) Every real output or virtual point displayed on a graphic shall be capable of being overridden by the user (subject to security level access) by mouse point-and-click from the graphic without having to open another program or view.
- 2) When the point is selected to be commanded
 - a) Dialog box opens to allow user to override the point (Operator Mode) or release the point (Automatic Mode). Operator Mode will override automatic control of the point from normal control programs.
 - b) Dialog box shall have buttons (for digital points) or a text box or slide bar (for analog points) to allow user to set the point's value when in operator mode. These are grayed out when in automatic mode.
 - c) When dialog box is closed, mode and value are sent to controller.
 - d) Graphic is updated upon next upload scan of the actual point value.
- 3) A list of points that are currently in an operator mode shall be available through menu selection.
- f. Point override status (if a digital point is overridden by the supervised manual override per Paragraph 2.3A or if a point is in operator mode per Paragraph 2.11C.1.e) shall be clearly displayed on graphics for each point, such as by changing color or flag.
- g. The color of symbols representing equipment shall be able to change color or become animated based on status of binary point to graphically represent on/off status.
2. Alarms
 - a. Standard Delta enteliWEB alarm package configured as indicated below.
3. Trends
 - a. Delta enteliWEB trend package configured as indicated below.
 - b. Trend Data Storage
 - 1) The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the BAS using SQL queries.
 - 2) Data shall be stored in an SQL compliant database format and shall be available through the Owner's intranet or internet (with appropriate security clearance) without having to disable BAS access to the database.
 - 3) The database shall not be inherently limited in size, e.g. due to software limitations or lack of a correct license. Database size shall be limited only by the size of the provided storage media (hard drive size).
4. Security Access
 - a. Standard Delta enteliWEB security package
5. Report Software
 - a. Delta enteliVault
 - b. Standard reports. Prepare the following standard reports, accessible automatically without requiring definition by user.
 - 1) Tenant or department after-hour usage. System must be capable of monitoring tenant override requests and generating a monthly report showing the daily total time in hours that each tenant has requested after-hours HVAC services.
 - 2) Monthly and annual energy usage and cost. See Utility cost calculation in Paragraph 3.12.
 - 3) Alarm events and status.
 - 4) Points in Hand (Operator Override) via Workstation command (including name of operator who made the command) or via supervised HOA switch at output, including date and time.

D. Control Programming Software

1. Delta GCL+

E. Miscellaneous Software

1. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide relevant data for the application or object that help is being called from.
2. Provide software for viewing (but not editing) electronic versions of as-built shop drawings of
 - a. Mechanical, electrical, and plumbing systems in Adobe pdf format
 - b. BAS drawings in Adobe pdf format

2.12 CONTROL POINTS

A. Table Column Definitions

1. Point description
2. Type (number in point schedule after each type refers to tag on schematics)
 - a. AO: analog output
 - b. AI: analog input
 - c. DO: digital or binary output
 - d. DI: digital or binary input
3. Device description
 - a. See Paragraph 2.9 for device definition.
4. Trend Logging
 - a. Commissioning: Where listed, point is to be trended at the basis listed for commissioning and performance verification purposes.
 - b. Continuous: Where listed, point is to be trended at the basis listed continuously, initiated after system acceptance, for the purpose of future diagnostics.
 - c. Trend Basis
 - 1) Where range of engineering units is listed, trend on a change of value (COV) basis (in other words record time stamp and value when point value changes by engineering unit listed).
 - 2) Where time interval is listed, trend on a time basis (in other words record time stamp and value at interval listed). All points relating to a specific piece of equipment shall be trended at the same initiation time of day so data can be compared in text format.
5. Calibration
 - a. F = factory calibration only is required (no field calibration)
 - b. HH = field calibrate with handheld device. See Paragraph 3.14D.6.a.2)

B. Note that points lists below are for each system of like kind. Refer to drawings for quantity of each.

C. Points mapped through gateways and network interfaces

1. Variable speed drives

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Fault reset	DO	Through network	COV	COV	–
On/off status	DI	Through network	COV	COV	–
Fault (Critical Alarm)	DI	Through network	COV	COV	–
Minor Alarm	DI	Through network	COV	COV	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Fault Text	DI	Through network (convert code to plain English text)	COV	COV	–
Alarm Text	DI	Through network (convert code to plain English text)	COV	COV	–
Keypad in hand/auto	DI	Through network	COV	COV	–
Minimum frequency setpoint	AO	Through network	±5%	±5%	–
Maximum frequency setpoint	AO	Through network	±5%	±5%	–
Acceleration rate	AO	Through network	±5%	±5%	–
Deceleration rate	AO	Through network	±5%	±5%	–
Actual frequency	AI	Through network	1 min	15 min	–
AC output voltage	AI	Through network	±10%	±10%	F
Current	AI	Through network	15 min	60 min	F
VFD temperature	AI	Through network	60 min	60 min	F
Power, kW	AI	Through network	1 min	15 min	F
Energy, MWh	AI	Through network	15 min	60 min	–

2. Electrical System Monitoring. See Division 26 Drawings for quantity of meters and location of network connection.

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Real kW	AI	Through network	15 min	15 min	–
Volts (each phase)	AI	Through network	±10%	±10%	–
Power factor	AI	Through network	±10%	±10%	–
Amps (each phase)	AI	Through network	–	–	–

3. BTU Meter (BTU-1)

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Return Temperature	AI	Through network	1 min	15 min	F
Supply Temperature	AI	Through network	1 min	15 min	F
Flow	AI	Through network	1 min	15 min	F
Btu/h	AI	Through network	1 min	15 min	–

4. Lighting Controls
a. Global

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Demand Shed 1	DO	Through network	COV	COV	–
Demand Shed 2	DO	Through network	COV	COV	–
Demand Shed 3	DO	Through network	COV	COV	–

- b. For each lighting zone

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Occupancy Sensor State	DI	Through network	COV	COV	-

5. Emergency Generator

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Status normal power	DI	Through network	COV	COV	-
Status generator power	DI	Through network	COV	COV	-
Generator running	DI	Through network	COV	COV	-
Generator not in auto	DI	Through network	COV	COV	-
Shut-down summary alarm	DI	Through network	COV	COV	-
Fuel tank alarm – low level	DI	Through network	COV	COV	-
Fuel tank alarm – high level	DI	Through network	COV	COV	-
Fuel tank alarm – rupture	DI	Through network	COV	COV	-
Water temperature alarm	DI	Through network	COV	COV	-
Low DC battery voltage	DI	Through network	COV	COV	-
Battery charger malfunction	DI	Through network	COV	COV	-
Ground fault	DI	Through network	COV	COV	-
Low coolant level	DI	Through network	COV	COV	-
Pre-alarm Low fuel	DI	Through network	COV	COV	-
Pre-alarm high water temperature	DI	Through network	COV	COV	-
Pre-alarm low oil pressure	DI	Through network	COV	COV	-
Over-speed alarm	DI	Through network	COV	COV	-
Over-crank alarm	DI	Through network	COV	COV	-
High water temperature alarm	DI	Through network	COV	COV	-
Low oil pressure alarm	DI	Through network	COV	COV	-
Emergency stop alarm	DI	Through network	COV	COV	-
Pre-overload alarm	DI	Through network	COV	COV	-
Overload alarm	DI	Through network	COV	COV	-
AC current Phase 1	AI	Through network	±10%	±10%	-
AC current Phase 2	AI	Through network	±10%	±10%	-
AC current Phase 3	AI	Through network	±10%	±10%	-
AC voltage neutral	AI	Through network	±10%	±10%	-
AC voltage Phase 1	AI	Through network	±10%	±10%	-
AC voltage Phase 2	AI	Through network	±10%	±10%	-
AC voltage Phase 3	AI	Through network	±10%	±10%	-

D. Hardwired Points

1. VAV Box - Cooling only

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
VAV Box Damper Position	AO	Modulating actuator	1 min	15 min	–
Local Override	DI	TS-3x – where applicable (see Paragraph 2.9F).	COV	COV	–
Supply Airflow	AI	DPT-5 connected to box manufacturer supplied flow cross	1 min	15 min	HH (see §230593)
Zone Temperature Setpoint Adjustment	AI	TS-3x – where applicable (see Paragraph 2.9F).	15 min	60 min	F
Zone Temperature	AI	TS-3x (see Paragraph 2.9F)	1 min	15 min	F

2. VAV dual duct zones

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Cooling damper	AO	Modulating actuator	COV	COV	–
Heating damper	AO	Modulating actuator	COV	COV	–
Local Override	DI	TS-3x – where applicable (see Paragraph 2.9F).	COV	COV	–
Zone Temperature Setpoint Adjustment	AI	TS-3x – where applicable (see Paragraph 2.9F).	15 min	60 min	F
Zone Temperature	AI	TS-3x (see Paragraph 2.9F)	1 min	15 min	F
Cooling air volume	AI	DPT-5 connected to box manufacturer supplied flow cross at cooling inlet	1 min.	10 min.	HH (see §230593)
Heating air volume	AI	DPT-5 connected to box manufacturer supplied flow cross at heating inlet	1 min.	10 min.	HH (see §230593)
CO ₂ concentration	AI	TS-3x (see Paragraph 2.9F)	1 min.	10 min.	F

3. VAV Box - Cooling only with Thermafusers

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
VAV Box Damper Position	AO	Modulating actuator	1 min	15 min	–
Duct Static Pressure	AI	DPT-3A, 0 to 0.5 inches	1 min	15 min	F
Supply Airflow	AI	DPT-5 connected to box manufacturer supplied flow cross	1 min	15 min	HH
Zone Temperature	AI	TS-3A	1 min	15 min	F

4. Ceiling Fans

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Ceiling Fan Start/Stop	DO	Connect to fan controller	COV	COV	–
Ceiling Fan Status	DI	Connect to fan status	COV	COV	–
Ceiling Fan Speed Setpoint	AO	Connect to fan controller	1 min	15 min	–
Wall Mounted Fan Override	DI	0-2 hour windup timer	COV	COV	–
Wall mounted speed override	AI	Speed potentiometer	1 min	±20%	–

5. Cooling VAV Air Handler

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Relief damper 1 open/close	DO	Two position actuator	COV	COV	–
Relief damper 2 open/close	DO	Two position actuator	COV	COV	–
Relief Fan 1 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Relief Fan 2 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Supply fan high static alarm reset	DO	Dry contact to 120V or 24V control circuit –see control schematics for details	COV	COV	–
Supply Fan 1 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Supply Fan 2 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Changeover valves	DO	Two position 2-way valves, CW and HW, spring return per drawings	COV	COV	–
Outdoor Air Damper	AO	Modulating actuator	1 min	15 min	–
Return Air Damper	AO	Modulating actuator by others (part of UL listed smoke damper)	1 min	15 min	–
Minimum Outdoor Air “Dump” Damper	AO	Modulating actuator by others (part of UL listed smoke damper)	1 min	15 min	–
Relief Fan Speed	AO	Connect to VFD Speed, RF-1 and 2	1 min	15 min	–
Supply Fan Speed	AO	Connect to VFD Speed, SF-1 and 2	1 min	15 min	–
Chilled/hot Water Control Valves	AO	Modulating 2-way valves, CHW and HW, spring return closed	1 min	15 min	–
Mixed Air Temperature	AI	TS-1B across filter bank	1 min	15 min	F
Filter Pressure Drop	AI	DPT-3A, 0 to 1 inch	–	60 min	F
Return Air Temperature	AI	TS-1A	1 min	15 min	F
Outdoor Airflow	AI	AFMS-1, flow output	1 min	15 min	F
Outdoor Temperature	AI	AFMS-1, temperature output	1 min	15 min	F
Supply Air Temperature	AI	TS-1A	1 min	15 min	HH
Duct Static Pressure	AI	DPT-3A, 0 to 2 inches	1 min	15 min	F

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Building Pressure, Building, 2 nd floor	AI	DPT-4, ±0.25	1 min	15 min	F
Building Pressure, Building, 3 rd floor	AI	DPT-4, ±0.25	1 min	15 min	F

6. Heating VAV Air Handler

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Supply fan high static alarm reset	DO	Dry contact to 120V or 24V control circuit –see control schematics for details	COV	COV	–
Supply Fan 1 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Supply Fan 2 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Supply Fan Speed	AO	Connect to VFD Speed, SF-1 and 2	1 min	15 min	–
Hot Water Control Valve	AO	Modulating 2-way valves	1 min	15 min	–
Filter Pressure Drop	AI	DPT-3A, 0 to 1 inch	–	60 min	F
Supply Air Temperature	AI	TS-1A	1 min	15 min	HH
Duct Static Pressure	AI	DPT-3A, 0 to 2 inches	1 min	15 min	F

7. Hot Water Pumps

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Start HWP-1	DO	Connect to VFD Run	COV	COV	–
Start HWP-2	DO	Connect to VFD Run	COV	COV	–
Pump speed	AO	Connect to VFD Speed, HWP-1 and 2	1 min	5 min	–
Hot Water Control Valve	AO	Modulating 2-way valves	1 min	15 min	–
HW differential pressure from plant	AI	DPT-1, 0 to 50 psi	5 min	15 min	F
HW differential pressure in building	AI	DPT-1, 0 to 40 psi	5 min	15 min	F

8. Chilled Water Connection

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
CHW differential pressure from plant	AI	DPT-1, 0 to 50 psi	5 min	15 min	F

9. Domestic Water Heaters

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Recirculation Pumps Start/Stop	DO	Line voltage contact to pump power circuit	COV	COV	–
DHW Supply Temperature	AI	TS-2A	5 min	15 min	F
Recirculation Pump Status	DI	CS-1 OR CT-1	COV	COV	See 3.11F
DHW heater Alarm	DI	Install relay wired downstream of DHW heater safeties with NC relay contact wired as alarm input.	COV	COV	–

10. Toilet Exhaust Fan

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Fan Start/Stop	DO	Dry contact to 120V starter control circuit	COV	COV	–
Fan Status	DI	CS-1 OR CT-1	COV	COV	See 3.11F

11. Miscellaneous Points

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Domestic water consumption	AI	FM-6	1 min	15 min	HH
Domestic hot water consumption	AI	FM-6	1 min	15 min	HH
Outdoor Air Temperature	AI	TS-4, located on north wall	1 min	15 min	HH

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details indicated on Drawings.
- B. Coordinate Work and Work schedule with other trades prior to construction.
- C. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment.
- B. Store equipment and materials inside and protect from weather.

3.3 IDENTIFICATION

- A. General
 - 1. Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.
 - 2. Identifiers shall match record documents.
 - 3. All plug-in components shall be labeled such that removal of the component does not remove the label.
- B. Wiring and Tubing
 - 1. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2 inches of termination with the BAS address or termination number.
 - 2. Permanently label or code each point of field terminal strips to show the instrument or item served.
 - 3. All pneumatic tubing shall be labeled at each end within 2 inches of termination with a descriptive identifier.
- C. Equipment and Devices
 - 1. Valve and damper actuators: None required.
 - 2. Sensors: Provide 1 inch x 3 inches x 1/8 inches black micarta or lamacoid labels with engraved white lettering, 1/4 inches high. Indicate sensor identifier and function (for example "CHWS Temp").
 - 3. Panels
 - a. Provide 2 inches x 5 inches 1/8 inches black micarta or lamacoid labels with engraved white lettering, 1/2 inches high. Indicate panel identifier and service.
 - b. Provide permanent tag indicating the electrical panel and circuit number from which panel is powered.
 - 4. Identify room sensors relating to terminal box or valves with indelible marker on sensor hidden by cover.

3.4 CUTTING, CORING, PATCHING AND PAINTING

- A. Provide canning for openings in concrete walls and floors and other structural elements prior to their construction.
- B. Penetrations through rated walls or floors shall be filled with a listed material to provide a code compliant fire-stop.
- C. All damage to and openings in ductwork, piping insulation, and other materials and equipment resulting from Work in this Section shall be properly sealed, repaired, or re-insulated by experienced mechanics of the trade involved. Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

- D. At the completion of Work, all equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired and repainted to original finish.

3.5 CLEANING

- A. Clean up all debris resulting from its activities daily. Remove all cartons, containers, crates, and other debris generated by Work in this Section as soon as their contents have been removed. Waste shall be collected and legally disposed of.
- B. Materials stored on-site shall be protected from weather and stored in an orderly manner, neatly stacked, or piled in the designated area assigned by the Owner's Representative.
- C. At the completion of work in any area, clean all work and equipment of dust, dirt, and debris.
- D. Use only cleaning materials recommended by the manufacturer of the surfaces to be cleaned and on surfaces recommended by the cleaning material manufacturer.

3.6 CONTROLLERS

- A. General
 - 1. Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details indicated on Drawings.
 - 2. Regardless of application category listed below, each Control Unit shall be capable of performing the specified sequence of operation for the associated equipment. Except as listed below, all physical point data and calculated values required to accomplish the sequence of operation shall reside within the associated CU. Listed below are point data and calculated values that shall be allowed to be obtained from other CUs via LAN.
 - a. Global points such as outdoor air temperature
 - b. Requests, such as heat/cool requests, used to request operation or for setpoint reset from zones to systems and systems to plants
 - c. Modes, such as system modes, used to change operating logic from plants to systems and systems to zones
 - 3. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

- B. Controller Application Categories
 - 1. Controllers shall comply with the application table below (X under controller type indicates acceptable controller type).

Application Category	Examples	Acceptable Controller		
		ASC	AAC	BC
0	Monitoring of variables that are not used in a control loop, sequence logic, or safety, such as status of sump pumps or associated float switches, temperatures in monitored electrical rooms.	X	X	X
1	Miscellaneous heaters Constant speed exhaust fans and pumps	X	X	X

Application Category	Examples	Acceptable Controller		
		ASC	AAC	BC
2	VAV Boxes	X		
3	HW/CHW Plant connections	X (note 1)	X	X
4	Heating Air Handling System		X (note 1)	X
5	Cooling Air Handling System			X
Notes: Controller may be used only if all control functions and physical I/O associated with a given unit resides in one AAC/ASC				

2. ASC Installation
 - a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure and shall be rated for plenum use if ceiling attic is used as a return air plenum.
 - b. ASCs that control equipment mounted in a mechanical room may either be mounted in or on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.
 - c. ASCs that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical/utility space.
3. AAC and BC Installation
 - a. AACs/BCs shall be located in a temperature control cabinets constructed per Paragraph 2.8.

3.7 COMMUNICATION DEVICES

- A. General
 1. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details indicated on Drawings.
 2. Provide all interface devices and software to provide an integrated system.
- B. LANID and LAN Routers
 1. Provide as required
 2. Connect networks to both sides of device
 3. Thoroughly test to ensure proper operation
 4. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted. The system shall automatically monitor the operation of all network devices and annunciate any device that goes off-line because it is failing to communicate.
- C. Gateways and Routers to Equipment Controllers
 1. See Paragraph 2.4C for network connection of gateways and routers.
 2. Wire to networks on both sides of device.
 3. Map across all monitoring and control points listed in Paragraph 2.12C.
 4. Thoroughly test each point to ensure that mapping is accurate.
 5. Initiate trends of points as indication in Paragraph 2.12C.
- D. External Communications
 1. Provide an Ethernet second port on the CSS to which the Owner can connect their Owner IT LAN (intranet), by others. Contractor shall coordinate with the Owner's

Representative to establish an IP address and communications parameters to assure proper operation. This connection shall also provide access to Internet through Owner's firewall to Internet Services Provider procured by Owner.

3.8 CONTROL AIR TUBING

- A. Sensor air tubing shall be sized by the Contractor.
- B. All control air piping shall be concealed except in equipment rooms or unfinished areas.
- C. Installation methods and materials
 - 1. Concealed and Inaccessible: Use copper tubing or FR plastic in metal raceway. Exception: Room thermostat drops in stud walls in areas with lay-in ceiling may be FR plastic tubing.
 - 2. Concealed and Accessible tubing (including ceiling return air plenums) shall be copper tubing or FR plastic tubing, subject to the following limitations
 - a. FR tubing shall be enclosed in metal raceway when required by local code.
 - b. Quantity of FR tubing per cubic foot of plenum space shall not exceed manufacturer's published data for Class 1 installation.
 - 3. Exposed to view or damage: Use hard-drawn copper or FR plastic in metal raceway.
 - a. Where copper tubing is used, a section 12 inches or less of FR plastic tubing is acceptable at final connection to control device.
- D. Mechanically attach tubing to supporting surfaces. Sleeve through concrete surfaces in minimum 1 inch sleeves, extended 6 inches above floors and 1 inch below bottom surface of slabs.
- E. Pneumatic tubing shall not be run in raceway containing electrical wiring.
- F. Where FR tubing exits the end of raceway or junction box, provide a snap-in nylon bushing. Where pneumatic tubing exits control panels, provide bulkhead fittings. Where copper tubing exits junction boxes or panels, provide bulkhead fittings.
- G. All tubing shall be number coded on each end and at each junction for easy identification.
- H. All control air piping shall be installed in a neat and workmanlike manner parallel to building lines with adequate support.
- I. Piping above suspended ceilings shall be supported from or anchored to structural members or other piping or duct supports. Tubing shall not be supported by or anchored to electrical raceways or ceiling support systems.
- J. Brass-barbed fittings shall be used at copper-to-FR tubing junctions. Plastic slipped-over copper tubing is not acceptable.
- K. Number-code or color-code tubing, except local individual room control tubing, for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.

3.9 CONTROL POWER

- A. Power wiring and wiring connections required for Work in this Section shall be provided under this Section unless specifically indicated on Division 26 Drawings or Specifications. See Paragraph 1.1B.
- B. Extend power to all BAS devices, including 120V power to panels, from an acceptable power panel.
 - 1. See Division 26 Electrical Drawings for power locations pre-allocated for BAS system.
 - 2. Where no power source is indicated on drawings, for bid purposes only, assume a dedicated circuit is available within an average of 20 feet of panel location. If this is not the case, request additional cost prior to submission of shop drawings or no additional costs will be reimbursed.
 - 3. Coordinate with Division 26 during shop drawing development for final connection location.
- C. General requirements for obtaining power include the following:
 - 1. Electrical service to controls panels and control devices shall be provided by isolated circuits, with no other loads attached to the circuit, clearly marked at its source. The location of the breaker shall be clearly identified in each panel served by it.
 - 2. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120V source fed from a common origin.
 - 3. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or not of the correct voltage to supply the controls, provide separate transformer(s).
 - 4. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, or interruptible), the controller shall be powered by the highest level of reliability served.
- D. Unless transformers are provided with equipment as specified in related Division 23 and 26 equipment Sections, Contractor shall provide transformers for all low voltage control devices including non-powered terminal units such as cooling-only VAV boxes and VAV boxes with hot water reheat. Transformer(s) shall be located in control panels in readily accessible locations such as Electrical Rooms.
- E. Power line filtering. Provide transient voltage and surge suppression for all workstations and BCs either internally or as an external component.

3.10 CONTROL AND COMMUNICATION WIRING

- A. Control and Signal Wiring
 - 1. Comply with Division 26.
 - 2. Line Voltage Wiring
 - a. All line-voltage wiring shall meet NEC Class 1 requirements.
 - b. All Class 1 wiring shall be installed in UL Listed approved raceway per NEC requirements and shall be installed by a licensed electrician.
 - c. Class 1 wiring shall not be installed in raceway containing pneumatic tubing.
 - 3. Low Voltage Wiring
 - a. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
 - b. Class 2 wiring shall be installed in UL Listed approved raceway as follows:

- 1) Where located in unconcealed or inaccessible locations, such as:
 - a) Equipment rooms
 - b) Exposed to weather
 - c) Exposed to occupant view
 - d) Inaccessible locations such as concealed shafts and above inaccessible ceilings
- 2) Class 2 wiring shall not be installed in raceway containing Class 1 wiring.
- c. Class 2 wiring need not be installed in raceway as follows:
 - 1) Where located in concealed and easily accessible locations, such as:
 - a) Inside mechanical equipment enclosures and control panels
 - b) Above suspended accessible ceilings (e.g. lay-in and spline)
 - c) Above suspended drywall ceilings within reach of access panels throughout
 - d) In shafts within reach of access panels throughout
 - e) Nonrated wall cavities
 - 2) Wiring shall be UL Listed for the intended application. For example, cables used in floor or ceiling plenums used for air transport shall be UL Listed specifically for that purpose.
 - 3) Wiring shall be supported from or anchored to structural members neatly tied at 10 foot intervals and at least 1 foot above ceiling tiles and light fixtures. Support or anchoring from straps or rods that support ductwork or piping is also acceptable. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceilings.
 - 4) Install wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- d. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two (for example relays and transformers).
4. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
5. All field wiring shall be properly labeled at each end, with self-laminating typed labels indicating device address, for easy reference to the identification schematic. All power wiring shall be neatly labeled to indicate service, voltage, and breaker source.
6. Use coded conductors throughout with different colored conductors.
7. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
8. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the Contractor shall provide step-down transformers.
9. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
10. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendation and NEC requirements.
11. Include one pull string in each raceway 1 inch or larger.
12. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
13. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 inches from high-temperature equipment (for example steam pipes or flues).
14. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
15. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
16. Terminate all control or interlock wiring.

17. Maintain updated as-built wiring diagrams with terminations identified at the jobsite.
18. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than ½ inches electrical trade size shall not be used. In areas exposed to moisture liquid-tight, flexible metal raceways shall be used.
19. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings per code. Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.
20. Wire digital outputs to either the normally-closed or normally-open contacts of binary output depending on desired action in case of system failure. Unless otherwise indicated herein, wire to the NO contact except the following shall be wired to the NC contact
 - a. Hot water pumps
21. Hardwire Interlocks
 - a. The devices referenced in this Section are hardwire interlocked to ensure equipment shutdown occurs even if control systems are down. Do not use software (alone) for these interlocks.
 - b. Hardwire device NC contact to air handler fan starter upstream of HOA switch, or to VFD enable contact.
 - c. Where multiple fans (or BAS DI) are controlled off of one device and the device does not have sufficient contacts, provide a relay at the device to provide the required number of contacts.
 - d. Provide for the following devices where indicated on Drawings or in Sequences of Operation:
 - 1) Duct smoke detector
 - 2) High discharge static pressure
 - 3) Low mixing plenum pressure
22. Shielded cable shield shall be grounded only at one end. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

B. Communication Wiring

1. Adhere to the requirements of Paragraph 3.10A in addition to this Paragraph.
2. Communication and signal wiring may be run without conduit in concealed, accessible locations as permitted by Paragraph 3.10A only if noise immunity is ensured. Contractor is fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.
3. All cabling shall be installed in a neat and workmanlike manner. Follow all manufacturers' installation recommendations for all communication cabling.
4. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
5. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.
6. Verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
7. All runs of communication wiring shall be unspliced length when that length is commercially available.
8. All communication wiring shall be labeled to indicate origination and destination data.
9. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communications Circuits, Cable and Protector Grounding.
10. Power-line carrier signal communication or transmission is not acceptable.

3.11 SENSORS AND MISCELLANEOUS FIELD DEVICES

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for the environment within which the sensor operates.
- C. Sensors used as controlled points in control loops shall be hardwired to the controller to which the controlled device is wired and in which the control loop shall reside.
- D. Temperature Sensors
 - 1. Room temperature sensors and thermostats shall be installed with back plate firmly secured to the wall framing or drywall anchors.
 - a. For sensors mounted in exterior walls or columns, use a back plate insulated with foam and seal all junction box openings with mastic sealant.
 - b. For sensors on exposed columns, use Wiremold or equal enclosures that are the smallest required to enclose wiring (e.g. Wiremold 400 BAC or equal) and Wiremold or equal junction boxes that are the narrowest required to enclose the temperature sensor and wiring connections (e.g. Wiremold 2348S/51 or equal). Color or raceway and boxes shall be per the architect; submit for approval prior to installation.
 - 2. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
 - 3. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip. Where located in front of filters (such as mixed air sensors), access for filter removal shall be maintained.
 - 4. Temperature sensors downstream of coils shall be located as far from the coil fins as possible, 6 inches minimum. Temperature sensors upstream of coils shall be a minimum of 6 inches away from the coil fins. No part of the sensor or its support elements or conduit shall be in contact with the coil, coil framing or coil support elements. Discharge temperature sensors on VAV boxes shall be mounted as far from the coil as possible but upstream of the first diffuser with the probe located as near as possible to the center of the duct both vertically and horizontally.
 - 5. All pipe-mounted temperature sensors shall be installed in wells. For small piping, well shall be installed in an elbow into pipe length. Install the sensor in the well with a thermal-conducting grease or mastic. Use a closed-cell insulation patch that is integrated into the pipe insulation system to isolate the top of the well from ambient conditions but allow easy access to the sensor. Install a test plug adjacent to all wells for testing and calibration.
 - 6. Unless otherwise noted on Drawings or Points List, temperature sensors/thermostats, humidity sensors/humidistats, CO₂ sensors, and other room wall mounted sensors shall be installed at same centerline elevation as adjacent electrical switches, 4 feet above the finished floor where there are no adjacent electrical switches, and within ADA limitations.
 - 7. Unless otherwise noted on Drawings or Points List, install outdoor air temperature sensors on north wall where they will not be influenced by building exhaust, exfiltration, or solar insolation. Do not install near intake or exhaust air louvers.
- E. Differential Pressure Sensors
 - 1. Supply Duct Static Pressure
 - a. Mount transmitter in temperature control panel near or in BAS panel to which it is wired.
 - b. Low pressure port of the pressure sensor
 - 1) Pipe to either
 - a) Building pressure (high) signal of the building static pressure transmitter.
 - b) Open to a conditioned space inside the building
 - c) Open to the BAS panel in which the DPT is mounted provided the panel is inside the building envelope and not in an air plenum.
 - c. High-pressure port of the pressure sensor

- 1) Pipe to the duct using a static pressure tip located as indicated on Drawings; if no location is indicated, locate at end of duct riser or main as far out in the system as possible but upstream of all smoke and fire dampers.
 - 2) Install pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions.
2. Building Static Pressure
 - a. Mount transmitter in temperature control panel near or in BAS panel to which it is wired.
 - b. Low pressure port of the pressure sensor
 - 1) Pipe to the ambient static pressure probe located on the outside and at high point of the building through a high-volume accumulator or otherwise protected from wind fluctuations.
 - c. High-pressure port of the pressure sensor
 - 1) Pipe to either
 - a) Behind a BAS temperature sensor cover in an interior zone (provided sensor has openings to allow ambient air to freely flow through it)
 - b) Wall plate sensor
 - 2) Do not locate near elevators, exterior doors, atria, or (for ceiling sensor applications) near diffusers.
 3. Filter Differential Pressure
 - a. Install static-pressure tips upstream and downstream of filters with tips oriented in direction of flow. If there is a Magnehelic gauge installed by the AHU manufacturer, it may be removed and discarded with its pressure tips used for the DPT provided the DPT has an LCD so it can double as a visual gauge.
 - b. Mount transmitter on outside of filter housing or filter plenum in an accessible position with LCD display clearly visible. This sensor is used in lieu of an analog gauge and thus must be readily viewable.
 4. High/Low Static Pressure Safeties
 - a. High static
 - 1) Install DPS-2 on side of supply air duct in accessible location.
 - 2) High port shall be open to supply air duct downstream of fan.
 - 3) Reference low port pressure shall be that at DP location.
 - b. Low static
 - 1) Install DPS-2 inside or outside of mixed air plenum whichever is most accessible.
 - 2) Low port shall be open to mixed air plenum.
 - 3) Reference high port pressure shall be pressure on other side of mixed air plenum with the highest pressure, e.g. ambient pressure for systems with relief fans or non-powered relief, or relief air plenum for systems with return fans.
 5. All pressure transducers, other than those controlling VAV boxes, shall be located where accessible for service without use of ladders or special equipment. If required, locate in field device panels and pipe to the equipment monitored or ductwork.
 6. The piping to the pressure ports on all pressure transducers (both air and water) shall contain a capped test port located adjacent to the transducer.
 7. Piping differential pressure transducers shall have one of the following:
 - a. Five valve manifold, brass, two valves to allow removal of sensor without disrupting the hydronic system, an equalizing valve to allow the sensor to be zeroed and to prevent sensor from experiencing full static (as opposed to differential) where, and two valves used as air vents that also can be used as test plugs for calibration.
 - b. For sensors using two separate sensors, install test plugs on each connection for calibration and also used as vents.

F. Current Switches and Current Transformers for Motor Status Monitoring

1. For CTs, create a software binary point for fan status triggered at a setpoint determined below and ~10% deadband.

2. Adjust the setpoint so that it is below minimum operating current and above motor no load current. For fans with motorized discharge dampers, adjust so that fan indicates off if damper is closed while fan is running. For pumps, adjust so that pump indicates off if valve is closed while pump is running.
- G. Airflow Measuring Stations: Install per manufacturer's recommendations for unobstructed straight length of duct both upstream and downstream of sensor, except those installations specifically designed for installation in fan inlet. For installations in fan inlets, provide on both inlets of double inlet fans and provide inlet cone adapter as recommended by AFMS manufacturer.
- H. Fluid Flow Meters: Install per manufacturer's recommendations for unobstructed straight length of pipe both upstream and downstream of sensor. Commission per the manufacturer's startup and commissioning recommendations. Complete all manufacturer's startup documentation and include this in prefunctional commissioning report.
- I. Actuators
1. Type: All actuators shall be electric.
 2. Mount and link control damper actuators per manufacturer's instructions.
 3. Dampers
 - a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage, or follow manufacturer's instructions to achieve same effect.
 - b. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - c. Provide all mounting hardware and linkages for actuator installation.
 4. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, mount the valve so that the position indicator is visible from the floor or other readily accessible location. However, do not install valves with stem below horizontal or down. The preferred location for the valve and actuator is on lowest point in the valve train assembly for ease of access and inspection. If this is on the coil supply piping, the control valve may be located there even if schematics (and standard practice) show valves located on the coil return piping. This comment applies to both 2-way valves and 3-way valves (which would become diverting valves rather than mixing valves in this location).

3.12 SOFTWARE INSTALLATION

- A. System Configuration
1. Thoroughly and completely configure BAS system software, supplemental software, network software etc. on OWS, POTs, and servers.
- B. Point Structuring and Naming
1. The intent of this Paragraph is to require a consistent means of naming points across the BAS. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, etc.
 2. Point Summary Table
 - a. The term "Point" includes all physical I/O points, virtual points, and all application program parameters.
 - b. With each schematic, provide a Point Summary Table listing
 - 1) Building number and abbreviation
 - 2) System type

- 3) Equipment type
 - 4) Point suffix
 - 5) Full point name (see Point Naming Convention Paragraph)
 - 6) Point description
 - 7) Ethernet backbone network number
 - 8) Network number
 - 9) Device ID
 - 10) Device MAC address
 - 11) Object ID (object type, instance number)
 - 12) Engineering units
 - 13) Device make and model number; include range of device if model number does not so identify.
 - 14) Device physical location description; include floor and column line intersection to one decimal place (for example line 6.2 and line A.3).
- c. Point Summary Table shall be provided in both hard copy and in a relational database electronic format (ODBC-compliant).
 - d. Coordinate with the Owner's representative and compile and submit a proposed Point Summary Table for review prior to any object programming or Project startup.
 - e. The Point Summary Table shall be kept current throughout the duration of the Project by the Contractor as the Master List of all points for the Project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the Owner the final Point Summary Table prior to final acceptance of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.
3. Point Naming Convention
 - a. All point names shall adhere to the format as established below, unless otherwise agreed to by the Owner. New categories and descriptors may be created with approval of the Owner.
 - b. Format:
 - 1) Building.Category.System.EquipmentTag.Component.Property.
 - 2) Example: 001.HVAC.Heatplant.B-1.HWS.Temperature

Building	Category	System	Equipment Tag	Component	Property	Typical units
Building number	ELCT	Lighting	(from equipment schedules)	SWITCH	Command	On/off
		Plug		PHOTO	Status	On/off
	Generator	CB		Light	Footcandles	
	Misc			Power	Watts	
HVAC	Airhandling	CWS	Voltage	Volts		
	Exhaust	CWR	Current	Amps		
Coolplant	Heatplant	HWS	ValvePos	%open		
	Misc	HWR	DamperPos	%open		
PLMB	Domwater	CHWS	Temperature	°F		
	Air	CHWR	Humidity	%RH		
Natgas	N2	OA	Pressure	Psig, "H ₂ O		
	O2	SA	Flow	Cfm, gpm		
Irrigation	Waste	RA	Energy	Btu		
	Misc	EA	Speed	%, Hz		
MISC	Weather		GAS	Signal	%	
			FLUID			

4. Device Addressing Convention

- a. BACnet network numbers and Device Object IDs shall be unique throughout the network.
 - b. All assignment of network numbers and Device Object IDs shall be coordinated with the Owner to ensure there are no duplicate BACnet device instance numbers.
 - c. Each Network number shall be unique throughout all facilities and shall be assigned in the following manner: VVVNN, where: VVV = 0-999 for BACnet Vendor ID, NN = 00 - 99 for building network.
 - d. Each Device Object Identifier property shall be unique throughout the system and shall be assigned in the following manner: VVVNNDD , where: VVV = number 0 to 999 for BACnet Vendor ID , NN = 00 - 99 for building network, DD = 01-99 for device address on a network.
 - e. Coordinate with the Owner or a designated representative to ensure that no duplicate Device Object IDs occur.
 - f. Alternative Device ID schemes or cross-project Device ID duplication if allowed shall be approved before Project commencement by the Owner.
5. I/O Point Physical Description
- a. Each point associated with a hardware device shall have its BACnet long-name point description field filled out with:
 - 1) The device manufacturer and model number. Include range of device if model number does not so identify.
 - 2) For space sensors, include room number in which sensor is located.

C. Point Parameters

- 1. Provide the following minimum programming for each analog input
 - a. Name
 - b. Address
 - c. Scanning frequency or COV threshold
 - d. Engineering units
 - e. Offset calibration and scaling factor for engineering units
 - f. High and low value reporting limits (reasonableness values), which shall prevent control logic from using shorted or open circuit values.
 - g. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the primary or secondary controlling networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides or failure of any network over which the point value is transferred.
- 2. Provide the following minimum programming for each analog output
 - a. Name
 - b. Address
 - c. Engineering units
 - d. Offset calibration and scaling factor for engineering units
 - e. Output Range
 - f. Default value to be used when the normal controlling value is not reporting.
- 3. Provide the following minimum programming for each digital input
 - a. Name
 - b. Address
 - c. Engineering units (on/off, open/closed, freeze/normal, etc.)
 - d. Debounce time delay
 - e. Message and alarm reporting as specified
 - f. Reporting of each change of state, and memory storage of the time of the last change of state
 - g. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

4. Provide the following minimum programming for each digital output
 - a. Name
 - b. Address
 - c. Output updating frequency
 - d. Engineering units (on/off, open/closed, freeze/normal, etc.)
 - e. Direct or Reverse action selection
 - f. Minimum on-time
 - g. Minimum off-time
 - h. Status association with a DI and failure alarming (as applicable)
 - i. Reporting of each change of state, and memory storage of the time of the last change of state.
 - j. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.
 - k. Default value to be used when the normal controlling value is not reporting.
- D. Site-Specific Application Programming
1. All site specific application programming shall be written in a manner that will ensure programming quality and uniformity. Contractor shall ensure:
 - a. Programs are developed by one programmer, or a small group of programmers with rigid programming standards, to ensure a uniform style.
 - b. Programs for like functions are identical, to reduce debugging time and to ease maintainability.
 - c. Programs are thoroughly debugged before they are installed in the field.
 2. Message and tune application programming for a fully functioning system. It is the Contractor's responsibility to request clarification on sequences of operation that require such clarification.
 3. All site-specific programming shall be fully documented and submitted for review and approval
 - a. Prior to downloading into the panel (see Submittal Package 2, Paragraph 1.7.)
 - b. At the completion of functional performance testing, and
 - c. At the end of the warranty period (see Warranty Maintenance, Paragraph 1.12).
 4. All programming, graphics and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the Project will be the property of the Owner and shall remain on the workstations/servers at the completion of the Project.
- E. Graphic Screens
1. All site specific graphics shall be developed in a manner that will ensure graphic display quality and uniformity among the various systems.
 2. Schematics of MEP systems
 - a. Schematics shall be 2-D or 3-D and shall be based substantially on the schematics provided on Drawings.
 - b. All relevant I/O points and setpoints being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the mouse.
 - c. Animation or equipment graphic color changes shall be used to indicate on/off status of mechanical components.
 - d. Indicate all adjustable setpoints and setpoint high and low limits (for automatically reset setpoints), on the applicable system schematic graphic or, if space does not allow, on a supplemental linked-setpoint screen.
 3. Displays shall show all points relevant to the operation of the system, including setpoints.

4. The current value and point name of every I/O point and setpoint shall be shown on at least one graphic and in its appropriate physical location relative to building and mechanical systems.
5. Show weather conditions (local building outside air temperature and humidity) in the upper left hand corner of every graphic.
6. CAD Files: The contract document drawings will be made available to the Contractor in AutoCAD format upon request for use in developing backgrounds for specified graphic screens, such as floor plans and schematics. However the Owner does not guarantee the suitability of these drawings for the Contractor's purpose.
7. Provide graphics for the following as a minimum
 - a. Site homepage: Background shall be a campus map, approximately to scale. Include links to each building, central plant, etc.
 - b. Building homepage: Background shall be a building footprint, approximately to scale, oriented as shown on the campus homepage. Include links to each floor and mechanical room/area, and to summary graphics described below. Include real-time site utility data such as building electrical demand and domestic cold water flow demand shown roughly on the map where the utilities connect to the site.
 - c. Electricity demand limiting
 - 1) Demand limit. Include entries for sliding window interval and a table of Off-Peak, On-Peak or Partial-Peak demand time periods, both Summer and non-Summer, with three adjustable demand level limits for each and adjustable deadband.
 - 2) Electricity demand calculation. For each month, show actual peak kW and kWh for each time-of-day rate period. Show side-by-side as month-this-year and month-last-year, and month-to-date and year-to-date data.
 - d. Each occupied floor plan, to scale
 - 1) HVAC: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, which provide a visual display of temperature relative to their respective setpoints. The colors shall be updated dynamically as a zone's actual comfort condition changes. In each zone, provide links to associated terminal equipment.
 - 2) If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens.
 - e. Each equipment floor/area plan: To scale, with links to graphics of all BAS controlled/monitored equipment.
 - f. Each air handler and fan-coil: Provide link to associated HW and CHW plants where applicable.
 - g. Each trim & respond reset: Next to the display of the setpoint that is being reset, include a link to page showing all trim & respond points (see Guideline 36) plus the current number of requests, current setpoint, and status indicator point with values "trimming," "responding," or "holding." Include a graph of the setpoint trend for the last 24 hours. Trim & respond points shall be adjustable from the graphic except for the associated device.
 - h. Each zone terminal:
 - 1) Provide link to associated air handling unit where applicable and to floor plan where terminal is located.
 - 2) Include supply air temperature from AHU serving terminal unit.
 - 3) Include a non-editable graphic (picture) showing the design airflow setpoints from the design drawings adjacent to the editable airflows setpoints. The intent is that the original setpoints be retained over time despite "temporary" adjustments that may be made over the years.

- i. Electrical power monitoring system: Show a schematic of the electrical system based on one-line diagrams with meter current kW reading and month-to-date kWh shown in actual locations. Power flow shall change on the diagram (by changing line color or width) to show which power line is active.
- j. Central plant equipment including chilled water system, cooling tower system, hot water system, steam system, generators, etc.: The flow path shall change on the diagram (by changing piping line color or width) to show which piping has active flow into each boiler, chiller, tower, etc. as valve positions change.
- k. Summary graphics: Provide a single text-based page (or as few as possible) for each of the following summary screens showing key variables listed in columns for all listed equipment. Include hyperlinks to each zone imbedded in the zone tag:
 - 1) Air handling units: operating mode; on/off status; supply air temperature; supply air temperature setpoint; fan speed; duct static pressure; duct static pressure setpoint; outdoor air and return air damper position; coil valve positions; etc. (all key operating variables); Cooling CHWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Heating HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier (if HW coil)
 - 2) VAV Zone terminal units: operating mode; airflow rate; airflow rate setpoint; zone temperature; active heating setpoint; active cooling setpoint; damper position; HW valve position (reheat boxes); supply air temperature (reheat boxes); supply air temperature setpoint (reheat boxes); CO2 concentration and CO2 loop output (where applicable); Fan start/stop command, speed, and status (fan-powered); Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Cooling SAT Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Heating Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier (dual duct); Heating SAT Reset current requests, cumulative %-request-hours, and request Importance Multiplier (dual duct).
 - 3) Electrical meters and switches: Volts, current, kW, switch positions.
- l. For all equipment with runtime alarms specified, show on graphic adjacent to equipment the current runtime, alarm setpoint (adjustable), alarm light, date of last runtime counter reset, and alarm reset/acknowledge button which resets the runtime counter.
- m. For all equipment with lead/lag or lead/standby operation specified, show on graphic adjacent to equipment the current lead/lag order and manual buttons or switches to allow manual lead switching by the operator per Paragraph 3.13B.5.
- n. For all controlled points used in control loops, show the setpoint adjacent to the current value of the controlled point.
- o. All other BAS controlled/monitored equipment.
- p. On all system graphics, include a "note" block that allows users to enter comments relevant to system operation.
- q. All equipment shall be identified on the graphic screen by the unit tag as scheduled on the drawings.

F. Alarm Configuration

- 1. Program alarms and alarm levels per Sequence of Operations.
- 2. Each programmed alarm shall appear on the alarm log screen and shall be resettable or acknowledged from those screens. Equipment failure alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for example, fan alarm shall be shown on graphic air handling system schematic screen). For all graphic screens, display values that are in a Level 1 or 2 condition in a red color, Level 3 and higher alarm condition in a blue color, and normal (no alarm) condition in a neutral color (black or white).

3. For initial setup, Contractor shall configure alarms as follows:

	Level 1	Level 2	Level 3	Level 4
Criticality	Critical	Not Critical	Not Critical	Not Critical
Acknowledgement	Required	Required	Not Required	Not Required
Acknowledgement of Return to Normal	Not Required	Not Required	Not Required	Not Required
Email to building engineer(s)	Y	Y	Y	N
SMS text to building engineer(s)	Y	Y	N	N
Pop-up dialog box on OWS	Y	Y	N	N
Remove from alarm log	After Acknowledged	After Acknowledged	After 2 weeks	After 2 weeks

3.13 SEQUENCES OF OPERATION

- A. Sequences herein reference ASHRAE Guideline 36-2018 including published addenda, possibly followed by exceptions or additions where indicated. Guideline 36 sequences are not repeated herein for brevity and to make exceptions/revisions very clear. However, the final as-built sequences of operation (see Paragraph 1.8B.1.j and 2.11C.1.d.3)a)1) shall include all installed sequences verbatim from Guideline 36.
- B. General
1. Fully comply with ASHRAE Guideline 36-2018 Section 5.1 General.
 2. Contractor shall review sequences prior to programming and suggest modifications where required to achieve the design intent. Contractor may also suggest modifications to improve performance and stability or to simplify or reorganize logic in a manner that provides equal or better performance. Proposed changes in sequences shall be included as a part of Submittal Package 2.
 3. Include costs for minor program modifications if required to provide proper performance of the system.
 4. Minimum speed setpoints for all VFD-driven equipment shall be determined in accordance with Paragraph 3.14D.8.
 5. Equipment Staging and Rotation
 - a. Parallel devices shall be lead/lag or lead/standby rotated to maintain even wear.
 - b. Two runtime points shall be defined for each device:
 - 1) Lifetime Runtime: The cumulative runtime of the device since device start-up. This point shall not be readily resettable by operators.
 - 2) Staging Runtime: An operator resettable runtime point that stores cumulative runtime since the last operator reset.
 - c. Lead/lag devices: Unless otherwise noted, parallel staged devices (such as CHW pumps and cooling towers) shall be lead/lag alternated when more than one is off or more than one is on so that the device with the most operating hours as determined by Staging Runtime is made the last stage device and the one with the least number of hours is made the lead stage device.
 - d. Exceptions to Lead/lag rotation
 - 1) Operators with appropriate access level shall be able to manually command staging order via software points, but not overriding the In Alarm or Hand Operation logic below.
 - a) Faulted Devices: A faulted device is any device commanded to run that is either not running or unable to perform its required duty. If an operating

device has any fault condition described subsequently, a Level 2 alarm shall be generated and a response shall be triggered as defined below.

1. Fans and Pumps
 - a. Status point not matching its on/off point for 15 seconds after a time delay of 15 seconds when device is commanded on.
 - b) Upon identification of a fault condition:
 1. For fans and pumps:
 - a. The next commanded OFF device in the staging order, Device “B”, shall be commanded ON while alarming Device “A” remains commanded ON.
 - b. If Device B fails to prove status (i.e. it also goes into alarm), it shall remain commanded on and the preceding step shall be repeated until the quantity of devices called for by the lead/lag logic have proven on.
 - c. When either the required number of devices proves on or all devices are commanded on, set alarming devices to the last positions in the lead/lag staging order sequenced reverse chronologically (i.e. the device that alarmed most recently is sent to last position).
 - d. Staging order of non-alarming devices shall follow the even wear logic. A device in alarm can only automatically move up in the staging order if another device goes into alarm.
 - e. Devices in alarm shall run if so called for by the lead/lag staging order and present stage.
 - 2) Hand Operation: If a device is on in Hand (e.g., via an HOA switch or local control of VFD), the device shall be set to the lead device and a Level 4 alarm shall be generated. The device will remain as lead until the alarm is reset by the operator. Hand operation is determined by:
 - a) Fans and Pumps
 1. Status point not matching its on/off point for 15 seconds after a time delay of 60 seconds when device is commanded off.
6. Occupancy Status
 - a. Occupancy status of all spaces shall be via the Lighting Control BACnet interface.
 - b. Where a zone serves more than one room, “unoccupied” (or “unpopulated” per Guideline 36 terminology) means all rooms are unoccupied and “occupied” (populated) means any room is occupied.
 - c. In case of the network connection with the Lighting Controls is lost, occupancy status shall default to “occupied” if the Zone Group is in Occupied Mode and “unoccupied” for any other Zone Group Mode.
 7. VAV Box Controllable Minimum
 - a. This section is used to determine the lowest possible VAV box airflow setpoint (other than zero) allowed by the controls (*V_m*) used in VAV box control sequences. The minimums shall be stored as software points that may be adjusted by the user but need not be adjustable via the graphical user interface.
 - b. Option 1: If the VAV box controller can control to 0.004” per Paragraph 2.9H.5.c., the minimum setpoint *V_m* shall be determined from the table below if the VAV box manufacturer is listed:

Inlet	Titus	Krueger	Price	MetalAire High Gain	ETI
4	15	15	20	15	15
6	30	35	30	30	30
8	55	60	55	50	55

Inlet	Titus	Krueger	Price	MetalAir High Gain	ETI
10	90	90	95	85	90
12	120	130	135	110	130
14	190	175	195	155	180
16	245	230	260	210	235
24x16	455	445	490	N/A	415

c. Option 2: The minimum setpoint V_m shall be determined per Guideline 36.

C. Electricity Demand Limiting

1. Sliding Window: The demand control function shall utilize a sliding window method selectable in increments of one minute, up to 60 minutes, 15 minute default.
2. Demand Levels: Demand time periods shall be set up as per utility rate schedule. For each On/Off/Partial-Peak period, three demand level limits can be defined. When the measured demand exceeds the limit, the Demand Limit Level switch for that level shall be set; when demand is more than 10% (adjustable) below the limit for a minimum of 15 minutes, or the time is no longer within the On/Off/Partial-Peak window, the switch shall be reset. These levels are used at the zone level (see Zone Control sequences) to shed demand.
3. In addition to setpoint reset logic triggered by Demand Levels as described below, include Demand Shed commands to the lighting control system via BACnet interface for each Demand Level. The response to each Demand Shed command shall be programmed into the lighting control system under Division 26.

D. Zones

1. Fully comply with ASHRAE Guideline 36-2018 Section 5.2 Generic Ventilation Zones.
 - a. Use Title 24 for ventilation logic.
 - 1) Add the following to 5.2.1.4.2
 - a) c. If no value or if "AUTO" is entered in VAV box schedules for Occupied Minimum Airflow Setpoint (V_{min}), V_{min} shall be set equal Zone-Abs-OA-min
 - b. Fully implement Time Averaged Ventilation (TAV) 5.2.2 and use it when VAV minimum, V_{min}^* , is below the lowest allowed by the controls (V_m).
2. Fully comply with ASHRAE Guideline 36-2018 Section 5.3 Generic Thermal Zones.
 - a. Default setpoints:

Zone type	Occupied		Unoccupied	
	Heat	Cool	Heat	Cool
VAV zones with ceiling fans	70°F	79°F	60°F	90°F
VAV exterior	70°F	75°F	60°F	90°F
VAV interior	70°F	73°F	60°F	90°F
Electrical and mechanical	60°F	85°F	60°F	85°F
IDF/MDF	60°F	80°F	60°F	85°F

E. Zone Groups

1. Fully comply with ASHRAE Guideline 36-2018 Section 5.4 Zone Groups.
2. Unless otherwise specified by Owner, the following Zone Groups shall be created:

Zone Group Name	AH Tag	Terminal Unit Tags	Default Schedule
1st Floor	AH-C/H	VAV-1-x	WD: 6am to 8pm WE: 8am to 10pm HOL: off

2 nd Floor	AH-C/H	VAV-2-x	WD: 6am to 8pm WE: 8am to 10pm HOL: off
3 rd Floor	AH-C/H	VAV-2-x	WD: 6am to 8pm WE: 8am to 10pm HOL: off

- F. VAV Cooling-only boxes
1. Fully comply with ASHRAE Guideline 36-2018 Section 5.5 unless otherwise noted below.
 2. Parameters
 - a. Design Information (see VAV Box schedule):
 - 1) V_{cool-max}, zone maximum cooling airflow setpoint
 - 2) V_{min}, zone occupied minimum airflow setpoint (optional; If V_{min} airflow setpoint is not entered in schedules, V_{min} will be dynamically calculated using Paragraph 3.13D.1.a.1).)
 - 3) V_{occ-min}, zone minimum outdoor airflow for occupants, per Title 24 prescribed airflow-per-occupant requirements
 - 4) V_{area-min}, zone minimum outdoor airflow for building area, per Title 24 prescribed airflow-per-area requirements
 - 5) Whether occupied-standby mode is allowed per Title 24.
- G. Dual Duct VAV Boxes – Snap Acting Control
1. Fully comply with ASHRAE Guideline 36-2018 Section 5.11. unless otherwise noted below.
 2. Parameters
 - a. Design Information (see VAV Box schedule):
 - 1) V_{cool-max}, zone maximum cooling airflow setpoint
 - 2) V_{min}, zone occupied minimum airflow setpoint (optional; If V_{min} airflow setpoint is not entered in schedules, V_{min} will be dynamically calculated using Paragraph 3.13D.1.a.1).)
 - 3) V_{heat-max}, zone maximum heating airflow setpoint
 - 4) V_{occ-min}, zone minimum outdoor airflow for occupants, per Title 24 prescribed airflow-per-occupant requirements
 - 5) V_{area-min}, zone minimum outdoor airflow for building area, per Title 24 prescribed airflow-per-area requirements
 - 6) If occupied standby is allowed
- H. Dual Duct VAV Terminal Unit – Mixing Control with Inlet Airflow Sensors
1. Fully comply with ASHRAE Guideline 36-2018 Section 5.12. unless otherwise noted below.
 2. Parameters
 - a. Design Information (see VAV Box schedule):
 - 1) V_{cool-max}, zone maximum cooling airflow setpoint
 - 2) V_{min}, zone occupied minimum airflow setpoint (optional; If V_{min} airflow setpoint is not entered in schedules, V_{min} will be dynamically calculated using Paragraph 3.13D.1.a.1).)
 - 3) V_{heat-max}, zone maximum heating airflow setpoint
 - 4) V_{occ-min}, zone minimum outdoor airflow for occupants, per Title 24 prescribed airflow-per-occupant requirements
 - 5) V_{area-min}, zone minimum outdoor airflow for building area, per Title 24 prescribed airflow-per-area requirements
 - 6) If occupied standby is allowed

- I. VAV Cooling-only boxes to Thermafuser
 1. Design airflow rates shall be as scheduled on plans:
 - a. Zone maximum cooling airflow setpoint (Vcool-max)
 - b. Zone occupant component of minimum outdoor air setpoint (Vocc-min)
 - c. Zone building area component of minimum outdoor air setpoint (Varea-min)
 - d. If occupied standby is allowed
 2. Zone minimum outdoor air setpoints (used at AHU level minimum outdoor air controls)
 - a. Zone-Abs-OA-min is equal to
 - 1) Varea-min if the zone has a CO₂ sensor
 - 2) Varea-min if the zone has an occupancy sensor and the zone is unoccupied
 - 3) Zone-Des-OA-min otherwise.
 - b. Zone-Des-OA-min is equal to the larger of Varea-min and Vocc-min.
 3. Zone minimum airflow setpoint (Vmin*) set to zero
 4. DP setpoint set by TAB contractor; default = 0.2"
 5. Active maximum and minimum setpoints shall vary depending on the mode of the Zone Group the zone is a part of:

Setpoint	Occupied	Cool-down	Setup	Warm-up	Setback	Unoccupied
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	0	0	0	0	0	0

6. Control logic
 - a. The zone thermostat is not used for direct zone control but is used for resets and space temperature alarms. In Occupied Mode, it shall control to 75F cooling, 60F heating. See Paragraph 3.13D
 - b. A PID loop shall maintain duct DP at DP setpoint; its output is the active airflow setpoint ranging from the Minimum endpoint at 0% to the Cooling Maximum endpoint at 100%.
 - 1) Enable the loop when
 - a) The Zone Group is in Occupied mode and, if the zone has occupancy sensor(s), the zone is occupied.
 - b) The Zone Group is in Cooldown or Setup modes.
 - 2) When the loop is enabled, the VAV damper shall be modulated by a control loop to maintain the measured airflow at the active set point.
 - 3) Loop is disabled and damper is closed otherwise.
7. Alarms
 - a. Fully comply with ASHRAE Guideline 36-2018 Section 5.5.6.
8. Testing/Commissioning Overrides
 - a. Fully comply with ASHRAE Guideline 36-2018 Section 5.5.7.
9. System Requests
 - a. Fully comply with ASHRAE Guideline 36-2018 Section 5.5.8.

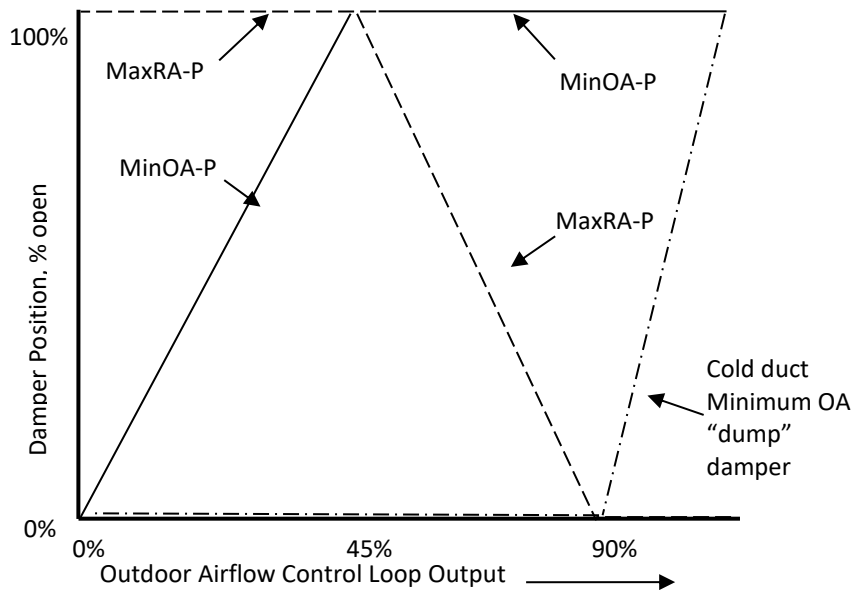
- J. Ceiling Fans
 1. Zone mode, zone state, cooling setpoint, and heating loop output shall be that of the associated VAV zone.
 2. Setpoints (adjustable)
 - a. Cfan-min = the minimum speed signal that causes the fan to visibly rotate
 - b. Cfan-max = 60%
 - c. Tfan-min = current cooling setpoint temperature minus 3°F
 - d. Tfan-max = current cooling setpoint temperature
 3. Ceiling fan shall be off except as follows:

- a. In Occupied or Warmup Modes, if the VAV zone heating loop output is greater than 30% and the heating fan supply air temperature is greater than the room temperature by at least 5°F, the ceiling fan shall operate for destratification at Cfan-min.
 - b. In Occupied Mode, if the VAV zone heating loop output is 0 (Zone State is not Heating), the ceiling fan shall operate when the space temperature is above Tfan-min with speed varying proportionally from Cfan-min at Tfan-min up to Cfan-max at Tfan-max.
 - 4. User override controls:
 - a. Local fan control includes a 0-2 hour windup timer and speed potentiometer.
 - b. While timer is on, and the VAV Zone Group is in Occupied Mode, fan shall run at the speed indicated by the potentiometer overriding other logic.
 - 5. Alarms
 - a. Generate a Level 4 maintenance alarm when fan has operated for more than 3000 hours. Reset interval counter when alarm is acknowledged.
 - a. Fan alarm is indicated by the status input being different from the output command for 15 seconds.
 - 1) Commanded on, status off: Level 2. Do not evaluate alarm until the device has been commanded on for 15 seconds.
 - 2) Commanded off, status on: Level 4. Do not evaluate the alarm until the device has been commanded off for 60 seconds.
 - 6. Testing/Commissioning Overrides: Provide software points that interlock to a system level point to
 - a. Force ceiling fan to any user defined speed
- K. Air Handling Unit System Modes:
- 1. Fully comply with ASHRAE Guideline 36-2018 Section 5.15 unless otherwise noted.
- L. Cooling VAV Air Handler
- 1. Fully comply with ASHRAE Guideline 36-2018 Section 5.16 unless otherwise noted.
 - 2. Parameters
 - a. Design Information:
 - 1) Temperature Setpoints
 - a) Min_ClgSAT, lowest cooling supply air temperature setpoint: 55°F.
 - b) Max_ClgSAT, highest cooling supply air temperature setpoint: 65°F.
 - c) OAT_Min, the lower value of the OAT reset range: 50°F.
 - d) OAT_Max, the higher value of the OAT reset range: 70°F.
 - 2) Ventilation Setpoints
 - a) AbsMinOA: the design outdoor airflow rate when all zones with CO2 sensors or occupancy sensors are unpopulated: per AHU schedule
 - b) DesMinOA: the design minimum outdoor airflow with areas served by the system are occupied at their design population: per AHU schedule
 - 3) Economizer High Limit: Paragraph 3.1.4.3.2 (California Title 24 economizer high limit requirements)
 - a) California Climate Zone: 3
 - b) High limit option: Fixed Dry Bulb + Differential Dry Bulb
 - b. TAB Information
 - 1) Duct design maximum static pressure, Max_DSP to be determined by Section 230593 Testing, Adjusting and Balancing.
 - 2) Minimum Fan Speed: Per Paragraph 3.14D.8
 - 3. Use the following options/revisions:
 - a. Supply fan control: Section 5.16.1 modified as follows:
 - 1) Staged supply fan controls
 - a) VFD Fan groups shall be lead/lag controlled per Paragraph 3.13B.5.

- b) When fans are enabled, start the lead supply fan. When %-supply airflow (totalized enabled VAV box readings divided by design AHU airflow) exceeds stage-up setpoint (below) for 15 minutes (adjustable) then the next lag supply fan shall run. All VFDs receive the same speed signal. When %-airflow falls below the stage-up setpoint for 15 (adjustable) minutes then last lag fan shall be staged off.

VFD Stage	Stage up Flow
1	0%
2	45%

- b. Supply Air Temperature Control:
 - 1) Per Figure 5.16.2.3-1, except:
 - a) When switching from Heating Mode to Cooling Mode and vice versa, wait the longer of the nominal timing of the changeover valve and 5 minutes (adj.) since the 2-way control valve was last shut prior to releasing the control valve to open (the intent of this logic is twofold: to avoid sending chilled water into the hot water system before the changeover valve is fully indexed, and to give the fluid trapped in the coil time to reach neutral temperature before being passed to the other loop).
 - b) Control valve output action shall be direct-acting when in Cooling Mode and reverse acting when in heating mode.
 - c. Minimum outdoor air setpoint and control: per Title 24
 - d. Minimum Outdoor Air Control: Section 5.6.16 except replace Figure 5.16.6.3 with the following where the cold duct minimum outdoor air “dump” damper is mounted on the cooling supply air main discharging to the mechanical room plenum.



- 1) The “dump” damper shall be capable of generating static pressure requests. Fully comply with ASHRAE Guideline 36-2018 Section 5.5.8.2 with “airflow” referring to the measured minimum outdoor airflow.
- e. Relief Fan Control. Section 5.16.9 modified as follows:
 - 1) Relief fans shall be lead/lag controlled per Paragraph 3.13B.5.

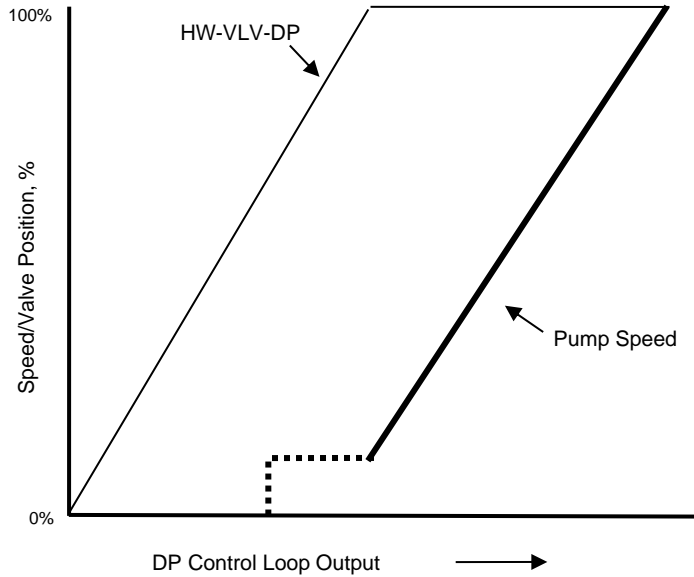
M. Heating VAV Air Handler

- 1. Fully comply with ASHRAE Guideline 36-2018 Section 5.17 unless otherwise noted.

2. Parameters
 - a. Design Information:
 - 1) Temperature Setpoints
 - a) Max_HtgSAT, highest heating supply air temperature = 95°F
 - b. TAB Information
 - 1) Duct design maximum static pressure, Max_DSP to be determined under Section 230593 Testing, Adjusting and Balancing.
 - 2) Minimum Fan Speed: Per Paragraph 3.14D.8
3. Use the following options/revisions:
 - a. Supply fan control: Section 5.17.1 modified as follows:
 - 1) Staged supply fan controls
 - a) VFD Fan groups shall be lead/lag controlled per Paragraph 3.13B.5.
 - b) When fans are enabled, start the lead supply fan. When %-supply airflow (totalized enabled VAV box readings divided by design AHU airflow) exceeds stage-up setpoint (below) for 15 minutes (adjustable) then the next lag supply fan shall run. All VFDs receive the same speed signal. When %-airflow falls below the stage-up setpoint for 15 (adjustable) minutes then last lag fan shall be staged off.

VFD Stage	Stage up Flow
1	0%
2	45%

- N. Building Hot Water Pumps
 1. Pumps shall be lead/lag controlled per Paragraph 3.13B.5.
 2. Building HW system enable/disable
 - a. Enable the building HW system when they have been disabled for at least 10 minutes and:
 - 1) Number of building Heating Hot-Water Plant Requests > I (I = Ignores shall default to 0, adjustable), and
 - 2) OAT < HW-LOT (default to 70F, adjustable)
 - b. Disable the building HW system when they have been enabled for at least 3 minutes and:
 - 1) Number of Heating Hot-Water Plant Requests ≤ I for 3 minutes, or
 - 2) OAT > HW-LOT + 1°F
 3. When the HW system is enabled, the building DP control loop shall be enabled. The loop shall be a reverse-acting loop maintaining the differential pressure (DP) sensor at setpoint. The output of the loop shall range from 0 to 100% and mapped to pump speed and the hot water control valve software point HW-VLV-DP as shown in the figure and described below:



- a. Point HW-VLV-DP is mapped from 0% to 100% as the DP loop output ranges from 0% to 50%.
 - b. Once the valve is wide open (DP loop at 50%), the lead pump shall start and its speed mapped from its minimum speed (see Paragraph 3.14D.8) to 100% as the DP Loop signal ranges from 50% to 100% as shown in the figure. The lead pump shall stop when the valve is below 50% open and the pump has run for a minimum of 5 minutes.
 - c. Lag pump shall be staged as a function of HW flow ratio (HWFR = actual flow divided by total plant design flow). When HWFR is above 47% for 10 minutes, start the lag pump. Both pumps shall receive the same speed signal when both are on. When HWFR is below 47% for 15 minutes, or the lead pump is commanded off, shut off the lag pump.
 - d. Differential pressure setpoint shall be DP-MAX, the design DP setpoint determined under 230593 Testing, Adjusting and Balancing.
4. HW Flow Limit
- a. Flow limit setpoint shall be the total pump design flow rate listed on drawings. The limit will ensure that one building does not take more flow than they are entitled to, starving other buildings.
 - b. When the pumping system is enabled, a proportional-only flow limiting loop shall be enabled to maintain measured flow at the flow limit setpoint. The output of the loop shall be a software point HW-VLV-FL ranging from 0 to 100%.
5. The signal to the HW valve from the central plant shall be the smaller of the signal determined from the pressure control HW-VLV-DP and the flow limiting loop HW-VLV-FL.
6. Alarms
- a. Generate a Level 4 maintenance alarm when pump has operated for more than 3000 hours. Reset interval counter when alarm is acknowledged.
 - b. Pump alarm is indicated by the status input being different from the output command for 15 seconds.
 - 1) Commanded on, status off: Level 2. Do not evaluate alarm until the device has been commanded on for 15 seconds.
 - 2) Commanded off, status on: Level 4. Do not evaluate the alarm until the device has been commanded off for 60 seconds.
 - c. Low differential pressure, below setpoint by 2 psi for 10 minutes with system enabled for 15 minutes.

- O. Domestic Water Heating Plant
 - 1. Recirculation pump shall operate when any AH unit serving the area that includes the toilet rooms served by the recirc pump is in Occupied Mode.
 - 2. Alarms
 - a. Generate a Level 4 maintenance alarm when pump has operated for more than 3000 hours. Reset interval counter when alarm is acknowledged.
 - b. Pump alarm is indicated by the status input being different from the output command for 15 seconds.
 - 1) Commanded on, status off: Level 2. Do not evaluate alarm until the device has been commanded on for 15 seconds.
 - 2) Commanded off, status on: Level 4. Do not evaluate the alarm until the device has been commanded off for 60 seconds.
 - c. Hot water supply temperature less than 110°F when recirculation pump is proven on: Level 2.
 - d. DHW heater alarm: Level 2

- P. Toilet Exhaust Fan
 - 1. Exhaust fans shall operate when any of the associated system supply fans is proven on and any associated Zone Group is in the occupied mode.
 - 2. Alarms
 - a. Generate a Level 4 maintenance alarm when fan has operated for more than 3000 hours. Reset interval counter when alarm is acknowledged.
 - b. Fan alarm is indicated by the status input being different from the output command for 15 seconds.
 - 1) Commanded on, status off: Level 2. Do not evaluate alarm until the device has been commanded on for 15 seconds.
 - 2) Commanded off, status on: Level 4. Do not evaluate the alarm until the device has been commanded off for 60 seconds.

- Q. Metering Summaries
 - 1. Provide metering summary separately for the following metering systems:
 - a. Electrical power
 - b. Potable water
 - 2. Include all submeters including those mapped from equipment (e.g. VFDs, water treatment system, etc.)
 - 3. Include “virtual meters” where loads are based on subtraction from or addition of other loads including:
 - a. Electricity
 - 1) All HVAC equipment. Sum of all HVAC equipment meters (including those in VFDs)
 - 2) Lighting loads
 - a) Each floor: Subtract plug load submeter from total floor power meter.
 - b) Sum of all interior lighting loads
 - c) Sum of all lighting including all exterior and garage lighting
 - 3) Plug loads: Sum of all plug loads
 - 4. For each metering system:
 - a. Provide the system 1-line riser diagram on a summary graphic with links to subsections of the system by floor and major system.
 - b. On each subsection, indicate meter and virtual meter location with a title indicating end-use.
 - c. Through a hyperlink, show a screen summarizing meter data including:
 - 1) Details of what is being metered
 - 2) Pie chart or other graphical format
 - 3) Summary of power on the following basis:

- a) Current
 - b) Past day
 - c) Past month
 - d) Past year and year-to-date
 - 5. Summary dashboards:
 - a. For both electricity and water
 - b. Pie chart or other graphical format showing total whole building consumption with a breakdown of the consumption by end-use, including the percentage of the total.
- R. Equipment not controlled or monitored by BAS system
 - 1. Equipment Room Transfer Fans
 - a. Set setpoint to energize fan when space temperature rises above 80°F with 2°F differential.
- S. Miscellaneous Alarms
 - 1. Points in Hand (Operator Override) via Workstation command (including name of operator who made the command) or via supervised HOA switch at output: Level 4
 - 2. Equipment alarm (for equipment with alarm contacts such as VFDs, AC units): Level 2
 - 3. Failure or disconnection of a sensor as indicated by signal widely out of range: Level 2.
 - 4. Panel or LAN failure: Level 2
 - 5. Loss of communication with any device via Gateway (e.g. VFD) for more than 30 seconds: Level 2 (alarm shall indicate which specific device is not responding).

3.14 SYSTEM COMMISSIONING

- A. Sequencing. The following list outlines the general sequence of events for submittals and commissioning:
 - 1. Submit Submittal Package 0 (Qualifications) and receive approval.
 - 2. Submit Submittal Package 1 (Hardware and Shop Drawings) and receive approval.
 - 3. Initiate installation of BAS hardware, devices and wiring.
 - 4. Develop point database and application software.
 - 5. Simulate sequencing and debug programming off-line to the extent practical.
 - 6. Submit Submittal Package 2 (Programming and Graphics) and receive approval.
 - 7. Complete installation of BAS hardware, devices and wiring.
 - 8. Install point database and application software in field panels.
 - 9. Submit Submittal Package 3 (Pre-Functional Test Forms) and receive approval.
 - 10. Perform BAS Pre-functional Tests (start up, calibration and tuning) and submit completed forms as Submittal Package 4 (Pre-Functional Test Report) for approval.
 - 11. Receive BAS Pre-functional Test Report approval and approval to schedule Functional Tests.
 - 12. Field test application programs prior to functional testing.
 - 13. Submit Package 5 (Post-Construction Trend Points List) in format specified for review and approval.
 - 14. Receive approval of successful Trend Log configuration, or reconfigure as required.
 - 15. Prepare and initiate commissioning Trend Logs.
 - 16. Perform and record functional tests and submit Submittal Package 6 (Functional Test Report) for approval.
 - a. Some tests may not be possible due to weather conditions. These tests may be deferred to post-occupancy period.
 - 17. Assist in TAB tests and determining setpoints as specified in Section 230593 Testing, Adjusting and Balancing.
 - 18. Assist in Title 24 Acceptance Testing as specified in Section 230800 Mechanical System Commissioning.

19. Submit Package 7 (Training Materials) and receive approval.
 20. Receive BAS Functional Test Report approval and approval to schedule Demonstration Tests.
 21. Perform Demonstration Tests to Commissioning Provider and Owner's Representatives and submit Demonstration Test Report.
 22. Receive acceptance of Demonstration Tests.
 23. Train Owner personnel on BAS operation and maintenance.
 24. Substantial Completion
 25. Submit Package 8 (Post-Construction Trend Logs) in format specified for review and approval.
 26. Receive approval of successful Trend Log tests, or retest as required.
 27. Complete all items in Completion Requirements per Paragraph 1.8B.
 28. Provide administration level password access to the Owner.
 29. Final Acceptance
 30. Begin Warranty Period.
 31. Prepare and initiate continuous Trend Logs per Paragraph 2.12A.4.
 32. Receive amended BAS Functional Test Report approval.
 33. Two months prior to end of Warranty Period, submit Package 9 (End-of-Warranty Trend Logs) in format specified for review and approval.
 34. Receive approval of successful Trend Log tests, or retest as required.
 35. Revise and submit record documents and O&M Manuals.
 36. Update all software as specified.
 37. End of Warranty Period
- B. Assist Commissioning Provider/Coordinator as specified in Section 019100 Commissioning, including attending commissioning meetings.
- C. Coordinate with Work specified in Section 230800 Mechanical Commissioning and Division 26 Electrical Commissioning.
- D. Pre-functional tests
1. General
 - a. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
 - b. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
 - c. Verify integrity/safety of all electrical connections.
 - d. Verify that shielded cables are grounded only at one end.
 - e. Verify that all sensor locations are as indicated on drawings and are away from causes of erratic operation.
 2. Test Documentation
 - a. Prepare forms to document the proper startup of the BAS components.
 - b. All equipment shall be included on test forms including but not limited to
 - 1) Wiring: End-to-end checkout of all wiring at terminations. Power to all controllers and actuators. Confirmation of emergency power where specified.
 - 2) Digital Outputs: Proper installation, normal position, response to command at CU
 - 3) Digital Inputs: Proper installation, device test, response at CU
 - 4) Analog Outputs: Proper installation of devices, verification of maximum and minimum stroke.
 - 5) Analog Inputs: Proper installation of sensors, calibration
 - 6) Panels: Confirmation of location, power source (electrical circuit used), confirmation of emergency power where specified.

- 7) Alarms and Safeties: Verification of alarm routing to all specified devices and correct hierarchy. Example: confirm alarm routing to cell phones, email, servers, remote workstations. Confirm that appropriate alarm levels are routed to appropriate devices.
 - 8) Loop Tuning: Document setting of P/I parameters for all loops, chosen setpoints, time delays, loop execution speed.
 - 9) Network Traffic: Document speed of screen generation, alarm and signal propagation in system with all required commissioning trends active.
 - c. Each form shall have a header or footer where the technician performing the test can indicate his/her name and the date of the test.
 - d. Submit blank forms for approval in Submittal Package 3.
 - e. Complete work, document results on forms, and submit for approval as Submittal Package 4 (Pre-Functional Test Report).
3. Digital Outputs
 - a. Verify that all digital output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
 4. Digital Inputs
 - a. Adjust setpoints, where applicable.
 - 1) For current switches used as status on fans, adjust current setpoint so that fan status is OFF when fan discharge damper (if present) is fully closed and when belt is broken (temporarily remove belt).
 - 2) For current switches used as status on pumps, adjust current setpoint so that pump status is OFF when pump is dead-headed (temporarily close discharge valve).
 - 3) For differential pressure sensors on pumps and fans, set so that status is on when pump operating with all valves open (out on its curve).
 5. Analog Outputs
 - a. Verify start and span are correct and control action is correct.
 - b. Check all control valves and automatic dampers to ensure proper action and closure. Make any necessary adjustments to valve stem and damper blade travel.
 - c. Check all normal positions of fail-safe actuators.
 - d. For outputs to reset other manufacturer's devices (for example, chiller setpoint) and for feedback from them, calibrate ranges to establish proper parameters.
 6. Analog Input Calibration
 - a. Sensors shall be calibrated as specified on the points list. Calibration methods shall be one of the following:
 - 1) Factory: Calibration by factory, to standard factory specifications. Field calibration is not required.
 - 2) Handheld: Field calibrate using a handheld device with accuracy meeting the requirements of Paragraph 2.9N.7.
 - b. The calibrating parameters in software (such as slope and intercept) shall be adjusted as required. A calibration log shall be kept and initialed by the technician indicating date and time, sensor and hand-held readings, and calibration constant adjustments and included in the Pre-functional Test Report.
 - c. Inaccurate sensors must be replaced if calibration is not possible.
 7. Alarms and Interlocks
 - a. A log shall be kept and initialed by the technician indicating date and time, alarm/interlock description, action taken to initiate the alarm/interlock, and resulting action, and included in the Pre-functional Test Report.
 - b. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - c. Coordinate with Division 26 to test fire and life safety systems alarm contacts.

- d. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - e. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
8. Variable Frequency Drive Minimum Speed
- a. Minimum speed for VFD-driven fans and pumps shall be determined in accordance with this Paragraph. Tests shall be done for each piece of equipment, except that for multiple pieces of identical equipment used for identical applications, only one piece of equipment need be tested with results applied to all. Note that for fans and pumps, there is no minimum speed required for motor cooling. Power drops with cube of speed, causing motor losses to be minimal at low speeds.
 - b. This work shall be done only after fan/pump system is fully installed and operational.
 - c. Determine minimum speed setpoint as follows:
 - 1) Start the fan or pump.
 - 2) Manually set speed to 6 Hz (10%) unless otherwise indicated in control sequences. For cooling towers with gear boxes, use 20% or whatever minimum speed is recommended by tower manufacturer.
 - 3) Observe fan/pump in field to ensure it is visibly rotating.
 - a) If not, gradually increase speed until it is.
 - 4) The speed at this point shall be the minimum speed setpoint for this piece of equipment.
 - 5) Record minimum speeds in log and store in software point as indicated in Guideline 36.
9. Tuning
- a. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the Pre-functional Test Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted)

Controlled Variable	Control Accuracy
Duct Pressure	±0.1 inches w.g.
Building and relief plenum	±0.01 inches w.g.
Airflow and water flow	±10%
Space Temperature	±1.5°F
Condenser Water Temperature	±2°F
Chilled Water Temperature	±1°F
Hot Water Temperature	±3°F
Duct Temperature	±2°F
Water Differential Pressure	±1.5 psi
Others	±2 times reported accuracy

10. Interface and Control Panels
- a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the Record Drawings.
 - b. Ensure that terminations are safe, secure and labeled in accordance with the Record Drawings.
 - c. Check power supplies for proper voltage ranges and loading.
 - d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
 - e. Check for adequate signal strength on communication networks.

- f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
 - g. Ensure that buffered or volatile information is held through power outage.
 - h. With all system and communications operating normally, sample and record update and annunciation times for critical alarms fed from the panel to the Operator Interface.
 - i. Check for adequate grounding of all BAS panels and devices.
11. Operator Interfaces
- a. Verify that all elements on the graphics are functional and are properly bound to physical devices or virtual points, and that hot links or page jumps are functional and logical.
 - b. Verify that the alarm, logging, paging, emailing etc. are functional and per requirements.
- E. Testing, Adjusting, and Balancing (TAB) Coordination
- 1. Coordinate with Work performed under Section 230593 Testing, Adjusting, and Balancing. Some balancing procedures require the BAS to be operational and require Contractor time and assistance.
 - 2. Calibration Software
 - a. Software shall be provided free of charge on at least a temporary basis to allow calibration of terminal box airflow controls and other Work specified under Section 230593 Testing, Adjusting, and Balancing.
 - b. Software shall be provided for installation on POT(s) provided by Others or Contractor shall loan a POT or handheld device with software installed for the duration of Work specified under Section 230593 Testing, Adjusting, and Balancing.
 - c. Provide sufficient training to those performing Work specified under Section 230593 Testing, Adjusting, and Balancing to allow them to use the software for balancing and airflow calibration purposes. Contractor shall include a single training session for this purpose.
 - 3. Setpoint Determination
 - a. Perform pre-functional tests described in Paragraph 3.14D before assisting in setpoint determination.
 - b. Coordinate with Work performed under Section 230593 Testing, Adjusting, and Balancing to determine fan and pump differential pressure setpoints, outdoor air damper minimum positions and DP setpoints, etc. as indicated in Section 230593 Testing, Adjusting and Balancing.
 - 4. Coil Valve Leak Check
 - a. Coordinate with Work performed under Section 230593 Testing, Adjusting, and Balancing to provide control valve leak check tests.
- F. Functional Tests
- 1. Test schedule shall be coordinated with the Commissioning Provider, Commissioning Coordinator, and Owner's Representative.
 - 2. Functional tests may be witnessed by Owner's Representative at the Owner's option.
 - 3. All approved Functional Tests shall be conducted by the Contractor with results confirmed and signed by the Contractor's start-up technician.
 - 4. Test documentation
 - a. Owner's Representatives will prepare functional testing forms after Submittal Package 2 has been reviewed and approved. Tests will be designed to test all sequences in a formal manner with simulations and expected outcomes.
 - b. Review tests and recommend changes that will improve ease of testing or avoid possible system damage, etc. and provide to Owner's Representative.

- c. Complete work, document results on forms, and submit for approval as Submittal Package 6 Functional Test Report. Tutorials for using the functional test Excel workbook can be found [here](#).

G. Demonstration Test

1. Demonstration tests consist of a small representative sample of functional tests and systems randomly selected by the Commissioning Provider. Tests will be designed to occur over no longer than 2 working days.
2. Schedule the demonstration with the Commissioning Provider and Owner's Representative at least 1 week in advance. Demonstration shall not be scheduled until the Functional Test Report has been approved.
3. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor-supplied personnel shall be those who conducted the Functional tests or who are otherwise competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems.
4. The system will be demonstrated following procedures that are the same or similar to those used in the Pre-Functional and Functional Tests. The Commissioning Provider will supply the test forms at the site at the start of the tests.
5. Demonstration tests may be witnessed by Owner's Representative at the Owner's option.
6. Contractor shall conduct tests as directed by and in the presence of the Commissioning Provider and complete test forms. Commissioning Provider will document the test results as the Demonstration Test Report after tests are complete.
7. Demonstration Tests shall be successfully completed and approved prior to Substantial Completion.

H. Trend Log Tests

1. Trends shall be fully configured to record and store data to the server for the points and at the interval listed in Paragraph 2.11 as follows:
 - a. Commissioning: Configure trends prior to functional testing phase. Retain configuration until post-construction commissioning trend review has been completed successfully and accepted by the Owner's representative. Trends shall be deactivated after acceptance.
 - b. Continuous: After system acceptance, configure trends for the purpose of long term future diagnostics. Configure trends to overwrite the oldest trends at the longest interval possible without filling the server hard disk beyond 80%.
2. Post-Construction Trend Test
 - a. Trend logging shall not commence until Demonstration Tests are successfully completed.
 - b. Hardware Points. Contractor shall configure points to trend as indicated in the Commissioning Trend column listed in Paragraph 2.11 points.
 - c. Software Points. Include the following in trends of systems and zones whose hardware points are being trended as called for above. Time interval shall be the same as associated hardware point.
 - 1) All setpoints and limits that are automatically reset, such as supply air temperature and fan static pressure setpoints, plus the points that are driving the reset, such as zone level cooling and static pressure requests
 - 2) All setpoints that are adjustable by occupants
 - 3) Outputs of all control loops, other than those driving a single AO point that is already being trended
 - 4) System mode points (e.g. Warm-up, Occupied, etc.)
 - 5) Global overrides such as demand shed signals
 - 6) Calculated performance monitoring points, such as chiller efficiency

- d. Submit for review and approval by the Commissioning Provider a table of points to be trended along with trend intervals or change-of-value a minimum of 14 days prior to trend collection period, as Submittal Package 5.
 - e. Trends shall be uploaded to the CSS in data format specified in Paragraph 2.11C.3.
 - f. Trend logs of all points indicated above shall be collected for a 3 week Trend Period.
 - g. At the completion of the Trend Period, data shall be reviewed by the Contractor to ensure that the system is operating properly. If so, data shall be submitted to the Owner in an electronic format agreed to by the Owner and Contractor (such as flash drive or via direct access to the CSS via the internet) as Submittal Package 8.
 - h. Data will be analyzed by the Commissioning Provider.
 - i. The system shall be accepted only if the trend review indicates proper system operation without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. If any but very minor glitches are indicated in the trends, steps f to h above shall be repeated for the same Trend Period until there is a complete Trend Period of error free operation.
 - j. After successfully completing the Post-Construction Trend Tests, the Contractor shall configure all points to trend as indicated in the Continuous Trend column listed in Paragraph 2.11 points list.
3. End-of-Warranty Trend Tests
- a. Archive trends up to the CSS without overwriting stored data for the entire Warranty Period.
 - b. At the completion of the End-of-Warranty Trend Period, data shall be submitted to the Owner in an electronic format agreed to by the Owner and Contractor (such as flash drive or via direct access to the CSS via the internet) as Submittal Package 9.
 - c. Data will be reviewed by Commissioning Provider at approximately 30 days prior to the end of the Warranty Period.
 - d. The system shall be accepted and warranty period considered complete only if the trend review indicates proper system operation without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. If any but very minor glitches are indicated in the trends, steps 2.f to 2.h above shall be repeated until there is a complete Trend Period of error free operation.
- I. Remedial Work
- 1. Repair or replace defective Work, as directed by Owner's Representative in writing, at no additional cost to the Owner.
 - 2. Restore or replace damaged Work due to tests as directed by Owner's Representative in writing, at no additional cost to the Owner.
 - 3. Restore or replace damaged Work of others, due to tests, as directed by Owner's Representative in writing, at no additional cost to the Owner.
 - 4. Remedial Work identified by site reviews, review of submittals, demonstration test, trend reviews, etc. shall be performed to the satisfaction of the Owner's Representative, at no additional cost to the Owner.
 - 5. Contractor shall compensate Owner's Representatives and Commissioning Provider on a time and material basis at standard billing rates for any additional time required to witness additional demonstration tests or to review additional BAS trends beyond the initial tests, at no additional cost to the Owner.

3.15 TRAINING

- A. Coordinate schedule and materials with Commissioning Provider.

- B. Interim Training
 - 1. Provide minimal training so the operating staff can respond to occupant needs and other operating requirements during start-up and commissioning phase.

- C. Formal Training
 - 1. Provide training sessions for four building engineers.
 - 2. Submit training materials as Submittal Package 7.
 - 3. Training shall be conducted after all commissioning is complete and systems are fully operational.
 - 4. Primary System Training
 - a. See Laney Central Utility Plant scope.
 - 5. On-Site Job Specific Training
 - a. Include 40 hours total of on-site training to assist personnel in becoming familiar with site-specific issues, systems, control sequences, etc.
 - b. Owner shall be permitted to videotape training sessions.
 - c. Training may be in non-contiguous days at the request of the Owner.
 - 6. During the warranty period, provide unlimited telephone support for all trained operators.

- D. Training materials shall include step-by-step instructions (including illustrations, screen captures, etc.) for how to perform all task identified in Paragraph 3.15C such that a new Operator, who has not attended the training in person and has minimal familiarity with this BAS system, can easily follow the instructions and successfully perform all of the identified tasks. One copy of training material shall be provided per student. An electronic copy of the materials shall be stored on the OWS.

- E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.

END OF SECTION

SECTION 260500
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work included in this Section: All materials, labor, equipment, services, and incidentals necessary to provide and install the Electrical Work as shown on the drawings and as specified hereinafter, including, but not limited to the following:
1. Electrical service provisions as outlined on the drawings, including temporary power for construction.
 2. Main switchboard, distribution switchboards, distribution panels, panels, transformers, circuit breakers, and feeders.
 3. Branch circuit wiring, wiring devices and connections to all equipment requiring electrical service.
 4. Lighting fixtures completely lamped, including switches, raceways and wiring.
 5. Emergency egress/exit illumination system.
 6. Mechanical equipment power connections, and motor starters where noted.
 7. Low voltage lighting control system and programming.
 8. Transient voltage suppression system.
 9. Medium voltage switchgear, transformers, and distribution system.
 10. All required incidental work, such as roof flashing, electrical testing, title 24 acceptance testing, and temporary power.
 11. Any other electrical work as might reasonably be implied as required, even though not specifically mentioned herein or shown on the drawings.
 12. It is the intent of the drawings and specifications that systems be complete and, except as otherwise noted, be ready for operation.

1.2 RELATED WORK

- A. Division 1 - General Requirements
- B. Division 9 - Finishes
- C. Division 23 - Mechanical

1.3 INCORPORATED DOCUMENTS

- A. Requirements of the General Conditions, Supplementary Conditions, and Division 1 Sections apply to all work in this Section, unless modified herein.
- B. Published specifications, standard tests or recommended methods of trade, industry or government organizations apply to work of this Section where cited by abbreviations noted below, unless modified herein.
1. 2019 California Code of Regulations.
 2. 2019 California Building Standards Administrative Code, Part 1, Title 24, C.C.R.
 3. 2019 California Building Code (CBC).
 4. 2019 California Electrical Code (CEC).
 5. 2019 California Mechanical Code (CMC).
 6. 2019 California Plumbing Code (CPC).
 7. California Energy Code, Part 6, Title 24, C.C.R.

8. 2019 California Fire Code (CFC).
9. 2019 California Green Building Standards (CALGreen) Code.
10. Underwriters' Laboratories, Inc. (UL).
11. Local Utility Company regulations.

C. All State and Municipal Codes and Ordinances.

1.4 CONDITIONS AT SITE:

- A. Visit to site is required of all bidders prior to submission of bid. All will be held to have familiarized themselves with all discernible conditions and no extra payment will be allowed for work required because of these conditions, whether specifically mentioned or not.
- B. Lines of other services that are damaged as a result of this work shall promptly be repaired at no expense to the Owner to the complete satisfaction of the Owner.

1.5 QUALITY ASSURANCE

- A. Conformance:
 1. All work shall conform to the applicable requirements of Article 1.3 above.
 2. The Contractor shall notify the Architect, prior to submission of bid, about any part of the design, which fails to comply with abovementioned requirements.
 3. If after contract is awarded, minor changes and additions are required by aforementioned authorities, even though such work is not shown on the drawings or covered in the specifications, they shall be included at Contractor's expense.
- B. Coordination:
 1. The Contractor shall become familiar with the conditions at the job site, and with the drawings and specifications and plan the installation of the electrical work to conform with the existing conditions and that shown and specified so as to provide the best possible assembly of the combined work of all trades.
 2. The Contractor shall work out in advance all "tight" conditions, involving all trades and if found necessary, supplementary drawings shall be prepared by this Contractor, for the Architect's approval, before work proceeds in these areas. No additional costs will be considered for work, which must be relocated due to conflicts with the work of other trades.
 3. The Contractor shall coordinate and verify all backbox, device, lighting fixture, or equipment mounting requirements with the devices or equipment to be installed, prior to rough in.

1.6 SUBMITTALS

- A. Product Data:
 1. Comply with the provisions of Section 013300 - Submittals.
 2. Within 15 days after award of the Contract, submit:
 - a. Complete electrical, lighting, and signal systems material list of all items proposed to be furnished and installed under this Division. Provide manufacturers data sheets for all devices, raceways, fixtures, equipment, and related products to be used for the Division 26 work.
 - b. Manufacturers' specifications and other data required demonstrating compliance with the specified requirements.
 - c. Manufacturers' recommended installation procedures which, when approved by the Architect, shall become the basis for inspecting and accepting or rejecting actual installation procedures used on the work.

3. Shop Drawings: Furnish shop drawings and/or equipment cuts for the following:
 - a. Light fixtures
 - b. Main Switchboard, distribution switchboards, distribution panels, panel boards, and transformers. Panel board submittals shall include diagrams of the circuit breaker arrangements in the panels. Arrange circuit breakers in panels exactly as shown on the panel schedules in the construction documents.
 - c. Disconnect switches
 - d. Motor starters
 - e. Low voltage lighting control system
 - f. Arc flash, Short Circuit, and Protective Device Coordination Study.
 - g. Power and signal concealed service floor boxes, and furniture panel infeed boxes.
 - h. Mechanical and Plumbing equipment. The Electrical Contractor shall review the Mechanical and Plumbing Submittals, and verify the voltage, wire size and overcurrent protection required. Also provide the Electrical Engineer with a copy of the submittals for their review.
 - i. Transient Voltage Surge Suppression system if specified herein and/or indicated on the drawings.
 - m. Medium voltage transformers, and cable if specified herein and indicated on the drawings.
 - n. Emergency Generator and Automatic Transfer Switches.
4. Test Reports:
 - a. Factory Tests: As specified for specific equipment.
 - b. Field Tests: Performance tests as specified for specific equipment.
 - c. Megger Tests: As specified under TESTING.
 - d. Special Seismic Certification documentation as per CBC Section 1616A and ASCE/SEI 7-10 requirements for all equipment defined as 'critical' with an importance factor of 1.5 in Paragraph 1.10.M.3 of this Section.
 - f. Manufacturer's Seismic Certification or Project-Specific Design of Supports and Attachments for all other equipment and fixtures as per CBC Section 1616A and ASCE/SEI 7-10 requirements.
5. Maintenance and Operating Manuals:
 - a. Systems Description: Description of operating procedures.
 - b. Controls: Diagrams and description of operation of each system.
 - c. Equipment: Manufacturer's brochures, ratings, certified shop drawings, maintenance data, and parts lists with part numbers. Mark each sheet with equipment identification number and actual installed condition.
 - d. Materials and Accessories: Manufacturer's brochures, parts lists with part numbers, and maintenance data where applicable. Mark each sheet with identification number of system and location of installation.
 - e.
6. Record Documents: "As-builts": As specified under Paragraph 3.2 of this Section.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all trades.
- B. Delivery and Storage: Deliver all materials to the job site in their original containers with all labels intact and legible at time of use. Store in strict accordance with approved manufacturers' recommendations.

- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.
- D. This Contractor shall personally, or through an authorized representative, check all materials upon receipt at jobsite for conformance with approved shop drawings and/or plans and specifications.

1.8 SCHEDULING/SEQUENCING

- A. Place orders for all equipment in time to prevent any delay in construction schedule or completion of project. If any materials or equipment are not ordered in time, additional charges made by equipment manufacturers to complete their equipment in time to meet the construction schedule, together with any special handling charges, shall be borne by this Contractor.
- B. The Contractor shall coordinate production and delivery schedule for all Owner-supplied equipment with the equipment suppliers to ensure that all Owner-supplied equipment is delivered to site in coordination with the construction schedule and in such a manner as to cause no delays in completion of the Contract as scheduled.

1.9 REQUIREMENTS

- A. The contract drawings indicate the extent and general arrangements of the conduit wiring systems, etc. If any departures from the contract drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted as soon as practicable, and within thirty-five (35) days after award of the electrical contract.
- B. Unless material list and data is received as a complete and all-inclusive submittal within the stipulated time all items shall be provided as specified, with no deviations permitted.
- C. Any and all additional costs incurred by the substitution of electrical material or equipment, or installation thereof, whether architectural, structural, plumbing, mechanical or electrical, shall be borne by the Contractor under this Section.
- D. Burden of proof of equality of any substitution for a specified product is the responsibility of this Contractor.
- E. Where required by Architect to ascertain equality of substitute product, Contractor may be requested to provide the specified item and the submitted substitution for comparison, at no additional cost to the Owner.

1.10 SEISMIC CERTIFICATION AND INSTALLATION OF EQUIPMENT

- A. See Architectural and Structural Drawings and Specifications for description of Occupancy Group and Seismic Design Category applicable to this project.
- B. Provide Special Seismic Certification per CBC Section 1616A and ASCE/SEI 7-10 for all equipment and components defined as critical with an importance factor 1.5 in Paragraph 1.10.M.3 of this Section.
- C. Special Seismic Certification shall require either certification through approved analytical method or approved shake table testing in accordance with Section 13.2.5 of ASCE/SEI 7-10 or experience data in accordance with Section 13.2.6 of ASCE/SEI 7-10.

- D. Manufacturer's Seismic Certification or Project-Specific Design of Supports and Attachments for all other equipment and fixtures as per CBC Section 1616A and ASCE/SEI 7-10 requirements.
- E. Provide seismic restraints per applicable code and as specified or indicated. Design restraints to prevent permanent displacement in any direction caused by lateral motion, overturning, or uplift.
- F. Rigidly Supported Equipment, Conduits, and Raceways.
- G. Lighting:
 - 1. Fasten lighting fixtures in suspended ceilings to ceiling grid system or otherwise support from the structures as specified herein and as per details indicated on the Drawings. Comply with National Electric Code (NEC) Article 410.
 - 2. Suspension systems for light fixtures shall allow fixtures to swing a minimum of 45 degrees from the vertical in all directions without contacting obstructions.
 - 3. Free-swinging suspension systems shall have a safety wire or cable attached to the fixture and structure at each support. The wire shall be capable of supporting four times the weight of the lights.
 - 4. Point-source fixtures: provide slack wires to structure at two diagonal corners.
 - 5. Troffer fixtures: provide hold-down clip at each fixture corner, and slack wires to structure at two diagonal corners.
 - 6. Supports for pendants: Provide diagonal seismic wire restraints per Code.
- H. Components supported by chains or simply suspended from above are not required to meet lateral seismic force requirements and seismic relative displacement requirements provided that they cannot be damaged or cannot damage any other component when subject to seismic motion. They must have ductile or articulating connections to the structure at the point of attachment.
- I. Electrical Cabinets:
 - 1. Electrical cabinet design shall conform to National Electrical Manufacturers Association (NEMA) 250 and NEMA ICS6 standards. Cutouts in the lower shear panel that do not appear to have been made by the manufacturer and significantly reduce the strength of the cabinet are not permitted unless analysis demonstrates that the remaining strength is sufficient.
 - 2. Single freestanding cabinets shall have a minimum of four anchor bolts designed and specified with one anchor located at each corner.
 - 3. Multiple sections of cabinets or enclosures located adjacent to each other shall be bolted together. Minimum acceptable bolting is three bolts in the front and back along the adjacent vertical faces - 6 bolts total.
 - 4. Multiple cabinets bolted together to form a section or line-up shall have at a minimum two anchors specified for each cabinet, one at the front and one at the rear.
 - 5. Base anchorage shall be installed through anchor points designated by the Manufacturer. The largest bolt diameter for the anchor hole provided in the equipment shall be provided.
 - 6. A latch or fastener to prevent opening during an earthquake event and damaging the cabinet and internal components shall secure all doors.
 - 7. Slide-out components in electrical control panels, etc., shall have a latching mechanism to hold contents in place.
 - 8. Attached cabling shall have adequate slack or flexibility between the cabinets and surrounding structure supporting the conduit to preclude severing of the cabling due to differential seismic displacements.

- J. The design load shall include the effects of loading on the equipment imposed by attached utility or service lines that are also attached to separate structures.
- K. The attachment of additional external items is not permitted unless such items have either been provided by the Manufacturer, or analysis shows that their effects are supported by design.
- L. Conduit and their connections shall be constructed of ductile materials unless otherwise approved by the Architect. Conduits and their connections constructed of non-ductile materials (e.g., cast iron, no-hub pipe and plastic) shall have brace lengths reduced to one-half that allowed for ductile material.
 - 1. All trapeze assemblies supporting conduit shall be braced to resist CBC design forces considering the total weight of the elements on the trapeze.
 - 2. Seismic restraint spacing shall be in accordance with hanger spacing.
- M. Critical Equipment:
 - 1. Design with importance factor of 1.5.
 - 2. Provide Special Seismic Certification for all equipment and components and their installation per CBC and ASCE/SEI requirements.
 - 3. Critical Equipment shall include the following:
 - a. Emergency Generator and Automatic Transfer Switches if specified herein and/or indicated on the drawings.
 - b. Emergency power systems switchboards, distribution panels, transformers, and panelboards if specified herein and/or indicated on the drawings.
 - c. Low Voltage Relay Panels on Emergency Power
- N. Seismic Design Submittals: For all Critical Equipment included in paragraph 26 05 00.1.10.M.3.
 - 1. The Manufacturer of each item of critical equipment shall arrange for the testing or analysis by an approved agency of each component and assembly and its mounting system or anchorage.
 - 2. The Manufacturer shall submit a Certificate of Compliance for each item for approval by the Architect and by the Authority Having Jurisdiction.
 - 3. Based on Manufacturer's approved submittal, Contractor shall retain the services of a State of California registered Structural Engineer to prepare final installation details and drawings for equipment supports and attachments.
 - 4. Submit drawings of the equipment showing dimensions, support equipment, connections, and the proper anchorage locations.
 - 5. Equipment weight and weight distribution (e.g., center of gravity in elevation and plan).
 - 6. Thickness of sheet metal bases.
 - 7. Seismic Vibration Isolation Devices: Manufacturer's product information indicating class and type. Indicate load ratings as published manufacturer's data or shop drawings. Indicate proper orientation of devices on plan.
 - 8. Inertia bases and support frames.
 - 9. Specific details of restraints including anchor bolts and welds and maximum load at each location.
- O. Independent Supports: An independent means of secure support shall be provided for all wiring methods in non-fire-rated assemblies. Where independent support wires are used, they shall be distinguishable by color, tagging, or other effective means.

1.11 DESCRIPTION OF DEMOLITION AND REPLACEMENT WORK

- A. This project includes the demolition and replacement, modification, or enhancement of existing facilities. As such, the project scope for this contractor shall include all associated electrical, lighting, and signal system upgrades and demolition/removal work at the existing buildings(s)

and/or site. The intent is that all systems will be complete and functional at the completion of this contract and that all old systems, equipment, feeders, circuits, wiring, and related devices (no longer used) be completely and neatly removed. Where discrepancies between the drawings and existing conditions are noted, the Architect or Owner shall be notified immediately for resolution.

- B. As with every renovation project, the electrical work will include (and require) exploration and other field work on a daily basis to complete the new designed equipment and connections within the constraints of the existing building and existing site conditions.
- C. The contractor shall include as part of the base bid, sufficient labor hours to provide such exploration and field work throughout the duration of the project. Change orders for miscellaneous coordination of existing conditions will not be approved unless specific and latent conditions are uncovered that warrant such additional compensation or require additional work not shown on the drawings or included in the specifications, or implied by the designed conditions.
- D. New raceways and wiring to new and renovated equipment are to be installed unless otherwise noted. Where raceways are installed in accessible concealed locations (i.e. unfinished spaces or electrical / mechanical / attic spaces), EMT with wire shall be used. Where new wiring is required to be routed through existing walls and ceilings that cannot readily be accessible for new conduit, MC cable or flex conduit and wiring may be installed, fished through and secured in each space as required by Code. Non-metallic sheathed cable shall not be utilized on this project.
- E. All new raceways shall be installed concealed and all new equipment installed flush, unless otherwise noted on the drawings or in these specifications.

1.12 GUARANTEE

- A. This Contractor shall guarantee that all work executed under this Section will be free from defects of materials and workmanship for a period of one (1) year or as per the General Conditions of this project, whichever is longer. Dates shall be from the date of final acceptance of the building. The contractor shall further guarantee that he will, at his own expense, repair and replace all such defective work, and all other work damaged thereby, which becomes defective during the term of the guarantee. Such repair or replacement shall be guaranteed for one (1) year from the date of repair or replacement.

1.13 PERMITS AND INSPECTIONS

- A. This Contractor shall arrange for and obtain all required permits and inspections.
- B. Do not allow or cause any of the work to be covered or enclosed until it has been tested and/or inspected.

1.14 IDENTIFICATION

- A. Switchgear, switchboards, distribution panels, and feeder circuit breakers therein, panels, disconnect switches, motor starters, transformers, motor disconnect switches, cabinets, and other apparatus used for the operation of, or control of circuits, appliances or equipment, shall be properly identified by means of engraved laminated plastic descriptive nameplates mounted on apparatus using stainless steel screws. Nameplates shall have white letters with black background and be submitted to the Architect for approval. Cardholders in any form are not acceptable.

- B. Provide p-touch style labeling of circuit designations for all receptacles on the project.
- C. Each branch circuit of panel boards to have a permanently fixed number with load directory, mounted under celluloid on inside of cabinet door, showing circuit numbers and typewritten description of equipment supplied by breakers. Where changes are made to existing panelboards, newly typewritten circuit directories shall be prepared to replace existing directories.
- D. Provide label on all motors: "Caution. Automatic equipment. May start at any time."
- E. Provide silk-screened or engraved identification labels on all switch box covers identifying specific loads that are not readily apparent to the user, including electroshades, projection screens, exhaust fans, audio-visual controls, etc.. Submit proposed labels to Architect for approval prior to manufacture of labels.
- F. Provide identification of all pull boxes, junction boxes, and conduit stub-ups on the project as outlined below:
 - 1. For Power Feeders:
 - a. Stencil cover with identifying circuit number.
 - b. Lettering 1" high.
 - c. Color of lettering black.
 - d. Place lettering on cover in neat manner; run parallel to long sides of box.
 - 2. For branch circuits, grounding, communication, signal, and control systems boxes and blank conduit stub-outs:
 - a. Paint inside back of each j-box, front of each cover, and ends of each blank conduit stub-out with identifying system color as listed below:

1) 277/480-volt	Orange
2) 120/208-volt	Blue
3) Telephone/Data	Grey
4) Ground system	Green
5) Lighting control	Orange/White
6) Emergency Power 277V	Orange/Red
7) Emergency Power 120V	Blue/Red

PART 2 - PRODUCTS

2.1 GENERAL

- A. Refer to applicable Division 26 Sections for complete products specifications.

2.2 MATERIALS

- A. Materials of the same type or classification, used for the same purpose, shall be the product of the same manufacturer.

2.3 ACCEPTABLE MANUFACTURERS

- A. Materials shall be of make mentioned elsewhere in this specification. All materials shall be the best of their several kinds, perfectly new and approved by the Underwriters' Laboratories.
- B. Where material, equipment, apparatus or other products are specified by manufacturer, brand name, type or catalog number, such designation is to establish standards of desired quality, style and utility and shall be the basis of the bid. Materials so specified shall be furnished

under the contract unless changed by written approval of the Architect. Where two or more designations are listed, choice shall be optional with this Contractor, but this Contractor must submit his choice for final approval.

2.4 POSTED OPERATING INSTRUCTIONS

- A. Furnish approved operating instructions for systems and equipment where indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment. Provide weather-resistant materials or weatherproof enclosures for operating instruction exposed to the weather. Operating instruction shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

2.5 CATALOGED PRODUCTS/SERVICE AVAILABILITY

- A. Materials and equipment shall be current products by manufacturers regularly engaged in the production of such products. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The 2-year period shall be satisfactorily completed by a product for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6,000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished. The equipment items shall be supported by service organizations which are reasonable convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the areas and conditions under which the work of this Section will be installed. Correct conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Drawings:
 - 1. The general arrangement and location of wiring and equipment is shown on the electrical drawings and shall be installed in accordance therewith, except for minor changes required by conflict with the work of other trades.
 - 2. The Contractor shall coordinate and verify all backbox, device, lighting fixture, or equipment mounting requirements with the devices or equipment to be installed, prior to rough in.
 - 3. Drawings indicate the circuit and panel which supplies each device or fixture. Provide and install conduit and conductors to make all connections from panel to nearest device and from first device to additional devices on same circuit. Conduit size and fill shall satisfy NEC requirements. Do not exceed 4 #12 or 3 #10 conductors in a ½" conduit, 7 #12 or 5 #10 in a ¾" conduit, and 11 #12 or 9 #10 in a 1" conduit, unless otherwise noted.

Provide common handle-tie on breakers for multi-wire branch circuits (with common neutral), per NEC. If more than three current carrying conductors are installed in one conduit, conductor size shall be increased as required per NEC. Do not share neutrals for branch circuits.

4. Drawings indicate the location of all light switches. Where fixtures in a room are controlled by more than one switch, the same lower case letter is drawn adjacent to a switch and each fixture controlled by that switch. Where no lower case letter is adjacent to a switch, all fixtures in the room are controlled by that switch. Provide and install conduit and wire from fixture to switch and between fixtures as required to accomplish switching shown. Do not route branch circuit wiring for light fixtures through switch boxes. Where dimming controls are specified, provide required dimming control wiring in addition to power wiring from control device to all controlled light fixtures. Provide separate conduit for dimming control wiring unless otherwise indicated on the drawings.
 5. Drawings indicate location of all signal outlet boxes. Provide and install conduit system as required and complete system wiring, unless otherwise noted.
 6. Control wiring is generally not shown on the plans. Contractor shall refer to control diagrams and provide and install all wiring and raceways required to make all interconnections.
 7. All branch circuit wiring No. 12 or No. 10 as noted, all control wiring No. 14, except as noted next to "slash marks" on the drawings, or as noted under "Wire," as specified herein.
 8. All dimensions, together with locations of doors, partitions, etc. are to be taken from the Architectural Drawings, verified at site by this Contractor.
 9. Maintain "as-built" records at all times, showing the exact location of concealed conduits and feeders installed under this contract, and actual numbering of each circuit. Upon completion of work and before acceptance can be considered, this Contractor must forward to the Architect, updated CAD plans, corrected to show the electrical work as actually installed.
 10. Branch circuit conductors shall be #12 minimum and #10 minimum for runs longer than 150 feet.
- B. Measurements: Before ordering any material or closing in any work, verify all measurements on the job. Any differences found between dimensions on the drawings and actual measurements shall be brought to the Architect's attention for consideration before proceeding.

3.3 FIELD QUALITY CONTROL

- A. All workmanship shall be first class and carried out in a manner satisfactory to and approved by the Architect.
- B. This Contractor shall personally, or through an authorized and competent representative, constantly supervise the work and so far as possible keep the same foreman and workmen on the job throughout.

3.4 COORDINATION

- A. In electrical rooms, where electrical equipment is located at walls with brace framing, provide and install steel channel supports for mounting of electrical equipment away from wall to avoid conflict with brace framing. Steel channel supports shall be Unistrut or equal, and shall include all channels, bases, fittings, etc., as required for a complete installation.
- B. In electrical rooms, Contractor is responsible for installation of electrical equipment within the space provided. Contractor shall provide ¼" scale plans of electrical room layouts, and

elevations of steel channel supports (where used or required) of electrical equipment for review and approval prior to any installation or rough-in

3.5 INSTALLATION/APPLICATION/ERECTION

- A. All electrical raceways and devices shall be installed concealed (for raceways) and/or flush mounted (for devices), unless otherwise noted. Provide cut-in boxes and "fish" flexible MC or flex conduit and wire through existing walls to remain, unless shown otherwise on plans. Cut and patch to facilitate such installation to match adjacent and original finish.
- B. All cutting, repairing and structural reinforcing for the installation of this work shall be done by the General Contractor in conformance with the Architect's requirements.

3.6 EMERGENCY POWER SOURCES

- A. All emergency source circuits shall be installed in separate raceways (from normal power), per 2017 NEC 700.10(B), or the applicable code at the time of permitting.

3.7 TEMPORARY LIGHTING AND POWER

- A. Provide and install temporary lighting and power systems for the duration of construction, of adequate size to accommodate the required lighting and power loads. Coordinate with other trades to insure adequate sizing.
- B. Provide distribution equipment as required to support all construction activities.

3.8 FIRE STOPPING AND FIRE RATED PENETRATIONS

- A. All electrical equipment mounted in, on, or through fire rated construction shall be installed to maintain the fire rating of the construction.
- B. Provide fire rated pads (or other suitable assembly) around all electrical junction boxes in fire rated walls/ceilings/floors to maintain the fire rating.
- C. Provide fire rated construction around all recessed light fixtures and/or panel board / cabinets mounted flush in fire rated walls to maintain the fire rating. Coordinate depth of construction with other trades to avoid conflicts.
- D. Conduit sleeves shall be provided as a means of routing cables through fire-rated walls or floors. Openings in sleeves and conduits used for system cables and those which remain (empty) spare shall be sealed with an approved fireproof, removable sagging material. Sleeves which pass vertically from floor to floor shall be sealed in a similar manner using an approved re-enterable system. Additional penetrations through rated assemblies necessary for passage of tel/data wiring shall be made using an approved method and permanently sealed after installation of cables.

3.9 ADJUSTING AND CLEANING

- A. All electrical equipment, including existing equipment not "finish painted" under other sections, shall be touched up where finished surface is marred or damaged.
- B. All equipment, lighting fixtures, etc., shall be left in clean condition, with all shipping and otherwise unnecessary labels removed there from.

3.10 SCHEDULES

- A. Coordination: Coordinate installation of electrical items with the schedule for other work to prevent unnecessary delays in the total Work.

3.11 WARNING SIGN MOUNTING

- A. Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.12 PAINTING OF EQUIPMENT

- A. Factory Applied: Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
- B. Field Applied: Paint electrical equipment as required to match finish or meet safety criteria. Painting shall be as specified in the respective equipment section.

3.13 TESTS

- A. Testing and inspection: See Section 260800 - Testing.

END OF SECTION

SECTION 260513

MEDIUM VOLTAGE DISTRIBUTION

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American National Standards Institute (ANSI) Publication (Latest Edition):
 - C2 National Electrical Safety Code
- C. Institute of Electrical and Electronic Architects, Inc. (IEEE) Publication (Latest Edition):
 - 48 Standard Test Procedures and Requirements for Alternating Current Cable Terminations 2.5KV through 765KV
 - 386 Separable Insulated Connectors for Power Distribution Systems Above 600V.
 - 400 Field Testing and the Evaluation of Insulation for Shielded Power Cable Systems
- D. National Fire Protection Association (NFPA) Publication (Latest Edition):
 - 70 National Electrical Code (NEC)
- E. Underwriter's Laboratories, Inc. (UL) Publications (Latest Edition):
 - UL 1072
- F. State of California Public Utilities Commission (Cal. P.U.C.) Publication:
 - G.O. 128 Rule for construction of Underground Electric Supply and Communication Systems.
- G. AEIC CS6-96: Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 69 kV
- H. ASTM B8-04: Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- I. ICEA S-93-639/NEMA WC74: Shielded Power Cables Rated 5 – 46 kV
- J. ICEA S-97-682: Utility Shielded Power Cables Rated 5 - 46 kV

1.2 SUBMITTALS

- A. Submittals: Submit the following information for approval:
 - 1. Manufacturer's Data and Shop Drawings:
 - a. Conduit
 - b. Medium Voltage Cables
 - c. Medium Voltage Splice Kits

- d. Medium Voltage Terminating Kits
 - e. Medium Voltage Connectors
 - f. Terminators
 - g. Fault Indicators
2. Manufacturer's and Installer's Experience: Submit evidence documenting manufacturer's ten-year experience in medium voltage cable and accessories manufacturing. Submit manufacturer's data on electrical cable and terminations. Contractor shall submit a list of previous work evidencing at least five years experience in medium voltage cable installation of similar type. Submit name and experience record of each person to be engaged in medium voltage cable work. Only those persons accepted by the Owner will be permitted to engage in medium voltage cable work.
 3. Cable Test Reports:
 - a. Three copies of factory test records on a per-reel basis shall be furnished at the time of cable shipment. The data shall include the following items: Purchase order and date; description of cable; description of sample high voltage test; dielectric loss and P.F. test; bending test; marked length and actual conductor resistance at 25 degrees C.; insulation resistance in megohms at the testing temperature of each reel length of cable or insulation resistance in megohms at the standard temperature of 15.5 degrees C. per 1000 feet of the cable supplied in this order; sheath integrity and thickness.
 - b. The maximum current carrying capacities and maximum safe operating temperatures on the basis of 3 equally loaded single conductor cables in underground ducts at 100 percent and at 75 percent load factors, and on the basis of 90 RHO, 20 degrees C. ambient and 80 degrees C. conductor temperatures, shall be stated. (Three cables in one duct.)
 4. Certificates:
 - a. Workmen's Competency: Submit high voltage cable Splicer/Terminator certification of competency and experience 30 days before splices or terminations are made in high voltage cables. Splicer/Terminator experience during the immediate past 3 years shall include performance in splicing and terminating cables of the type and classification being provided under this contract.
 - b. Before assigning any cable splicer to work covered by this specification, the Contractor shall provide the Owner with the names of the cable splicer to be employed, together with satisfactory proof that each splicer has had at least 3 years experience in splicing high-voltage cables and is experienced with the type and rating of cables to be spliced.
 5. Contractor to submit a medium voltage cable pulling plan complete with calculations and layout. Cable pulling plan shall include but not be limited to the actual calculations of jam ratios, sidewall bearing pressures and maximum pulling tensions using pulling eyes or cable grips for each run. Also, provide cable information on the plan and diagram of each pull run.
 6. Contractor to provide submittal of lubricants.
 7. Submit shipping and handling protocol.

1.3 COORDINATION AND SCHEDULING

- A. Coordinate with the Owner for the interception of existing underground medium voltage distribution conductors where indicated on the drawings. Comply with all Owner requirements for splicing and rerouting of existing conductors.
- B. It is the responsibility of the Contractor to arrange for all services with the Owner and to ensure that all conduit and other service provisions are as required by the Owner prior to

installation of these service provisions. No extra payments will be made to the Contractor as a result of his failure to fully coordinate with the Owner.

- C. Location of existing utilities: Although the Architect has endeavored to show all underground or above ground utilities at the project site, all utility locations are not necessarily known nor shown. The Contractor is cautioned that the utilities encountered at the site include communication cables and electrical cables conducting high voltage, as indicated. When excavating in the vicinity of such cables, special precautions are to be observed by the Contractor at his own cost and shall include the following: All cables and their enclosure ducts shall be exposed by careful hand excavation so as not to damage the ducts or cables nor cause injury to persons, and suitable warning signs, barricades, and safety devices shall be erected whenever necessary or appropriate.
- D. Provide schedule notification to the Owner 5 working days prior to medium voltage testing.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials and equipment shall conform to the Owner's Standards and to the specifications herein. Electrical ratings shall be as indicated.

2.2 MATERIALS

- A. Conduit:
 - 1. See Section 262700.
- B. Tape: UL 510. Plastic insulating tape shall be capable of performing in a continuous temperature environment of 80 degrees C.
- C. Power Wire and Cable:
 - 1. Wire and Cable Conductor Sizes: American Wire Gauge (AWG) designates wire and cable conductor sizes. Conductors shall be copper. Insulated conductors shall bear the date of manufacture imprinted on the wire insulation with other identification. Wire and cable manufactured more than 6 months before delivery to the job site shall not be used. Provide conductor identification within each enclosure where a tap, a splice or a termination is made.
- D. Medium Voltage Wires and Cables: 15KV single conductor, Class B concentric stranded copper, compact round type, bare or annealed uncoated copper per ASTM B-496, size as noted on the drawings. Underwriters' Laboratories shall list Cable as 15,000-volt power cable type MV-105, the cable shall bear the U.L label, and shall be rated for installation in wet or dry conditions. Cables shall be designed to operate continuously at 105 degrees C for normal operation; 140 degrees C for emergency overload conditions, and 250 degrees C for short circuit conditions.
 - 1. Strand Screen: Extruded semi-conducting EPR (ethylene propylene rubber) layer over conductors.
 - 2. Insulation: The insulation shall be type EPR, 133 percent insulation level, 220 mils.
 - 3. Insulation Screen: The insulation shall be screened by an extruded semi-conducting EPR layer. The thickness shall be in accordance with the referenced standards.
 - 4. Shield: 5 mil bare copper tape helically applied with 12.5% nominal overlap.
 - 5. Medium voltage shield drain wrap half-lapped shall not exceed 12.5%.
 - 6. Outer jacket: Black polyvinyl chloride jacket, 80 mils, surface printed, water, oil, alkali, and sunlight resistant.

7. Strand Screen, Insulation, Insulation Screen, and Jacket shall meet ICEA S-93-639 / NEMA WC74, ICEA S-97-682, AEIC CS8 and U.L 1072 standards.
8. The manufacture, reeling, testing, certification and shipping of this cable shall be in accordance with IEEE-48 standards.
9. All factory serial numbers of reels and all other markings must match identically with those shown on the Factory test certificates.
10. Each reel must have one pulling-eye attached to outer cable end.
11. Medium voltage conducting thermosetting compound shall be compatible with both the insulation and the conductor and have an allowable operating temperature equal to that of the insulation.
12. Cable ratings shall include medium voltage emergency overloads for up to 1,500 hours cumulative through the life of the cable.
13. The cable must be free stripping without the use of heat cutting or the need of machine removal.
14. Cable Warranty: 40 years from date of shipment.
15. Provide stranded copper ground conductor in each conduit with phase conductors. Size for ground conductor shall be as indicated in Section 26 24 00 or on the drawings.

E. Terminations and splices shall be rated as follows:

Voltage: BIL: 110kV, 1.2 X 50 microseconds

Withstand: 50kV, 60 Hz, 1 minute
75kV, DC, 15 minutes

Corona: 19 kV extinction

Current: Continuous: Equal to cable ampacity – see drawings
8-hour overload: 150% of cable ampacity

Momentary: 25,000 amps, RMS, 12 cycles
10,000 amps, RMS, .5 seconds
3,500 amps, RMS, 3.0 seconds

Production

Tests: Applied Potential: 50kV, 60 Hz, 1 minute
Corona: 19kV extinction
Test Point: Verify operation

F. Medium Voltage Terminations (Indoor):

1. Medium Voltage Cable Terminations: IEEE 48 Class 1. The manufacturer shall provide all components, materials and complete instructions for installations, which shall include stress relief devices.
2. Terminators: Shall be modular, molded rubber type: IEEE 48 Class I. Provide terminator as specified herein for terminating single conductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 15 KV. The terminator shall consist of stress control, ground clamp, non-tracking rubber skirts, crimp-on connector, rubber cap, and serial lug. Separate parts of copper or copper alloy shall not be used in contact with aluminum or aluminum alloy parts in the construction and installation of the terminator.

G. Medium Voltage Terminations (Outdoor):

1. Terminators shall be 600 ampere, non-loadbreak, separable elbow type, Elastimold Type 655LR or equal, with shield terminator with appropriate shield adapt kit.

2. Terminators shall be fully shielded, fully submersible, designed for energized operation.
 3. Terminators shall be of the materials and construction to ensure dead front construction, shielding, and proper creep path length and water seal. An integral voltage test point and a reinforced pulling ring of stainless steel shall enable the elbow connector to be removed with a shotgun tool. The crimp-type connector for the cable conductor shall meet all requirements of TDJ-162 for Class "A" connectors. A copper pin incorporating Belleville washers at the engagement point with conductor contact shall ensure the integrity of the electrical connection and result in the total connector system meeting Class "A" connector requirements. A stainless steel hold down bail shall mechanically lock the elbow connector onto the bushing.
 4. All separable connectors and junctions shall comply with IEEE-386.
- H. Splices: Splicing shall be allowed only with the prior permission of the Owner and will be allowed only if cable cannot be installed in one continuous piece without splice. Splices shall be made using a "kit" which shall be the product of one manufacturer and shall have the approval in writing of the manufacturer of the cable, which is to be spliced. Splice shall be suitable for continuous immersion in water. Kit shall be modular, molded rubber type, and shall be as manufactured by Raychem HVS-1520S Series for Heat-Shrinkable splice and Elastimold 655LR Series Separable Connector for elbow splice, or approved equal.
1. Molded Kits shall be fully shielded, fully submersible, designed for energized operation.
 2. Connectors shall be shielded, with proper creep path length and water-seal. The crimp-type connector for the cable conductor shall meet all requirements of TDJ-162 for Class "A" connectors.
- I. Fault Indicators:
1. At elbow connectors provide and install Cooper Power Systems Type TPR or approved equal test point reset fault indicators. Fault indicators shall not trip due to mechanical forces caused by handling. An electric pulse shall turn the indicator's display. When line voltage is restored, the indicator shall reset in approximately 3 minutes. A semi-conductive molded rubber housing, epoxy encapsulated electronic componentry and sealed target window shall make indicator suitable for submersible applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cable installation shall conform to NFPA 70 and ANSI C2:
1. Ends of cable shall be taped immediately after cutting to prevent moisture from entering the cable. Where the cable is not expected to be connected for at least 72 hours, the tape shall also be varnished.
 2. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.
 3. Bends in cables shall have an inner radius not less than 12 times the cable diameter.
 4. Leave a horizontal slack of approximately 3 feet on each end of cable runs, on each side of connection boxes, and at all points where connections are brought to equipment. Leave additional slack to make necessary connections.
 5. Ground cable shielding, metallic sheath, and armor at each cable joint or splice by means of braided tinned copper wire connected to equipment grounding conductor. See Section 262400. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground wires shall be neatly and firmly attached to pullbox walls and the amount of exposed bare wire shall be held to a minimum.

- B. Cable Pulling: Test raceways with a mandrel and thoroughly swab out to remove foreign material before the pulling of cables. Pull cables down grade with the feed-in point at the pullbox or equipment enclosure of the highest elevation. Use flexible cable feeds to convey cables through the pullbox opening and into the raceway runs. Cable slack shall be accumulated at each junction box where space permits by training the cable around the interior to form one complete loop. Minimum allowable bending radii shall be maintained in forming such loops.
1. Lubricants for assisting in the pulling of jacketed cables shall be those specifically recommended by the cable manufacturer. Cable lubricants shall be soapstone, graphite, or talc for plastic jacketed cables. The lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.
 2. Cable pulling tensions: Use a dynamometer and do not exceed a value of $TM =$ number of conductors in the run, times the cross sectional area in circular mills, times the constant .011, or the maximum pulling tension recommended by the cable manufacturer, whichever is lower.
 3. Installation of Cables in Pullboxes: Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form all cables to closely parallel walls, not to interfere with conduit entrances, and support on brackets and cable insulators at a maximum of 18 inches separation. Support cable splices by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space opening for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each pullbox.
 4. Use nylon or manila rope.
 5. Cable racks, supports and related fittings to be UL listed, cable iron insulators to be dry processed glazed porcelain, use industry standard equipment.
- C. Observation by Owner's representative: pulling set up and approved pulling plan, pulling operation.
- D. Cable Terminating: Protect terminations of insulated power cables from accidental contact, deterioration of coverings and moisture by the use of terminating devices and materials. Install all terminations of insulated power cables, cable splices, and high voltage terminations in accordance with the manufacturer's requirements. Make terminations using materials and methods as indicated or specified herein or as designated by the written instructions of the cable manufacturer and termination kit manufacturer.
- E. Splices in Medium Voltage Cables: Splices shall be made only in pullboxes and only where approved in advance by the Owner. Splices in Shielded Cables: Splices in shielded cables shall include covering the spliced area with metallic tape, or like material, to the original cable shield and by connecting it to the cable shield on each side of the splice. Provide a copper ground connection as part of the splice installation. Wire shall be trained to the sides of the enclosure in a manner to avoid interference with the working area.
- F. Cable in Underground Duct:
1. The duct shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points, and shall run in straight lines except where a change of direction is necessary. As each conduit run is completed, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the duct shall be drawn through the duct; after which a brush, having stiff bristles, shall be drawn through until the conduit is clear of all particles of earth, sand or gravel; conduit plugs shall then immediately be installed. Provide a plastic warning tape in the backfill approximately 12 inches below grade.

- The tape shall be yellow plastic with integral warning legend repeated continuously throughout the entire length of the tape.
2. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter, a minimum radius of 36 inches for ducts of 3 inches in diameter and larger, and a minimum of 48 inch radius for medium voltage applications.
 3. Use end bells where duct lines enter pullboxes or handholes and rigid steel exposed in pullboxes or handholes. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs.
 4. Removal of Ducts: Where duct lines are removed from existing manholes, close the openings to waterproof the manhole. Chip out the wall opening to provide a key for the new section of wall.
 5. Multiple duct runs shall maintain 3-inch minimum separation between runs. Provide plastic spacers at maximum 5 feet-0 inch centers to maintain 3 inch spacing between conduits. Drive two reinforcing bars to anchor the conduits at 10 feet-0 inch centers to prevent floating during concrete pour.
 6. Do not install plastic conduit in rock base. Provide double wrapped galvanized rigid steel elbows on runs greater than 100 feet or on runs with more than two 90-degree elbows.
 7. Install 3" minimum concrete encasement on duct banks that include two or more raceways in a single trench. Drive two reinforcing bars to anchor the conduits at 10 feet-0 inch centers to prevent floating during concrete pour.
 8. Burial depth - Concrete encased: 30-inch minimum for 600V or lower systems to top of concrete encasement.
 9. Color mix on medium voltage ductbanks to be 10-lbs red oxide per yard of concrete.
 10. Manholes shall be left in a clean condition with all debris removed and with all cables supported on approved cable supports. All stubs for manholes shall be concrete encased and shall extend 5 inches beyond manholes.
 11. Underground Structures: Precast concrete - risers and tops to conform to ASTM C 478. Precast units (ACI 318) shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete pullboxes. Pullboxes shall be the type noted on the drawings. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Duct entrances and windows shall be located near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair their strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide all necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. A pulling-in iron shall be installed in the wall opposite each duct line entrance. The words "HIGH VOLTAGE" and "M.H.-XX" (confirm manhole number with Owner) shall be cast in, or welded on, the top of pullbox cover - see drawings for details. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable. All steel covers, frames, and steel fittings shall be galvanized. Penthead security bolts shall secure steel cover.
 - a. Metal Frames, Covers and Gratings: Full traffic covers shall satisfy the ASSHTO H-20 loading criteria, and pedestrian traffic covers shall satisfy the ASSHTO H-10 loading criteria.

- b. Drainage Pipe and Fittings: Cast-iron, extra strength. Drains shall be cast-iron, coated or uncoated, plain pattern, bottom outlet with perforated or slotted hinged cover.
- G. Transformer or Concrete Pullbox Grounding: See Section 26 24 00. Install ground rod in manholes and in transformer compartment, and connect properly to the cable shielding, metallic sheath, and armor at each cable joint or splice by means of braided tinned copper wire. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations.

3.2 LABELING

- A. Label medium voltage conductors, splices, and terminations as per Section 260500 and as detailed on Drawings.

3.3 SERVICES INSTALLATION

- A. Electric Service: Arrange with the Owner for scheduling of splicing into existing medium voltage site distribution system where indicated on the drawings. Furnish and install all materials and labor necessary for complete installation as noted on drawings, and as required by the Owner.

3.4 EARTHWORK

- A. See Section 262700.

3.5 TESTING

- A. Perform inspection and tests per NETA ATS-2017 Section "Cables-Medium Voltage-69kV Maximum" and per Owner's requirements.
- B. All medium voltage cables, cable splices, junctions and jumpers shall be subjected to dielectric-absorption and high voltage test after the installation has been completed.
- C. Provide schedule notification to the Owner 5 working day prior to testing.
- D. Each medium voltage power cable shall be tested with a 2,500 volt insulation resistance test set and readings recorded each 15 seconds for the first 3 minutes until fully charged and then at 1 minute intervals for 3 minutes with a minimum reading of 200 megohms at 60° F and corrected accordingly at all other temperatures.
- E. For each medium voltage cable: An initial voltage shall be applied and increased in no less than 5 uniform steps up to the maximum test voltage for 15 KV system to 63 KVDC and hold for 5 minutes.
- F. Ensure that terminator voltage limits are not exceeded. Investigate any readings exceeding 10 micro-amps for every 1,000 feet of cable.
- G. Perform a shield continuity test on each power conductor by ohmmeter method. Contractor to investigate resistance values in excess 10 ohms per 1,000 feet of cable.
- H. All cables failing tests or with evidence of damage shall be removed and replaced in their entirety (no splices), at no cost to the Owner.

- I. Contractor shall assist in testing by providing test equipment, labor and technical personnel.
- J. Contractor to provide equipment that will allow for proper bailing to avoid premature connection failure.
- K. Test Fault Indicators and verify correct operation per Manufacturer's instructions.
- L. See Section 260800 for additional requirements.

END OF SECTION

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SECTION 260573
PROTECTION & COORDINATION STUDIES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Short-circuit analysis.
- B. Protective device evaluation.
- C. Coordination study.
- D. Arc Flash study.

1.2 REFERENCE STANDARDS

- A. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001.
- B. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements

1.3 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Electrical testing agency regularly engaged in arc flash, short circuit, and coordination studies, with at least 5 years experience in work of this type, and employing professional electrical engineers licensed in the State in which the Project is located to perform the studies.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
 - 1. SKM Systems Analysis
 - 2. Operation Technology, ETAP
 - 3. Power Analytics Corporation
- C. Contractor Responsibility: Provide all project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, and actual circuit lengths.
- D. Owner's Responsibility: Provide data on relevant Owner power distribution equipment.

1.4 PROTECTIVE DEVICES

- A. Provide protective devices of ratings and settings as required so that the protective device closest to the fault will open first.
- B. In addition to requirements specified elsewhere, provide overcurrent protective devices having ratings and settings in accordance with results of this analysis.

PART 2 - PRODUCTS

2.1 SHORT-CIRCUIT ANALYSIS, PROTECTIVE DEVICE EVALUATION, COORDINATION, AND ARC FLASH STUDY

- A. Scope of Services: Provide a current and complete short-circuit study, equipment interrupting or withstand evaluation, protective device coordination, and arc flash evaluation study for the electrical distribution system..
1. Study shall include all portions of electrical distribution system. Normal and emergency system connections and those which result in maximum fault conditions shall be adequately covered in the study.
 2. The study shall be performed by Emerson Network Power, or equal. Study shall be prepared and signed by a California registered Electrical Engineer.
 3. In the case of additions or modifications to existing distribution systems, the scope of the Study shall include all new portions of the distribution system, and all existing devices upstream of the distribution system modifications all the way to the facility main service switchboard.
- B. Submittals:
1. Submit Study to Architect for review prior to receiving final acceptance of distribution equipment shop drawings or prior to release of equipment for manufacture. If formal completion of Study may cause delay in equipment manufacture, acceptance from Architect may be obtained for preliminary submittal of sufficient study data to ensure that selection of device ratings and characteristics will be satisfactory.
- C. Short-Circuit Study:
1. The study shall be in accordance with applicable ANSI and IEEE Standards.
 2. The study input data shall include the utility company's primary short-circuit single-and three-phase contribution, with the X/R ratio, the resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and all other applicable circuit parameters.
 3. Short-circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each switchgear bus, switchboard, distribution switchboard, panelboard, and other significant locations through the system.
- D. Equipment Evaluation Study:
1. An equipment evaluation study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters, switches, and fuses by tabulating and comparing the short-circuit ratings of these devices with the available fault currents. Any problem areas or inadequacies in the equipment shall be promptly brought to the Architect's attention.
- E. Protective Device Coordination Study:
1. A protective device coordination study shall be performed to select or to check the selections of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker and fuse trip characteristics and settings.
 2. The coordination study shall include all voltage classes of equipment and protective devices. The phase and ground overcurrent protection shall be included, as well as settings for all other adjustable protective devices.
 3. The time-current characteristics of the specified protective devices shall be plotted on appropriate log-log paper. The plots shall include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low-voltage circuit breaker trip curves, relay

curves and fuse curves. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, ANSI transformer magnetizing inrush and withstand curves per ANSI C37.91, cable damage curves, symmetrical and asymmetrical fault currents. All requirements of the current National Electrical Code shall be adhered to. Reasonable coordination intervals and separation of characteristics curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a complete system basis. Sufficient curves shall be used to clearly indicate the coordination achieved to each main breaker or fused device, each feeder breaker, and each primary protective device.

4. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fuses in the system. Discrepancies, problem areas, or inadequacies shall be promptly brought to the Architect's attention.

F. Arc Flash Evaluation Study:

1. An arc flash evaluation study shall be performed to determine, in coordination with the Owner's safety policy, the required personal protective equipment (PPE) when working on energized equipment.
2. The arc flash evaluation study shall comply with all NFPA 70E and OSHA requirements for calculating and identifying incident energy levels and the corresponding PPE that would be required in each instance.
3. The calculated incident energy levels and recommended PPE for each location shall be summarized in a tabulated form listing location, circuit identification, and PPE. Discrepancies, problem areas, or inadequacies shall be promptly brought to the Architect's attention.
4. Arc flash calculations shall be based on values of fault current magnitudes identified in the short-circuit analysis and the associated clearing times of the over current protective devices determined by the coordination study. The settings recommended by the coordination study shall be the basis of arc flash calculations.
5. Calculation methods shall comply with IEEE Standard 1584 "IEEE Guide for Performing Arc-Flash Hazard Calculations".
6. Per IEEE Standard 1584, a maximum arc time of two seconds shall be utilized to limit incident energy values.
7. Recommended settings of all protective equipment based on the short circuit and equipment coordination study shall be implemented prior to attaching arc flash hazard labels to the equipment.
8. All electrical equipment shall be field marked to indicate where a flash hazard exists in compliance with NEC 110-116. Labels shall be submitted for approval prior to application. Labels shall be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

G. Study Report:

1. The results of the power system study shall be summarized in a final report. Five (5) bound copies of the final report shall be submitted to the Architect.
2. The report shall include the following sections:
 - a. Description, purpose, basis, written scope, and a single-line diagram of the portion of the power system which is included within the scope of study.
 - b. Tabulations of circuit breaker, fuse, and other equipment ratings versus calculated short-circuit duties, and commentary regarding same.
 - c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

- d. Fault current tabulations including a definition of terms and a guide for interpretation.
- e. Tabulation of appropriate tap settings for relay seal-in units.
- f. Tabulation of arc flash study incident energy levels and PPE requirements.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Provide the services of a qualified field engineer and necessary tools and equipment to test, calibrate, and adjust the installed protective devices to conform to requirements determined by the coordination analysis.
- B. Adjust installed protective devices (including existing upstream devices in the case of modifications or additions to an existing distribution system) having adjustable settings to conform to requirements determined by the coordination analysis.
- C. Submit report showing final adjusted settings of all protective devices.

END OF SECTION

SECTION 260800
TESTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included in This Section: All materials, labor, equipment, services, and incidentals necessary to perform the testing and inspection of the electrical work, including but not limited to the general systems noted below:
 - 1. Grounding system.
 - 2. Lighting system.
 - 3. Distribution system.
 - 4. Lighting control system.
 - 5. Title 24 Acceptance Testing.

- B. Test additional work where specified in other Sections of these specifications or where indicated on the drawings (provide all materials, labor, equipment, services, and incidentals necessary to perform the testing and inspection of this Electrical Work):
 - 1. Medium voltage switchgear, transformers, and distribution system.
 - 2. Emergency Generator and Automatic Transfer Switches.

- C. Any other electrical work as might reasonably be implied as required, even though not specifically mentioned herein or shown on the drawings.

- D. All work shall comply with Sections 260500 and 262700.

- E. In addition to the general system tests and inspections indicated above, the Contractor shall perform the following inspections and tests. The Contractor shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections:
 - 1. System Grounding.
 - 2. Switchgear, Switchboards, Distribution Panels, Panelboards.
 - 3. Feeders.

- E. In addition to the general system tests and inspections indicated above, the Contractor shall retain the services of a recognized corporately and financially independent testing firm (Emerson Network Power or equal) for the purpose of performing the following inspections and tests. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections:
 - 1. System Grounding.
 - 2. Switchgear, Switchboards, Distribution Panels, Panelboards.
 - 3. Feeders.

- E. The purpose of these tests is to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

1.2 APPLICABLE CODES, STANDARDS, AND REFERENCES

- A. All inspections and tests shall be in accordance with the International Electrical Testing Association - Acceptance Testing Specifications ATS-2017 (referred to herein as NETA ATS-2017).

1.3 QUALIFICATIONS

- A. Qualifications of the Testing Firm shall be as listed in NETA ATS-2017.

PART 2 - PRODUCTS

2.1 THIS ARTICLE DOES NOT APPLY TO TESTING.

PART 3 - EXECUTION

3.1 GENERAL

- A. Final test and inspection to be conducted in presence of the Authority having Jurisdiction (AHJ) or Inspector of Record (IOR). Test shall be conducted at the expense of, and managed by, the Contractor, at a mutually agreed time. Submit written test report of all tests, with test result values and overall outcome.
- B. All portions of the electrical installation shall be inspected and tested to ensure safety to building occupants, operating personnel, conformity to code authorities and Contract Documents, and for proper system operation.

3.2 INSPECTIONS AND TESTS

- A. Tests: Field tests shall be performed and reports submitted, as per Section 260500, Part 1.
 - 1. Final Inspection Certificates: Prior to final payment approval, deliver to the Owner, with a copy to the Architect, signed certificates of final inspection by the appropriate local authority having jurisdiction.
- B. Grounding System:
 - 1. All ground connections shall be checked and the entire system shall be checked for continuity. The resistance of grounding electrodes in the system shall be measured using a 3 point fall-of-potential method. The maximum ground resistance shall be three ohms. If the measured ground resistance exceeds three ohms, install (1) additional ground rod, bonded and interconnected with the grounding electrode system.
 - 2. Ground tests shall meet or exceed the requirements of the National Electric Code.
- C. Lighting Systems:
 - 1. The interior and exterior lighting systems shall be checked for proper local controls and operation of entire installation, including the operation of the low voltage lighting control system.
- D. Power Distribution System:
 - 1. Test main switchboard, distribution boards, panel boards, and transformers for grounds and shorts with mains disconnected from feeders, branch circuits connected and circuit breakers closed, all fixtures in place and permanently connected and grounding jumper to neutral lifted and with all wall switches closed.
 - 2. Test each individual circuit at each panelboard with equipment connected for proper operation. Inspect the interior of each panel.
 - 3. Check verification of color coding, tagging, numbering, and splice make-up.
 - 4. Verify that all conductors associated with each circuit are in same conduit.
 - 5. Demonstrate that all lights, jacks, switches, outlets, and equipment operate satisfactorily and as called for.
 - 6. Test proper functioning of the ground fault protective system(s).

7. Perform megger tests of all distribution system feeders prior to energizing. All Cables failing megger tests or with evidence of damage shall be removed and replaced in their entirety (no splices), at no cost to the Owner. Damaged cables may not be field repaired without specific approval of the Architect.
- E. Lighting Control System: Verify that all equipment, components, and devices function as specified. Refer to Section 265700 for additional testing requirements.
- F. Where the following systems are specified herein and/or indicated on the drawings, verify that all equipment, components, and devices function as specified and meet all additional testing as described in related individual Sections of this specification:
 1. Medium voltage switchgear, transformers, and distribution system.
 2. Emergency Generator and Automatic Transfer Switches.
- J. Title 24 Acceptance Testing: Contractor shall complete the requirements for Title 24 Acceptance Testing, as per CA Title 24, Part 6.
 1. Perform testing requirements as per Title 24 Lighting Acceptance requirements. Testing shall include construction inspection of installed controls, occupancy / motion sensor testing, manual daylighting controls testing, automatic time switch controls testing, and demand response system interface, as applicable.
 2. Complete and submit all required forms for complete Acceptance Testing.
 3. Obtain required review and approval of Acceptance Forms to allow final certificate of occupancy to be granted.

END OF SECTION

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SECTION 261202

THREE-PHASE PADMOUNTED TRANSFORMER

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American National Standards Institute (ANSI) Publications:
- C2 National Electric Safety Code
 - C57.12.26 Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, Separable Insulated High Voltage Connectors; High Voltage 24,940 GRDY/14400 Volts and below; 2500 kVA and Smaller
 - Z35.1 Specifications for Accident Prevention Signs
- C. American Society for Testing and Materials (ASTM) Publications (Latest Edition):
- D 92 Test Method for Flash and Fire Points by Cleveland Open Cup
 - D 117 Test Method for Electrical Insulating Oils of Petroleum Origin
 - D 877 Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
 - D 3487 Mineral Insulating Oil Used in Electrical Apparatus, Standard Specification
- D. Institute of Electrical and Electronic Engineers, Inc. (IEEE) Publication (Latest Edition):
- 386 Separable Insulated Connectors for Power Distribution Systems Above 600 V
- E. National Fire Protection Association (NFPA) Publication (Latest Edition):
- 70 National Electrical Code
- F. Nema 210.

1.2 SUBMITTALS

- A. Catalog Information and Shop Drawings: Indicate ratings, capacity, and detailed arrangement of components.
1. Distribution Transformer
 2. Primary Fuses
 3. Primary Oil-Immersed Switches
- B. Certificates:
1. Certified Test Report of Transformer Manufacturer

2. Provide CBC 2019 compliant seismic installation. See Section 260500 for all certification and submittal requirements.
- C. Equipment bushings, dead-end plugs, dead break junctions and grounding connectors shall be submitted to and approved by the Architect before ordering.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Distribution Padmount Compartmental-Type Transformer: The unit shall be suitable for loop connection and shall contain the transformer, six 200A universal bushing wells, three two position rotary oil-immersed load break - load make switches including an A and a B loop switch and a transformer winding switch, primary current limiting fusing, and primary overload fusing in a weather resistant, tamper-resistant enclosure, arranged for padlocking, with a full tank and compartment weather cover. Transformer shall conform to ANSI C57.12.26. High voltage and low voltage compartments shall be isolated from each other in a manner to require a separate unlatching or unbolting action to give access to the high voltage compartment. (Note: provide radial connection where indicated on the drawings).
- B. Transformer shall conform to Owner's Standards, including testing and adjustment requirements.
- C. Transformer: Dead front, three phase, two winding, 60 Hz, 65 degree C rise, oil insulated, self-cooled type rated as indicated on the drawings, with two 2-1/2% full capacity taps above and below rated primary voltage. Basic Insulation Level shall be 125 kV on the primary side, and 30 kV minimum on the secondary side. High voltage winding shall be 12.47 kV delta (or 12.00 kV where indicated on the drawings). Low voltage shall be 277/480 V grounded wye, 4-wire. Windings shall be copper. Transformer tank shall be sealed except for bolted handhole access. Provide lifting lugs. Provide external tap changing for de-energized operation only. Locate the changer control handle within the high voltage compartment and provide position indicator and method of securing the control handle against unintentional operation. Switch indicating plate shall be readable from 5 feet away. Tank Construction: Liquid immersed transformer shall have a totally bolted gasketed cover with a weather cover over the compartment and over the tank.
- D. The transformer tank and compartment shall be assembled as an integral unit for mounting on a pad. There shall be no exposed screws, bolts, or other fastening devices, which are externally removable. There shall be no openings through which foreign objects such as sticks, rods, or wires might contact live parts. The construction shall limit the entry of water (other than flood water) into the compartment so as not to impair the operation of the transformer.
- E. Full-height, air-filled high voltage and low voltage terminal compartments with full-height and full-width hinged door for each compartment shall be located side-by-side separated by a steel barrier, with the high voltage compartment on the left (as viewed from the front of the transformer). To facilitate making connections and permit cable pulling, the doors and compartment hood shall be removable. Removable doorsill on compartments shall be provided to permit rolling or skidding of unit into place over conduit studs in foundation.
- F. Mineral Oil: ASTM D 3487, Type II tested in accordance with ASTM D 117.
- G. Transformer: Provide the accessories listed below:

1. Bronze drain and sampling valve: 1-inch trade size minimum, with FPT plugged discharge
 2. Filter press connections
 3. Ground pads
 4. Provision for lifting and jacking
 5. Top liquid dial-type thermometer without alarm contacts
 6. Pressure-vacuum gauge
 7. Pressure-relief device
 8. Oil fill connection: Capped, 1.25-inch trade size minimum
 9. Oil level gauge: With normal level at full load rated temperature rise indicated
 10. Oil temperature gauge: Calibrated in degrees C, with full load temperature rise indicated
 11. 4 extra hold down pads compliant with CBC 2019 seismic requirements
- H. High-voltage switches: Provide internal, oil-immersed rotary, gang-operated, load break - load make switches. Minimum switch rating shall be load-break and make, 200A continuous; make and latch 10,000A symmetrical; 6,000A minimum for 1 second.
- I. Primary Fusing:
1. Internal Fault Protection: Provide current limiting fusing in dry well, air-insulated, with non-load break fuse holders inserted in the transformer tank. Provide an integral warning notice and safety baffle to prevent fuse removal unless the transformer is de-energized. Fuse values shall be 150 percent of full load current and fuses shall be Class E.
 2. "Weak-link" primary fusing is not acceptable in lieu of current limiting primary fusing.
 3. Overload Protection: Expulsion fuses, dead front Bay-O-Net type.
 4. Provide a spare set of (3) fuses of each type in original cartons.
- J. A-B Loop Switches: Provide primary loop switches (both switches normally closed, to maintain loop).
- K. Enclosure: Enclosure shall be constructed in accordance with ANSI C57.12.26.
- L. Finish - Prior to prime coating, all welds shall be ground smooth. Rust inhibiting prime coat over cleaned and degreased surfaces. Vinyl paint for finish coat on all surfaces. Color shall be Munsell No. 7GY3.29/1.5 Green.
- M. Latches - Three Point Vault Style, chromium plated with 4-inch handle and provisions for padlocking.
- N. Grounding Pads - Steel ground pad welded to tank wall in primary and secondary compartment. Each pad drilled and tapped for two 3/8 inch (min.) steel bolts.
- O. Termination compartment dimensions shall be as follows:
1. Height: Maximum of 66 inches or the transformer height plus 2 inches (approx.)
 2. Depth: 18 inches minimum, 24 inches maximum.
 3. Width: Primary Compartment 42 inches min.; Secondary Compartment 24 inches min.
- P. The nameplate shall comply with ANSI C57.12.26 except that the number of gallons of coolant shall be shown.
- Q. Transformer shall be as manufactured by Eaton-Cutler Hammer, Schneider-Square D, ABB, Cooper, or approved equal.

- R. High Voltage Separable Connectors: Provide well bushings with 15 kV inserts for separable connector terminations – see Section 260513 for connector requirements.
- S. Secondary Connections - Spade bushings: National Electrical Manufacturers Association (NEMA) drilled copper terminal, 1.75 inch hole spacing. Provide secondary bus supports using an insulating material to prevent spade from bending due to cable weight. Hi-press lugs only for cable termination.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Padmounted transformer installation shall conform to the Manufacturer's shop drawings and mounting instructions and shall include securing it to a concrete pad by at least four anchor bolts. Completed installation shall conform to the requirements of ANSI C2.

3.2 FIELD TESTS

- A. Testing of medium voltage equipment shall be performed in conjunction with the Manufacturer's representative.
- B. Coordinate with the factory representative and provide all assistance required in the start-up and testing of the equipment.
- C. Perform inspection and tests per NETA ATS-2017 Section "Transformers - Liquid-Filled". Laboratory tests on the insulating fluid for the following items are not required: Specific gravity, power factor, water content, dissolved gas analysis, total combustible gas content. The following tests are not required; winding-resistance tests on each winding in final tap position, percent oxygen tests on the nitrogen gas blanket.
- D. Field testing requirements for transformer to include ASTM D877 dielectric liquid test, ASTM D971 interfacial tension test and ASTM D1533 moisture content test.
- E. See Section 260800, "TESTING", for additional requirements.

END OF SECTION

SECTION 262400
SERVICE AND DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included in This Section: All materials, labor, equipment, services and incidentals necessary to install the electrical work as shown on the drawings and as specified hereinafter, including but not limited to the work listed below.
- B. Temporary power for construction.
- C. Main switchboard, Distribution Switchboards, Distribution Panels, Transformers, Distribution System, Panel Boards, Grounding, and Overcurrent Protective Devices.
- F. All required incidental work, such as excavating, backfilling, testing, and temporary power.
- G. Any other electrical work as might reasonably be implied as required, even though not specifically mentioned herein or shown on the drawings.
- H. All work shall comply with Sections 260500 and 262700.

1.2 RELATED WORK

- A. Division 09 - Finishes
- B. Division 23 - Heating, Ventilating, and Air Conditioning

1.3 SUBMITTALS

- A. Comply with the provisions of Section 260500 - Submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Refer to Section 260500, Part 2 - Products
- B. All new equipment shall match existing.
- C. List of Equipment Manufacturers:
 - Switchboards and Motor Control Centers
 - Eaton-Cutler Hammer, General Electric, Industrial Electric Manufacturing, Schneider-Square D.
 - Panelboards and Distribution Panel
 - Same manufacturer as Main Switchboard.
 - Dry-type Transformers

Eaton-Cutler Hammer, Schneider-Square D, General Electric.

2.2 MATERIALS

- A. Provide and install conduits for primary cables by utility company, concrete pad and grounding for utility company transformer, and conduit for secondary service to main switchboard. Comply with all Utility Co. requirements.
- B. Furnish and install telecommunications service conduits and pullboxes; install conduits to main point-of-entry backboard as indicated on the drawings. All work shall conform to utility company requirements and to Section 262700.
- C. Grounding:
 - 1. Provide and install grounding system as noted on the drawings.
 - 2. Grounding electrode conductor: bare stranded copper type, #4/0 minimum.
 - 3. Install ground wires in rigid conduit.
 - 4. All grounding electrode conductor connections "thermite" or "cad-weld" welded.
 - 5. Use approved pressure type solderless connector or use fusion welding for all connections to and bonding of grounding electrode system. All connections shall be visible, readily accessible for testing purposes. Grounding electrode conductor between the grounding electrode and service equipment: Minimum #4/0.
 - 6. Furnish and install solid copper or copper-clad 5/8" x 10'-0" ground rod(s). Where multiple ground rods are shown, install a minimum of 20'-0" apart. Install ground rods in accessible boxes with covers. Furnish and install 2-#4/0 bare copper cables between multiple ground rods and main switchboard ground bus.
 - 7. Terminate grounding conduits at equipment with ground bushing, with ground wire connected through bushing.
 - 8. Provide No. 12 stranded (green) THHN conductor from outlet box to ground screw of every receptacle.
 - 9. Ground all isolated sections of metallic raceways.
 - 10. Provide #12 minimum stranded (green) THHN conductor sized per NEC, or as noted, connected continuously throughout branch circuit for all circuits, bonded to panel ground bus, and to all electrical devices and equipment enclosures.
 - 11. Grounding electrode installed as follows:
 - a. Place #4/0 bare copper cable in foundation trench; tensioned, supported in such a manner that it cannot be less than two (2) inches from bottom or side of concrete when foundation concrete is poured; not less than one hundred feet of conductor. Embed in foundation with a loop at approximate center, brought out at top of foundation at location of building service equipment for connection to service equipment and for bonding to other parts of the grounding electrode system.
 - b. Use approved pressure type solderless connector or use fusion welding for all connections to grounding electrode. Connection visible, readily accessible for testing purposes. Grounding electrode conductor between the grounding electrode and service equipment: Minimum #4/0.
 - c. Connect grounding electrode system to metallic water service entry metallic cold water pipe (if available) with nonferrous clamp and bare copper cable (sized as required) in conduit. Connection shall be accessible for inspection.
 - d. Connect grounding electrode system to effectively grounded building steel as indicated on the drawings. Use exothermic weld, connection shall be accessible for inspection.
 - e. After installation, test system using the three-point fall of potential method only. Record results and submit to Architect for approval. If resistance to ground exceeds three ohms, install an additional ground rod, bonded and interconnected to the grounding electrode system.

- f. Connect ground bar of separately derived systems (e.g all dry-type transformers) to effectively grounded building steel at the closest possible accessible location, or if building is concrete, or the steel is not effectively grounded, to the main switchboard ground bus: Use #4/0 copper conductor for all connections.
- D. Main Switchboard, Distribution Switchboards, and Distribution Panels:
1. General: Switchboard shall be group-mounted type, metal enclosure with ground bus and insulated full capacity neutral bus.
 2. Equipment:
 - a. The switchboard shall be braced for a short circuit current as indicated on the drawings. Bracing shall be per NEMA and UL standards.
 - b. The switchboard shall comply with all the requirements of the Utility Company.
 3. The switchboard shall be pad-mounted, self-supporting, dead-front and rear, front-operated, front-connected, distribution type. Nema 1 (indoor) or Nema 3R (outdoor). The enclosure shall be 90 inches high, made of cold rolled steel on a structural shape, or formed, steel frame and shall be mounted on two 3-inch, 5-pound continuous channel iron sills, which shall be closed at the ends between the two channels.
 4. This contractor is responsible for the complete installation of the switchboard within the space provided (both vertical and horizontal) and shall verify and/or coordinate all dimensions prior to ordering equipment. Proper allowances should be included to allow complete installation and erection.
 5. The switchboard shall be a minimum of 24 inches deep and shall be constructed of National Electrical Code (NEC) gauge steel.
 6. For all switchboards or distribution panels rated 1,200 Amps or higher, provide an arc energy reduction measure in compliance with NEC 240.87(B), to reduce arc clearing time.
 7. The switchboard shall be provided with a cable pull section at the top of the switchboard. Provide a minimum 12 inches of vertical clearance between the cable terminal lugs bolted to the switchboard busses and the top and bottom of the switchboard enclosure. Horizontal pull sections and gutters shall be kept free and clear of busses. Where busses cross vertical pull sections, the busses shall be insulated.
 8. All connections between bus bars shall be of a bolted type using Belleville washers. Clamps will not be accepted. All bus bars shall be accurately formed, and all holes shall be made in a manner which will permit bus bars and connections to be fitted into place without being forced.
 9. The design of all current-carrying devices or parts of the switchboard shall conform to the standard specified in the related sections of Underwriters' Laboratories, Inc. (UL) No. UL-891 and National Electric Manufacturer's Association (NEMA) Standard PB-2, except as these characteristics may be modified herein.
 10. Bus bars, connection bars and wiring on the back of the switchboard shall be arranged so that maximum accessibility is provided for cable connections from the front.
 11. Ampere ratings for rectangular bus bars shall be in accordance with the temperature rise standard of National Electric Manufacturer's Association (NEMA) and the Underwriters' Laboratories, Inc. (UL).
 12. The enclosure shall be chemically cleaned by parkerizing, bonderizing or phoshorizing as a unit after all welding has been completed. The enclosure shall then be painted with a rust-resisting primer coat of paint and shall be finished with a coat of light gray, baked enamel.
 13. Each section shall be bussed for the full connected load of that section. Extend bussing to spare circuit breaker "Spaces." Drill busses for future circuit breakers, and provide breaker connector hardware where indicated on the drawings or where required for ready installation of future circuit breakers.
 14. Provide copper bus bars and connections with silver-plated contact surfaces.
 15. The contact surfaces and studs of all devices to which bus connections are made shall also have silver-plated surfaces.

16. Locate ground bus, with a cross-section equal to at least 25 percent of the capacity of the main bus rating, in the back of the switchboard and extend bus throughout the length of the switchboard assembly. Ground each housing of the assembly directly to this bus.
18. Rigidly support all bus and connection bars and current transformers.
19. Fit all nuts and connections with locking devices to prevent loosening.
20. Provide load connections with solderless lugs. Factory-install all devices shown on Drawings as specified herein.
21. Provide ground fault protection for all main breakers or feeder breakers rated at 1000A or higher at 277/480V 3PH, and when otherwise indicated on the single line diagram or where otherwise noted on the drawings. Protection shall consist of a current sensor, relaying device, and the appropriately sized overcurrent protection device.
22. Provide a bonding strap from the equipment ground bus to the neutral bus.
24. Provide transient voltage surge protection, integral to or adjacent to the switchboard when indicated on the plans or where otherwise noted in the specifications herein. Refer to Section 264300.
25. Distribution Panels shall comply with all relevant requirements of the above paragraphs - minimum 12" deep, for floor or wall-mounting.
26. All equipment shall be door in door construction.

E. Panelboards:

1. Surface (or flush where indicated on the drawings) mounted, with branch circuits as indicated on the drawings.
2. Enclosures: code gauge galvanized sheet steel with welded full flange end pieces, stretcher- leveled steel trim, backpan and door.
3. Bussing of copper with silver-plated contact surfaces.
4. Trims on surface-mounted cabinets secured with nickel-plated screws with cup washers, bottom of all trims to have lugs for resting on cabinet flange.
7. Panels shall be 20 inches minimum in width, provided with approved gutter space, barriers and adjustable supports. Doors mounted with concealed hinges provided with combination spring latch and lock. Doors and trims and surface mounted cabinets primed and finished with one coat baked on gray enamel. All visible panel enclosures and covers in finished (occupied) areas shall be painted to match adjacent wall finish.
8. Breakers on same phase to be aligned horizontally. Each panel provided with quantity (5) spare handle locks. Install handle locks on all breakers serving fire alarm equipment.
9. Each branch circuit of panelboards to have a permanently fixed number with one word directory, mounted under celluloid on inside of cabinet door, showing circuit numbers and typewritten description of outlets controlled by breakers. Color code mains and each breaker terminal, same as conductor insulation.
10. Each panel shall be equipped with a copper ground bus.
11. All panels shall be fully bussed to accept future circuit breakers, with breaker hardware provided where indicated on the drawings.
12. Panel board submittals shall include diagrams of the circuit breaker arrangements in the panels. Arrange circuit breakers in panels exactly as shown on the panel schedules in the construction documents - no deviations permitted.
13. All panels shall be door in door construction.

F. Circuit Breakers:

1. General: Circuit breakers shall be molded case rated for 480 or 240 volts, multiple or single pole and amperage rating as shown on the drawings, bolt on, manually operated with "de-ion" arc chutes.
2. For all circuit breakers rated 1,200 Amps or higher, provide an arc energy reduction measure in compliance with NEC 240.87(B), to reduce arc clearing time.

3. Main circuit breaker shall be shall be rated to interrupt the available short circuit current - 65,000 amps RMS unless otherwise indicated on the drawings.
 4. Distribution circuit breakers shall be rated for the amps interrupting capacity noted on the drawings or U.L. series rated with the main circuit breaker.
 5. Branch circuit breakers shall be rated for the amps interrupting capacity or U.L. series rated with the distribution and main circuit breakers, General Electric type THQB or equal, minimum 10,000 A.I.C for 120/208 volt; type TEY or equal, minimum 14,000 A.I.C for 277/480 volt.
 6. Branch breakers feeding dwelling unit Bedroom 15 and 20 Amp branch circuits shall be arc-fault circuit-interrupting type (per NEC 210-12).
- G. Dry-Type Transformers:
1. Ventilated type.
 2. Dry-type general distribution transformers shall meet the California Title 24 requirements for energy efficiency standards and DOE 10 - CFR, Part 431 (2016) for energy efficient transformers.
 3. Transformer shall be 3 phase, 60 Hertz. Primary winding shall be Delta connected and secondary winding shall be Wye connected. The temperature rise at rated voltage and full load shall not exceed 150 degrees C with a 220 degrees C U.L. Component Recognized Insulation System. The windings shall be aluminum or copper.
 4. The higher voltage winding shall have quantity (6) 2.5% taps - (2) FCAN and (4) FCBN. Set secondary voltage for 120/208V.
 5. Transformer terminals shall be front connected for ease of installation and maintenance.
 6. Where the transformers are installed outdoors provide weatherproof drip cover, rodent screen and a weathertight rating of the enclosure.
- H. 'K' Type Transformers:
1. The transformers shall be marked with a label stating "Suitable for Non-Sinusoidal Current Load with K Factor of 13 (or higher where indicated on the drawings) per UL Guide Specifications.
 2. Transformers shall be 3 phase, 60 Hertz. Primary winding shall be Delta connected and secondary winding shall be Wye connected. The temperature rise at rated voltage and full load shall not exceed 150 degrees C with a 220 degrees C U.L. Component Recognized Insulation System. The windings shall be aluminum or copper.
 3. The higher voltage winding shall have quantity (6) 2.5% taps - (2) FCAN and (4) FCBN. Set secondary voltage for 120/208V.
 4. A copper electrostatic shield shall be inserted between the primary and secondary windings. The primary and secondary conductors shall all be individually insulated, as small in size as possible, and transposed where necessary to keep eddy current losses at an absolute minimum. The primary winding conductor shall be of sufficient size to limit the temperature rise to its rated value even with the circulating 3rd harmonic current. The secondary neutral shall be twice the ampacity of the secondary phase conductors. The Basic Impulse Level of all windings shall be 10 KV. The core flux density shall be well below the saturation point to prevent core saturation caused by the harmonics even with a 10% primary overvoltage.
 5. Transformer terminals shall be front connected for ease of installation and maintenance.
 6. Transformers shall meet DOE 10 - CFR, Part 431 (2016) for energy efficient transformers.
- I. Magnetic starters: shall be rated in accordance with latest published NEMA standards for size and horsepower rating, Eaton-Cutler Hammer A-200 series or equal. Provide with overload sensor in each phase, hand-off-auto switch, red "run" pilotlight, in NEMA 1, NEMA 4X, or NEMA 3R enclosure or in motor control center where indicated. Coil shall be rated 120 VAC. Starters shall be across-the-line nonreversing unless otherwise noted.

1. Contacts: Across-the-line magnetic starters shall be equipped with double break silver alloy contacts. All contacts shall be replaceable without removing power wiring or removing starter from panel. The starter must have straight-through wiring.
2. Coils: Coils shall be of molded construction. All coils shall be replaceable from the front without removing the starter from the panel.
3. Overload Relays and Thermal Units: Overload relays shall be the melting alloy type with a replaceable control circuit module. Thermal units shall be of one-piece construction and interchangeable. The starter shall be inoperative if the thermal unit is removed.

PART 3 - EXECUTION

3.1 REFER TO SECTION 260500 FOR DETAILS OF WORK UNDER THIS SECTION.

3.2 INSTALLATION/APPLICATION/ERECTION

- A. Excavate and trench as necessary for the electrical installation, and when the work has been installed, inspected and approved, backfill all excavations with clean earth from excavation, or imported sandy soil in maximum 8" (eight-inch) layers, moisten and machine tamp to 95% compaction, and restore the ground and/or paving or floor surfaces to their original condition.
- B. Switchboards and Distribution Panels Installation: Mount as detailed on the drawings.
- C. Motor Connections:
 1. Install motor circuits complete for all motors by other trades
 2. Furnish and install all disconnect switches, outlet boxes, etc., as required by code.
 3. All motor and temperature control low voltage wiring shall be installed and connected by Division 23 Section of specifications, unless otherwise indicated on electrical drawings.
- D. Motor Starters Installation:
 1. Deliver starters to site without thermal overload elements. Determine nameplate rating of each motor, after motor and starter installation, select thermal element rating from measured motor running current and install proper elements in starters.
 - a. Submit chart denoting motor designation, motor H.P., motor running current (N.P.), actual running current fuse/breaker size and thermal element catalog number. Take readings of motor running currents in conjunction with Division 23 - Heating, Ventilating, and Air Conditioning.

3.3 TESTS

- A. Testing and Inspection: See Section 260800 - Testing.

END OF SECTION

SECTION 262700
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work included in this Section: All materials, labor, equipment, services, and incidentals necessary to install the electrical work as shown on the drawings and as specified hereinafter, including but not limited to the work listed below:
 - 1. Raceways, feeders, branch circuit wiring, wiring devices, safety switches and connections to all equipment requiring electric service.
- B. Any other electrical work as might reasonably be implied as required, even though not specifically mentioned herein or shown on the drawings.
- C. All work shall comply with Section 260500.

1.2 RELATED WORK

- A. Division 09 - Finishes
- B. Division 23 - Motors and Mechanical Equipment Installation

1.3 SUBMITTALS

- A. Comply with the provisions of Section 260500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Refer to Section 260500, Basic Electrical Requirements, Part 2 - Products.
- B. List of Equipment Manufacturers:

Conduit and Conduit Fittings

Allied Tube and Conduit, Wester Tube and Conduit, LTV Steel Tubular, National Electric Products, AFC, Republic Steel Corporation, Rome Cable Corporation, United States Steel Corporation, Killark Electric Manufacturing Company, Raco, VAW Aluminum Company, Bridgeport, Steel City, Thomas & Betts, Carlon, O.Z. Gedney, Appleton, Regal.

Wire and Cable (600V)

American Wire Company, General Wire and Cable Corporation, Okonite Company, Rome Cable Corporation, Cerrwire, American Insulated Wire, AFC Cable Systems, Essex, Simplex Wire and Cable Company, Southwire.

Solderless Lugs and Grounding Connections

Burndy Engineering Company Inc, O.Z. Gedney Company Inc, Penn Union Electric Corporation, Thomas and Betts Company Inc.

Pull Boxes, Gutters, Special Cabinets

Schneider-Square D Company, Columbia Electric Manufacturing Company, General Electric Company, Eaton Inc.

Outlet Boxes

Appleton Electric Company, Killark Electric Manufacturing Company, Lew Electric Fittings Company, National Electric Products Corporation, Raco, Steel City Electric Company, Carlon, Bowers.

Wiring Devices

Leviton, Arrow-Hart, Cooper, Hubbell, Lutron, Bryant.

Conduit Racks, Hangers

General Electric Company, Killark Electric Manufacturing Company, Caddy, National Electric Products Corporation, Republic Steel Corporation, Rome Cable Corporation, United States Steel Corporation, VAW Aluminum Company, Superstrut, B-Line.

Safety Switches (Disconnect and Fusible)

Schneider-Square D Company, Eaton-Cutler Hammer Inc, General Electric Company.

Fuses

Bussman Manufacturing Company, Chase-Shawmut Company.

Firestopping

3M, Nelson.

2.2 MATERIALS

- A. Raceways: Only the raceways specified below shall be utilized on this project. Substitutions shall be pre-approved in writing. All bare conduit ends (stub-ups or stub-outs) shall be provided with bushed ends or manufactured insulated throat connectors:
1. Rigid Type - hot dip galvanized or sherardized steel, use on all interior and exterior locations, below grade or in concrete slab, and to 18" on either side of structural expansion joints in floor slabs, with completely watertight, threaded fittings throughout. Compression fittings are not acceptable.
 - a. All rigid steel conduit couplings and elbows in soil or concrete or under membrane to be ½ lap wrapped with Scotch #50 tape and threaded ends coated with T&B #S.C.40 rust inhibitor prior to installation of couplings.
 - b. ½ lap wrap all rigid steel conduit stub-ups from slab or grade to 6" above finished grade level with Scotch #50 tape.
 2. In lieu of rigid steel conduit for power and control raceways and branch circuit conduits in soil or concrete slabs, "Schedule 40" PVC with Schedule 80 PVC conduit elbows and stub-ups may be used with code size (minimum No. 12) ground wire. A "stub-up" is considered to terminate 6" above the finished surface.
 - a. Schedule 80 PVC conduit shall be used in all concrete footings or foundations and to 18" of either side of footings or foundation walls.

- b. Schedule 80 PVC conduit shall be used in all concrete masonry unit (CMU) walls or columns.
 - c. All conduit runs in concrete floor slabs (where allowed) shall be installed to comply with all applicable CBC and structural codes to maintain the structural integrity of the floor slab. Where conflicts occur, alternate routing shall be provided at no additional cost to the Owner.
 - d. Where schedule 80 PVC is coupled to schedule 40 or other raceways with differing interior dimensions, each end shall be reamed with a reaming tool to reduce the edge profile for protection of the passing conductors during the pull.
3. Intermediate metal conduit may be used in all exposed interior locations, except that electrical metallic tubing may be used in some locations as noted below. Utilize steel compression type fittings for all exposed conduit runs, unless otherwise noted. Die-cast zinc fittings are unacceptable.
 4. Electrical metallic tubing may be used exposed in interior electrical and mechanical rooms, in interior unfinished spaces, and in interior concealed and furred spaces, made up with steel watertight or steel set screw type fittings and couplings. EMT shall not be used in under-building crawl spaces or other areas subject to moisture. Set screws shall have hardened points. Die-cast zinc fittings are unacceptable.
 5. Surface mounted rectangular non-metallic dual service raceways; Wiremold #5400 (Ivory) or equal with all required compatible activation covers, bezels, inserts, and blank plates for a complete installation. Refer to drawings for outlet quantities in raceway and feed points. All raceway fed flush from rear with horizontal j-boxes, unless otherwise noted.
 6. Flexible conduit shall be used in the following instances:
 - a. For all motor, transformer and recessed fixture connections, minimum ½"; "Seal tite" type used outdoors and in all wet locations, provide with code size (minimum No. 12) bare ground wire in all flexible conduit.
 - b. Where existing conditions preclude the installation of EMT in existing walls to remain, provide and install cut-in type boxes and "fish" flexible MC or flexible conduit and wire through existing walls to remain, unless shown otherwise on plans.
 - c. With the exception of the above, flexible conduit shall not otherwise be used on this project.
 7. All conduit cuts (factory or field cut) shall be perfectly square to the length of the conduit and cut ends shall be reamed with a reaming tool to provide a smooth edge to the passing conductors and to remove all burrs and scrapes. Use of a hand file is not acceptable.
 8. All electrical raceways shall be installed concealed, unless otherwise noted. Cut and patch to facilitate such installation to match adjacent and original finish. All exposed conduits, where required, shall be installed parallel to building members.
 9. All emergency source circuits shall be installed in separate raceways (from normal power), per 2017 NEC 700.10(B), or the applicable code at the time of permitting.
 10. Fasten conduits securely to boxes with locknuts and bushings to provide good electrical continuity.
 11. Provide chrome escutcheon plates at all exposed wall, ceiling and floor conduit penetrations.
 12. Support individual suspended conduits with heavy malleable strap or rod hangers; supports for ½ inch or ¾ inch conduit placed on maximum 7-foot centers; maximum 10-foot centers on conduits 1 inch or larger.
 13. Support multiple conduit runs from Kindorf B907 channels with C-105 and C-106 straps.
 14. Conduit bends - long radius.
 15. Flash conduits through roof, using approved roof jack; coordinate with General Contractor.
 16. To facilitate pulling of feeder conductors, install junction boxes as shown or required.
 17. All empty conduits on the project shall be provided with a nylon pull rope to allow pulling of future conductors intended for the specific raceway. Provide plastic wire-tie style

- nameplate tags on each end of pull rope with printed identification of conduit use and the location of the opposite end of the rope. Pull ropes for telecommunications service conduits shall meet the utility company requirements.
18. Where conduits pass through structural expansion joints in floor slab, rigid galvanized conduit shall be used 18" on either side of joint, complete with Appleton expansion couplings and bonding jumpers, or equal. All above grade expansion joint crossings shall also utilize expansion joint couplings or flex conduit transitions as required for each particular installation. Installed condition shall allow for a minimum deflection of raceway and wire (in any direction) equal to the structural expansion joint dimension (building to building). No solid conduits shall be allowed to cross expansion joints without proper provisions for building and seismic movement.
 19. Minimum cover of conduits in ground outside of building - 36 inches, unless otherwise noted.
 20. Provide and install exterior wall conduit seals and cable seals in the locations listed below. Coordinate installation and scheduling with other trades:
 - a. Conduit seals through exterior wall or slab (below grade): O.Z. Gedney series "FSK" in new cast in concrete locations, series "CSM" in cored locations.
 - b. Conduit seals through exterior wall or slab (above grade): O.Z. Gedney series "CSMI."
 - c. Cable seals at first interior conduit termination after entry through exterior wall or slab: O.Z. Gedney series "CSBI." Coordinate quantity of conductors at each location.
- B. Outlet Boxes and Junction Boxes. Verify all backbox requirements with devices to be installed prior to rough-in.
1. One piece steel knockout type drawn boxes, unless otherwise noted, sized as required for conditions at each outlet or as noted.
 2. Flush-mounted boxes equipped with galvanized steel raised covers for device mounting flush with finished surface. Provide extension rings as required on all acoustical or additional wall treatment areas to bring top of cover flush with finished surface (coordinate with architectural drawings). Devices shall be capable of being tightly mounted to boxes without distorting or bending device or mounting hardware.
 3. Boxes for fixture outlets: 4-inch octagon or larger as required, or as noted.
 4. Switch and receptacle outlets - not smaller than 4-inch-square in furred walls, with raised cover for single device; ganged where required.
 5. Outlet and switch boxes for wet locations, cast aluminum FS or FD type with cast aluminum gasketed spring lid cover. Weatherproof "Bell" type boxes are not acceptable.
 6. All connectors from conduit to junction or outlet boxes shall have insulated throats. Connectors shall be manufactured with insulated throats as integral part. Insertable insulated throats are unacceptable.
 7. Outlet boxes for telecommunications, 4" square or larger as required or noted, multi-ganged for voice, data, and other services where indicated on the drawings.
 8. Conduit Bodies: Malleable iron type, with lubricated spring steel clips over edge of conduit body, O-Z/Gedney type EW, or equal.
 10. Pull boxes: All site pull boxes shall be flush in-ground concrete, with engraved covers identifying service use (i.e. electrical, communications, etc.). Boxes shall be Nema 250, Type 6, outside flanged, with recessed cover for flush mounting, by Christy or equal, with required depth to provide box and conduit depths shown or required.
 - a. Provide concrete covers for all boxes in planted or paved areas (up to available concrete cover size).
 - b. Provide galvanized steel covers for all larger boxes (when concrete is not available), or in traffic areas. No cast iron covers.

- c. Provide bolted covers and slab bottoms (with grouted perimeter) or vault type boxes for all electrical distribution and signal system pull boxes used for site distribution, to prevent rodent entry. No collar type boxes with dirt or gravel bottoms
 - d. Provide drain hole at bottom of all vault type boxes, with loose aggregate base below, for proper drainage.
 - e. All covers to be completely flush with finished adjacent surfaces.
 - f. Provide galvanized steel H20 rated covers and installation of box rated for H20 in all traffic areas.
 - g. Provide pullboxes per utility company specifications for all electrical primary and secondary services and for telecommunications service runs. Verify exact size and type prior to order with each utility company.
- C. Wire and Cable (line voltage and signal systems):
1. 600-volt class where used for or run with line voltage power wiring, insulation color coded, minimum No. 12 AWG for power branch circuits, No. 14 for power control circuits, and wiring size and type as directed by signal system manufacturer for each signal system.
 2. All conductors shall be copper.
 3. Size and insulation type:
 - a. Use 75 degree C insulation ratings on this project, regardless of insulation allowable ratings, unless specifically indicated otherwise on the drawings.
 - b. Standard locations: #12 to #1 AWG: THWN/THHN dual rated for all wet and dry locations; #1/0 through #4/0 AWG: XHHW (55 Mils) for all wet and dry locations; 250MCM and larger: XHHW (65 Mils). All wire sizes used shall be based on a 75 degree insulation rating, unless specifically used with 90 degree rated breakers and devices.
 - b. All wiring (power and signal) installed underground between buildings, or in wet or damp locations, shall be outside listed and rated for wet locations.
 - c. High temperature and non-standard locations: Provide wire type and insulation category suitable for area of use as defined in NEC Article 310.
 - d. Photovoltaic applications: provide 90 degree C insulation ratings.
 4. Conductors No. 8 and larger and as otherwise noted on drawings shall be stranded. Power conductors No. 12 and No. 10 shall be solid or stranded. Power conductors No. 14 or smaller shall be solid.
 5. Provide signal system wiring for each system to meet the system manufacturers requirements and recommendations for each device or equipment type. Signal wiring systems shall be provided with shielding and/or insulation type and cable quantities as directed by the manufacturer, and meet all NEC requirements for locations used.
 6. Install all wiring branch circuits and feeders (low voltage and line voltage) in conduit unless noted otherwise on the drawings. Contractor shall mandrel all feeders and pass a "sock" (or utilize other suitable means) through each raceway prior to pull to remove all water and construction debris. All raceways shall be completely clear of any obstructions or debris and all cut ends shall be reamed, prior to pull. Utilize pulling compound on all runs to insure minimum friction and pulling tension.
 7. Megger test all feeders prior to energizing. See section 26 08 00 for additional information.
 8. Approximately balance branch circuits about the neutral conductors in panels.
 9. Connections to devices from "thru-feed" branch circuit conductors to be made with pigtails, with no interruption of the branch circuit conductors.
 10. Neutral conductor identified by white outer braid, with different tracers of "EZ" numbering tags used where more than one neutral conductor is contained in a single raceway.
 11. Neatly arrange and "marlin" wires in panels and distribution panelboards with "T and B Ty- rap" or approved equal plastic type strapping.

12. All wire and cable shall bear the Underwriters' Label, brought to the job in unbroken packages; wire color-coded as follows:

<u>Voltage</u>	<u>Phasing</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>N</u>
120/208	3PH4W	Black	Red	Blue	White
2083PH	3W	Black	Red	Blue	--
277/480	3PH4W	Brown	Orange	Yellow	White
4803PH	3W	Brown	Orange	Yellow	--

13. The equipment grounding conductor shall be insulated copper; where it is insulated, the insulation shall be colored green.
14. Label each wire of each electrical system in each pull box, junction box, outlet box, terminal cabinet, and panelboard in which it appears with "EZ" numbering tags indicating the connected circuit numbers.
15. Properly identify the "high leg" of 4-wire delta connected systems (in each accessible location) as required by NEC 110.15 and 230-56.
16. Provide permanently affixed adhesive labels with machine printed lettering (min. 1/8" high) at junction boxes serving fixtures that are supplied by (2) electrical sources (i.e. normal and emergency lighting). Label to read "CAUTION - This light fixture is powered by (2) separate sources. The normal power source breaker and the emergency power source breaker must be turned off before servicing this light fixture."
17. Install feeder cables in one continuous section unless splices are approved by Architect. Exercise care in pulling to avoid damage or disarrangement of conductors, using approved grips. No cable shall be bent to smaller radius than the spool on which it was delivered from the manufacturer. Color code feeder cables at terminals. Provide identifying linen tags in each pullbox.
- D. Switches: Model numbers are Hubbell, color to be selected by architect, unless otherwise noted. All switches to utilize screw terminals for wire connections - no plug-in terminations:
1. Single Pole - No. HBL1221
 2. Two Pole - No. HBL1222
 3. Three Way - No. HBL1223
 4. Momentary contact - No. HBL1557
 5. Momentary contact Keyed - No. HBL1556L
 6. Keyed, - No. HBL1221L
 7. Pilot Light (on with load on) - Hubbell No. 1221-PLC
 8. Motor Rated Double Pole (30A) - Hubbell No. 7832
 9. Motor Rated Three Pole (30A) - Hubbell No. 7810.
 10. Low voltage Data line switches - Refer to lighting control system (for compatibility)
- E. Receptacles: Mounting straps and contacts shall be one piece design, constructed of minimum .050" solid brass. Base shall be high strength, heat resistant, glass reinforced nylon. Device shall accept up to #10 wire, side or back wired with screw terminals - no plug-in terminations. Hubbell, Leviton, Pass & Seymore, or equal. Color to be selected by architect, unless otherwise noted. Numbers listed below are Hubbell:
1. 15A 3PG 125 volt duplex - No. HBL5262
 2. 20A 3PG 125 volt duplex - No. HBL5362
 3. 20A 3PG 125 volt ground fault interrupter receptacle; GFI receptacles shall conform to the 2006 UL requirements to a) interrupt power to the unit in the event of internal failure, or b) provide an audible or visual indication of internal failure of the GFI; No. GF20 or equal. Through wiring to down stream GFI designated receptacles is not acceptable.
 4. 15A 3PG 125 volt half controlled duplex receptacle - No. BR15C1(color), with permanent "controlled" marking, factory applied.

5. 20A 3PG 125 volt half controlled duplex receptacle - No. BR20C1(color), with permanent "controlled" marking, factory applied.
 6. 15A 3PG 125 volt full controlled duplex receptacle - No. BR15C2(color), with permanent "controlled" marking, factory applied.
 7. 20A 3PG 125 volt full controlled duplex receptacle - No. BR20C2(color), with permanent "controlled" marking, factory applied.
 8. GFI Module (blank face), no indicator light, 20A – No. GFBF20 or equal.
 9. All receptacles located in exterior or wet locations shall be corrosion resistant with UV stabilized body.
- F. Plates: Leviton, or equal, except as noted:
1. The color of all faceplates shall match the color of the devices installed under/in the faceplate, except as specifically noted otherwise.
 2. For flush outlet boxes, for switches, and receptacles: nylon, color to be selected by architect, unless otherwise noted.
 3. Plates for surface-mounted outlets: galvanized steel unless otherwise noted.
 4. Weatherproof duplex receptacle plates for exterior locations with ground fault interrupter receptacles in type FS or FD boxes – Hubbell #WPFS26 or compatible equal. Verify cover compatibility with box type and device installed.
 5. Weatherproof "in-use" cover, vertical or horizontal mount, for exterior with GFCI receptacles. Die-cast metal alloy, TayMac MX series or equal with openings to match installed devices.
 6. Locking plates for duplex receptacles where noted; Pass & Seymour #WP26-L (non-weather proof).
 7. Locking plates for duplex exterior GFCI receptacles (or in wet or damp locations); Heavy duty cast aluminum flush cover with locking latch and key, Pass & Seymour #4600 with appropriate mounting plate for type of device installed. Coordinate backbox requirements and finished wall trim-out with wall installer prior to rough-in to insure an adequate and neat trim appearance upon completion.
 8. Plates for flush tele/data boxes: white nylon or as otherwise directed - provide and install at each tele/data outlet plate to match duplex power outlet plate, for jack installation under Section 27 00 00. Where the power and tele/data outlet boxes are shared the plate shall be continuous in multi-gang locations. See drawings.
- G. Equipment Disconnects: All disconnects shall be located to allow proper code required clearance in each area. Locations shown on drawings are diagrammatic only. The contractor shall coordinate exact locations in the field (with other trades) prior to rough-in to insure proper clearances.
1. Motor Disconnect Switches and Safety Switches: General Electric Company Heavy Duty Type "THD", cover interlocked with operating handle so that cover cannot be opened with switch in closed position and switch cannot be closed with cover in open position. 240V or 480V rating, single or multi-pole as required or as noted on drawings, in Nema 1 enclosure indoors or Nema 3R enclosure outdoors unless otherwise noted. Provide dual element motor circuit fuses sized as recommended by equipment manufacturer (for final equipment actually installed).
 2. Code required disconnects: Provide a local disconnect in addition to the branch circuit protection device for all equipment as required by code (whether shown or not). Disconnects shall consist of a motor rated switch (or disconnect) for all motor loads less than 3/4HP or other suitable disconnect sized to match branch circuit conductors and load current of equipment, with number of poles as required.
- H. Lugs and Connectors: Thomas and Betts "lock-tite", for No. 4 and larger wire; 3M "Scotchlock" fixed spring screw-on type wire connectors with insulator for No. 6 and smaller wire.

1. All splices shall be made up with screw-on type connectors - no plug-in or push-in style connectors acceptable. Wires shall be solidly twisted together with electricians pliers before screw-on connector is installed to ensure a proper connection in the event of wire nut failure. No exceptions.
 2. Connectors listed or labeled for "no wire twisting required" are not an acceptable substitute for actual wire twisting.
 3. Utilize porcelain type connectors in all high temperature environments (above 105 degrees Celsius).
- I. Splice Insulation: "Scotch" electrical tape with vinyl plastic backing or rubber tape with protective friction tape for interior work.
1. Splices in electrical cables of 600 volt insulation class in underground system duct shall be made only in accessible locations such as pullboxes, light pole handholes, etc., using a compression connector on the conductor and by insulating and waterproofing (for exterior and underground locations) by one of the following methods:
 - a. Cast type splice insulation shall be provided by means of a molded casting process employing a thermosetting epoxy resin insulating material which shall be applied by a gravity poured method or by a pressure injected method. The component materials of the resin insulation shall be in a packaged form ready for convenient mixing after removing from the package. Do not allow the cables to be removed until after the splicing material has completely set.
 - b. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be applied. When the mold is in place around the joined conductors, the resin mix shall be prepared and poured into the mold. Do not allow cables to be moved until after the splicing materials have completely set.
- J. Identification: Refer to Section 260500.
- K. Firestopping: as manufactured by 3M Fire Protection Products or equal.
1. Fire-rated and smoke barrier construction: Maintain barrier and structural floor fire and smoke resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound vibration absorption, and at other construction gaps.
 2. Systems or devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetration type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall penetrations. Systems or devices must be asbestos free.

2. 3 MULTI-SERVICE FLOOR BOXES COMBO - AV / TEL / POWER

- A. Application: For use indoors as a multi-service (telecommunications, audiovisual, power) outlet box to house wiring, cabling, termination, connectors, and receptacles installed within a cast concrete floor
- B. Box Construction: Seam welded 14 gauge steel
- C. Compliances:
 1. Floor boxes shall be listed by a nationally recognized testing laboratory to UL 514A for Class 2 and Class 3 power-limited circuits (such as data and signal) providing bonding without the use of bonding jumpers, and remote control) circuits and for

- telecommunications circuits in accordance with NFPA 70 Article 314 for use in tile, terrazzo, carpet, and wood covered floors.
 - 2. Floor box assemblies shall meet the scrub water exclusions requirements of UL 514A for use in tile, terrazzo, carpet, and wood covered floors.
- D. Load Capacity: Floor box assembly (back box, cover, etc) shall be rated to 300 lbs (minimum) static load.
- E. Features:
- 1. Suitable for cast-in-place concrete applications
 - 2. 8 gangs, minimum
 - 3. Knock-outs (or punch-outs) for easy creation of holes to accept conduit connectors
 - 4. Permit access to conductors behind terminations (for maintenance)
- F. Cover Finish: Coordinate with Architect
- G. Manufacturers:
- 1. FSR Inc or equal.
 - a. #FL-500P-4-B; c-i-p floor box, 4-in depth

2.4 MULTI-SERVICE FLOOR BOXES COMBO - TEL / POWER

- H. Application: For use indoors as a multi-service (telecommunications, power) outlet box to house wiring, cabling, termination, connectors, and receptacles within a cast concrete floor
- 1. Floor boxes shall permit access to conductors for maintenance
 - 2. Floor boxes shall come with knock-outs or punch-outs for easy creation of holes to accept conduit connectors.
- I. Compliances:
- 1. Floor boxes shall be listed by a nationally recognized testing laboratory to UL 514A for Class 2 and Class 3 power-limited circuits (such as data and signal) providing bonding without the use of bonding jumpers, and remote control) circuits and for telecommunications circuits in accordance with NFPA 70 Article 314 for use in tile, terrazzo, carpet, and wood covered floors.
 - 2. Floor box assemblies shall meet the scrub water exclusions requirements of UL 514A for use in carpet and wood covered floors.
- J. Construction: Seam welded 14 gauge steel.
- K. Cover Finish: Coordinate with Architect.
- L. Manufacturer:
- 1. Wiremold or equal.
 - a. #RFB-4; c-i-p floor box, 3-7/8 in depth, 4 gangs

2.5 MULTI-SERVICE POKE-THRUS COMBO - AV / TEL / POWER

- M. Application: For use indoors as a multi-service (telecommunications, audiovisual, power) outlet to house wiring, cabling, termination, connectors, and receptacles
- 1. Poke thrus shall permit access to conductors for maintenance.

- N. Compliances:
 1. Poke thrus shall be listed by a nationally recognized testing laboratory for the purpose.
 2. Poke thrus shall comply to UL 514A for Class 2 and Class 3 power-limited circuits (such as data and signal) providing bonding without the use of bonding jumpers, and remote control) circuits and for telecommunications circuits in accordance with NFPA 70 Article 314 for use in tile, terrazzo, carpet, and wood covered floors.
 3. Poke thrus shall meet (or exceed) UL 514A requirements for scrub water test.
- O. Fire Rating:
 1. Poke thrus shall be listed by a nationally recognized testing laboratory as a rated penetrating device.
 2. The poke-thru outlet shall maintain the rating of the concrete slab/deck within allowable penetration methods.
 3. Poke thrus shall provide at least two-hour fire rating.
- P. Load Capacity: Floor box assembly (back box, cover, etc) shall be rated to 300 lbs (minimum) static load. Wiremold Evolution poke-thru is rated to 1,000 lbs
- Q. Construction:
 1. Body shall be fabricated of steel (or die cast) non-flammable materials.
 2. Body shall include integral intumescent material for firestopping feature.
 3. Stubs shall be fabricated of listed EMT.
 4. Boxes shall fabricated of welded steel and shall be listed for the purpose.
- R. Cover Finish: Coordinate with Architect.
- S. Manufacturer:
 1. Wiremold or equal.
 - a. "Evolution" 6AT series poke-thru; 6 inch diameter

1.6 MULTI-SERVICE WALL BOXES FOR FLAT PANEL DISPLAYS

- A. Application: indoor use as a multi-service (telecommunications, audiovisual, power) outlet box to house wiring, cabling, termination, connectors, and receptacles and serve a flat panel display
- B. Listings: Wall boxes shall be listed by a nationally recognized testing laboratory to UL 514A.
- C. Fabrication Material: Backbox: Seam welded 14 gauge steel; Cover: 1/16" steel, electro-painted
- D. Outlet box shall feature capacity for the following:
 1. Power: 1 duplex receptacle, duplex or decora style
 2. Telecom/Network: 2 network jacks (refer to section 271513 for jack information)
 3. AV: _ positions for AAP (or equivalent) modules
 4. Conduit Connections: _ positions for 1.25-inch conduits at top, _ positions for 1.25-inch conduits at bottom, _ positions for 1.25-inch conduits at each side,
- E. Manufacturers:
 1. FSR or equal.
 - a. #PWB-250; in-wall multi-service box for flat panel display

1.7 STEEL OUTLET BOXES AND COVERS FOR TELECOM AND AV

- A. Application: For use indoors as outlet box, backbox, and/or junction box of low voltage systems to house wiring, cabling, terminations, and connectors; may also house and support components.
1. Outlet boxes shall permit access to conductors for maintenance
 2. Outlet boxes shall come with knock-outs or punch-outs for easy creation of holes to accept conduit connectors.
- B. Compliances:
1. Outlet boxes shall meet the requirements of CEC Article 314.
 2. Outlet boxes shall be listed by a nationally recognized testing laboratory to UL 514A for Class 2 and Class 3 power-limited circuits (such as data and signal) providing bonding without the use of bonding jumpers, for remote control circuits, and for telecommunications circuits in accordance with NEC Article 314.
 3. Outlet boxes shall be manufactured compliant to NEMA: FB-1 and OS-1.
 4. Outlet boxes shall be fire resistant and suitable for use in rated spaces (reference: UL Fire Resistance Directory / "Orange Book").
- C. Material and Finish:
1. Material: <AISI/SAE 1008 Steel source: OZ Gedney or equal, hot rolled, pre-galvanized steel, minimum spangle, AISI C-1008 source.
 2. Thickness: CEC 314.40(B) / 1.59 mm (0.0625in), minimum
 3. Finish: G60 hot dip zinc galvanized (0.60 oz/sq ft), meeting ASTM A123, or pre-galvanized (continuous sheet galvanizing) meeting per ASTM A653
 4. Finish Thickness: ~0.0005 inches
- D. Telecom and AV Square Box and Covers/Rings – 5"
1. Dimensions: 5 in square x 2.875 in deep
 2. Volume: 64 in³
 3. Outlet box shall come equipped with integrated cable management/slack support.
 4. Manufacturers:
 - a. Randl Industries or equal.
 - 1) #T-55017; "5 Square" outlet box, knockouts: one 1" + one 1-1/4" per side, one 1/2" per back
 - 2) #TB-55057; "5 Square" outlet box with side mounting bracket, knockouts: one 1" + one 1-1/4" on 3 sides, one 1/2" per back
 - 3) #D-51G000; one gang cover for "5 Square" outlet box, flat
 - 4) #D-51G034; one gang cover for "5 Square" outlet box, 3/4" raised

PART 3 - EXECUTION

3.1 REFER TO BASIC ELECTRICAL REQUIREMENTS - SECTION 260500 FOR WORK UNDER THIS SECTION.

3.2 TESTS

- A. Testing and Inspection: See Section 260800 - Testing.

END OF SECTION

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SECTION 263200

EMERGENCY ELECTRIC GENERATOR

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide a complete Emergency Generator plus accessories in a single common housing, as noted herein and as indicated on the Drawings. Accessories will include the Generator, Base Tank, Integral 50% rated Load Bank, and Acoustic Enclosure.
- B. Provide CBC 2019 compliant seismic installation. See Section 260500 for all certification and submittal requirements.
- C. Manufacturer shall be responsible for providing a complete assembly of all components in one overall housing with base tank, which is certified to comply as an integrated assembly with CBC 2019 requirements.
- D. Manufacturer shall provide technical assistance to Owner in securing all required local Air Quality Management District permits for installation of the Emergency Generator, including review and inclusion of existing engine generators where applicable on the same site in site analysis.
- E. The Contractor shall include a Manufacturer-provided three-year engine-generator maintenance agreement as described herein as part of the bid. The maintenance agreement shall include an annual 2-hour full load test using a portable load bank.

1.2 SUBMITTALS

- A. Refer to Section 260500 for procedure.
- B. Tests and Reports (Test Requirements are detailed in Paragraph 1.4).
 - 1. Provide certified test reports of the following:
 - a. Factory tests.
 - b. Field Tests: Test reports shall include dates performed, method of testing, test results, test interpretation and recommended action.
- C. Shop Drawings and Product Data
 - 1. The following list includes the required Shop Drawing information that shall be submitted for the generator:
 - a. Physical dimensions and weights.
 - b. CBC Special Certificate of Compliance with importance factor of 1.5 for all components and overall assembly.
 - c. Brake horsepower of engine.
 - d. Fuel consumption.
 - e. Cooling requirements.
 - f. Noise db level. Provide details of acoustical housing and factory testing to prove acoustical housing performance (71dbA at 7 meters).
 - g. Electrical characteristics of generator, voltage regulator, and battery charger.
 - h. Load graphs.
 - i. Control panel.
 - j. Elevation.

- k. Wiring and control diagrams.
 - l. Engine and generator details, including governor and base fuel tank.
 - m. Location of available parts and service.
 - n. Confirmation that engine meets the latest required EPA Tier Exhaust Emission Compliance Statement, complies with latest CARB requirements for emergency standby equipment, and complies with the local Air Quality Management District requirements.
 - o. Details of base tank fill connection, including overfill basin.
 - p. Details of primary tank venting, primary and secondary tank emergency relief venting, high fuel alarm panel and sensing, and tank labeling.
 - q. Passive diesel particulate filter.
 - r. 50% of full-capacity load bank, integral to the generator line-up and located within the generator enclosure.
- D. Maintenance and operating instruction manuals, six bound copies, including approved shop Drawings, parts list, list of recommended spare parts, sources of purchase and similar information.
- E. The Load Bank manufacturer shall submit for review technical data including features, performance, electrical characteristics, physical characteristics, ratings, accessories, and finishes. Shop drawings shall include dimensional plans and mounting details sufficient to properly install the load bank. Load bus configuration and load connections termination area shall be clearly identified. Electrical schematic drawings shall be provided to detail the operation of the load bank and the provided safety circuits. Over-current protection and control devices shall be identified and their ratings marked. An interconnection drawing shall be included for control wiring related to the load bank.

1.3 GUARANTEE

- A. Provide a written guarantee against all defects in materials and application, which prevent proper functioning for one (1) year from date of acceptance of the project.

1.4 TESTS

- A. Certified copies of factory test giving guaranteed performance characteristics to meet the Specifications should be furnished by the Manufacturer. The unit shall be tested at the Manufacturer's plant for performance of all functions including a 2-hour full load test, using 0.8pf reactive to 1.0pf resistive load banks and until all temperatures have been stabilized for at least 30 minutes.
- B. The Manufacturer shall have field tests made of the generator and wiring systems in place by a qualified factory technician. The complete engine generator set with all of its appurtenances shall be tested after installation for all functions, including a 2-hour full load test with full-rated resistive (1.0pf) load bank. The Manufacturer shall supply all equipment necessary for the tests.
- C. Testing of fuel system – see Part 3 of this Section.

1.5 FUNCTION

- A. The emergency generator shall function to start automatically immediately upon power failure of the normal power supply, assume full load within ten (10) seconds and automatically switch into the emergency power system. The unit shall be automatically removed from the line upon resumption of normal power and stopped five (5) minutes later.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Provide and install a complete emergency power system, including power plant powered by diesel engine driven generator and operated by means of a signal from an automatic transfer switch. The system shall be complete, tested and meet all the functional requirements of a fully automatic emergency power source serving full load power stabilized at rated voltage and frequency within three seconds after normal power source failure.
2. The diesel engine generating set shall be fully automatic and shall be complete with starting and control equipment, base fuel-tank, skid-mounted batteries, charger, acoustical enclosure, and other equipment necessary to provide a complete, fully automatic system.
3. Arrange for the services of a factory erection engineer for checking installation, making specified and all other necessary tests, making initial start, instructing operating personnel in operating unit through all of its functions to ensure that the unit is performing in accordance with the intentions of the Specifications.
4. Generator set shall be provided with a vertical scoop on discharge.
5. Manufacturers: Cummins-Onan, Kohler, or Caterpillar. The Kohler unit shall utilize a Detroit Diesel engine – no other engine manufacturer will be accepted for a Kohler unit.
6. Generator set shall be provided with a passive diesel particulate filter (DPF) mounted above engine-generator in a common housing with the generator set.
7. Provide integral 50%-of-rated-generator-KW capacity load bank within the generator enclosure and all associated controls.

B. Power Plant:

1. Rating shall be based on continuous standby power rating of the generator and with capabilities to carry 100% full load without damage to the engine, generator or components, and with capabilities for starting the largest motor scheduled for the standby power system while carrying full connected load at an altitude of 350 feet above sea level. Full load power ratings shall be as indicated on the drawing, continuous standby at 0.8 PF at 277/480V 3PH 4W or 120/208V 3PH 4W where indicated on the drawings.
 - a. Voltage regulation shall be +/-0.5% for any constant load between no load and rated load.
 - b. Frequency regulation shall be isochronous from steady state no load to steady state rated load.
 - c. The diesel engine generator set shall be capable of single step load pick up of 100% nameplate KW and power factor, less applicable derating factors, with the engine-generator set at rated operating temperature.
 - d. Under motor starting conditions the generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified KVA load at near zero power factor applied to the generator set.
 - e. Maximum transient voltage dip shall not exceed 35 percent below rated on application of the single largest surge load step.
2. Provide unit and all accessories in a common weatherproof acoustical enclosure, with a common base for unit capable of skidding into place. Provide sound absorbing insulation on interior of weatherproof enclosure to produce overall sound rating noted above. All accessories, including muffler shall be concealed within common generator

enclosure. If a diesel particulate filter is specified, it shall be concealed within the enclosure.

2. Provide minimum 18" flexible section in all electrical, fuel and exhaust lines at connection to power plant.
3. Provide flexible steel disc coupling to engine-generator.
4. Provide lifting brackets.
5. Provide a CBC 2019 compliant and certified vibration isolation system. The vibration isolation system shall be designed to withstand the seismic forces from ground motions and installation shall comply with critical equipment (importance factor = 1.5) requirements. CBC conforming vibration isolators shall be provided and installed at the bolt-down locations between the skid and the base fuel tank.

C. Engine:

1. The engine shall be 4-cycle design, water-cooled; series turbo charged with after cool, having no inherent unbalanced reciprocating forces. Operating speed shall be 1800 RPM.
2. Starting by battery-driven starter. Include cranking sequencer, which shall give three (3) start attempts before locking out over-cranking protection.
3. Governor shall be isochronous electronic as required to maintain generated frequency at 60 Hz. at 75% full load within a steady state band-width of (+/-) 0.25%. Frequency shall not vary over 3% from no load to full load. Governors using engine crankcase lube oil will not be acceptable. Governor shall be type EFC, Electronic Isochronous.
4. Provide fuel and lubrication systems for diesel engine, complete with replacement element type air cleaner; primary and secondary fuel filter and oil filter; full pressure lubrication system with positive displacement lube oil pump and spring-loaded bypass valve; lube oil cooler; engine driven fuel transfer pump; extended base-mounted fuel tank, sight gauge, automatic float switch to maintain fuel level, and high-fuel and low-fuel alarm dry contacts for local and remote indication. Provide base fuel tank rupture basin contacts (2 sets) for local and remote alarm. Point of fuel fill at the base tank shall have provisions for spill containment. Provide shop drawings indicating spill containment system.
5. Provide a cooling system with sufficient capacity for cooling engine when generator is delivering 100% full load for four hours at ambient of 40 degrees C at an altitude of 350 feet. Include water-circulating pump and thermostatic valve to maintain recommended engine temperature; radiator with drain and air vent and fan with protective guard; jacket water corrosion resistant heating elements (wattage as specified by engine manufacturer, rated at 208V 1PH or 3PH). Radiator shall be filled with antifreeze solution of strength as recommended by Manufacturer. Exhaust air shall be discharged vertically, using a scoop design.
6. All areas within 24 inches of the muffler shall be covered with 6 lb. density mineral wool. All piping shall be schedule 40 black pipe.
 - a. The exhaust system, piping, and insulation shall be factory supplied and installed. Extend black standard weight iron pipe from the engine with 18" flexible connection between engine and muffler. The muffler shall be installed within the same overall enclosure as the engine-generator.
7. Provide a unit-mounted battery for engine start, 24-volt DC with a capacity of not less than 160-ampere hours at 20-hour rate. The battery shall also be sized for six starts of 30-second cranking duration each, with ambient 15 degree F, mounted on earthquake-proof tray on pad with all necessary battery cables, hydrometer and enclosure-mounted voltage-regulated battery charger in Nema 3R enclosure with float, taper, and equalize charge settings and with DC voltmeter, DC ammeter and circuit for low voltage alarm. Battery shall be lead-acid type.
8. Auxiliary switches for over-speed trip and automatic over-speed shut down at a speed 10% greater than the normal specified operating RPM. The engine shall shut down on

over-speed, low oil pressure, high oil temperature and high water temperature by means of auxiliary switches, actuating signal lights and alarms.

9. Temporary batteries may be used for testing, but new, unused batteries shall be furnished after final testing is complete and before acceptance. New batteries shall be used for one generator start to demonstrate adequacy of final battery installation.
10. Engine exhaust emissions shall meet the latest adopted EPA Tier Exhaust Emission Compliance Statement, the latest CARB requirements for emergency standby applications, and the local Air Quality Management District standards.
11. Provide a DPF - concealed within enclosure.

D. Diesel Particulate Filter: The DPF shall be a passive continuously regenerating type as manufactured by Johnson Matthey, or equal.

1. DPF shall meet latest EPA and CARB requirements and be on the CARB-approved and verified list for latest emissions standards.
2. It shall meet all applicable CARB requirements for after-treatment of engine-generator emissions.
3. The DPF shall solely use the heat of the engine exhaust and not require any supplemental heat source. The DPF shall regenerate and remain continuously operational even if the KW load on the engine-generator is no more than 25% of nominal.
4. The DPF shall be supplied with a monitoring device which shall log exhaust temperature and backpressure when the engine is running. Back pressure and pressure on the engine shall be continuously monitored as they increase due to build up of the ash layer in the filter. The monitoring device shall derive 24 volt DC power from engine-generator control panel – all connected complete by Manufacturer. It shall have an RS232 interface and be provided with software to download the data onto a portable computer. It shall have alarm points which can be set to indicate the increase in backpressure based upon the Manufacturers' specifications.
5. The DPF shall be housed within a carbon steel, fully insulated, corrosion resistant shell with removable cover panels for full access to the diesel particulate filters mounted inside. The DPF stainless steel shell shall in turn be mounted within the common overall generator housing, with housing access panels aligning with the shell access panels to the filters.
6. The DPF shall have critical-grade sound attenuation.

E. Generator:

1. Rated for continuous standby service, complying with NEMA standards.
2. Brushless, balanced 4-pole revolving field type with rotating rectifier exciter mounted on end of shaft, single ball bearing support to starter housing, rotor connected by semi-flexible steel disc coupling to engine flywheel to assure permanent alignment free of injurious tensional vibrations at speeds up to 125% of synchronous. Rated for 105 degrees Centigrade rise.
3. Generator insulation shall be in accordance with latest NEMA standards using minimum Class H materials. All insulation system components shall meet NEMA MG1 temperature rise limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees centigrade.
4. A permanent magnet generator (PMG) shall provide excitation power for immunity to voltage distortion caused by non-linear loads. The PMG shall sustain excitation power for optimum motor starting and to sustain short circuit current at approximately 300% of rated current for not more than 10 seconds.
5. Voltage regulator of static solid state design to give (+/-) 2% regulation from no-load to full load; instantaneous voltage dip less than 20% of rated when full load at rated power factor suddenly applied; and recovery to stable operation of voltage within 1% of rated within four seconds. The voltage regulator shall be of the asynchronous pulse width

modulated type and shall be insensitive to severe load-induced waveshape distortion from SCR or thyristor circuits such as those used in UPS and motor speed control equipment. Manual adjustment of (+/-) 5% of normal to be included by a lockable device or screwdriver slot in rheostat shaft. All voltage sensing shall be 3-phase.

a. The automatic voltage regulator shall be temperature compensated, solid-state design. The voltage regulator shall control build up of AC generator voltage to provide a linear rise and limit overshoot. The regulator shall include a torque-matching characteristic, which shall use differential rate of frequency change compensation to use the maximum available engine torque and provide optimal transient load response. Regulators, which use a straight line fixed volts per hertz characteristic, are not acceptable.

6. Shielding of generator, exciter and regulator to prevent radio frequency interference.
7. The generator, exciter, and voltage regulator shall be designed and manufactured by the engine-generator set manufacturer so that the characteristics shall be matched to the torque wave of the engine to provide the fastest possible system recovery from transient load changes and to prevent engine stall during transient overload conditions.

F. Control Equipment:

1. Panel mounted with vibration isolators to plant frame. Top of panel shall not exceed 6'-6" above slab with generator mounted to a 30" high base tank on top of a 3" high pad.
2. The generator set shall be provided with a microprocessor-based control system, which shall be designed, to provide automatic starting, monitoring and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set and remote monitoring and control as described in this Specification. The control panel shall be mounted on the generator set.
3. The control panel shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.
4. The control panel shall be UL508 labeled, CSA282-M1989 certified and meet IEC8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight and the enclosure door shall be gasket. There shall be no exposed points in the control panel (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9 and IEC Std 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions. The entire control shall be tested and meet the requirements of IEEE587 for voltage surge resistance.
5. The generator set mounted control panel shall include the following features and functions:
 - a. Three position control switch labeled RUN/OFF/AUTO: In the RUN position the generator set shall automatically start and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - b. Red "mushroom-head" push-button EMERGENCY STOP switch: Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.
 - c. Push-button RESET switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - d. Push-button PANEL LAMP switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed or after the switch is depressed a second time.
 - e. Generator Set Metering: The generator set shall be provided with a metering set with the following features and functions:

- (1) 2.5-inch, 90-degree scale analog voltmeter, ammeter, frequency meter and kilowatt (KW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.
 - (2) Digital metering set, 0.5% accuracy, RMS type to indicate generator voltage, frequency, output current, output KW, KW-hours and power factor. Generator output voltage shall be available in line-to-line neutral voltages and shall display all three-phase voltages (line to neutral or line to line) simultaneously.
- f. Generator Set Alarm and Status Indication: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel.
- (1) Low oil pressure (alarm)
 - (2) Low oil pressure (shutdown)
 - (3) Oil pressure sender failure (alarm)
 - (4) Low engine temperature (alarm)
 - (5) High engine temperature (alarm)
 - (6) High engine temperature (shutdown)
 - (7) Engine temperature sender failure (alarm)
 - (8) Low coolant level (alarm or shutdown--selectable)
 - (9) Fail to crank (shutdown)
 - (10) Over-crank (shutdown)
 - (11) Over-speed (shutdown)
 - (12) Low DC voltage (alarm)
 - (13) High DC voltage (alarm)
 - (14) Weak battery (alarm)
 - (15) Low fuel-base tank (alarm)
 - (16) High AC voltage (shutdown)
 - (17) Low AC voltage (shutdown)
 - (18) Under frequency (shutdown)
 - (19) Over current (warning)
 - (20) Over current (shutdown)
 - (21) Short circuit (shutdown)
 - (22) Ground fault (alarm)
 - (23) Under frequency (alarm)
- In addition, provisions shall be made for indication of two customer-specified alarm or shutdown conditions. The non-automatic indicating lamp shall be red and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.
- g. Engine Status Information: The following information shall be available from a digital status panel on the generator set control:
- (1) Engine oil pressure (psi or kPA)
 - (2) Engine coolant temperature (degrees F or C; both left and right bank temperature shall be indicated on V-block engines)
 - (3) Engine oil temperature (degrees F or C)
 - (4) Engine speed (rpm)
 - (5) Number of hours of operation (hours)
 - (6) Number of start attempts

- (7) Battery voltage (DC volts)
 - h. The Generator Control Panel shall monitor the status of each Automatic Transfer Switch. The monitoring for each Automatic Transfer Switch shall be:
 - (1) ATS Normal Position
 - (2) ATS Emergency Position
 - i. The ATS status for each switch shall also be displayed on the Generator Remote Annunciator.
 - 6. Control Functions: The control system provided shall also include a cycle cranking system, which allows for user selected crank time, rest time and number of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each with 15-second rest periods between cranking periods.
 - 7. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode the alternator excitation system shall be disabled.
 - 8. The control system shall include an engine governor control which functions to provide steady state frequency regulation as noted elsewhere in this Specification. The governor control shall include adjustments for gain; damping and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
 - 9. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
 - 10. The control system shall include sender failure monitoring logic, which is capable of discriminating between failed senders or wiring components and an actual failure conditions.
- G. Remote Indicator Panel: The remote annunciator panel shall be surface or flush-mountable with micarta label reading "Engine Operator Conditions," and with the following devices:
- 1. Green pilot light with engraving to indicate "ENGINE RUNNING."
 - 2. One audible alarm with silencing switch to indicate engine start failure for any of the following reasons:
 - a. High water temperature.
 - b. Low oil pressure.
 - c. Over-speed.
 - d. Over-crank.
 - e. Low battery voltage.
 - f. Low-level fuel alarm.
 - 3. Remote indicator panel shall include an amber light indication for each of the following:
 - a. Control switch not in auto position.
 - b. Low water temperature.
 - c. ATS in normal position (for each ATS).
 - d. ATS in emergency position (for each ATS).
 - 4. Each of the functions listed previously in Paragraphs 2.(a) through (f) shall be indicated by a separate red warning light and each warning light shall be so engraved.
- H. Fuel System: The fuel system shall conform to NFPA 30 and 37. The fuel system shall be complete and shall consist of a dual filtering system, and engine fuel pump. The engine shall start, operate, and stop on DF-2 fuel.
- 1. Fuel Filtering System: The fuel filtering system shall consist of a strainer, located between the storage tank and the fuel transfer pump, and a duplex fuel filter, located between the engine fuel pump and the engine. The filtering system shall be capable of removing from the fuel system flakes, dirt, metallic chips, carbon, water, or other foreign matter, which would be harmful to the engine. The filtering system shall be easily accessible for quick-and-easy replacement of the filter element and cleaning of

the strainer. Components of the filtering system shall be the standard products of the engine Manufacturer.

2. Engine Fuel Pump: The engine fuel pump shall be a positive-displacement, engine-driven pump capable of supplying an adequate quantity of fuel to the engine under all operational conditions. Solenoid shut-off valve in fuel line discharge side of pump shall be interlocked with the emergency engine shutdown circuitry.
3. Fuel Tank: The fuel tank shall be skid mounted under the engine, and shall be capable of providing an immediate fuel supply to the engine fuel pump. The tank shall be no more than 30" high. The tank shall be provided with a flexible tubing suction line to the engine, an excess fuel return line from the engine to the tank, a fuel gauge, a vent, a drainpipe, and high and low-level float switches for activating the low-level alarms. Usable fuel tank capacity shall not exceed 660 gallons – see drawings for exact capacity of fuel tank. The tank shall be a full double wall, U.L. listed design and shall be factory tested in accordance with the requirements of U.L. 142. The outer containment cavity shall be equipped with an emergency leak-detection float switch for the leak detection and alarm system. The tank shall as a minimum include the following:
 4. Primary tank venting shall be provided and shall be a minimum of 1.25" nominal inside diameter. The primary vent shall be extended thru the roof of the generator enclosure to a height not less than 12 feet above grade. The normal vent shall have a screened mushroom style cap.
 5. Emergency relief venting shall be provided for both the primary and secondary tanks. Rain protected, open style rupture basins are not acceptable. These vents shall be extended thru the roof of the generator enclosure to a height of not less than 12 feet above grade. The extended emergency vents shall be capped with U.L. listed pressure relief type caps designed to open at 2.5 PSI. Materials used for vent pipes, supply and return piping, valves and fittings shall conform to Article 79, Division VII.
 6. A 5 gallon capacity overflow basin shall be provided around the fill pipe and shall include a means of draining spills back into the main tank. The fill pipe shall be extended down into the fuel tank and terminate within 6" of the bottom of the tank.
 7. The high fuel sensor shall be wired to an audible and visual local alarm that shall be activated at 90% of the tank capacity. The alarm panel shall be mounted at the fill location and shall include a reset/silence for the alarm and light that will automatically reset the controller for the next fill. An "off switch" is not acceptable.
 8. The tank shall include labels to indicate "Diesel Fuel". The lettering shall be 3" high, half-inch stroke, red letters on a white background outlined in red.
 9. All of the above items shall be submitted for approval. Do not release the fuel tank for manufacture until it has been approved.
- I. Output Circuit Breakers:
 1. Provide engine-generator mounted circuit breakers for each automatic transfer switch, and where indicated on the drawings one for a portable load bank, with ratings as noted on the Drawings. Breaker handles shall not exceed 6'-6" above grade when engine-generator is mounted to a 30" high base fuel tank on top of a 3 inch high structural isolation pad.
- J. Weather Protective Sound Attenuated Enclosure:
 1. The generator set and accessories, including muffler and load bank, shall be completely housed in a weather protective and sound attenuated enclosure. The enclosure shall have a cambered roof to prevent rain accumulation, shall include stainless steel hardware to prohibit rust, and shall include stainless steel retainers to hold doors securely in place. The enclosure sound level shall be as specified herein. The generator set, enclosure, load bank and sub-base fuel tank shall be U.L 2200 listed as a package.

2. Material used for the enclosure shall be 14-gage steel for panels and 12-gage steel for posts. Three hinged lockable access doors shall be provided on each side, with hold-open retainers as indicated in Paragraph 1 above. Non-hygroscopic sound insulating materials shall be provided on the interior walls. Rodent barriers shall be provided on inlet and outlet sides. Louvers shall be fixed. The enclosure shall attach to the sub-bases fuel tank. Oil and coolant drains shall be run to the exterior of the enclosure. Interior valves on the oil and coolant lines shall be provided for ease of service.
3. The enclosure shall completely house the muffler on the generator set.
4. Provide sheet metal scoop on radiator output, to direct the radiator exhaust air directly up and vertically out of the generator enclosure. Provide screen on output of scoop to prevent dirt, leaves, and bird incursions. Provide drain on floor of scoop to drain off any water. Provide access door in scoop for cleaning of any accumulated debris. Scoop shall be factory-mounted as part of the engine-generator package. Provide detailed shop drawings of scoop with engine-generator submittals.

K. Load Bank

1. The total capacity of the load bank shall be 50% of rated generator KW.
2. The load step resolution shall be a nominal 20% of the load bank rating.
3. The load bank shall be designed for continuous duty cycle operation with no limitations.
4. Radiator/Duct mounted load banks are designed as a supplemental load to the generator set, and shall be sized at 50% of generator nameplate kW rating.
5. The load bank shall be suitable for installation on the generator radiator core, within the radiator exhaust ductwork, or on the roof of the generator set enclosure. Due to the high radiator exhaust from the generator, the load bank shall be constructed of heavy gauge aluminized steel per ASTM A463. Aluminized steel shall provide superior corrosion protection and extended service life, with a better tolerance to high heat exposure compared to the more common galvanized steel.
6. The main input load bus, load step relays, fuses and control relays shall be located within the load bank enclosure. The load bank shall have a self-contained 2" flange on the top and bottom edges for mounting. Load banks with a depth of 13" shall have provisions for overhead lifting and duct adaptors.
7. The load bank shall be designed for installation and operation outdoors. Load bank shall have a screened exhaust or a louver. Load bank shall be painted ASA-61 grey and have a baked polyester powder coated finish with a film thickness of 2.8 +/- 0.4 mils per coat.
8. Load elements shall be ASCO Helidyne, helically wound chromium alloy rated to operate at approximately 1/2 of maximum continuous rating of wire. Elements must be fully supported across the entire length within the air stream by segmented ceramic insulators on stainless steel rods. Element supports shall be designed to prevent a short circuit to adjacent elements or to ground. The change in resistance due to temperature shall be minimized by maintaining conservative watt densities.
9. The overall tolerance of the load bank shall be -0% to +5% kW at rated voltage. A -5%,+5% rating shall allow the load bank to deliver less than rated kW and shall not be used. The load bank must deliver full rated kW at rated voltage.

10. Sealed wire type elements (which have the internal resistance wire totally enclosed) prevent internal cooling of the element wire and shall not be used.
11. The engine generator shall provide sufficient air to cool the load bank. The load bank shall have a static pressure drop of approximately 0.1" H₂O at design velocity (50 ft.min).
12. An over-temperature switch shall be provided to sense the load bank exhaust. The switch shall be electrically interlocked with the load application controls to prevent load from being applied in the event of an over-temperature condition.
13. To provide for major fault protection, branch fuses shall be provided on all three phases of switched or load steps. Branch fuses shall be current limiting type with an interrupting rating of 200K A.I.C.
14. The exterior of the load bank shall have appropriate warning/caution statements on access panels.
15. Building Management Interface: Load bank control module shall have provisions to interface with existing building management system. Modbus communications protocol shall allow integration of load bank with building supervisory and monitoring systems through a PLC, HMI or SCADA systems. Interface shall be directly from an Ethernet port within load bank.
16. Manual controls shall be provided via a control panel housed in a NEMA 4 type wall mount enclosure in the generator enclosure. The control panel shall contain a power on indication light and an overtemperature alarm light and also the following manual controls:
 - a. Power ON/OFF switch
 - b. Master load ON/OFF switch.
 - c. Load step switches for ON/OFF application of individual load steps.
17. A standard remote load dump circuit shall be provided as part of the load bank control circuit. Provisions shall be provided to remove the load bank off-line from the operation of a remote normally closed set of auxiliary contacts from a transfer switch or other device. In the event of the remote contact opening, all load shall be removed.
18. Installation and operation manuals shall be provided with the equipment and shall include complete details for the installation, commissioning, operation, and maintenance of the load bank. The manuals shall include the electrical schematic and interconnect drawings for the power and control wiring for the load bank and all control devices. A complete parts list with part numbers, device identification, and rating shall be included in the manuals. The original manufacturer's name and part number shall be included in the parts listing. The manuals shall be provided electronically on a USB drive.
19. The load bank shall be fully tested using a test specification written by the supplier. Tests shall include electrical functional testing, verifying conformance to assembly drawings and specifications. Each load step shall be cold resistance checked to verify proper calibration of resistive

load steps and proper ohmic value. The manufacturer shall maintain this data on file for inspection purposes by the purchaser. Tests using high potential equipment shall be performed to ensure isolation of the load circuits from the control circuits and to determine isolation of the load circuits from the load bank frame. Tests of all safety circuits shall be performed to verify conformance to the specification. All electrical circuits shall have a high potential insulation resistance test performed at twice rated voltage plus 1000 VAC to assure insulation integrity.

- 20.** The load bank shall be manufactured by a firm regularly engaged in the manufacture of load banks and who can demonstrate at least twenty five (25) years of experience with at least twenty five (25) installations of load banks similar or equal to the ones specified herein. ASCO Power Technologies or approved equal. A 2-year warranty shall be provided for both the resistors and the load bank.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The engine-generator set shall be mounted on a rigid steel chassis suitable for installation on seismic isolators.
- B. The Contractor shall assist the Owner in preparing and submitting a permit-to-construct application to the local Air Quality Management District for installation of the engine-generator. The Contractor shall pay for permit and permit approval fees, and the Owner shall pay for annual operational fees. Granting of such permit will require a site-specific screening application followed by an analysis by the local Air Quality Management District.
- C. Load tests shall be run as required in Paragraph 1.4 of this Section to the generator rated load after generator installation is complete. The Manufacturer shall provide auxiliary load banks for full-load testing of the generator. Manufacturer shall schedule the tests with the Owner so that final tests may be witnessed. Verify correct reading and operation of all meters, indicators and controls.
- D. Readings required during both preliminary and final tests requested in Paragraph 1.04 shall be taken and shall include the following:
1. Frequency.
 2. Voltage.
 3. Current.
 4. Wattage.
 5. Ambient temperature.
 6. Water temperature.
 7. Oil pressure and temperature.
- E. Protection: Provide protection facilities and procedures to prevent damage and deterioration.
- F. Verify utility phase rotation prior to connection of the Generator to the distribution system. Modify the Generator output phase rotation to match the Utility Company.
- G. The Manufacturer shall perform the following fuel tank tests at the site after the installation is complete, but before the fuel is delivered. Tests shall be conducted in the presence of the Owner and shall include as a minimum the following:
1. Primary tank shall be pneumatically tested at 5 psig for 30 minutes; during which time the connections to the primary tank shall be soap tested.

2. Secondary tank shall be pneumatically tested at 3 psig for 30 minutes; during which time the connections to the secondary tank shall be soap tested.
 3. Primary piping shall be pneumatically tested at 150 percent of the maximum operating pressure for 30 minutes; during which time all fittings shall be soap tested.
 4. Secondary piping, if provided, shall be pneumatically tested at 5 psig for 30 minutes, with soap testing.
 5. Other secondary containment shall be liquid tight as demonstrated by a 24-hour standing water test.
 6. Correct operation of the leak detection system shall be demonstrated.
- H. The DPF manufacturer's authorized factory representative shall verify correct installation of the DPF and filter at the site prior to engine-generator start-up and shall perform all testing and commissioning of the DPF in conjunction with the engine-generator testing after the installation is complete. Tests shall be conducted in the presence of the Owner.

3.2 INSTRUCTION AND MAINTENANCE

- A. Instruct the Owner's personnel in the proper use, operation and maintenance of the generator, fuel tank and load bank. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in the procedures to be followed, checking for the source of an operational failure or malfunction.
- B. Instruct the Owner's personnel in the proper use, operation and maintenance of the DPF, including maintenance and replacement of the filters and periodic use of a portable load bank to maintain DPF in optimum condition.
- C. Maintenance Period: Starting at the date of acceptance of the Work, provide complete systematic inspection and maintenance for the first three years. Furnish trained experts and equipment to check, adjust, lubricate and otherwise maintain the generator set in operation without defects or deterioration. Replace or repair materials and parts, which become defective or deteriorated for any reason.
- D. Furnish a factory-trained Engineer for a minimum of one working day prior to final acceptance of the generator installation, or as needed to satisfy Owner that the system is functioning properly. Testing and training for the new engine-generator installation will take place at non-standard times. Training and testing will take place on weekends, and could be scheduled on holidays and in the middle of the night, at the discretion of the Owner. Provisions shall be made in the bidding for this contract for such scheduling requirements.
- E. Provide 3 year Manufacturer maintenance Contract, for the new engine-generator installation. This shall include two site visits per year and annual load-bank testing as specified in Paragraph 1.1 of this Section.

END OF SECTION

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SECTION 263601
AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide quantity of automatic transfer switches as indicated on the drawings and as specified herein.

1.2 SUBMITTALS

- A. Refer to Section 260500 and Division 1 for procedure.
- B. Shop Drawings and Product Data, including complete wiring diagrams, including system interconnections.
- C. Test and Test Report for each Automatic Transfer Switch:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect for physical damage.
 - b. Compare equipment nameplate information and connections with single line diagram and report any discrepancies.
 - c. Check switch to ensure positive interlock between normal and alternate sources.
 - d. Check tightness of all cable connections and bus joints.
 - e. Perform manual transfer operations.
 - f. Electrical Tests for Automatic Transfer Switch:
 - 1) Perform insulation resistance tests phase-to-phase and phase-to-ground with switch in both source positions.
 - 2) Set and calibrate in accordance with the Manufacturer's recommendations.
 - (a) Voltage-sensing relays.
 - (b) Transfer time delay relays.
 - (c) Engine shutdown relays.
 - 3) Perform automatic transfer by:
 - (a) Simulating loss of normal power.
 - (b) Return to normal power.
 - 4) Monitor and verify correct operation and timing:
 - (a) Normal voltage-sensing relays.
 - (b) Engine start sequence.
 - (c) Time delay upon transfer.
 - (d) Alternate voltage-sensing relays.
 - (e) Automatic transfer operation.
 - (f) Interlocks and limit switch function.
 - (g) Timing delay and retransfer upon normal power restoration.
 - (h) Engine shutdown feature.
 - (i) Correct functioning of auto-exercising controller.
- D. Maintenance and operating instruction manuals. Submit four bound copies including approved Shop Drawings, parts list, list of recommended spare parts, sources of purchase and similar information.

1.3 REFERENCE STANDARDS

- A. The following Specifications and standards, except as hereinafter modified, are incorporated herein by reference and form a part of this Specification to extend the indicated by the references thereto. Except where specific date is given, issue in effect (including amendments, addenda, revisions, supplements, and errata) on the bid date shall be applicable. In text such Specifications and standards are referred to by basic designation only.
- B. National Fire Protection Association (NFPA)
 - 1. No. 70 National Electrical Code (NEC)
- C. Underwriters' Laboratories, Inc. (UL):
 - 1. No. 1008 Automatic Transfer Switches
 - 2. No. 489 Molded Case Circuit Breakers
- D. National Electrical Manufacturers Association (NEMA):
 - 1. ICS 2.447 Industrial Control and Systems
- E. American National Standards Institute (ANSI):
 - 1. V37-90a Guide for Surge Withstand Capability (SWC) Tests

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. ASCO
- B. Russelectric
- C. Onan
- D. Kohler
- E. Caterpillar

2.2 AUTOMATIC TRANSFER SWITCH, GENERAL

- A. Each automatic transfer switch (ATS) shall be 3-pole or 4-pole as indicated on the drawings and rated as indicated on the drawings. Transfer switch shall be listed and labeled under UL-1008 as a device for use on emergency generator systems. ATS shall be mounted in a Nema 1 or Nema 3R enclosure as indicated on the drawings. ATS shall be the standard product of a company engaged in manufacturing automatic transfer switches for at least 10 years. ATS shall be manufactured so that no rear or side access is required.

2.3 CONSTRUCTION AND PERFORMANCE

- A. Transfer Switch shall consist of completely enclosed multi-pole contact assembly and a separate control logic panel. The contact assemblies shall be operated by a stored energy mechanism, and be energized only momentarily during transfer providing inherently double throw switching action. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.
- B. Transfer Switch shall be positively interlocked mechanically and electrically to prevent simultaneous closing of both sources under either automatic or manual operation. A neutral

position shall not be possible under normal electrical operation except that the switch shall be provided with a Delayed Transition accessory for switching highly inductive loads. Transfer Switch shall have a manual neutral position for load circuit maintenance. A Transfer Switch position indicator shall be visible from the front of the switch to show to which source the transfer switch is connected.

- C. Transfer switch shall be capable of being operated manually under full load conditions. Manual operation shall be accomplished via integrally mounted pushbutton operators located on the face of the contact assemblies. Removable manual operation handles and handles which will move in the event the electrical operator becomes energized while performing a manual transfer operation are not acceptable. The manual operator shall provide the same contact-to-contact transfer time as provided under normal automatic operation to prevent possible flashovers from switching the main contacts slowly. In addition, provisions shall be provided to allow disengagement of the electrical operator during manual operation.
- D. Transfer Switch shall have four extra sets of normally open and normally closed auxiliary contacts, which indicate ATS positions.
- E. A solid state sensing and control logic panel shall be separately mounted from the power-switching portion of the Transfer Switch. The two Sections shall be connected together by control cables with plug-in connectors. The control Section shall be capable of being disconnected from the power Section for maintenance purposes.
- F. The logic circuit shall utilize differential sensing solid-state components mounted on printed circuit boards to accomplish proper operation and to perform functions such as timing and voltage and frequency monitoring. LED's on each PC card shall indicate the proper operation of each function furnished. Construction shall be such that functions cards are individually replaceable without requiring replacement of the complete solid-state package. Cards for plug-in modifications shall be available for field installation with retention of the UL label.
- G. Where indicated on the drawings, ATS shall be provided with power meter, Square D PM850 or equal, with network card for communications interface with Owner's power management system.

2.4 SEQUENCE OF OPERATION

- A. Upon reduction of phase-to-phase voltage of the normal source to 80% of nominal, and after a time delay of 1-90 seconds (adjustable to meet field conditions) to override momentary dips and/or outages, the auxiliary engine start contacts shall close to initiate starting of the Emergency Generator.
- B. After the Generator has reached 90% of nominal voltage and frequency, and after a time delay, ATS shall transfer the load to the Generator. Provide an under-voltage / under-frequency monitor for the Emergency/Standby Source.
- C. When the Normal Source has been restored to 90% of rated voltage, and after a time delay adjustable from 0.5-30 minutes (to insure the integrity of the Normal Power Source), the load shall be retransferred to the Normal Source.
- D. A time delay module shall be provided in the ATS, adjustable 0.5-30 minutes, to delay shutdown of the Emergency/Standby Power Source after retransfers to allow the generator to run unloaded for cool-down.

- E. If the Emergency Generator should fail while carrying the load, transfer to the Normal Power supply shall be made instantaneously upon restoration of the Normal Source to satisfactory conditions.
- F. ATS shall be provided with a Delayed Transition timer, adjustable 0-120 seconds. The ATS shall pause during transfer with both sources disconnected from the load, to allow back-EMF from large inductive loads to decay. Methods, which use relative phase-angle differences to control transfer, are not acceptable.
- G. ATS shall be provided with 4 sets of Auxiliary Contacts to indicate 'Normal' or 'Emergency' Position of the ATS.

2.5 ADDITIONAL ACCESSORIES/SPARE PARTS

- A. Provide an engine exercise timer in the ATS indicated on the drawings which shall automatically start the engine periodically. Timer shall be digital, with lithium battery back up. Provide a selector switch to select exercise with load transfer or without load transfer. The timer shall include a failsafe circuit, such that if the engine fails during exercise the ATS will immediately retransfer to the Normal source.
- B. Provide pilot lights to indicate to which source the load is connected, and to indicate the availability of each power source.
- C. The transfer switch shall be rated for the short circuit currents noted on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Section 260500 for details of Work under this Section, including seismic installation requirements.
- B. Testing: See Section 260800 and Section 263214.

END OF SECTION

SECTION 264300
SURGE PROTECTIVE DEVICE
(SPD)

PART 1 GENERAL

1.1 WORK INCLUDED

- A. The Basic Electrical Requirements, Section 26 05 00, are part of this Section, and the contract for this work, and apply to this Section as fully as if repeated herein.
- B. This specification describes the mechanical and electrical requirements for a Surge Protective Device and noise filter herein known and shown on all drawings as SPD. The SPD shall be suitable for application in category C3, B3/C1, and B3 environments (see Part 2 of this Section for specific application) as described in ANSI/IEEE C62.41. The SPD shall be of parallel design and provide surge protection in all modes as well as electrical high frequency noise filtering for high exposure locations as defined in ANSI/IEEE C62.41-1991.
- C. The unit shall be UL 1449 2nd Addition Listed (including 2005 Revisions) as a Surge Protective Device and UL 1283 Listed as an Electromagnetic Interference Filter.

1.2 SUBMITTALS

- A. Comply with the requirements of Section 01 33 00.
- B. Submit all related SPD specifications, electrical and mechanical drawings, maintenance manuals and U.L. 1449 surge suppression ratings for the SPD.
- C. Equipment Manual: Furnish with the submittal and with each unit delivered an equipment manual (3 copies) that details the installation, operation and maintenance instructions for the specified unit.
- D. Drawings: Electrical and mechanical drawings (3 copies) shall be provided with the submittal and with each unit delivered that show unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
- E. UL 1449 Listing/Clamp Voltages: Manufacturer shall provide data showing UL 1449 product listing. Manufacturer shall also submit certified documentation of applicable Location Category Testing in full compliance with Nema LS 1-1992, paragraphs 2.2.10 and 3.10.
- F. Single Pulse Surge Current Capacity Testing: Certified documentation of the unit*s Single Pulse Surge Current Capacity Testing shall be included in the submittal.
- G. Minimum Repetitive Surge Current Capacity Testing: Certified documentation of the unit*s Minimum Repetitive Surge Current Capacity Testing shall be included in the submittal.
- H. Spare Parts: A list of customer-replaceable spare parts shall be included in the submittal and with each unit delivered. All spare parts shall be quickly and easily field-replaceable.
- I. Diagnostic Signature Card: Each SPD unit shall include a Diagnostic Signature Card listing factory-established benchmark suppression voltage values for all modes of protection. The

suppression voltage values shall be established during final production line testing utilizing a DTS-2 Diagnostic Test Set. This Diagnostic Signature Card shall provide space for subsequent field testing allowing comparison of the initial factory benchmark testing with subsequent field testing suppression voltage values.

1.3 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Firms regularly engaged in the manufacture of SPD products for categories C3, B3/C1, and B3 (ANSI/IEEE C62.41) and whose products have been in satisfactory service for not less than 5 years.

1.4 CODES AND STANDARDS

- A. UL compliance and labeling: Listed per UL 1449 and UL 1283.
- B. ANSI/IEEE compliance: Comply with ANSI/IEEE C62.41 (Categories C3, B3/C1 and B3 as applicable - see Part 2 of this Section) and C62.45.
- C. NEC compliance: Comply with NEC as applicable to construction and Article 280 for installation.
- D. National Electrical Manufacturers Association (NEMA LS1-1992)
- E. The SPD shall be capable of surviving 1000 sequential Category C3, B3/C1, or B3 surges (as applicable - see Part 2 of this Section) without failure. Follow IEEE test procedures established in C62.45.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. List of Equipment Manufacturers:
Current Technology, Liebert, L.E.A. Dynatech or equal.
- B. Surge Suppressor shall be Current Technology or approved equal with options as listed in paragraph 2.02-L below:
 - 1. Switchboards, Distribution Panels, or other distribution equipment rated 1600A and above (Category C3):
 - a. 300,000A Single Surge Current Capacity (L-N / L-G / N-G / L-L)
 - b. Type SEL300-120/208V-3GY-DM-L2 for 120/208V systems.
 - 2. Switchboards, Distribution Panels, or other distribution equipment rated 1000A or 1200A (Category C3 for service entrance or B3/C1):
 - a. 250,000A Single Surge Current Capacity (L-N / L-G / N-G / L-L)
 - b. Type TG250-120/208-3GY-DM-L2 for 120/208V systems.

3. Switchboards, Distribution Panels and other distribution equipment rated 800A or less with no upstream SPD protection (Category B3/C1):
 - a. 200,000A Single Surge Current Capacity (L-N / L-G / N-G / L-L)
 - b. Type TG200-120/208V-3GY-DM-L2 for 120/208V systems.
4. Switchboards, Distribution Panels and other distribution equipment rated 800A or less with upstream SPD protection (Category B3):
 - a. 150,000A Single Surge Current Capacity (L-N / L-G / N-G / L-L)
 - b. Type TG150-120/208-3GY-DM-L1 for 120/208V systems.
5. Branch Circuit Panelboards with up-stream SPD protection (Category B3):
 - a. 80,000A Single Surge Current Capacity (L-N / L-G / N-G / L-L)
 - b. Type TG80-120/208V-3GY-DM-L1 for 120/208V systems.
6. Branch Circuit Panelboards with integral SPD protection (Category B3):
 - a. 80,000A Single Surge Current Capacity (L-N / L-G / N-G / L-L)
 - b. Type EGPE2-80-120/208V-3GY WYE for 120/208V systems

2.2 SPD GENERAL

- A. The SPD maximum continuous operating voltage (MCOV) shall be capable of sustaining 115% of the nominal rms voltage continuously without degradation. All suppression filter systems maximum continuous operating voltages shall be in compliance with test and evaluation procedures outlined in NEMA LS 1-1992.
- B. Operating frequency range shall be 47 to 63 Hertz.
- C. Protection Modes. All protected modes shall be as defined per NEMA LS 1-1992, paragraph 2.2.7. SPD shall provide protection in all modes, including Line-to-Neutral, Line-to-Ground, Line-to-Line and Neutral-to-Ground protection.
- D. The rated single pulse surge current capacity for each mode of protection of the unit shall be as indicated in Paragraph 2.01.B of this Section.
- E. In compliance with NEMA LS 1-1992, suppression filter systems shall be single pulse surge current tested in all modes at surge currents up to 150% of the product design rating by an industry-recognized independent test laboratory. The test shall include an ANSI/IEEE C62.41-1991 Category C1 surge defined as a 1.2 X 50 Fsec, 6000V open circuit voltage waveform and an 8 X 20 Fsec, 3000A short circuit current waveform to benchmark the unit's suppression voltage, followed by a single pulse surge of maximum rated surge current magnitude with an approximated 8 X 20 Fsec waveform. To complete the test, another Category C1 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two category C1 surges does not vary by more than 10%. Test results shall be submitted.

- F. Per ANSI/IEEE C62.41 and ANSI/IEEE C62.45-1992, all suppression filter systems shall be repetitive surge current capacity tested in every mode utilizing a 1.2 x 50 Fsec, 20 KV open circuit voltage, 8 x 20 Fsec, 10 KA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. Test results shall be submitted.
- G. Suppression filter systems EMI-RFI noise rejection or attenuation values shall be in compliance with test and evaluation procedures outlined in NEMA LS-1-1992.

Attenuation Frequency	100KHz	1MHz	10MHz	100MHz
Insertion loss (ratio)	50-1	350-1	500-1	250-1
Insertion loss (dB)	34	51	54	48

- H. SPD systems clamping voltages shall be in compliance with test and evaluation procedures outlined in NEMA LS 1-1992. Maximum clamping voltages shall be as follows:

System Voltage	Mode	A3 Ringwave	B3 Ringwave	B3/C1 Comb. Wave	C3 Comb. Wave
120/208	L-G	355	420	410	775
	N-G	220	290	380	550
	L-L	440	540	750	1400

- I. The unit shall be installed with coordinated UL 489 or UL 198 listed or recognized overcurrent protection devices.
- J. The SPD shall have a response time no greater than .5 nanoseconds, for any of the individual protection modes.
- K. The SPD shall use LED indicators which provide indication of suppression failure as well as optically isolated N.C dry contacts for remote monitoring.
- L. SPD Product Characteristics:
 1. SPD Units for connections to equipment rated 1600A and above: The SPD shall include an engineered solid-state high performance suppression system utilizing a predetermined number of selenium cells and arrays of non-linear voltage dependent metal oxide varistors with similar operating characteristics. The suppression system shall not utilize gas tubes, spark gaps, silicon avalanche diodes. The suppression system shall not incorporate non-field replaceable components which may degrade performance or long term reliability of the suppression system.
 2. SPD Units for connections to switchboards and panels rated 1200A and below: The SPD shall include an engineered solid-state high performance suppression system utilizing arrays of non-linear voltage dependent metal oxide varistors. The suppression system shall not utilize gas tubes, spark gaps, silicon avalanche diodes. The suppression system shall not incorporate non-field replaceable components which may degrade performance or long term reliability of the suppression system.

3. Each SPD shall include a high frequency extended range power filter and shall be UL 1283 listed as an Electromagnetic Interference Filter. The filter shall reduce fast rise-time, high frequency, error-producing transients and electrical line noise to harmless levels, thus eliminating disturbances which may lead to electronic system upset. The filter shall provide minimum noise attenuation values as specified in Paragraph 2.2.G of this Section.
4. All internal wiring associated with the suppression filter system and subject to surge currents shall utilize low-impedance copper bus bar. All internal connections associated with the suppression filter system and subject to surge currents shall be made with compression or mechanical solderless-type lugs and shall be bolted to the bus bars in order to reduce overall system impedance. No plug-in component modules, quick-disconnect terminals, non-field replaceable fusing or printed circuit boards shall be used in surge current-carrying paths.
5. The unit shall include long-life, solid state, externally visible status indicators that monitor the on-line status of each phase of the unit.
6. The unit shall incorporate an integral test point allowing easy off-line diagnostic testing verifying the operational integrity of the unit's suppression filter system. Field testing shall permit proactive testing to ensure performance and long term reliability. Testing shall include injection of an impulse into the off-line suppression filter system to verify the suppression performance values established at final factory testing and recorded on the Diagnostic Signature Card. Indicator lights monitoring fuse condition or power available which inform the user of failure after the fact do not meet the intent of this specification.
7. The SPD shall include an integral non-fused safety interlocked disconnect switch with an externally mounted manual operator.
8. The SPD shall include a battery-powered audible alarm that detects and provides notification of any single or multiple phase failure of the suppression filter system. The unit shall also include a status indicator for each phase that extinguishes to indicate a failure mode and an LED that flashes to indicate any alarm condition. The alarm shall have a silence switch and a test switch for ensuring positive function and shall have an alarm disable LED that illuminates when the alarm is disabled. The monitoring unit shall have an easily replaceable, commonly available battery for backup to ensure audible alarm function in the event of a total power failure. The unit shall have a battery backup monitor light which shall illuminate when the battery requires replacement. To monitor on-line status, the monitoring package shall also include two sets of form C dry contacts (N.O. or N.C.) to facilitate connection to remote monitoring facilities. The contacts shall be normally open or normally closed and shall change state upon the failure of the suppression system or power loss in any combination of all three phases.

PART 3 EXECUTION

3.1 GENERAL

- A. Refer to Section 260500 for details of work under this section.

3.2 TESTING

- A. Upon completion of installation, a factory-certified local service technician shall provide testing services. The following tests shall be performed:

1. Voltage measurements from Line-to-Ground, Line-to-Neutral, Line-to-Line and Neutral-to-Ground at the time of the testing procedure.
 2. Impulse injection to verify the system suppression voltage tolerances for all suppression paths. Impulse testing shall be completed while the unit is off-line to isolate the unit from the distribution system.
- B. Test results shall be recorded and compared to factory benchmark test parameters supplied with each individual unit. A copy of the start-up test results and the factory benchmark testing results shall be supplied to the engineer and the owner for confirmation of proper suppression filter system function. In addition, the integrity of the neutral-ground bond shall be verified through testing and visual inspection.

3.3 GUARANTEE

- A. The manufacturer shall provide a 5 year warranty from date of installation against failure of each SPD unit.

END OF SECTION

SECTION 265101
LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Luminaires (i.e., lighting fixtures): Refer to the Luminaire Schedule and provide a complete and working facility Lighting System. Catalog numbers in the Luminaire Schedule are design series references and may not represent the exact catalog number as specified or as required for particular installations. Provide complete luminaires to correspond with the number of LEDs, power supply, wattage, mounting hardware, ceiling type, trim, size, and special requirements as specified in the Luminaire Schedule for each luminaire type. Additional features, accessories, and options specified, described, scheduled, or necessary for installation shall be included.
- B. LEDs and power supplies.
- C. Lighting controls, including occupancy sensors. See Section 265700 for Low Voltage Lighting Control System.
- D. Exit and Emergency Egress lighting where indicated and where required.
- E. Supports for outlet boxes and luminaires, including seismic restraint slack wires for recessed luminaires in suspended ceilings per code and backing in walls as required to keep luminaires secure and level.

1.2 INCORPORATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.
- B. Section 260500 and 262700 apply to all work in this section.
- C. Division 03: Concrete (Bases for pole-mounted luminaires as noted in Luminaire Schedule).
- D. Division 09: Painting and Finishes (cutting of holes in finished surfaces for recessed luminaires).

1.3 RELATED WORK

- A. Ceiling Access panels where required for access to equipment, outlets, transformers, etc., located above suspended ceilings, sheet rock or plaster ceilings. Coordinate with the Architect and other trades.

1.4 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 260500.
- B. Submit (6) six sets of submittals for review by the project team unless otherwise noted in these specifications. The submittals shall include the following information:
 - 1. Product Index: The following information shall be included in the product index.
 - a. Luminaire Type. The index shall list, in alphabetical order, each luminaire type per the Luminaire Schedule.

- b. Manufacturer's Catalog Number. Outstanding information required to make a complete catalog number shall be clearly identified in the index.
 - c. Where a pole is included with the luminaire, include the catalog number of the pole in addition to that of the luminaire.
 - d. LED Data. Provide the Manufacturer's name for each LED array including wattage, color temperature, lumen output, and color rendering index.
2. Manufacturer's literature for every luminaire listed on the Luminaire Schedule.
 - a. Catalog Information:
 - 1) Luminaire Data Sheet: The manufacturer's cut sheet shall include the following:
 - (a) Photometrics: Candlepower distribution curve or table with horizontal readings at 0, 22.5, 45, and 90 degrees and vertical readings from 0 to 180 degrees in 5 degree increments in accordance with the Illuminating Engineering Society published test procedures.
 - (b) Catalog Number Nomenclature
 - (c) Coefficient of Utilization Tables
 - (d) Luminaire Line Drawing
 - (e) Power supply (each type)
 3. Data sheets for power supplies. Indicate luminaire types on applicable power supply data sheets.
 4. Data sheets for wallbox controls and other products specified in this section.
 5. Shop Drawings:
 - a. Provide shop drawings of suspension details for luminaires recessed in, mounted on, or suspended from hung ceilings. Details shall clearly illustrate proposed methods for supporting luminaires independent of the suspended ceiling system.
 - b. Detailed shop drawings of pendant mounted luminaires constructed with linear metal housings containing the following information.
 - 1) Support mechanism, including swivel canopies.
 - 2) Trim details.
 - 3) Closure piece details.
 6. Samples:
 - a. Provide samples of luminaire trim where "Finish as selected by Architect" is indicated on the Luminaire Schedule. Submit two finish samples, 75 mm x 75 mm (3" x 3") minimum, of all custom color, decorative metal, or anodized aluminum finishes. Samples must be approved in writing by the Architect prior to ordering.
 - b. Submit sample of custom luminaires: complete and operational, equipped with 120V, 6 foot cord and 3 prong grounded plug. Luminaire shall be fabricated and finished as specified, full size, using specified materials & equipment. Submit one luminaire to Owner's representative for review prior to production.
- C. For Any Luminaires Substituted For Those Specified:
1. Refer to Division 1 - Product Requirements, for all substitution procedures.
 2. Provide independent testing laboratories, Inc., or equal, photometric test report for each Luminaire type and lamp combination listed on the Luminaire Schedule. Test reports shall be based on Illuminating Engineering Society published test procedures and shall contain polar coordinate candlepower distribution curves in five lateral planes for luminaires with asymmetric distributions and luminaire luminance data for vertical angles above 45 degrees from nadir. Test results shall indicate luminaire efficiency for the lamp and aperture assembly specified. Luminaires with efficiencies more than 2% below the values of specified luminaires are not acceptable and will be rejected.
 3. Provide photometric calculations for each room or area where a substituted luminaire is proposed. Such calculations shall be made using comprehensive lighting software, such as AGI32, and include point-by-point illuminance values at IES recommended heights, average illuminance, and maximum-to-minimum and average-to-minimum uniformity

ratios. Room dimensions, configurations (including sloping ceilings), room surface reflectances, light loss factors, and heights of suspended luminaires shall match the heights specified in the contract documents.

4. Due to the variety of lumen outputs and light distributions of LED Luminaires, substitutions will require additional review on the part of the Engineer or Architect to ascertain the equivalency of the substituted luminaires. Substitutions will be reviewed to determine their aesthetic, construction, and photometric equivalency to maintain similar design impact and performance in their intended environment. The Engineer and Architect have not included such unknown and unquantifiable review time in their scope of work and are not compensated by the Owner for such services. The Contractor shall reimburse the Engineer and Architect for labor costs to review substitutions.
5. Prior approval does not guarantee final approval by the Engineer. The Contractor shall be responsible for providing luminaires that meet or exceed the quality and performance of the specified products in their entirety. All deviations in quality and performance from the specified products must be listed and individually signed off by the engineer.
6. The Owner reserves the right to reject a proposed substitution based on their agent's professional judgment as to the utility, quality, performance, visual appropriateness, or finish of substitutions.

1.5 OCCUPANCY SENSORS

A. Equipment Qualification

1. Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.
2. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.
3. Contractor and Contractor's Supplier shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.
4. Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, luminaires, HVAC systems and building management systems.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site and store in unopened cartons in protected location. Inspect products immediately and report all damage accordingly.

1.7 GUARANTEE AND WARRANTIES

- A. All work performed under this section must be guaranteed to be free of defects in products or workmanship for one year after date of acceptance by Owner, unless noted otherwise in General Conditions.
- B. Warranties:
 1. Electronic power supplies must be warranted against failure for at least five years after date of substantial completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide luminaires as indicated in Luminaire Schedule; if conflict exists between Luminaire Schedule and Specifications, the more stringent requirement shall take precedence.
- B. Provide luminaires new and complete with mounting accessories, junction boxes, trims, and lamps.
- C. Provide products with UL labels appropriate to intended installation conditions, or with labels from other testing laboratories whose results are acceptable to local inspector, showing compliance with UL standards. Labels must be concealed from normal viewing angles.
- D. All products of same type by same manufacturer.

2.2 SOLID STATE LUMINAIRES

- A. Housing, where applicable:
 - 1. Steel bonderized or equal rust protected, or aluminum, rigid construction. Minimum gauge thickness shall be as follows:
 - a. Interior locations: No. 20-gauge steel, No. 16-gauge aluminum.
- B. Finish:
 - 1. Baked enamel finish (except when otherwise specified).
 - a. Concealed interior surfaces (this applies to interior hardware, circuit boards, etc.) matte black.
 - b. Concealed exterior surfaces: matte black.
 - c. Visible surfaces: color and texture as specified below for each luminaire type or as selected.
- C. Light Emitting Diode (LED) requirements:
 - 1. Correlated color temperature (CCT) for phosphor-coated white LEDs must have one of the following designated CCTs, as specified on the Luminaire Schedule, and fall within the following binning standards.
 - a. 3000K defined as 3045 +/- 175K
 - b. 3500K defined as 3465 +/- 245K
 - c. 4000K defined as 3985 +/- 275K
 - 2. Color spatial uniformity shall be limited to variations in chromaticity for different directions (i.e. changes in viewing angle) within 0.004 from the weighted average point on the CIE 1976 (u',v') diagram.
 - 3. Color maintenance shall be limited to a maximum change in chromaticity of 0.007 on the CIE 1976 (u',v') diagram over the lifetime of the product.
 - a. Color rendering index: Color rendering index to be determined using ANSI C78.377-2008 and applicable IESNA standards.
 - b. Laboratory tests must be produced using specific module(s)/array(s) and power supply combination that will be used in production.
 - c. Manufacturers must provide a test report from a laboratory accredited by NVLAP or one of its MRA signatories
 - 4. Lumen depreciation
 - a. Lumen depreciation to be measured using IESNA LM-80-08 and TM-21-11 standard for IES approved method of measuring lumen maintenance of LED light sources.

- b. Phosphor-coated white LED modules/arrays shall deliver at least 70% of initial lumens for a minimum of 50,000 hours when installed in-situ and operated at 100% output and the maximum specified operating temperature.
 - c. Colored LED modules/arrays shall deliver at least 50% of initial lumens for a minimum of 50,000 hours when installed in-situ and operated at 100% output and the maximum specified operating temperature.
 - 5. Acceptable LED manufacturers:
 - a. Cree
 - b. Nichia
 - c. Osram Opto Semiconductors
 - d. Philips Lumileds
 - e. Soraa
 - f. Xicato
- D. Luminaire Efficacy:
 - 1. Luminaire efficiency shall be measured using IESNA LM-79-08 standard for electrical and photometric measurements of solid state lighting products.
 - 2. Manufacturer shall provide published luminaire efficacy, which is defined as luminaire light output divided by luminaire input power measured in a 25 degree Celsius environment. Efficacy shall include power supply, thermal, optical, and luminaire losses.
- E. Thermal Management:
 - 1. Solid state luminaire shall not exceed LED manufacturer's maximum junction temperature requirements when operated in-situ at luminaire manufacturer's maximum ambient operating temperature and 100% light output.
 - 2. Solid state luminaires shall be thermally protected using one or more of the following thermal management techniques:
 - a. Metal core board
 - b. Gap pad
 - c. Internal monitoring firmware
 - 3. Solid state luminaire housing shall be designed to transfer heat from the LED board to the outside environment.
- F. Power Supplies (LED Drivers) requirements:
 - 1. Power factor of 0.90 or greater for primary application
 - 2. Input current shall have Total Harmonic Distortion (THD) of less than 20%.
 - 3. Minimum operating temperature of minus 20 degrees Celsius or below when used in luminaires intended for outdoor applications.
 - 4. Operating frequency equal to or greater than 120 Hz.
 - 5. Operate with sustained input variations of +/- 10% (voltage and frequency) with no damage to the driver.
 - 6. Tolerate sustained open circuit and short circuit output conditions without damage and without need for external fuses or trip devices.
 - 7. Output shall be regulated to +/- 5% across published load range.
 - 8. Class A sound rating.
 - 9. Outputs shall have current limiting protection.
 - 10. Operate LEDs at constant and regulated current levels. LEDs shall not be overdriven beyond the diode manufacturer's specified nominal voltage and current.
- G. Solid State Lighting Controls:
 - 1. Control interface to dimmable power supplies shall consist of one of the following:
 - a. Line Voltage Dimming. Controls to be rated for magnetic or electronic low voltage transformer operation.

- b. Low voltage (0-10V) control. Controls to be compatible with either current sink or current source operation.
 - 2. Dimmable LED power supplies shall use pulse width modulation (PWM) or constant current reduction (CCR) to regulate power to LEDs.
 - a. PWM power supplies shall have 12-bit or greater resolution to obtain flicker-free operation throughout their dimming range.
 - b. PWM power supplies shall be provided in luminaires that will be dimmed lower than 40% and must maintain consistent color temperature.
 - c. CCR power supplies shall be provided in areas that have strict electromagnetic interference (EMI) requirements, high motion activity, or rotating machinery.
- H. System Installation
 - 1. Hardwired connections to solid state luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
 - 2. All solid state luminaires (100% of each lot) shall undergo a minimum eight-hour burn-in test during manufacturing. Solid state lighting installations shall be UL Listed as a low-voltage lighting system including, but not limited to, luminaire, power supply, controller, keypad, and wiring.
- I. Warranty
 - 1. Luminaires, drivers, and controllers for solid state lighting systems shall be covered by a five-year warranty against defects in workmanship or material. Warranty shall include in-warranty service program providing for payment of authorized labor charges incurred in replacement of inoperative in-warranty equipment.

2.3 LUMINAIRE CONSTRUCTION

- A. Sheet metal: materials and thicknesses shall be 20 gauge (0.7 mm or 0.027") min., free of dents, scratches, oil-can, or other defects.
- B. Painted luminaires: exposed weld marks, joints, and seams shall be filled and sanded smooth before finishing.
- C. All edges cleaned and dressed to remove sharp edges or burrs.
- D. Extrusions: 1/10" min. wall thickness, smooth and free of tooling lines, with cast end plates that exactly match extrusion profiles.
- E. Castings: smooth, free of pits, scales, gate marks, or blemishes.
- F. Spinings shall have 1/32" min. thickness, smooth, free of spinning lines or blow-back, with clean edges.
- G. Welds: Follow recommendations of American Welding Society. All welds continuous and free of spatter, residue, or warping.
- H. No light leaks visible in finished room. Ensure that downlight housings mounted in wood slat ceilings are not visible from below. Field paint exterior of housing with high temperature paint if necessary.
- I. Exposed end plates and joiners, with concealed fasteners.

- J. End-to-end mounted luminaires: Verify row configurations and provide joiners, aligning splines, and trims to suit.
- K. Hardware:
 - 1. Steel or aluminum interior luminaires: cadmium-plated hardware.
 - 2. Steel or aluminum exterior luminaires: stainless steel hardware.
 - 3. Stainless steel luminaires: stainless steel hardware.
 - 4. Copper alloy luminaires: brass hardware.
- L. Raceways: Where used for through wiring, luminaires must be approved for use as raceways.

2.4 RECESSED LUMINAIRES

- A. Point-source luminaires: provide pre-wired junction box and thermal protection, and provide slack wires to structure at two diagonal corners.
- B. Troffer-type and flat panel luminaires: provide hold-down clips and slack wires to structure as detailed on the drawings. The detail will take precedence.
- C. Verify ceiling construction details and provide luminaire housings and trims to suit.
- D. Non-accessible ceilings: Provide access to junction boxes, ballasts, transformers, and battery packs through luminaire apertures; no access panels in ceiling.
- E. Mounting frames: To prevent rusting, provide galvanized steel or cast aluminum frames for installation in damp locations or in plaster ceilings.
- F. Adjustable luminaires shall be provided with rotation and tilt locking devices.

2.5 PENDANTS

- A. Cable-mounted: 1 X 7 strand 3/32" diameter stainless steel aircraft cable, factory crimped, independently tested and verified to exceed 1500 pounds.
 - 1. Verify mounting heights for each luminaire and provide cable lengths and coordinate cord lengths with manufacturer as required prior to ordering luminaires. Provide aircraft cable adjuster nipple with locking jaws.
- B. Supports: Carry luminaire weight to structure and provide horizontal bracing from suspension points to ceiling framing to prevent sideways shifting. Provide diagonal seismic restraint wires per code.

2.6 TRIMS

- A. Trims must fit tightly and be held in by gravity, spring clips, or mechanical fasteners. Trims must not drop out under normal conditions or seismic forces which do not exceed the design criteria of the building.
- B. Aluminum parabolic cones shall be smooth, properly shaped, with Alzak finish in colors as indicated.
 - 1. No hot spots or lamp images visible at angles shallower than lamp shielding angle.
 - 2. Self-flange cones must bend parallel to ceiling and cover ceiling hole without additional trim ring. Unpainted flange, shall have the same finish as cone interior.
 - 3. Cones and louvers for fluorescent luminaires must have permanent anti-iridescence treatment.

- C. Lenses, diffusers, and patterned glass: glass or virgin acrylic as noted, with patterns as noted.
 - 1. Finished thickness 2 mm (1/10") min. unless noted otherwise.
 - 2. Linear runs over 1200 mm (4'-0") long shall be in equal-length pieces.

2.7 FINISHES

- A. Steel Reflectors: Unless otherwise specified, the reflector surface finish shall be of synthetic white enamel or polyester powder coating. Finish shall show no indication of chipping, cracking, flaking or any other sign of loss of adhesion. The initial reflection factor shall be not less than 88 percent averaging 5 randomly selected points on the reflector. After 100 hours of exposure to the radiation of a glass enclosed carbon arc lamp, such as a Fade-O-Meters, the reflectance of the exposed portion shall not be less than 5 percent and finish shall show no appreciable color change. The carbon arc lamp shall be operated at appreciable color change. The carbon arc lamp shall be operated at 13 plus or minus 0.5 amperes at 140 volts. The reflector shall be placed ten inches from the arc and the lamp so ventilated that the temperature of the exposed portion does not exceed 105 degrees F.
- B. Aluminum Reflectors: Reflecting surfaces shall be provided with either a specular or diffuse finish as indicated. Reflection factors shall be not less than 83 percent for specular reflecting surfaces. Each reflecting surface shall be protected by dense coating of oxide weighing not less than 5.0 milligrams per square inch, applied by an anodic process. The reflector shall be given a sealing treatment that will prevent staining of the reflecting surface when subjected to a stain test. All aluminum reflectors & louvers shall be a low iridescent equivalent to that provided by Coil Anodizers.
- C. Non-Reflecting Surfaces: Unless otherwise specified, the finish on all non-reflecting exterior surfaces shall be aluminum oxide or aluminum; white, gray or aluminum paint on steel; nickel or chromium plating on copper alloy. Fastening devices shall be nickel, chromium, cadmium or zinc plated. All painted surfaces shall be free of tears, star marks, blisters, pinholes, chipping and any other defects that may impair appearance or serviceability.

2.8 LAMPS

- A. Relamp luminaires or replace LED boards and power supplies at no cost to owner if lamps or LEDs exhibit color variation, flicker, or burn out within 90 days of substantial completion date.
- B. LEDs:
 - 1. LED quantity, wattage, and color temperature as specified for each LED luminaire.
 - 2. 3500 deg. K color temperature for interior luminaires, 3000 deg. K for exterior luminaires, unless otherwise specified.

2.9 DRIVERS AND TRANSFORMERS

- A. General:
 - 1. Verify input voltages and match to branch circuit voltages.
 - 2. Remote drivers or transformers: Provide suitable enclosures and mounting hardware, and install in accessible, ventilated locations.
 - a. Secondary wiring: provide number and size of conductors as required, with 3% max. voltage drop between transformer and last lamp.
 - b. Keep transformers at least 300 mm (12") apart and do not stack vertically.
 - c. If load served by remote driver or transformer is not obvious to a future service technician, provide permanently affixed descriptive label at remote driver or transformer, clearly describing load served.

- B. LED Drivers:
 - 1. High power factor, thermally-protected.
 - 2. Compatible with LED lamps being used.
 - 3. Capable of dimming LED source without perceptible flicker or stroboscopic effects.

2.10 EMERGENCY LIGHTING AND EXIT SIGNS

- A. Emergency lighting:
 - 1. Provide lighting for paths of egress as required by Code.
- B. Exit signs shall be edge or back lit LED, surface-mounted on ceiling or wall, or integrated into ground mounted bollard.
 - 1. Fabricated aluminum construction, no light leaks around canopy. Plain box, with no decorative trim.
 - 2. Letters shall be 20mm (3/4") stroke, 150 mm (6") high, with concealed knockouts for left or right arrows, brightness and evenness of illumination per code, green color.
 - a. Green LED lamps located at interior perimeter for indirect illumination of stencil letters.
 - b. Provide finish as specified in the Luminaire Schedule.
 - c. Knock out the arrows as indicated on the plans.
- G. Emergency luminaires supplied by a separate emergency power source.
 - 1. For luminaires supplied by a separate emergency power source, provide "switched" control of the emergency designated lamps to allow complete "off" control when required by the user. The switched control shall include an automatic transfer feature to automatically turn "on" the emergency designated lamps upon the normal source power failure.
 - 2. Automatic transfer function shall be provided using a UL 924 listed relay, LVS Inc. #EPC-A or equal, suitable for mounting in a standard 4" square j-box (min. 2.5" deep). Transfer relay shall provide automatic diagnostic test feature which shall maintain power to the emergency designated lamps for 15 seconds after the room is switched off via the respective light switch or control relay. Emergency designated lamps shall turn off after the 15 second test period and shall come back on when the control device is turned back on to restore full lighting to the space.
 - 3. Provide (1) transfer module per "switched" zone.
- H. Emergency luminaires supplied by a dimmer panel and/or emergency source.
 - 1. For luminaires supplied by a dimmed power source, provide "dimmed" control of the emergency designated lamps to allow normal dimming control with the normal lamps. The dimmed control shall include an automatic transfer feature to automatically turn "on" the dimmed lamps to full light output upon the normal source power failure.
 - 2. Automatic transfer function shall be provided using a UL 924 listed relay, LVS Inc. #EPC-D (2-wire dimmed), #EPC-D-U (3-wired dimmed) or equal, suitable for mounting in a standard 4" square j-box (min. 2.5" deep).
 - 3. Provide (1) transfer module per "dimmed" zone.

2.11 WALL-BOX DIMMERS

- A. Provide dimmer controls as specified on the drawings and in Specifications Section 26 57 00.
- B. Ganging and Labeling:
 - 1. Labels: text as indicated 3 mm (1/8") high, all capital letters, engraved on device faceplate, filled with black paint and wiped clean.

2.12 OCCUPANCY SENSORS

A. General

1. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
2. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.
3. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.
4. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
5. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.
6. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.
7. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.
8. Passive infrared sensors shall utilize mixed signal ASIC which provides high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line), superior performance, and greater reliability.
9. Passive infrared sensors shall have a multiple segmented Lodif Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
10. Where specified, passive infrared and dual technology sensors shall offer daylighting foot-candle adjustment control and be able to accommodate dual level lighting.
11. Dual technology sensors shall be corner mounted to avoid detection outside the controlled area when doors are left open.
12. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.
13. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
14. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within $\pm 0.005\%$ tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
15. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
16. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
17. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
18. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
19. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
20. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

21. All sensors shall have UL rated, 94V-0 plastic enclosures.
- B. Circuit Control Hardware - CU
1. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.
 2. Relay Contacts shall have ratings of:
 - a. 13A - 120 VAC Tungsten
 - b. 20A - 120 VAC Ballast
 - c. 20A - 277 VAC Ballast
 3. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.
 4. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.
- C. Acceptable Manufacturers
1. The Watt Stopper, or Pre-Approved Equal: For pre-approval, provide all the information listed under "submittals" a minimum of ten (10) working days prior to initial bid date.
 2. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any price quotations received and submittals made are for sensors that meet or exceed the specifications and the requirements of the contract documents.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Architectural Reflected Ceiling Plans and Elevations shall govern exact location and mounting conditions for all luminaires. Contractor shall coordinate luminaire mounting and compatibility with ceiling construction and other trades.
- B. Coordinate work with other trades. Location of lighting has priority over location of new framing (except major structural members), ducts, diffusers, sprinklers, speakers, smoke detectors, and other obstructions.
- C. If obstructions are encountered which prevent installation of luminaires according to drawings, notify Architect immediately and do not proceed until conflict has been resolved.
- D. Coordinate the location of luminaires in mechanical or unfinished spaces. Locations shown on Drawings may be adjusted by the Contractor to suit conditions. Install luminaires to avoid obstructions and maximize light output, 2100 mm (7'-0") min. mounting height.
- E. In Elevator Machine Rooms, locate the luminaires so that the illumination level at the floor is not less than 200 lx (19 fc). Illuminate areas in front of and behind (if accessible) controllers, machines and other elevator equipment.
- F. In Elevator Pits, locate the luminaires so that the illumination level at the pit floor is not less than 100 lx (10 fc).
- G. Coordinate the location of any exposed conduit used to feed luminaires with the Architect prior to installation.

3.2 INSTALLATION

A. General:

1. Contractor shall be responsible for handling and installation of luminaires including all supports, hangers and hardware necessary for a complete installation. Luminaires shall be clean, plumb, level in straight lines, without distortion. Luminaires must be installed so they do not shift during relamping or adjustment. Remedy any light leaks which may develop after installation of recessed or enclosed luminaires.
2. Install luminaires at locations and heights as indicated, in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that luminaires fulfill requirements.
3. Point-source luminaires shall be located as dimensioned, or in center of tile or on tile joint as drawn; 6 mm (1/4") max. off-center tolerance.
4. Linear luminaires shall have 3 mm (1/8") max. horizontal or vertical alignment variation in any 5 m (16-ft.) portion of run.
5. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486 A and B, and the National Electrical Code.
6. Clean luminaires of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses.
7. Remove and replace luminaires that may have been damaged during construction at no additional cost to the Owner.
8. Protect installed luminaires from damage during remainder of construction period.
9. Provide equipment grounding connections for luminaires as indicated. Tighten connections to comply with tightening torques specified in UL 486 A to assure permanent and effective grounds.
10. Install luminaires, lamps, lenses, etc., after building is enclosed, weather tight and environmental conditions are nominally the same as expected for the complete spaces. All lenses, glass, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.
11. All wall mounted luminaires and all ceiling mounted surface luminaires including exit lights shall be fed through a luminaire Stud/Hickey/Nipple assembly and with provisions to prevent luminaire turning.
12. Installation of exit signs shall be coordinated with other trades to ensure signs are visible as intended.
13. All junction box cover plates for the lighting branch circuit system shall be clearly marked with a permanent ink felt pen identifying the branch circuit and control relay (panel number, circuit number, lighting control cabinet designation and control relay number) contained in the box.
14. Provide permanently affixed adhesive labels with machine printed lettering (min. 1/8" high) at junction boxes serving luminaires that are supplied by (2) electrical sources (i.e. normal and emergency lighting). Label to read "CAUTION - This luminaire is powered by (2) separate sources. The normal power source breaker and the emergency power source breaker must be turned off before servicing this luminaire."

B. Recessed Luminaires:

1. The contractor shall verify the fire rating of the ceiling system and wall in which the luminaires are to be mounted. Where luminaires are installed in fire rated ceilings or walls, provide fire rated enclosures around and over luminaires to maintain ceiling fire rating. No additional cost shall be allowed for failure to include such enclosures and installation in the bid.

2. Holes for Recessed Point-Source Luminaires: Cut holes to follow luminaire housings exactly so no gaps will be visible after trims are installed.
 3. Install bottom of housing aligned with finished ceiling.
 4. Keep ceiling insulation at least 75 mm (3") away from luminaires. Exception: luminaires with insulated contact (IC) rating shall be permitted to be in contact with insulation.
 5. Install trims after painting of spaces. Install trims tightly, with no gaps or light leaks.
 6. Seismic restraints: Provide and install slack wires and hold-down clips per code.
 7. Wallwashers:
 - a. Orient wallwasher housings according to manufacturer's instructions to maximize brightness on the upper portion of the wall.
- C. Ceiling-Mounted and Pendant Luminaires:
1. Provide support for outlet boxes and suspension points so luminaires can be installed securely, including seismic supports per code.
 - a. Luminaire weight less than 23 kg (50 lb) at each suspension point: hang from strap or stud on outlet box, or at non-feed points, provide 1/4"-20 stud projecting 20 mm (3/4") below ceiling.
 - b. Luminaire weight 23 kg (50 lb) or more at each suspension point: hang directly from structure, either independent of outlet box or from stud extending through outlet box to structure, unless the outlet box is listed for not less than the weight to be supported. Boxes used as the sole support of luminaires weighing more than 50 pounds must be listed and marked by the manufacturer with the maximum weight.
 2. Pendants:
 - a. Provide horizontal bracing from suspension points to ceiling framing to prevent sideways shifting.
 - b. Provide diagonal seismic restraint wires above ceiling per code.
 - c. Furnish suspended luminaires with universal joint type hanger canopy (and longitudinal sway adapter at each stem connection point for linear luminaires), to permit 45 degree swivel on 360 degree circle from Nadir at canopy (and 45 degree longitudinal movement at sway adapter).
 - d. Luminaires over 450 mm (18") wide shall be provided with supports at all corners.
 - e. Install pendants plumb and level.
 - f. Verify luminaire weights and provide backing in ceiling as required.
- D. Wall-Mounted Luminaires:
1. Mounting heights shown on Drawings are measured from finished floor to centerline of outlet box or recessed housing, unless otherwise noted.
 2. Verify luminaire weights and provide backing in wall as required. Luminaires must not droop or tilt away from wall.
 3. Wet locations: install sealant between luminaire and outlet box.
 4. In circulation areas, wall-mounted luminaires must not project more than 100 mm (4") from wall if mounted above 685 mm (27") and below 2030 mm (80").

3.3 LIGHTING CONTROLS

- A. Install controls so that all operable parts are at 48 inches (1220 mm) maximum height.
- B. Lighting controls to include occupancy sensors in most spaces (for local control) and relay system lighting control for larger common spaces as indicated on the drawings.
- C. Occupancy sensors shall initially be set as follows:
 1. Maximum sensitivity.
 2. Maximum time delay (or 20 minutes).

3. Manual-on operation.
 4. Automatic off operation.
 5. Aim all adjustable sensors to properly cover room areas.
- D. Timeclock System shall initially be set to control the low voltage relays as per the Relay Panel Schedule LCP.
1. Assign all interior relays to an automatic off sweep, with flick warn (except those noted as "NL"). Off time shall be set to an Owner-determined time in the evening, after dark or normal business operations.
 2. On/Off signals may originate from BAS system, which shall be inter-connected to the Lighting Control System where indicated on the drawings.
 3. Assign all interior relays noted as "NL" to be on 24 hours per day. No automatic relay operation.
 4. Assign "after hours" and "Weekend / Holiday" hours to match normal business calendar and times.
 5. All interior relays shall be allowed to be overridden by use of the local dataline switches for a maximum of 2 hours (per Title 24) when used after hours or on Weekends / Holidays. If used during these times, automatic shut-off shall re-activate at the end of the 2-hour period.
 6. All interior relays shall be allowed to be overridden by use of the local dataline switches when used during normal business hours. Standard timeclock operation shall resume with the next scheduled timeclock function for each relay.
 7. Assign all exterior relays for automatic on operation with the astro-dial feature, set to 30 minutes before sunset. Latitude = 37.5 degrees North / Longitude = 122 degrees West.
 8. Assign exterior relays noted as "astro-on, astro-off" for automatic off operation with the astro-dial feature, set to 30 minutes after sunrise. Latitude and Longitude as noted above.
 9. Assign exterior relays noted as "astro-on, timeclock-off" for automatic off operation with the normal timeclock feature, set to an owner determined time in the late evening.
 10. Assign exterior relays noted as "NL" or "On All Night" for astro-dial operation, for automatic on 30 minutes before sunset and automatic off 30 minutes after sunrise.

3.4 DELIVERY, STORAGE, & HANDLING:

- A. Deliver luminaires in factory-fabricated containers or wrappings, which properly protect luminaires from damage. Inspect luminaires immediately upon delivery to ensure correct shipment without damage.
- B. Store luminaires in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.
- C. Handle luminaires carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new. Protection wrapping on louvered (parabolic) luminaires shall not be removed until luminaires are ready for operation.

3.5 SEQUENCING AND SCHEDULING:

- A. General:
 1. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of luminaires with other work.
 2. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

3.6 PROJECT CLOSEOUT

- A. Clean luminaires and remove plaster and paint spatters.
- B. Clean fingerprints and dust from downlight reflectors. Refer to manufacturer's instructions.
- C. Verify that luminaires and controls are working at time of final acceptance by Owner.
 - 1. Repair or replace lighting control devices that are inoperable.
 - 2. Repair or replace LED modules or entire LED luminaires that are inoperable.
 - 3. Repairs and/or replacements shall be at no additional cost to the Owner.
- D. Test emergency lighting system for 90 minutes in presence of Owner's representative, check each luminaire for proper operation at end of 90-minute test, then recharge for 24 hours and briefly test each luminaire again for proper operation.
- E. Install and aim adjustable lighting as directed by Architect.
 - 1. Provide personnel, lifts, ladders, and walkie-talkies as required.
 - 2. Aiming will occur at night, outside of normal working hours, at times as approved by the Architect.
- F. Prepare two copies of a Lighting Systems Maintenance Manual consisting of the following in a hardcover binder. Deliver to Architect. After review, Architect will deliver one copy to Owner.
 - 1. One complete set of approved submittals, including product data and shop drawings.
 - 2. Luminaire cleaning instructions, including chemicals to be used or avoided.
 - 3. Instructions for code-required testing and maintenance of emergency lighting system.

END OF SECTION

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SECTION 265601
SITE LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Luminaires
- B. LEDs
- C. Power Supplies/Drivers
- D. Poles
- E. Pole bases
- F. Controls and wiring

1.2 SYSTEM DESCRIPTION

- A. Furnish all labor, materials, apparatus, tools, equipment transportation, temporary construction and special or occasional services as indicated on the Drawings or described in these Specifications and as required to make a complete working site lighting system.
- B. Illumination levels shall be in accordance with recommendations by the Illuminating Engineering Society (IES) and all applicable state and local codes.

1.3 INCORPORATED DOCUMENTS

- A. Section 260500 and Section 265101 apply to all work in this Section.

1.4 SUBMITTALS

- A. Catalog Information:
 - 1. Luminaire (each type) with photometric pattern.
 - 2. Contactors.
 - 3. Power Supply or Driver (each type)
 - 4. Poles.
 - 5. Brackets.
- B. Shop Drawings.
- C. Laboratory Test: Determine soil density relationships for compaction of backfill material in accordance with ASTM D1557, Method D.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

- A. Provide new materials and equipment unless otherwise specifically indicated or specified. Materials shall be listed by Underwriter's laboratories, Inc. (U.L.) and bear evidence of such approval where applicable.

- B. Luminaires: Site luminaires shall be weatherproof. Reflectors and refractors shall provide the light configuration indicated and conforming to IES recommendations.
- C. Luminaires and poles shall be finished in epoxy enamel designed to withstand the effects of salt spray. Lens shall be securely attached to the lens frame for security during maintenance and relamping.
- D. Lighting Contactors: NEMA ICS 2. Electrically operated, magnetically held unit in NEMA enclosure, rated poles and ratings as indicated on Drawings. Units shall have silver alloy double breaker contacts and coil clearing contacts and shall require no arcing contacts. On-off selector switch.
- E. Poles, Brackets, Pole Bases and Attachments: Shall be rated for service with wind velocities of 100 mph considering the force exerted by the wind on the maximum exposure of the fixture luminaire selected.
- F. Poles shall be anchor base type round, height and style as indicated, finished to match luminaire, complete with handhole and gasketed cover, anchor bolts with leveling and locking screws, grounding connection, and matching base cover.
- G. Concrete pole bases shall be cast-in-place reinforced concrete as indicated with anchor bolts and conduit entries as per manufacturer. Concrete shall be rated 3,000 PSI at 28 day test.
- H. Concrete:
 - 1. Concrete for electrical requirements shall be at least 3,000 psi concrete with 1-inch maximum aggregate conforming to the requirements of Division 3 for Cast-In-Place concrete.

2.2 SOLID STATE LUMINAIRES

- A. Housing, where applicable:
 - 1. Steel bonderized or equal rust protected, or aluminum, rigid construction. Minimum gauge thickness shall be as follows:
 - a. Interior locations: No. 20-gauge steel, No. 16-gauge aluminum.
- B. Finish:
 - 1. Baked enamel finish (except when otherwise specified).
 - a. Concealed interior surfaces (this applies to interior hardware, circuit boards, etc.) matte black.
 - b. Concealed exterior surfaces: matte black.
 - c. Visible surfaces: color and texture as specified below for each luminaire type or as selected.
 - d. Exterior luminaire finish: refer to Luminaire Schedule.
- C. Light Emitting Diode (LED) requirements:
 - 1. Correlated color temperature (CCT) for phosphor-coated white LEDs must have the following designated CCT and fall within the following binning standard:
 - a. 3000K defined as 3045 +/- 175K
 - 2. Color spatial uniformity shall be limited to variations in chromaticity for different directions (i.e. changes in viewing angle) within 0.004 from the weighted average point on the CIE 1976 (u',v') diagram.
 - 3. Color maintenance shall be limited to a maximum change in chromaticity of 0.007 on the CIE 1976 (u',v') diagram over the lifetime of the product.

- a. Color rendering index: Color rendering index to be determined using ANSI C78.377-2008 and applicable IESNA standards.
 - b. Laboratory tests must be produced using specific module(s)/array(s) and power supply combination that will be used in production.
 - c. Manufacturers must provide a test report from a laboratory accredited by NVLAP or one of its MRA signatories
4. Lumen depreciation
- a. Lumen depreciation to be measured using IESNA LM-80-08 standard for IES approved method of measuring lumen maintenance of LED light sources.
 - b. Phosphor coated white LED module(s)/array(s) shall deliver at least 70% of initial lumens for a minimum of 35,000 hours when installed in-situ and operated at 100% output and the maximum specified operating temperature.
 - c. Colored LED module(s)/array(s) shall deliver at least 50% of initial lumens for a minimum of 35,000 hours when installed in-situ and operated at 100% output and the maximum specified operating temperature.
5. Acceptable LED manufacturers:
- a. Cree
 - b. Nichia
 - c. Osram Opto Semiconductors
 - d. Philips Lumileds
 - e. Sora
 - f. Xicato
- D. Luminaire Efficacy:
- 1. Luminaire efficiency shall be measured using IESNA LM-79-08 standard for electrical and photometric measurements of solid state lighting products.
 - 2. Manufacturer shall provide published luminaire efficacy, which is defined as luminaire light output divided by luminaire input power measured in a 25 degree Celsius environment. Efficacy shall include power supply, thermal, optical, and luminaire losses.
- E. Thermal Management:
- 1. Solid state luminaire shall not exceed LED manufacturer's maximum junction temperature requirements when operated in-situ at luminaire manufacturer's maximum ambient operating temperature and 100% light output.
 - 2. Solid state luminaires shall be thermally protected using one of more of the following thermal management techniques:
 - a. Metal core board
 - b. Gap pad
 - c. Internal monitoring firmware
 - 3. Solid state luminaire housing shall be designed to transfer heat from the LED board to the outside environment.
- F. Power Supply/Driver requirements:
- 1. Power factor of 0.90 or greater for primary application
 - 2. Input current shall have Total Harmonic Distortion (THD) of less than 20%.
 - 3. Minimum operating temperature of minus 20 degrees Celsius or below when used in luminaires intended for outdoor applications.
 - 4. Output operating frequency to be equal to or greater than 120 Hz.
 - 5. Operate with sustained input variations of +/- 10% (voltage and frequency) with no damage to the driver.
 - 6. Tolerate sustained open circuit and short circuit output conditions without damage and without need for external fuses or trip devices.
 - 7. Output shall be regulated to +/- 5% across published load range.

8. Class A sound rating.
9. Outputs shall have current limiting protection.
10. Operate LEDs at constant and regulated current levels. LEDs shall not be overdriven beyond the diode manufacturer's specified nominal voltage and current.
11. Inrush currents not exceeding peak currents in NEMA 410.

G. System Installation

1. Hardwired connections to solid state luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
2. All solid state luminaires (100% of each lot) shall undergo a minimum eight-hour burn-in test during manufacturing. Solid state lighting installations shall be UL Listed as a low-voltage lighting system including, but not limited to, luminaire, power supply, controller, keypad, and wiring.

HI. Warranty

1. Luminaires, drivers, and controllers for solid state lighting systems shall be covered by a minimum five-year warranty against defects in workmanship or material. Warranty shall include in-warranty service program providing for payment of authorized labor charges incurred in replacement of inoperative in-warranty equipment.

2.3 LUMINAIRE CONSTRUCTION

- A. Sheet metal: materials and thicknesses shall be 20 gauge (0.7 mm or 0.027") min., free of dents, scratches, oil-can, or other defects.
- B. Painted luminaires: exposed weld marks, joints, and seams shall be filled and sanded smooth before finishing.
- C. All edges cleaned and dressed to remove sharp edges or burrs.
- D. Extrusions: 1/10" min. wall thickness, smooth and free of tooling lines, with cast end plates that exactly match extrusion profiles.
- E. Castings: smooth, free of pits, scales, gate marks, or blemishes.
- F. Spinings shall have 1/32" min. thickness, smooth, free of spinning lines or blow-back, with clean edges.
- G. Welds: Follow recommendations of American Welding Society. All welds continuous and free of spatter, residue, or warping.
- H. No light leaks visible. Field paint exterior of housing with high temperature paint if necessary.
- I. Exposed end plates and joiners, with concealed fasteners.
- J. Hardware:
 1. Steel or aluminum exterior luminaires: stainless steel hardware.
 2. Stainless steel luminaires: stainless steel hardware.
 3. Copper alloy luminaires: brass hardware.
- K. Raceways: Where used for through wiring, luminaires must be approved for use as raceways.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Refer to Section 262700, Part 2.2, for wiring and splicing requirements.
- B. Underground cable installation shall conform to National Electrical Code except as otherwise specified or indicated.
- C. Contractor Damage: The Contractor shall promptly cause repairs to be made to any indicated utility lines or systems damaged by his operation.
- D. Under roads and paved areas, ducts shall be EPC-80-PVC polyvinyl chloride conduit.
- E. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.
- F. Bends in cables shall have an inner radius of not less than 12 times the cable diameter.
- G. Horizontal slack of approximately 3 feet shall be left in the ground on each end of cable runs, on each side of connection and at all points where connections are to be made above ground level.
- H. Earthwork: Earthwork for electrical requirements shall conform to the requirements of Division 31.
- I. Coordinate work with other trades. Pre-ship anchor bolts and templates for use in preparing bases for installation. After leveling luminaires, pack grout between mounting plate and concrete footing. Provide weep holes to prevent accumulation of moisture inside pole base.

3.2 TESTS

- A. Test under provisions of Division 1, Section 260800, and Section 265101.
- B. The Owner shall be notified at least three working days in advance of the Contractor's proposed date of the tests to permit scheduling, and to permit witnessing of the tests. The Contractor shall furnish the Owner with three copies of the results of the tests.
- C. Circuits: The Contractor shall test each circuit, all controllers, and components of the system for proper operation. The Contractor shall furnish the Owner with three copies of the test results.
- D. Compaction Tests: Backfill shall be tested for compaction in accordance with ASTM D1556.
- E. Operating Test: Contractor shall operate the system in the presence of the Owner proving the proper operation.

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SECTION 265700
LOW VOLTAGE LIGHTING CONTROL SYSTEM
(NETWORK, DEMAND RESPONSE, BMS INTEGRATION)

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

- A. Furnish all labor, materials, apparatus, tools, equipment transportation, temporary construction and commissioning services as indicated on the Drawings or described in these Specifications and as required to make a complete working facility lighting control system.
- B. Integrated Low Voltage Lighting Control System:
 - 1. The low voltage lighting control system shall consist of relay panels, digital device Segment Manager and LMCS system configuration software.
 - 2. The system shall accept program changes from the LMCS system configuration software for date and time, location, holidays, event scheduling, button binding and group programming.
- C. Requirements are indicated in Section 262700 for raceways and electrical boxes and fittings required for installation of control equipment and wiring.
- D. Provide CBC 2019 compliant seismic installation. See Section 260500 for all certification and submittal requirements.

1.2 INCORPORATED DOCUMENTS

- A. Sections 260500, 262700, 265101 and 265601 apply to all Work in this Section.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer Qualifications: Installer shall be one who is experienced in performing the Work of this Section, and who has specialized in installation of Work similar to that required for this project.
- C. Component Pre-testing: All components and assemblies are to be factory pre-tested prior to installation.
- D. System Support: Factory applications engineers shall be available for telephone support.
- E. NEC Compliance: Comply with NEC as applicable to electrical wiring Work.
- F. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
- G. UL Approvals: Remote panels are to be UL listed under UL 916 Energy Management Equipment.

- H. CSA Approvals: Remote panels are to be CSA listed.
- I. FCC Emissions: All assemblies are to be in compliance with FCC emissions Standards specified in Part 15 Subpart J for Class A application.
- J. All System components shall be California Title 24 compliant, where applicable.

1.4 SUBMITTALS

- A. Submit under provisions of Division 1 and 260500.
 - 1. Bill of Materials: Complete list of all parts needed to fully install selected System components.
 - 2. Shop Drawings: Submit dimensional Drawings of all lighting control system components and accessories.
 - 3. One Line Diagram: Submit a one-line diagram of the system configuration.
 - 4. Typical Wiring Diagrams: Submit typical wiring diagrams for all components including, but not limited to, relay panels, relays, digital low voltage switches, digital occupancy sensors and digital daylighting controls.

1.5 MANUFACTURERS

- A. Integrated Low Voltage Lighting Control System:
 - 1. The basis of the specified system is the Watt Stopper Digital Lighting Management (DLM) or an equal. Any other system to be considered must submit descriptive information 10 days prior to bid.
- B. Prior approval does not guarantee final approval by the electrical engineer. The contractor shall be completely responsible for providing a system meeting this specification in its entirety. All deviations from this specification must be listed and individually signed off by the engineer.
- C. The Owner reserves the right to reject a proposed substitution based on his agent's professional judgment as to the utility, visual appropriateness, or finish of substitutions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in Manufacturer's original, unopened, undamaged packages with intact identification labels.
- B. Storage and Protection: Store materials away from exposure to harmful weather conditions and at temperature and humidity conditions recommended by Manufacturer.

1.7 GUARANTEE AND WARRANTIES

- A. All Work performed under this Section must be guaranteed to be free of defects in products or workmanship for one year after date of acceptance by Owner, unless noted otherwise in General Conditions.

PART 2 – PRODUCTS

2.1 DIGITAL LIGHTING MANAGEMENT DLM

- A. Description
 - 1. Lighting Control System shall include Dimming / Switching Room Controllers, Digital Occupancy Sensors, Digital Daylight Sensors, Digital Dimmers / Switches, Network

Components and Relay Panels. All project components shall be UL listed and consist of the following:

2. Lighting Control Panel Enclosure Tub: NEMA 1, NEMA 3R, or NEMA 4 as indicated on the drawings, sized to accept an interior with 1-8 relays, 1-24 relays and six (6) four pole contactors, or 1-48 relays with six (6) four pole contactors.
3. Cover: Surface or Flush as required, hinged and lockable and with restricted access to line voltage section. A final typed wiring schedule directory card shall be affixed to the cover's back.
4. Interior: Barrier included for separation of high voltage (class 1) and low voltage (class 2) wiring. The interior shall include intelligence boards, power supply, mechanically latched control relays and multi-pole contactors. The interiors shall include the following features:
 - a. Screwless, removable, plug-in connections for all low voltage terminations.
 - b. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches, digital occupancy sensors and digital daylight sensors.
 - c. Each relay shall be capable of individual ON/OFF control by a low voltage switch and / or occupancy sensor input.
 - d. The system shall monitor true relay status; the relay status shall be displayed at the onboard pilot LED and monitored by the system electronics.
 - e. Stagger the On and OFF sequence of the relays.
 - f. Heavy Duty Relays – Mechanically latching contacts with single moving part design for improved reliability. Relays to have the following characteristics:
 - 1) 30 amp NEMA 410 electronic ballast rated and 20 amp tungsten, rated for 50,000 ON/OFF cycles at full load. Support #12-#14 AWG solid or stranded wire and rated for 120 and 277 volts; 20 amp NEMA 410 electronic ballast rated and 20 amp tungsten 347 volts.
 - (a) 30 VAC isolated contacts for status feedback and pilot light indication.
 - (b) 14,000 amp short circuit current rating.
 - (c) Contactors shall be DIN rail mounted, four pole standard, normally open or normally closed, electrically held with 120 or 277 volt coil voltage to match panel control power voltage. Contractors shall be compatible with all lighting, ballast and HID loads and be rated for 277 volt 20 amp tungsten and 600 volt 30 amp ballast loads.
5. Power Supply: Multi-voltage transformer assembly with enough power to supply all electronics, occupancy sensors, dataline switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
6. Multiple panels shall be able to be networked together for global control. The LMCP panels shall be networked together over a MS/TP 3-conductor connection.

2.2 GROUP, CHANNEL, SCHEDULE AND PATTERN CONTROL

A. Description

1. The lighting control panel shall support schedule, group, and photocell control functions via the network as configured using the LMCS Configuration Software.
2. Group Status: Each group pushbutton shall include an LED status indication. The LED shall be ON whenever all of the relays within the group are ON; and shall go OFF when all of the relays within the group go OFF. The LED will be green when in a "mixed" state. Each channel shall also have an associated dry contact closure and pilot contact which tracks the LED operation described above.

B. Features

1. Individual relays shall be able to be assigned to more than one channel, and the channel status shall be annunciated appropriately.

2. Each channel shall also have an input for connecting switch or dry contacts for controlling a channel. Inputs shall accept 2 or 3-wire maintained or momentary inputs, and groups shall be controllable by: an on-board group pushbutton switch, low voltage switch, digital switch, digital occupancy sensor, digital photocell, or time of day.
3. Screwless, removable, plug-in terminals will be provided for all low voltage wiring connections.

2.3 NETWORK CLOCK

A. Description

1. Provide an eight channel integral network clock that connects to the system using the digital MS/TP three conductor data communications wire network described in Section 2.10.
2. The clock shall be used to schedule any of the eight global channel groups (Section 2.03) in the relay panel network. The clock shall support all of the energy saving features required of ASHRAE 90.1 – 2001, IECC 2003, as well as all state and local energy codes.
3. The clock shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and shall include a battery back-up for the clock function and EEPROM for program retention. Clocks that require multiple events to meet local Code lighting shut off requirements shall not be allowed.
4. The clock shall allow unique scenario and time delays. Scenarios shall include:
 - a. Scheduled ON / OFF
 - b. Manual ON / Scheduled OFF
 - c. Manual ON / Auto Sweep OFF (for AS-100 Switches)
 - d. Astro ON / OFF (or Photo ON / OFF)
 - e. Astro and Schedule ON / OFF (for Photo and Schedule ON / OFF)

B. Features

1. Runs event-based schedule routines independently (does not require BAS or Segment Manager).
2. Supports astronomical, time-based event types
3. Retains memory and time for a minimum of 10 years.

2.4 DIGITAL SWITCHES

A. Description

1. Intelligent digital switching shall operate on the DLM Category 5e local network. Switches shall be available in single, dual, quad, or octal (1-button, 2-button, 4-button, or 8-button) designs. All devices shall mount in a standard single-gang box
2. Each button in a switch shall be able to be individually programmed. Programming shall be done by the LMCT-100 handheld configuration tool. Each button shall control any one of the following options:
 - a. Any individual relay in any single panel.
 - b. Any group of relays in any single panel.
 - c. Any group of relays in the system.

B. Features

1. Switches shall be constructed of non-breakable Lexan on all exposed parts and shall include a matching screwless Lexan wall plate.
2. Individual buttons shall be custom engraved with a maximum of 15 characters (including spaces) on two lines, where shown on plans.
3. Multiple digital switches wired to control the same relay or relay group shall indicate the same status automatically.

4. Each switch shall also include a locator light illuminating the switch for easy location in the dark.
5. Switches can be configured to follow a "Cleaning" scenario. This specific scenario shall prevent the cleaners from overriding OFF any relays turned ON by the occupant.

2.5 DIGITAL OCCUPANCY SENSORS

A. Description

1. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.

2.6 DIGITAL PHOTOSENSORS

A. Description

1. Digital Photosensors – Single-zone closed loop, multi-zone open loop and dual-loop daylighting sensors with two-way active infrared (IR) communications shall provide switching, bi-level, tri-level or dimming control for daylight harvesting.

2.7 DIGITAL DIMMING / SWITCHING ROOM CONTROLLERS

A. Description

1. Digital controllers for lighting and plug loads shall automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room and plug load controllers shall be provided to match the room lighting and plug load control requirements. The controllers shall be simple to install, and shall not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units shall include the following features.
2. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
3. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.
4. Multiple room controllers connected together in a local network must automatically prioritize each room controller, without requiring any configuration or setup, so that loads are sequentially assigned using room controller device ID's from highest to lowest.
5. Device Status LEDs to indicate:
 - a. Data transmission
 - b. Device has power
 - c. Status for each load
 - d. Configuration status
6. Quick installation features including:
 - a. Standard junction box mounting
 - b. Quick low voltage connections using standard RJ-45 patch cable
7. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
 - a. Turn on to 100%
 - b. Remain off
 - c. Turn on to last level
8. Each load shall be configurable to operate in the following sequences based on occupancy:
 - a. Auto-on/Auto-off (Follow on and off)
 - b. Manual-on/Auto-off (Follow off only)
9. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.

10. BACnet object information shall be available for the following objects:
 - a. Load status
 - b. Electrical current
 - c. Total watts per controller
 - d. Schedule state – normal or after-hours
 - e. Demand response control and cap level
 - f. Room occupancy status
 - g. Total room lighting and plug loads watts
 - h. Total room watts/sq ft
 - i. Force on/off all loads
 11. UL 2043 plenum rated
 12. Manual override and LED indication for each load
 13. Dual voltage (120/277 VAC, 60 Hz). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); plug load controllers shall carry application-specific UL 20 rating for receptacle control.
 14. Zero cross circuitry for each load
 15. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
- B. On/Off Room Controllers shall include:
1. One or two relay configuration
 2. Efficient 150 mA switching power supply
 3. Three RJ-45 DLM local network ports with integral strain relief and dust cover
 4. WattStopper product numbers: LMRC-101, LMRC-102
- C. On/Off/Dimming enhanced Room Controllers shall include:
1. Real time current monitoring
 2. Multiple relay configurations
 - a. One, two or three relays (LMRC-21x series)
 - b. One or two relays (LMRC-22x series)
 3. Efficient 250 mA switching power supply
 4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
 5. One dimming output per relay
 - a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
 - b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
 - c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
 - d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
 - e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
 - f. Calibration and trim levels must be set per output channel.
 - g. Devices that set calibration or trim levels per controller are not acceptable.

- h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.
- 6. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
- 7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
- 8. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - a. Establish preset level for each load from 0-100%
 - b. Set high and low trim for each load
 - c. Set lamp burn in time for each load up to 100 hours
- 9. Override button for each load shall provide the following functions:
 - a. Press and release for on/off control
 - b. Press and hold for dimming control
- 10. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMRC-221, LMRC-222

D. Plug Load Room Controllers shall include:

- 1. One relay configuration with additional connection for unswitched load
- 2. Configurable additive time delay to extend plug load time delay beyond occupancy sensor time delay (e.g. a 10 minute additive delay in a space with a 20 minute occupancy sensor delay shall ensure that plug loads turn off 30 minutes after the space is vacated).
- 3. Factory default operation shall be Auto-on/Auto-off, based on occupancy
- 4. Real time current monitoring of both switched and un-switched load (LMPL-201 only)
- 5. Efficient switching power supply
 - a. 150mA (LMPL-101)
 - b. 250mA (LMPL-201)
- 6. RJ-45 DLM local network ports
 - a. Three RJ-45 ports (LMPL-101)
 - b. Four RJ-45 ports (LMPL-201)
- 7. WattStopper product numbers: LMPL-101, LMPL-201.

2.8 DLM SEGMENT NETWORK (ROOM TO ROOM NETWORK).

- A. The segment network shall be a linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and LMCP relay panels for centralized control.
 - 1. Each connected DLM local network shall include a single network bridge (LMBC-300), and the network bridge shall be the only room-based device that is connected to the segment network.
 - 2. Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate "in" and "out" terminations, for segment network connections.
 - 3. The segment network shall utilize twisted pair, shielded, cable as specified by the lighting control manufacturer. The maximum cable run for each segment shall be 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pf/ft and have a characteristic impedance of 120 Ohms.
 - 4. Network signal integrity will require that each conductor and ground wire be correctly terminated at every connected device.
 - 5. Substitution of manufacturer-specified cable must be pre-approved: Manufacturer may not certify network reliability and may void warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer's specific requirements.
 - 6. Segment networks shall be capable of connecting to BACnet-compliant BAS (provided by others) either directly, via MS/TP, or through NB-ROUTERS, via BACnet/IP or

BACnet/Ethernet. Systems whose room-connected network infrastructure require gateway devices to provide BACnet data to a BAS are unacceptable.

B. WattStopper Product Number: LM-MSTP, LM-MSTP-DB

2.9 CONFIGURATION TOOLS

- A. A wireless configuration tool shall facilitate optional customization of DLM local networks using two-way infrared communications, while PC software shall connect to each local network via a USB interface.
- B. Features and functionality of the wireless configuration tool shall include but not be limited to:
1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
 3. Ability to read and modify parameters for room controllers, occupancy sensors, wall switches, daylighting sensors, network bridges and relay panels, and identify room devices by type and serial number.
 4. Ability to save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
 5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
 6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
 7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
 8. Verify status of building level network devices.
- C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.10 NETWORK BRIDGE

- A. The network bridge module shall connect a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver.
1. The network bridge shall be provided as a separate module connected on the local network through an available RJ-45 port.
 2. Provide Plug n' Go operation to automatically discover room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network.
 3. The network bridge shall automatically create standard BACnet objects for selected room device parameters to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM room devices on each local network. BACnet objects shall be created for the addition or replacement of any given in-room DLM device for the installed life of the system. Products requiring that an application-specific point database be loaded to create or map BACnet objects are not acceptable. Systems not capable of providing BACnet data for control devices via a dedicated BACnet Device ID and physical MS/TP termination per room are not acceptable. Standard BACnet objects shall be provided as follows:
 - a. Read/write the normal or after hours schedule state for the room

- b. Read the detection state of each occupancy sensor
- c. Read the aggregate occupancy state of the room
- d. Read/write the On/Off state of loads
- e. Read/write the dimmed light level of loads
- f. Read the button states of switches
- g. Read total current in amps, and total power in watts through the room controller
- h. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings
- i. Activate a preset scene for the room
- j. Read/write daylight sensor fade time and day and night setpoints
- k. Read the current light level, in foot-candles, from interior and exterior photosensors and photocells
- l. Set daylight sensor operating mode
- m. Read/write wall switch lock status
- n. Read watts per square foot for the entire controlled room
- o. Write maximum light level per load for demand response mode
- p. Read/write activation of demand response mode for the room
- q. Activate/restore demand response mode for the room

B. WattStopper product numbers: LMBC-300

2.11 SEGMENT MANAGER

- A. For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default 443).
- B. Each segment manager shall have integral support for at least three segment networks. Segment networks may alternately be connected to the segment manager via external routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the plans.
- C. Operational features of the Segment Manager shall include the following:
 - 1. Connection to PC or LAN via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.
 - 2. Easy to learn and use graphical user interface, compatible with latest version of Internet Explorer, or equal browser. Shall not require installation of any lighting control software to an end-user PC.
 - 3. Log in security capable of restricting some users to view-only or other limited operations.
 - 4. Automatic discovery of DLM devices and relay panels on the segment network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels.
 - 5. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree shall allow the device settings and operational parameters to be viewed and changed by the user.
 - 6. Ability to view and modify room device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.
 - 7. Ability to set up schedules for rooms and panels, view and override current status of panel channels and relays, and assign relays to groups. Schedules shall automatically set

- controlled zones or areas to either a normal hours or after hours mode of operation. Support for a minimum of 100 unique schedules, each with up to four time events per day. Support for annual schedules, holiday schedules and unique date-bound schedules.
8. Ability to group rooms and loads for common control by schedules, switches or network commands.
 9. Ability to monitor connected load current and display power consumption for areas equipped with room controllers incorporating the integral current monitoring feature.
 10. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control.
 11. The Segment Manager shall allow access and control of the overall system database via Native Niagara AX FOX connectivity. Systems that must utilize a Tridium Niagara controller in addition to the programming, scheduling and configuration server are not acceptable.
- D. Segment Manager shall support multiple DLM rooms as follows:
1. Support up to 120 network bridges and 900 digital in-room devices (LMSM-3E).
 2. Support up to 300 network bridges and 2,200 digital in room devices, connected via network routers and switches (LMSM-6E).
- E. WattStopper Product Numbers: LMSM-3E, LMSM-6E, NB-ROUTER, NB-SWITCH, NB-SWITCH-8, NB-SWITCH-16.

2.12 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

- A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.
- B. Additional parameters exposed through this method shall include but not be limited to:
1. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
 2. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
 3. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
 4. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
 5. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
 6. Load control polarity reversal so that on events turn loads off and vice versa.
 7. Per-load DR (demand response) shed level in units of percent.
 8. Load output pulse mode in increments of 1 second.
 9. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.

- C. Generation of reports at the whole file, partial file, or room level. Reports shall include but not be limited to:
 - 1. Device list report: All devices in a project listed by type.
 - 2. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
 - 3. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
 - 4. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
 - 5. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
 - 6. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100%, 2 = all loads 75%, 3 = all loads 50%, 4 = all loads 25%, 5-16 = same as scene 1).
 - 7. Occupancy sensor report: Basic settings including time delay and sensitivity(ies) for all occupancy sensors.

- D. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
 - 1. Set, copy/paste an entire project site of sensor time delays.
 - 2. Set, copy/paste an entire project site of sensor sensitivity settings.
 - 3. Search based on room name and text labels.
 - 4. Filter by product type (i.e. LMRC-212) to allow parameter set by product.
 - 5. Filter by parameter value to search for product with specific configurations.

- E. Network-wide firmware upgrading remotely via the BACnet/IP network.
 - 1. Mass firmware update of entire rooms.
 - 2. Mass firmware update of specifically selected rooms or areas.
 - 3. Mass firmware upgrade of specific products.

- F. WattStopper Product Number: LMCS-100, LMCI-100

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Integrated Low Voltage Lighting Control System:
 - 1. Digital Switches and/or photocells shall be mounted in the spaces as indicated on the Drawings. Each low voltage wire shall be labeled clearly indicating which relay panel it connects to. Use only Watt Stopper pre-terminated LMRJ series Cat 5e cable as indicated on the Drawings. All relays and switches shall be tested after installation to confirm proper operation and the loads recorded on the directory card in each panel.
 - 2. The relay panels shall be mounted in electrical closets as indicated on the Drawings. The numbered relays in the panel shall be wired to control the power to each load as indicated on the Panel Wiring Schedules included in the Drawings. All power wiring shall be identified with the circuit breaker number controlling the load. If multiple circuit breaker panels are feeding into a relay panel, wires shall clearly indicate the originating panel's designation.

3.2 PRE-INSTALLATION MEETING

- A. Manufacturer shall provide a factory authorized representative to provide a functional overview of the lighting control system prior to products being installed.
 - 1. Discuss functionality and integration of all products per design requirements.

2. Confirm location of occupancy sensors and photocells as required.
3. Confirm low voltage control wires meet specification.
4. Explain adjustment options and verify specification requirements for each device.

3.3 PROGRAMMING

- A. Set / program lighting controls per relay schedules on drawings, with input from Owner for exact times required for each operation.
- B. All programming shall comply with Title 24 requirements (i.e. automatic control and override limits).
- C. For relays controlling halogen and metal halide lamps, a minimum 15 minute off period is required per day to mitigate potential for non-passive end of life failure. Review programming schedules and program this off-cycle for relays otherwise scheduled for continuous operation. Coordinate timing of off-cycle with Owner.
- D. Test all programming for proper operation of each relay at scheduled times.

3.4 SYSTEM STARTUP

- A. The Manufacturer shall provide a factory authorized technician to commission and confirm proper installation and operation of all system components.
- B. Contractor shall provide system documentation after the equipment has been installed:
 1. Lighting control operational summary sheet.
 2. Programming record sheet.
 3. System Installation and Operation Manual shall be provided to the owner.

3.5 TRAINING

- A. Manufacturer shall provide factory authorized application engineer to train Owner personnel in the operation and programming of the lighting control system for the first (2) two days of occupancy; then (1) one week later, and again (1) month later.

3.6 TESTS

- A. Test under provisions of Section 260500 and 260800.
- B. The Owner shall be notified at least three working days in advance of the Contractor's proposed date of the tests to permit scheduling, and to permit witnessing of the tests. The Contractor shall furnish the Owner with three copies of the results of the tests.
- C. Circuits: The Contractor shall test each circuit, all controllers, and components of the system for proper operation. The Contractor shall furnish the Owner with three copies of the test results.
- D. Operating Test: Contractor shall operate the system in the presence of the Owner proving the proper operation of the system and all components.

END OF SECTION

SECTION 270000

BASIC COMMUNICATIONS REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general administrative and procedural requirements for Division 27, and is intended to supplement, not supersede, the general requirements specified in Division 00.
- B. The requirements described herein include the following:
 - 1. References
 - 2. Definitions
 - 3. Submittals
 - 4. Quality Assurance
 - 5. Delivery, Storage, and Handling
 - 6. Scheduling
 - 7. Warranty
 - 8. Product Substitutions
 - 9. Project Management and Coordination Services
 - 10. Permits and Inspections
 - 11. Field Quality Control
 - 12. Project Closeout and Record Documents
- C. Related Items
 - 1. General and Supplementary Conditions: General provisions of the Prime Contract and Divisions 00 and 01 apply to Division 27.
 - 2. Consult other Divisions and Sections, determine the extent and character of related work, and coordinate Work of Division 27 with that specified elsewhere to produce a complete and operable installation.
 - 3. Section 270526, "Communications Grounding and Bonding"
 - 4. Section 270528, "Communications Building Pathways"
 - 5. Section 270536, "Communications Building Pathways – Cable Tray"
 - 6. Section 270811, "Communications Twisted Pair Testing"
 - 7. Section 270821, "Communications Optical Fiber Testing"
 - 8. Section 271100, "Communications Equipment Rooms"
 - 9. Section 271313, "Communications Backbone ISP Twisted Pair Cabling"
 - 10. Section 271314, "Communications Backbone OSP Twisted Pair Cabling"
 - 11. Section 271323, "Communications Backbone ISP Fiber Optic Cabling"
 - 12. Section 271324, "Communications Backbone OSP Fiber Optic Cabling"
 - 13. Section 271513, "Communications Horizontal Twisted Pair Cabling"
 - 14. Section 274116, "Integrated Audiovisual"
 - 15. Section 275133, "Two-Way Communications System for Accessible Means of Egress"

1.2 REFERENCES

- A. General
 - 1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated.

Consider such codes and/or standards a part of this specification as though fully repeated herein.

2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
 3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.
- B. Codes: Perform work and furnish materials and equipment under Division 27 in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
1. California Code of Regulations (CCR):
 - a. Title 8, "Industrial Relations"
 - 1) Chapter 3.22, "California Occupational Safety and Health Regulations (CAL/OSHA)"
 - b. Title 24, "California Building Standards Code"
 - 1) Part 1, "California Building Standards Administrative Code"
 - 2) Part 2, "California Building Code" (CBC)
 - 3) Part 3, "California Electrical Code" (CEC)
 - 4) Part 11, "California Green Building Standards Code" (CALGreen)
 2. National Fire Protection Agency (NFPA)
 - a. NFPA 75, "Protection of Information Technology Equipment"
 3. Other applicable national, state, and local binding building and fire codes
- C. Standards: Perform work and furnish materials and equipment under Division 27 in accordance with the latest editions of the following standards as applicable:
1. Building Industry Consulting Services International (BICSI):
 - a. "Telecommunications Distribution Methods Manual" (TDMM)
 - b. "Customer-Owned Outside Plant Design Manual"
 - c. "Wireless Design Reference Manual" (WDRM)
 - d. "Network Design Reference Manual" (NDRM)
 2. EIA testing standards
 3. National Electrical Contractors Association (NECA):
 - a. ANSI/NECA 1-2015, "Standard Practices for Good Workmanship in Electrical Construction"
 4. Telecommunications Industry Association (TIA):
 - a. ANSI/TIA-568.0-D, "Generic Telecommunications Cabling for Customer Premises"
 - b. ANSI/TIA-568.1-D, "Commercial Building Telecommunications Cabling Standards"
 - c. ANSI/TIA-568.2-C, "Balanced Twisted Pair Telecommunications Cabling and Components"
 - d. ANSI/TIA-568.3-D, "Optical Fiber Cabling Components"
 - e. ANSI/TIA-569-D, "Telecommunications Pathways and Spaces"
 - f. ANSI/TIA/EIA-598-D, "Optical Fiber Cable Color Coding"
 - g. ANSI/TIA-606-C, "Administration Standard for Telecommunications Infrastructure"
 - h. ANSI-TIA-607-C, "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises"
 - i. ANSI/TIA-758-B, "Customer-Owned Outside Plant Telecommunications Infrastructure Standard"
 - j. ANSI/TIA-1005-A, "Telecommunications Infrastructure Standard for Industrial Premises"

1.3 DEFINITIONS

- A. The definitions of Divisions 00 and 01 shall apply to Division 27 sections.
- B. In addition to those definitions of Divisions 00 and 01, the following list of terms as used in this specification defined as follows:
1. "AFF": Above Finished Floor
 2. "As directed": As directed or instructed by the Owner, or their authorized representative
 3. "AHJ": Authority Having Jurisdiction
 4. "Cabling": installed media ready for electronic or optical signal circuit use; a complete media connection comprised of cables, termination apparatus (patch panels, blocks, connectors), outlets, connecting media (path cord, crossconnects), labeling
 5. "CBC": California Building Code (CCR Title 24 Part 2)
 6. "CCR": California Code of Regulations
 7. "CEC": California Electrical Code (CCR Title 24 Part 3)
 8. "Connect": To install patch cords, equipment cords, crossconnect wire, etc. to complete an electronic or optical signal circuit
 9. "Cord": a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper" and "Lead"
 10. "Engineer": TEECOM
 11. "First-In-Place": a single unit of work for the Owner's and Engineer's review and written approval prior to proceeding with the work of the entire project
 12. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories
 13. "General Contractor": <name><successful bidder>
 14. "Identifier": A unique code assigned to an element of the Telecommunications infrastructure that links it to its corresponding record
 15. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Make installation complete and ready for regular operation
 16. "IOR": Inspector Of Record
 17. "ISP": Inside Plant
 18. "LED": Light Emitting Diode
 19. "MSDS": Material Safety Data Sheets
 20. "NEC": National Electrical Code (NFPA 70)
 21. "NEMA": National Electrical Manufacturers Association
 22. "NFPA": National Fire Protection Agency
 23. "NIC": Not In Contract (work or equipment)
 24. "OFCL": Owner-furnished contractor-installed; coordinate the integration of components furnished by the Owner; provide mounting hardware, cable, connectors, etc. to ensure proper integration of OFCL equipment
 25. "OFE": Owner Furnished Equipment
 26. "OSP": Outside Plant
 27. "Owner": <name>
 28. "Owner's Representative": <name>
 29. "PDF": portable document format (electronic file format / *.pdf)
 30. "Pigtail": a length of cordage having connectors at one end
 31. "Provide": To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation
 32. "UL": Underwriters Laboratories

1.4 SYSTEM DESCRIPTION AND PROJECT CONDITIONS

- A. In circumstances where the Specifications and Drawings conflict, the Drawings shall govern quantity and the Specifications shall govern quality.

1.5 SUBMITTALS

- A. Submit required submittals to the General Contractor in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.
- B. Failure to comply with requirements in part or whole shall constitute grounds for non-review and/or rejection of resubmittal packages.
- C. Resubmittals: For resubmittals, include a cover letter that lists actions taken and revisions made to each product in response to the Engineer's submittal review comments. Lack of this actions-taken cover letter shall constitute grounds for non-review and/or rejection of resubmittal packages.
- D. Obtain written approval from the Engineer for the product data submittal, the shop drawing submittal, and other required pre-construction submittals prior to materials and equipment purchase order and prior to installation.
- E. Submittal Description: Product Data
 - 1. Electronically submit the product data submittal via cloud-based project management application (such as Proliance) or as a file transfer (such as Dropbox).
 - 2. File Format:
 - a. File format shall be PDF, either as a single compiled PDF file or as a PDF portfolio.
 - b. PDF files should be produced from original electronic media, not scans of printed media. If scans from prints are the only option, annotate electronically, not on the prints prior to scanning.
 - c. Page size should be letter (8.5"x11").
 - 3. Organization:
 - a. Organize the Content in the following order:
 - 1) Cover
 - 2) Table of Contents (TOC)
 - 3) Statement of compliance
 - 4) Product information
 - 5) Seismic calculations (as required)
 - b. Clearly and precisely indicate the submitted product and accessories by part number using an electronic annotation (arrow, rectangle, oval, etc.). Where the product data presents "part number builds", list the exact part number of the submitted products and accessories.
 - c. Add page numbers in numerical order with no gaps to each page that correctly correspond to the TOC.
 - d. Add bookmarks to the file to improve navigation.
 - 4. Content:
 - a. Cover: Include a cover that clearly displays the following information:
 - 1) Owner name
 - 2) Project name and address
 - 3) Submittal name (e.g., "Product Data Submittal for Telecommunications Equipment Rooms")
 - 4) Project submittal number

- 5) Contractor's submittal number (discretionary)
- 6) Submittal date; format: Month Day, Year (e.g., "January 1, 2020")
- 7) Specification section numbers included in the submittal (e.g., "Section 271100")
- 8) Contractor name and contact information
- b. Table of Contents (TOC): Include a TOC that lists materials by section number, article and paragraph number. Add a brief product description (what it is, size or color or other optional features), manufacturer and part number. List the submittal page number per product. Example heading for TOC:

Section	Article	Paragraph	Description	Manufacturer	Part #	Page #
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- c. Statement of Compliance: Include a "Statement of Compliance" letter or memorandum on the submitter's company letterhead from the highest ranking employee assigned to this project stating the submittal has been reviewed (quality control check) and is in full compliance with the requirements of the contract documents, and listing the submittal's contents. Wet sign (and stamped, if applicable) the letter.
- d. Product Information: Include manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary) that clearly describe the product's characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color and finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Include products listed in the specifications, at a minimum. Include relevant products that will be installed, which are not listed in the specifications.

F. Submittal Description: Shop Drawings

- 1. Electronically submit the shop drawings submittal via cloud-based project management application (such as Proliance) or as a file transfer (such as Dropbox).
- 2. Format:
 - a. Use the same sheet size as the contract drawings.
 - b. Use the same title block as the contract drawings, modified to include contractor information.
 - c. Text: 3/32" - 1/8" high when plotted at full size.
 - d. Symbols should match those in the contract documents.
 - e. Screen background information.
 - f. Plot system components (symbols, outlet, devices, pathways, cable routes, etc.) and text using a heavier line weight sufficient enough to stand out against background information.
 - g. Scaling:
 - 1) Scale floor plans and reflected ceiling plans at 1/8"=1'-0"
 - 2) Scale enlarged room plans at 1/4"=1'-0"
 - 3) Scale wall elevations at 1"=1'-0"
 - 4) Scale rack elevations at 1"=1'-0"
- 3. Content:
 - a. Cover Letter: Accompany each shop drawing submittal with a cover letter stating that the shop drawings have been thoroughly reviewed by the Contractor and are in full compliance with the requirements of the contract documents. Have the person who prepared the submittal sign (and stamped, if applicable) the cover letter and include a drawing index.
 - b. Drawings: Shop drawing submittals shall consist of symbols list, point-to-point diagrams, block diagrams, riser diagrams, line diagrams, floor plans, reflected ceiling plans, enlarged room plans, wall and rack elevations, installation details,

- and other aspects of the system. Include detailed labeling examples for cables, outlets, termination apparatus, devices, equipment, etc.
4. As-built drawings shall accurately represent actual installed conditions and shall incorporate modifications made during construction.
 5. Electronically submit the as-built drawings submittal via cloud-based project management application (such as Proliance) or as a file transfer (such as Dropbox).
 6. Format:
 - a. Electronic files shall include native format and plotted PDF files. The file names shall include the sheet number.
 - b. Use the same sheet size as the approved shop drawings.
 - c. Use the same title block as the approved shop drawings.
 - d. Text: 3/32" - 1/8" high when plotted at full size.
 - e. Use symbols identical to the symbols shown on the approved shop drawings.
 - f. Screen background information.
 - g. Plot system components (symbols, outlet, devices, pathways, cable routes, etc.) and text using a heavier line weight sufficient enough to stand out against background information.
 7. Content:
 - a. Title Sheet, including symbols list and sheet index
 - b. Diagrams, such as (but not limited to) point-to-point diagrams, block diagrams, riser diagrams, line diagrams, and other diagrams that conceptually describe the system
 - c. Floor Plans and Reflected Ceiling Plans: Scale plans at 1/8"=1'-0". Plans shall show:
 - 1) Locations and identifiers of telecommunications outlets
 - 2) Routes, types, sizes, and quantities of pathways (such as cable trays, conduits, hangers, and other pathways)
 - d. Enlarged Rooms Layouts: Applicable rooms: BDF, IDFs. Room drawings shall show:
 - 1) Floor layouts – scaled at either 1/4"=1'-0" or 1/2"=1'-0", showing dimensioned placement of equipment cabinets/frames, rack bays, etc.
 - 2) Overhead layouts – scaled at either 1/4"=1'-0" or 1/2"=1'-0", showing dimensioned placement of overhead cable support (e.g., cable tray, cable runway, conduit sleeves, etc.)
 - 3) Rack elevations – scaled at 1"=1'-0", showing placement of termination apparatus and other equipment installed onto rack bays
 - 4) Wall Elevations – scaled at 1"=1'-0", showing dimensioned placement of termination apparatus (e.g., termination/crossconnect blocks)
- G. Submittal Description: Operation and Maintenance (O&M) Manual
1. Quantity and Media: Submit O&M Manual as described in Division 01. In the absence of requirements given, submit one packaged O&M Manual set and one electronic copy.
 2. Electronic Submission: Submit the product data submittal via cloud-based project management application (such as Proliance) or as a file transfer (such as Dropbox).
 3. Electronic Format:
 - a. File format shall be PDF, either as a single compiled PDF file or as a PDF portfolio.
 - b. PDF files should be produced from original electronic media, not scans of printed media. If scans from prints are the only option, annotate electronically, not on the prints prior to scanning.
 - c. Page size should be letter (8.5"x11") or full size for drawings.
 - d. Insert bookmarks to improve navigation through the file.
 4. Printed Format:
 - a. Package contents in a 3-ring binder with front cover and spine clear pockets for insertion of the submittal information.

- b. Page size should be letter (8.5"x11") or tabloid (17"x11") for drawings.
- c. Include tabbed separators to improve navigation through the manual.
- 5. Content and Organization:
 - a. Cover, showing the following information
 - 1) Owner name
 - 2) Project name and address
 - 3) Manual name (e.g., "Operation and Maintenance Manual for Telecommunications Cabling System")
 - 4) Date; format: Month Day, Year (e.g., "January 1, 2020")
 - 5) Contractor name and contact information
 - b. Table of Contents (TOC)
 - c. Product information (the final approved product submittal and updates through construction)
 - d. As-built drawings (the final approved as-built submittal)
 - e. Seismic calculations (the final approved product submittal)
 - f. Warranty Information
 - 1) Warranty certificate from the manufacturer and the contractor
 - 2) Instructions on making a warranty claim during the warranty period
 - 3) Contact information during the warranty period
 - 4) Contact information beyond the warranty period for maintenance and related service
 - g. Manufacturer's instructions for system or component use
 - h. Instructions and requirements for proper maintenance (according to the manufacturer) and as to maintain warranty

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications
 - 1. Five continuous years, minimum, design and manufacture of the materials and equipment specified herein.
 - 2. Manufacturer(s) of products and equipment specified herein shall demonstrate that they have a quality assurance program in place to assure that the specifications are met. Include in the program, at a minimum, provisions for:
 - a. Incoming inspection of raw materials
 - b. In-process inspection and final inspection of the cable product
 - c. Calibration procedures of test equipment to be used in the qualifications of the product
 - d. Recall procedures in the event that out of calibration equipment is identified.
 - 3. Conform to government standards on quality assurance for applications within these specifications.
- B. Contractor Qualifications
 - 1. A current, active, and valid and C7 or C10 California State Contractors License
 - 2. Five, minimum, continuous years of experience
 - 3. Five, minimum, completed projects of similar scope and cost
 - 4. Evidence of technicians qualified for the work (such as successfully completed training by the cabling vendor or BICSI, etc.)
 - 5. IBEW / CWA union affiliation
- C. Materials
 - 1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials

2. Use specified products and applications, unless otherwise submitted and approved in writing.

D. Regulatory Requirements

1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 27 shall conform to the most stringent of the applicable codes.
2. Provide the quality identified within these specifications and drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The contract documents address the minimum requirements for construction.

E. Drawings

1. Follow the general layout shown on the contract drawings except where other work may conflict with the drawings.
2. Contract drawings for the work within this division are essentially diagrammatic within the constraints of the symbology applied.
3. Contract drawings do not fully represent the entire installation. Rather, they indicate the general route for pathways and cables and show general locations of outlets. Contract drawings might not expressly show every conduit, sleeve, hanger, etc.; regardless, a complete system is required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Do not deliver products to the site until protected storage space is available.
2. Coordinate materials delivery with installation schedule to minimize storage time at jobsite.
3. Deliver materials in manufacturer's original, unopened, undamaged packaging and containers with identification labels (name of the manufacturer, product name and number, type, grade, UL classification, etc.) intact.
4. Immediately replace equipment damaged during shipping at no cost to the Owner, so as not to impact the construction schedule.

B. Storage and Protection

1. Store materials in clean, dry, ventilated space free from temperature and humidity conditions (as recommended by manufacturer) and protected from exposure to harmful weather conditions.
2. Comply with manufacturer's storage requirements for each product. Comply with recommended procedures, precautions or remedies as described in the MSDS as applicable.
3. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
4. Storage outdoors covered by rainproof material is not acceptable.
5. Provide heat where required to prevent condensation or temperature related damage.

C. Handling

1. Handle materials and equipment in accordance with manufacturer's written instructions. Handle with care to prevent damage, breakage, denting, and scoring.
2. Do not install damaged materials and equipment. Replace damaged equipment at no cost to the Owner.

1.8 SCHEDULING

- A. Unless otherwise specified, the construction schedules of the Sections within Division 27 may be combined into a single, overall schedule.
- B. Do not proceed without written approval from the Owner or Owner's Representative for schedule of this Work.

1.9 PROJECT MANAGEMENT AND COORDINATION

- A. Project Management and Coordination Services
 - 1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.
 - 2. Review of Shop Drawings Prepared by Other Subcontractors:
 - a. Obtain copies of shop drawings for equipment provided by others that require telecommunication service connections or interface with work.
 - b. Thoroughly review other trades' shop drawings to confirm compliance with the service requirements contained in the Division 27 contract documents. Document discrepancies or deviations as follows:
 - 1) Prepare memo summarizing the discrepancy
 - 2) Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy
 - c. Prepare and maintain a shop drawing review log indicating the following information:
 - 1) Shop drawing number and brief description of the system/material
 - 2) Date of the review
 - 3) Name of the individual performing the review
 - 4) Indication if follow-up coordination is required
 - 3. Should existing conditions prohibit construction progress as submitted and approved, coordinate the adjusted installed locations with the other contractors (AV, electrical, etc).
- B. Concurrent Installation
 - 1. The network will be installed concurrent with the work of Division 27. Coordinate your work with the Owner's/network integrator's work. For example, coordinate scope and dates for rack and cabling (terminations) readiness to allow the network integrator to plan and schedule installation of the network equipment (for example, access switches).
- C. Role of the Engineer
 - 1. The network will be installed concurrent with the work of Division 27. Coordinate your work with the Owner's/network integrator's work. For example, coordinate scope and dates for rack and cabling (terminations) readiness to allow the network integrator to plan and schedule installation of the network equipment (for example, access switches).
- D. Use of Electronic Drawing Files
 - 1. Should the Contractor require the Engineer's electronic files to produce shop drawings and/or as-built drawings, the Engineer will require the Contractor sign a file release agreement.

1.10 WARRANTY

- A. As a minimum, warrant products and labor provided will, under normal use and service, be free from defects and faulty workmanship for period of 5 years from the date of acceptance. During the warranty period the entire system shall be kept in operating condition at no additional material or labor costs to the Owner. Also refer to specific sections for additional warranty requirements that supersedes the project's minimum warranty.
- B. Render service within 24 hours of system failure notification. Note deviations or improvements to this service at the time of bid and obtain written acceptance from the Owner, or Owner's Representative.
- C. Manufacturers of the major system components shall maintain a replacement parts department and provide testing equipment when needed. Provide complete replacement parts within 24 hours during the warranty period.
- D. Conformance to certain government standards on quality assurance may be required for some applications outlined in these specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.
- B. Product numbers are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the Engineer in writing prior to ordering the material and performing installation work.

2.2 PRODUCT SUBMITTAL AT TIME OF BID

- A. At the time of bid, include a list of major products in the Contract documenting the intended cabling system solution, AV equipment, etc.

2.3 SUBSTITUTIONS

- A. Conform to the substitutions requirements and procedures outlined in Division 01.
- B. Only one substitution for each product specified will be considered.
- C. Where products are noted as "or equal", a product of equivalent design, manufacture, and performance will be considered. Submit product data (product information, catalog cuts, pertinent test data, etc.) to substantiate that the product is in fact equivalent to that specified. The burden of proof that the substituted product is equivalent to the specified product rests with the Contractor. Whenever material, process or equipment is specified in accordance with an industry specification (ANSI, TIA, etc.), UL rating, or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard

specification. When requested by the Engineer, submit supporting test data to substantiate compliance.

- D. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the contract documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when "or equal" follows the manufacturers' names or model number(s).
- E. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.
- F. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the specifications.
- G. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or another Contractor's work.

PART 3 - EXECUTION

3.1 PERMITS AND INSPECTIONS

- A. Furnish materials and execute workmanship for this work in conformance with applicable legal and code requirements.
- B. Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of legal authority having jurisdiction.
- C. Arrange and pay for review/inspection from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with requirements of reference codes indicated herein.

3.2 EXAMINATION

- A. Verify existing conditions, stated under other sections, are acceptable for installation in accordance with manufacturer's instructions.
- B. Verify cable routes and lengths prior to pulling cables. Immediately notify the Engineer if actual lengths are expected to exceed project's maximum length requirement(s).

3.3 FIELD QUALITY CONTROL

- A. Staffing: Provide a qualified foreman to supervise the crew performing the work and who is present at the job site at times work is being performed.

- B. Construction Meetings: Participate in construction coordination meetings throughout the course of construction to review the progress and to resolve issues and conflicts. Prepare and distribute meeting agenda for telecommunication issues prior to, and meeting notes after meetings, in a format acceptable to the Owner. Publish meeting notes within 3 business days following the meeting.
- C. Scheduling: Perform the work within the approved construction schedule. Keep the construction schedule current, based on the results of the construction meetings. At minimum, schedule shall document critical due dates, tasks, and milestones. Submit revised schedules for approval within 3 business days whenever there are modifications.
- D. Inspection: Inspect the work after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion ready for inspection. Document completion and inspection as required.

3.4 INSTALLATION

- A. Complete work in conformance to applicable federal, state and local codes, and telephone standards.
- B. Complete work in a neat, high-quality manner, relative to common industry practices, and in accordance to NECA "Standard of Installation".
- C. Coordinate the entire installation throughout the construction team (general contractor and subcontractors).
- D. Manufacturer's Instructions: Comply with manufacturer's published installation instructions, product data, product technical bulletins, product catalog, and other instructions for installation. Maintain a file on the jobsite of MSDSs for each product delivered to jobsite packaged with an MSDS.
- E. Adjusting: Make changes and revisions to systems to optimize operation for final use. Make changes to systems such that defects in workmanship are corrected and completed systems pass the minimum test requirements.
- F. Protection: Protect installed products and finish surfaces from damage during construction.
- G. Repair/Restoration: Replace or repair work completed by others that you deface or destroy. Pay the full cost of this repair/replacement. Repair defects prior to system acceptance.

3.5 CLEANING

- A. Remove temporary coverings and protection of adjacent work areas. Remove unused, excess, and left over products, debris, spills, or other excess materials. Remove installation equipment.
- B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.
- C. Repair or replace damaged installed products.
- D. Legally dispose of debris.

- E. Clean installed products in accordance with manufacturer's instructions prior to Owner's, or Owner's Representative's, punch walk.

3.6 PUNCH WALKS AND PUNCH LISTS

- A. Punching the work of individual sections of Division 27 may be combined when noted so.
- B. Execute a punch walk with the Engineer and the Owner or Owner's Representative to observe Work.
- C. Develop a punch list for items needing correction. Issue this punch list to Engineer.
- D. Correct the Work as noted on punch list.
- E. Execute follow up punch walk with the Engineer and the Owner or Owner's Representative to verify punch list items have been corrected.

3.7 SYSTEM ACCEPTANCE

- A. Complete corrections (punch list items) prior to submitting acceptance certificate.
- B. On completion of the acceptance test, submit system acceptance certificate to the Owner or Owner's Representative requesting their signature and return of the certificate. Issue copies of the signed certificate back to the Owner or Owner's Representative with copy to the Engineer.

3.8 TRAINING

- A. After acceptance, schedule a time convenient with the Owner, or Owner's Representative, for instruction in the configuration, operation, and maintenance of the system.

END OF SECTION

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SECTION 270526

COMMUNICATIONS GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Communications Grounding Backbone and bonding of communications infrastructure and equipment to Communications Grounding Backbone.
- B. Related Sections
 - 1. Comply with the Related Sections requirements of Section 270000.
 - 2. Section 260526, "Communications Grounding Backbone system"

1.2 REFERENCES

- A. Comply with the References requirements of Section 270000.
- B. In particular or addition to the codes and standards listed in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. NFPA 70, "National Electrical Code", particularly the following Articles:
 - a. Article 250: Grounding
 - b. Article 770: Optical Fiber Cables and Raceways
 - c. Article 800: Communications Systems
 - 2. Underwriters Laboratories, Inc. (UL) UL 467: Grounding and Bonding Equipment
 - 3. Electronic Industries Association/Telecommunication Industry Association:
 - a. ANSI-TIA-607-C, "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises"
 - 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. IEEE 467, "IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems"
 - b. IEEE P1100, "IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems"

1.3 DEFINITIONS

- A. Definitions as described in Section 270000 shall apply to this section.
- B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
 - 1. "BCT": Bonding Conductor for Telecommunications
 - 2. "CM" and "cmil": Circular Millionths of an inch
 - 3. "GE": Grounding Equalizer Conductor
 - 4. "MBRGB": Main Building Reference Grounding Busbar
 - 5. "PBB": Primary Bonding Busbar
 - 6. "SBB": Secondary Bonding Busbar
 - 7. "TBB": Telecommunications Bonding Backbone

8. "TBC": Telecommunications Bonding Conductor
9. "THHN": Thermoplastic High Heat-resistant Nylon-coated

1.4 SYSTEM DESCRIPTION

- A. Base Bid Work: The Work under this section includes furnishing materials, installation, and coordination through the General Contractor with other trades for a Communications Grounding Backbone and for bonding of telecommunications equipment and apparatus to the Communications Grounding Backbone.
- B. Communications Grounding Backbone System: The Communications Grounding Backbone System contains grounding busbars, grounding conductors, bonding conductors, and connecting devices (including but not limited to pressure connectors, lugs, clamps, or exothermic welds). These components, upon completion of installation and testing, shall provide the means of a low impedance path to earth for unintentional and/or stray voltages or spurious signals present on telecommunications media and equipment. The Communications Grounding Backbone System will consist of the following aspects (refer to Drawings for additional information)
 1. PBB: Locate the PBB in the EF/BDF with the following connections:
 - a. MBRGB, via BCT (refer to Drawings for wire size)
 - b. Each TBB
 - c. Ground bushings installed on each entrance conduit opening within the space, via TBC
 - d. Overhead cable support within the space, via TBC
 - e. Dedicated power panel's ACEG within the space serving communication equipment, via TBC
 - f. Metallic pathways (conduits, surface raceway, etc.) within the space, via TBC
 2. TBB: TBB(s) are the primary bonding conductor between the PBB and other SBBs provided throughout a single building. The length of TBBs shall not exceed 500 feet. The TBB shall route from the BDF through each of the IDFs bonding each of the SBBs to the PBB. Maintain TBB continuity and do not break continuity in order to bond to a SBB.
 3. SBB: Locate the SBB in each IDF with the following connections:
 - a. TBB
 - b. Building steel, via TBC
 - c. Each entrance conduit into the space, via TBC and ground bushings
 - d. Overhead cable support within the space,, via TBC
 - e. Panelboard's ACEG within the space serving telecommunication equipment, via TBC
 - f. Metallic pathways (conduits, surface raceway, etc.) within the space, via TBC
- C. Performance Criteria for the Grounding Backbone:
 1. Resistance from any point of the communication grounding backbone system to the ground electrode and to earth shall not exceed 20 Ohms.
 2. Field test resistance and document, both electronically and printed, measured values.
- D. Bonding: Bonding consists of TBCs within telecommunications rooms from the PBB and SBBs to the following components:
 1. Rack bay
 2. Overhead cable support and vertical cable support
 3. Wall-mounted termination equipment
 4. Conduit ground bushings

5. Exit pathways
 6. Bonding jumpers between basketway, cable runway, and cable tray joints & splices, and between basketway/cable runway/tray and equipment racks
- E. Conductor Gauge Criteria:
1. Size BCT as the greater of either 2,000 cmil per linear foot up to 3/0 AWG or the largest TBB.
 2. Size TBB, and TBCs as 6 AWG minimum, then as 2,000 cmil per linear foot up to 3/0 AWG.

1.5 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.
- B. Submittal Requirements at Start Of Construction:
1. Product Data Submittal
 2. Shop Drawing Submittal(s), if the Contractor's installation intent differs from the Contract Documents or the design intent
- C. Substitutions
1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.
- D. Submittal Requirements at Closeout: Submit to the Owner at the time of project closeout the following and before certificate of final payment is issued.
1. Test Report: Submit computer-generated test records of measured resistance values for inclusion into the Operation and Maintenance Manual.
 2. As-Built Drawings, consisting primarily of the Communications Grounding Backbone (not necessarily each bonded component or apparatus)

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of Section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

- A. Warrant Work to perform as described within this Section for a period of 1 year. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Application: Suitable for indoor installation as a BCT, TBB, and/or TBC.
- B. Type: THHN (or THWN)
- C. Approvals:
 - 1. UL 83 as Type THHN
 - 2. Federal Specification A-A-59544, NEMA WC-5, UL-758
- D. Conductor: soft drawn annealed copper, stranded
- E. Gauge: Refer to System Description for conductor sizing criteria.
- F. Insulation: PVC, high-heat and moisture resistant
- G. Jacket: Nylon, abrasion, moisture, gasoline and oil resistant
- H. Color: green
- I. Flame Resistance: Meet the flame resistance requirements of IEEE 383, CSA FT-4 and UL VW-1.

2.2 CONNECTOR – “PARALLEL” TAP

- A. Application: H-type thick wall compression tap, for making conductor-to-conductor (e.g., TBB-to-TBC) permanent connection (pigtail, tapping, or splicing). Connectors shall be UL Listed.
- B. Manufacturers:
 - 1. Panduit
 - a. #HTCT2-2-1; “H-type” compression tap, run = #6-#2, tap = #2-#6.
 - b. #HTCT250-2-1; “H-type” compression tap, run = #2-250MCM, tap = #6-#2
 - 2. Or equal

2.3 CONNECTOR – “C” TAP

- A. Application: C-type copper thick wall compression tap, for making conductor-to-conductor (e.g., TBB-to-TBC) permanent connection (pigtail, tapping, or splicing). Connectors shall be UL Listed.
- B. Manufacturer:
 - 1. Panduit
 - a. #CTAPF4-12-C; CTAP for #6 AWG run –to– #6 AWG tap
 - b. #CTAPF2-12-C; CTAP for #2 AWG run –to– #6 AWG tap
 - c. #CTAPF1/0-12-L; CTAP for 1/0 AWG run –to– #6 AWG tap
 - d. #CTAPF2/0-12-Q; CTAP for 2/0 AWG run –to– #6 AWG tap
 - e. #CTAPF3/0-12-Q; CTAP for 3/0 AWG run –to– #6 AWG tap
 - 2. Or equal

2.4 GROUNDING BUSBAR - TINNED

- A. General: Busbar shall be UL listed.
- B. Standards: Compliant to ANSI-J-607-A
- C. Material: Solid copper, tinned cladding
- D. Holes: Predrilled, compatible with standard NEMA bolt hole sizing and spacing and with ANSI-J-607-A recommendations for 2-hole lugs.
- E. Mounting: Wall-mounted with standoffs. Standoffs shall insulate busbar from the mounting substrate.
- F. Manufacturer:
 - 1. Panduit
 - a. # GB4B0624TPI-1; busbar, 20"L x 4"W x 1/4"T, PBB hole pattern
 - b. # GB4B0612TPI-1; busbar, 12"L x 4"W x 1/4"T, PBB hole pattern
 - c. # GB2B0312TPI-1; busbar, 20"L x 2"W x 1/4"T, SBB hole pattern
 - d. # GB2B0306TPI-1; busbar, 12"L x 2"W x 1/4"T, SBB hole pattern
 - e. #GB2B0304TPI-1; busbar, 10"L x 2"W x 1/4"T, SBB hole pattern
 - 2. Or equal

2.5 CONNECTION TO STRUCTURAL STEEL

- A. Application: Exothermic welds shall be used for cable-to-cable, cable-to-ground rod, and cable-to-structural steel.
- B. Manufacturers:
 - 1. Cadweld
 - a. Each particular type of weld shall use a kit unique to that type of weld
 - 2. Or equal

2.6 CONNECTOR – COMPRESSION LUG

- A. Application: Conductor-to-busbar and/or –rack (or other flat surfaces) connection
- B. Type: compression lug, standard or long barrel, two-hole (1/4 inch diameter 5/8 inch on center)
- C. Manufacturers:
 - 1. Panduit
 - a. #LCC6-14JAW-L; for 6 AWG conductor
 - b. #LCC4-14ADW-L; for 4 AWG conductor
 - c. #LCC2-14AW-Q; for 2 AWG conductor
 - d. #LCC1-14AW-E; for 1 AWG conductor
 - e. #LCC1/0-14AW-X; for 1/0 AWG conductor
 - f. #LCC2/0-14AW-X; for 2/0 AWG conductor
 - 2. Or equal

2.7 CONNECTOR – SPLIT-BOLT, MECHANICAL TYPE

- A. Application: Conductor-to-conductor (or other round component) connection
- B. Type: split-bolt mechanical connector
- C. Material: high-strength copper alloy
- D. Manufacturers:
 - 1. Cooper B-Line
 - a. #WB2GC; split bolt bonding clamp
 - 2. Panduit
 - a. #SBC3-C; split bolt bonding clamp for #6 to #3 conductor
 - 3. Or equal

2.8 GROUND BUSHING

- A. Plated malleable iron body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.
- B. Manufacturers:
 - 1. OZ/Gedney BLG
 - 2. Thomas & Betts #TIGB series
 - 3. Or equal.

2.9 BONDING STRAPS

- A. Cable Runway Bonding Straps
 - 1. Application: makes multiple sections of cable tray conductively continuous
 - 2. Conductor: Flexible braided straps with factory terminated connectors.
 - 3. Manufacturers:
 - a. Chatsworth Products Inc
 - 1) #12061-001
 - b. Cooper B-Line
 - 1) #SB6691x7³/₄
 - c. OZ/Gedney
 - 1) Type BJ
 - d. Thomas & Betts
 - 1) #3840 series
 - e. Or equal
- B. Cable Tray Bonding Straps
 - 1. Application: makes multiple sections of cable runway conductively continuous
 - 2. Conductor: Flexible braided straps with factory terminated connectors.
 - 3. Manufacturers:
 - a. Cooper B-Line
 - 1) #99-N1
 - b. Thomas & Betts
 - 1) #FB95
 - c. Or equal.

2.10 ANTIOXIDANT JOINT COMPOUND

- A. Application: Compound to inhibit oxide forming at copper-to-copper, aluminum-to-aluminum or aluminum-to-copper connections.
- B. Manufacturer, or equal:
 - 1. Chatsworth Products Inc
 - a. #40168-801; antioxidant joint compound for copper-to-copper connections
 - b. #40166-801; antioxidant joint compound for aluminum-to-aluminum or aluminum-to-copper connections
 - 2. [Eaton] Cooper B-Line
 - a. #SBJCC; antioxidant joint compound for copper-to-copper connections
 - b. #SBJCA; antioxidant joint compound for aluminum-to-aluminum or aluminum-to-copper connections

2.11 LABELS

- A. Labels for Busbars
 - 1. Labels shall be machine-printable (such as by a laser printer or hand-held printer)
 - 2. Printable area should be approximately 2 inch wide x 0.5 inch high
 - 3. Printable area color shall be white
 - 4. Manufacturer:
 - a. Panduit
 - 1) #C200X100FJJ; laser/ink jet labels, white – for busbars
 - b. Or equal
- B. Labels for Conductors
 - 1. Labels shall be machine-printable (such as by a laser printer or hand-held printer)
 - 2. Labels shall be adhesive-backed and have a self-laminating feature
 - 3. Printable area should be 1 inch wide x 0.5 inch high, or larger
 - 4. Printable area color shall be white
 - 5. Manufacturer:
 - a. Panduit
 - 1) #S100X150YAJ; laser/ink jet labels, white – for #6 wires
 - 2) # S100X225YAJ; laser/ink jet labels, white – for #6 to #1/0 wires
 - b. Or equal

2.12 MISCELLANEOUS

- A. Wire Clamp
 - 1. Material: nylon, UV stabilized.
 - 2. Color: black
 - 3. Size: 0.25" holding diameter for 6 AWG; or size as required based on conductor size.
 - 4. Manufacturer:
 - a. Richco Inc.
 - 1) #N4B-BLK
 - b. Or equal

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of Section 270000.
- B. Work shall comply with the International Building Code, International Fire Code, National Electrical Code, UL 467, and ANSI-J-607-C standards, as well as local codes that may specify additional grounding and/or bonding requirements. If discrepancies between codes and/or standards arise, codes shall prevail, and then the more stringent requirement shall prevail, and as directed by the AHJ.
- C. Install components to manufacturer's instructions and recommendations and as required per UL listing.
- D. Identify grounding and bonding conductors and components according to local codes.
- E. Terminations must be accessible for inspection and maintenance during the life of the system.

3.2 EXAMINATION AND PREPARATION

- A. Prior to the start of this section's work, examine pathways and communications rooms for completeness, compatibility with the work of this section, and readiness for connections with the work of this section.

3.3 INSTALLATION

- A. BCT, TBB, and Conductors
 - 1. Install BCT, and TBB conductors in conduit and in a manner to protect them from physical damage.
 - 2. When routing BCT, or TBB conductors through metallic conduit 3 feet or longer, bond the conductor to the conduit at both ends using a #6 AWG bonding conductor as a pigtail, an irreversible connection (preferably exothermic weld) for the conductor-to-pigtail connection, and insulated ground bushings at the conduit ends.
 - 3. Install the BCT, or TBB conductor without splices.
 - a. In the event that a splice is necessary, notify the Engineer in writing. Do not proceed with splicing work until the Engineer has accepted in writing the installation of a splice.
 - b. Locate the splice in a telecommunications space and ensure accessibility.
 - c. Perform the splice using an exothermic weld and an irreversible compression-type connector.
 - 4. Where shown on the drawings, connect grounding conductors to structural steel using exothermic welds. Each particular type of weld shall use a kit unique to that type of weld.
- B. PBB and SBB Busbars
 - 1. Mount busbars as noted on Drawings and using insulating standoffs.
- C. Panelboard Bonding
 - 1. Where a panelboard is located in the same communications room as a PBB/SBB and serves that room, provide TBC between busbar and that panelboard's Alternating Current Equipment Ground (ACEG) bus (where equipped) or the enclosure.

D. Bonding

1. Provide TBC and appropriate grounding hardware between the nearest TMGB/TGB and the equipment racks / rack bay, overhead cable support, vertical cable support, telecommunication conduits, primary pathways that enter/exit the room (if applicable), and other metallic telecommunication infrastructure components. Refer to Drawings for additional information.
2. Minimum size: #6. If longer than 25 feet, size TBCs based on length using 2000 cmil per foot, up to 2/0 AWG.
3. Install TBCs in a manner that will protect them from physical and mechanical damage.
4. Routing:
 - a. Route TBCs in the shortest possible path, using right angles for turns and routed parallel to building lines. Route on outside edges of wall plywood. Do not cut across the middle of the plywood taking space away from other equipment or components.
 - b. Utilize a minimum 1-foot bend radius.
5. Connection to PBB/SBBs:
 - a. Thoroughly clean busbars prior to attaching connectors to the busbar.
 - b. Fasten connectors (e.g., lugs) to the busbar using matching size bolt, flat washer Belleville washer, and nut. Torque hardware set.
6. Rack Bay Bonding
 - a. Refer to Drawings for detailed diagrammatic requirements for bonding the rack bay.
 - b. Bond equipment racks, frames, frame bays, cabinets, server racks, and other similar support systems located within the same room or space as the PBB/SBB to the busbar.
 - c. Use approved connectors for TBC-to-rack, -frame, and -cabinet connections.
 - d. Rack bays may be bonded in series using either of the following configurations:
 - 1) Series: Provide a TBC from the SBB to the rack closest to the busbar; then provide a TBC to the other racks in the rack bay in series using a common lug/connection per rack. The rack shall not be used as a 'conductor' in the series connection.
 - 2) String: Provide one 'main' TBC from the SBB along the length of the rack bay, and provide a pigtail from the 'main' TBC per rack. Use an irreversible connection (such as "C" tap) for the 'main'-to-pigtail connection.
7. Overhead and Vertical Cable Support Bonding
 - a. Bond overhead and vertical cable support located within the same room or space as the PBB/SBB to the busbar.
 - b. Provide either UL listed connectors and splice plates or UL Listed bonding strap to bond sections of overhead cable support for ground continuity. This requirement applies to cable tray, basketray, runway sections and junctions within a single telecommunication room.
8. Metallic Surface Raceway Bonding
 - a. Bond metallic surface raceways for telecommunications cabling to approved electrical ground located within the same room or space as the surface raceway.

3.4 LABELING

A. General Requirements

1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A Administration Standard and as approved by the Engineer before installation.
2. Permanently label TBCs. Affix label as close as practical to each end of the conductor.

- B. Label Format
 - 1. Provide permanent labels with machine-generated text; hand written labels will not be accepted.
 - 2. Labels on TBCs shall fully wrap around conductors with a self-laminating feature to provide permanent marking.

- C. Identifier Assignment
 - 1. Separate label fields of the identifier with a hyphen.
 - 2. Assign identifiers according to current practice and as approved by the Engineer before installation.
 - 3. BCT and TBB
 - a. First field: "BCT" or "TBB" (the conductor type).
 - b. Second field: a unique sequential number, for example, "01".
 - c. Example: "TBB-01"
 - 4. Ground Busbars
 - a. First field: "PBB" or "SBB" (the busbar type)
 - b. Second field: the room's identity (IDF identifier's suffix) where the busbar is installed; for example, "3A2.1".
 - c. Example: "SBB-3A2.1"
 - 5. TBC:
 - a. First field: "TBC" (the bonding conductor type).
 - b. Second field: The room identity where TBC exists; for example: "A1.1".
 - c. Third field: A unique sequential number; for example: "01", "02", etc.
 - d. Fourth field: describe the device, equipment, component, or raceway being bonded.
 - e. Example: "TBC-A1.1-01 (RACK BAY)"

3.5 GROUNDING BACKBONE RESISTIVITY MEASUREMENT

- A. Measure ground resistance from each ground busbar to earth; record measurement. Provide additional grounding electrodes, bonding, and other elements as required to comply with resistance limits specified in this Section.

- B. Submit computer-generated records of measured resistance values to Engineer for approval and for inclusion into the Operation and Maintenance Manual.

3.6 FINAL INSPECTION AND CERTIFICATION

- A. Punch the Work of this Section compliant to the requirements of Section 270000. Punching the Work of this Section may be combined with punching the rooms.

- B. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION

SECTION 270528

COMMUNICATIONS BUILDING PATHWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Pathway systems within buildings to support low voltage systems - namely cable hangers and rated sleeves.
- B. Base Bid Work:
1. Provide materials and labor, whether explicitly mentioned herein or not, needed for complete pathway systems to satisfy the requirements of this section and the related drawings. "Complete" shall include primary components, supports, seismic bracing, bonding straps (as required), etc., necessary for a complete installation. This specification lists major equipment but not every accessory, support, fastener, etc., needed to complete the work.
 2. Install pathway systems in accordance with CEC, UL listing information, manufacturer's instructions, compliant to local inspections and seismic restraint requirements, NECA's "Standards of Installation" pertaining to general electrical installation practices and recognized industry practices, and in conformance to ANSI/TIA-569 standard and BICSI TDMM guidelines.
 3. Cable Hanger Systems
 - a. Provide a complete cable hanger system compliant with requirements of the CEC (in particular, compliant with the requirements of Article 300.11), in accordance with NECA's "Standards of Installation" (pertaining to general electrical installation practices), compliant with applicable portions of NFPA 70B, in accordance with manufacturer's instructions, and in accordance with recognized industry practices. A "complete system" shall include cable hangers, supports, anchors, fasteners, and other required accessories.
 - b. Provide cable hangers between primary pathways (or telecommunications rooms) and work area pathways and/or outlet locations at intervals up to 48 inches on center per a given route, at transitions downward/upward, and within 24 inches of an outlet stub/outlet location.
 - c. Supports:
 - 1) Provide dedicated supports for cable hangers. Do not support cable hangers on ceiling grid support wires. Do not share supports with other trades. Do not support hangers from ductwork, piping, or other equipment hangers.
 - 2) Support Wires:
 - a) Support wires shall consist of #12 drop wire (or as approved) with integral clip and fastener (such as power-actuated deck pin, beam flange, or other fastener appropriate for the use).
 - b) Secure support wires at both ends in accordance with CEC.
 - 3) Support Rods:
 - a) Support rods shall consist of 1/4 inch (6.3mm) or 3/8 inch (9.5mm) threaded or smooth rod and concrete anchor or beam flange clip or angled flange clip (as required for attachment to the building structure).

4. Spiral Wrap
 - a. Provide spiral wrap to support and dress cables from feed pathways to the point where the cables enter the furniture system.
5. Seismic Bracing: If required by code, provide seismic bracing and restraints to supports and pathways. Seismic bracing shall be approved by a structural engineer licensed in the state of California.

C. Related Sections

1. Comply with the Related Sections paragraph of section 270000.
2. Section 260533, "Raceways and Boxes for Electrical Systems"
3. Section 270536, "Communications Cable Trays"
4. Section 270526, "Communication Grounding and Bonding"
5. Section 271100, "Communication Rooms"

1.2 REFERENCES

- A. Comply with the References requirements of section 270000.
- B. In addition to those codes, standards, etc., listed in 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 1. Underwriters Laboratories (UL)
 - a. UL 5, "Standard for Surface Metal Raceways and Fittings"
 - b. UL 5A, "Nonmetallic Surface Raceways and Fittings"
 - c. UL 5C, "Standard for Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits"
 2. Underwriters Laboratories (UL)
 - a. UL 467, "Grounding and Bonding Equipment"

1.3 DEFINITIONS

- A. Definitions of section 270000 apply to this section.
- B. In addition to those Definitions of section 270000, the following list of terms as used in this Section defined as follows:
 1. "Cable Hanger": A cable support component often shaped (section view) similar to the letter J (thus gaining the nickname "J hanger"), metallic (most often steel) or non-metallic (most often thermoplastic); available in different sizes (to support different quantities of cables) and with different attachment hardware suiting multiple installation methods (e.g., wire support, beam flange clip, etc.).
 2. "Cable Strap": A flexible cable support that generally 'wraps' around cables and 'latches' into a fixed position, most often textile, available in different sizes (to support different quantities of cables) and with different attachment hardware suiting multiple installation methods (e.g., wire support, beam flange clip, etc.).
 3. "CEC": California Electrical Code (CCR Title 24 Part 3)
 4. "Enclosure": The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage.
 5. "J Hanger" and "J Hook": nickname for cable hanger
 6. "NEC": National Electrical Code (NFPA 70)
 7. "NFPA": National Fire Protection Agency
 8. "UL": Underwriters Laboratories

1.4 SYSTEM DESCRIPTION

- A. Clearances (minimum):
 1. From fluorescent light fixtures, or other EMI sources = 6 inches (150 mm)
 2. From any motor = 48 inches (1,220mm)
 3. From flue, hot water, steam line or other non-insulated heat sources = 12 inches (300 mm)

1.5 SUBMITTALS

- A. General: Conform to Submittal requirements as described in section 270000.
- B. Quantity: Furnish quantities of each submittal as noted in section 270000.
- C. Submittal Requirements Prior to the Start of Construction:
 1. Product Data Submittal, showing product dimensions, fabrications materials, fabrication details, knockout sizes and locations, capacities, finishes, and accessories
 2. Shop Drawings Submittal, consisting of proposed changes to pathways (routes, types, sizes, etc.) compared to the contract documents
 3. Seismic Calculations for Anchoring and Bracing: Submit seismic calculations for support systems in conformance section 270000. Calculations shall be prepared and signed by a Structural Engineer registered in the state of California. If used, specify proof loads for drilled-in anchors.
- D. Submittal Requirements at Close Out:
 1. As-Built Drawings, showing the routes/locations, dimensions, types, sizes, quantities, etc., of pathways/pathway devices.
 2. O&M Manual, including as-builts, a parts list, repair information, and detailing ongoing maintenance requirements
- E. Substitutions
 1. Requests for substitutions shall conform to the general requirements and procedure outlined in section 270000.

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of section 270000.

1.8 WARRANTY

- A. Comply with Warranty requirements of section 270000.

PART 2 - PRODUCTS

2.1 HANGERS AND STRAPS

- A. Application: Suitable for indoor installation within ceiling space for the support of communications cables.
- B. Hanger shall be rated for use in air handling space.
- C. Hangers shall contain a closing loop, retainer, or latch to prevent cables from falling off the hanger.
- D. Manufacturer, or equal:
 - 1. Eaton B-Line
 - a. #BCH21-W2; for drop wire installation
 - b. #BCH32-W2; for drop wire installation
 - c. #BCH21; for wall installation
 - d. #BCH32; for wall installation
 - 2. Panduit
 - a. #JM JH2-X20; cable hanger

2.2 DROP WIRE

- A. Application: Suitable for indoor installation within ceiling space into structure above (e.g., deck or slab) for the support of cable supports such as cable hangers.
- B. Listings: UL 2043, for use in air handling spaces
- C. Drop wire shall be equipped with pre-mounted ceiling clip, fastening pin, and pre-tied wire. Pin shall be 7/8". Wire shall be 12 gauge.
- D. Manufacturer, or equal:
 - 1. Hilti #CC27 X-AL-H22P8T x ft. PT (100); drop wire assembly, "x" for length
 - 2. Armstrong #7891
 - 3. Dottie #CWC
 - 4. Garvin Industries
 - 5. Oregon Wire Products

2.3 DROP ROD

- A. Application: Suitable for indoor installation within ceiling space into building structure above (e.g., deck or slab) for the support of cable supports such as cable hangers.
- B. Listings: UL 2043, for use in air handling spaces
- C. Zinc plated for corrosion resistance

- D. Manufacturer, or equal:
 - 1. CEAS #01014801; "Stiffy" straight rod, 1-1/4" power-actuated pin, 48 inches (or configured as required per instance)

2.4 FIRE RATED SLEEVE

- A. Application: Suitable as a sleeve for cables to pass through a full-height partition (e.g., gypsum or masonry) or floor (e.g., cast-in-place slab or concrete metal deck), and as a through-penetration fire stop system maintaining the fire rating of the penetrated partition.
- B. Sleeves shall be re-enterable.
- C. Sleeve system shall be tested in accordance with ASTM E 814 (ANSI/UL1479).
- D. Sleeve system shall be UL Listed and shall bear a UL Classification marking.
- E. Sleeve system shall match (or exceed) the partition's/floor's F and T rating.
- F. Manufacturer:
 - 1. Specified Technologies Inc (STI)
 - a. #EZDP44; "EZ Path Series 44" 4-inch square sleeve kit
 - b. #EZDP144FK; "EZ Path Series 44" 4-inch square sleeve kit with kick plate
 - c. #EZDG444; "EZ Path Series 44" 4-inch square kit with 4 sleeves and 1 grid
 - d. #EZD44; "EZ Path Series 44" 4-inch square sleeve
 - e. #EZP144W; "EZ Path Series 44" wall plates (1 pair) for EZD44 sleeve
 - f. #EZP544W; "EZ Path Series 44" wall plates (1 pair) for up to 5 EZD44 sleeves
 - g. #EZP144K; "EZ Path Series 44" kick plate for EZD44 sleeve
 - h. #EZG844; "EZ Path Series 44" grid for 8 sleeves
 - i. #TRK444; T-rating kit, for 4 Series 44 sleeves

2.5 SPIRAL WRAP

- A. Application: Suitable for an indoor installation for the support of telecommunications cables from a feed pathway to furniture systems, or similar.
- B. Material shall be flame retardant polyethylene (UL94V-0), or equivalent.
- C. Color: Black.
- D. Size: As required to support the given cable bundle size (e.g., 3/4" minimum).
- E. Manufacturer, or equal:
 - 1. HellermannTyton
 - 2. Panduit

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Prior to starting the work of this section, examine areas to receive pathways systems to verify conditions are ready for work and to verify conformance with manufacturer and specification tolerances. Notify the Owner's Representative in writing of conditions that would adversely affect the installation, or subsequent utilization, of the system. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. Prior to installation, plan routes and locations of pathway systems and coordinate with other trades (ductwork, plumbing, electrical raceways, wall construction, ceilings, etc.). Pathway systems shall not unnecessarily cross other trade's work, shall not prevent removal of ceiling tiles or panels, and shall not block access to mechanical or electrical equipment. Provide offsets as required to avoid obstruction of pathway systems with other trades.

3.3 INSTALLATION

- A. Hangers and Straps
 1. Install hangers so they are accessible through the ceiling grid and are not blocked by other building infrastructure.
 2. Install hangers above ceiling grid to result in cables sag 6 to 12 inches (150 to 300 mm), minimum, above ceiling grid. Cables shall not rest on the ceiling grid and/or ceiling tiles.
 3. Where hangers have loops/retainers, close loop/retainer (latch after cable installation).
- B. Fire Rated Sleeve
 1. Install the sleeves in strict accordance with the UL System drawing, with the approved shop drawings, and with the equipment manufacturer's instructions.
 2. Framed Walls – Pre-Framed and Cut-In
 - a. Coordinate location of penetration with other trades such as framing (wall studs), electrical (lighting), mechanical (ducts), and other trades.
 - b. For cut-in instances, cut wallboard to fit rated sleeve system – no more wallboard than is necessary to fit the system.
 - c. Apply the factory-supplied gasket prior to the installation of the wall plates.
 - d. Secure wall plates to sleeves per the equipment manufacturer's recommendations.
 3. Affix a label at each fire sleeve location onto the wall or floor – within 2 to 3 feet. Place label in a location that will not be obscured after cables get installed through the sleeve. Label shall describe the system's applicable ratings, such as F, T, and L ratings.

3.4 FINAL INSPECTION AND CERTIFICATION

- A. Punch the Work of this Section compliant to the requirements of section 270000.
- B. Comply with system acceptance and certification requirements of section 270000.

END OF SECTION

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SECTION 270536

COMMUNICATIONS BUILDING PATHWAYS – CABLE TRAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Cable tray systems as pathways within buildings to support low voltage/signal systems
- B. Base Bid Work
1. Provide materials and labor, whether explicitly mentioned herein or not, needed for a complete cable tray system to satisfy the requirements of this section and the related drawings. "Complete" shall include supports, seismic bracing, straight sections, fittings, connectors/splices, bonding straps (as required), etc., necessary for a complete installation. This specification lists major equipment but not every accessory, support, fastener, etc., needed to complete the work.
 2. Install cable tray systems in accordance with CEC (e.g., Articles 392 and 250), UL listing information, manufacturer's instructions, and NEMA VE 2, and compliant to local inspections and seismic restraint requirements, NECA's "Standards of Installation" pertaining to general electrical installation practices, and recognized industry practices. Cable tray systems shall conform to ANSI/TIA-569-B standard and BICSI TDMM guidelines.
 3. Supports: Provide supports at each connection point, at fittings, direction transitions, at the end of each run, and at other locations necessary to attain a fully supported and seismically braced cable tray system using a structurally-approved anchoring system and in accordance with NEMA VE 2.
 - a. Allowable Support Methods:
 - 1) Trapeze, consisting of threaded rod, channel/strut or angle iron, and appropriate hardware (anchors, nuts, washers, hold-down clips, etc.)
 - 2) Single hanger clip ("Flip-Clip", "trapeze support clip", other side wire clip)
 - b. Disallowable Support Methods:
 - 1) Center hung, consisting of a single threaded rod and strut or angle iron
 - 2) Cantilever (wall), consisting of wall-mount strut assembly, gusset or triangle assembly, and appropriate hardware (lag bolts, nuts, washers, hold-down clips, etc.)
 4. Seismic Bracing: Provide seismic bracing and restraints to supports and tray system. Seismic bracing shall be approved by a structural engineer licensed in the state of California.
 5. Splices: Provide UL classified splice systems by the same manufacturer as the straight sections and fittings.
 - a. Wire Mesh Cable Tray Systems Straight Section Splices:
 - 1) Allowable Splice Methods: washer splice, splice plate, splice bar, wing splice
 6. Expansion Connections: Provide expansion connectors where required per NEMA VE 1 and/or NEMA VE 2 and per manufacturer's instructions.
 7. Provide pre-manufactured radius kits at each bend/corner of "T" type intersections and cross intersections.
 8. Vertical Transitions: At vertical transitions of 36 inches (~1 m) or less, provide either a vertical section of tray between both tray levels or a cable dropout on the higher tray

section. At vertical transitions of greater than 36 inches (~1 m), provide a section of tray to span between both tray levels.

9. Dropouts:
 - a. Provide dropouts as shown on the drawings.
 - b. In locations that require 12" wide or 18" wide dropouts, the Engineer will accept combined dropouts, such as two 6" wide dropouts to create one 12" wide dropout, or one 12" wide dropout with one 6" wide dropout to create an 18" wide dropout.
10. Provide blind ends where tray truncations are exposed (i.e., not at a wall).
11. Bonding and Grounding
 - a. Provide a bonding strap at connections, expansion joints, sleeves, crossovers, and at other locations where the tray system's electrical continuity is interrupted and where splices and other accessories are not UL Listed.
 - b. Where straight sections or field fittings have been modified during installation such that wires have been removed, provide bonding straps or other accessories to ensure minimum continuous area to satisfy CEC requirements.
 - c. Bond cable tray system to approved ground, as per CEC 250.96, using approved connection means. Provide 2 AWG bare copper grounding conductor through entire length of tray. Bond grounding conductor to each component (straight section, fitting, etc.). Connect grounding conductor to approved ground, as per CEC 250.96, using approved connection means.
12. Provide acoustic treatments and/or acoustically rated systems where cable trays or their routs penetrate acoustically rated assemblies/walls. Such treatments and/or systems shall be approved by the project's acoustician.
13. First-In-Place: Install a single unit of work as described below.
 - a. As requested by the Owner, Owner's Representative, Engineer, or the General Contractor, install a section or sections of cable tray as a first-in-place using the products and installation means and quality intended to be used throughout the building. The installation shall demonstrate cable tray, support means, connections, bonding (as applicable) and seismic bracing (as applicable). Coordinate a meeting for the Owner and Engineer to review the installation. Proceed after obtaining written approval from either the Engineer or the Owner.

C. Related Sections

1. Comply with the Related Sections paragraph of section 270000.
2. Section 260536, "Cable Trays for Electrical Systems"
3. Section 270526, "Communication Bonding"
4. Section 271100, "Communication Rooms"

1.2 REFERENCES

- A. Comply with the References requirements of section 270000.
- B. In addition to those codes, standards, etc., listed in 270000, products (including fabrication process) and installation shall comply with the latest edition of the following applicable specifications and standards:
 1. ASTM International
 - a. ASTM A 123, "Specification for Zinc (Hot Galvanized) Coatings on Iron and Steel"
 - b. ASTM A 510, "Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel"
 - c. ASTM A 580, "Standard Specification for Stainless Steel Wire"
 - d. ASTM A525, "General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process"
 - e. ASTM A 580, "Standard Specification for Stainless Steel Wire"

- f. ASTM A591, "Specifications for Electrodepositing Coatings of Zinc on steel wire or sheets"
- g. ASTM A 641, "Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire"
- h. ASTM A 653, "Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process"
- i. ASTM B 633, "Specification for Electrodeposited Coatings of Zinc on Iron and Steel"
- j. ASTM D 769, "Standard Specification for Black Oxide Coatings"
- k. ASTM D3451, "Standard Guide for Testing Coating Powders and Powder Coatings"
- 2. National Electrical Manufacturer Association (NEMA)
 - a. NEMA VE 1, "Metal Cable Tray Systems"
 - b. NEMA VE 2, "Metal Cable Tray Installation Guidelines"
- 3. National Electrical Contractors Association (NECA)
 - a. NECA/NEMA 105, "Recommended Practice for Installing Cable Trays"
- 4. National Fire Protection Agency (NFPA)
 - a. NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance"
 - b. NFPA 70E, "Standard for Electrical Safety In The Workplace"
- 5. Underwriters Laboratories (UL)
 - a. UL 467, "Grounding and Bonding Equipment"
- 6. Manufacturer's guidelines and installation instructions

1.3 DEFINITIONS

- A. Definitions of section 270000 apply to this Section.
- B. In addition to those Definitions of 270000, the following list of terms as used in this Section defined as follows:
 - 1. "AHJ": Authority Having Jurisdiction; "the organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure" (per NFPA)
 - 2. "Cable Tray" and "Cable Tray System": a unit or assembly of units or sections and associated fittings forming a structural system used to securely fasten or support cables and raceways
 - 3. "CEC": California Electrical Code (CCR Title 24 Part 3)
 - 4. "LEED": Leadership in Energy and Environmental Design
 - 5. "CEC": California Electrical Code (NFPA 70)
 - 6. "NEMA": National Electrical Manufacturers Association
 - 7. "NFPA": National Fire Protection Agency
 - 8. "Wire Mesh Cable Tray": a cable support and management system fabricated of continuous, rigid, welded steel wire mesh; available in many sizes with attachment hardware suiting multiple installation methods; falls under NFPA 70's definition as cable tray.

1.4 SYSTEM DESCRIPTION

- A. Cable tray systems shall be electrically continuous maintaining minimum metal area requirements per CEC Table 392.7 (for use as an equipment grounding conductor).
- B. Bend Radius: Completed cable tray systems shall have a 12", minimum, radius, e.g., at fittings (factory and field-fabricated) and changes of direction.

- C. Cable tray supports (e.g., trapeze) shall carry a concentrated load of at least 200 pounds per anchorage point.
- D. Seismic Bracing: Cable tray systems shall include both lateral and longitudinal seismic bracing.
- E. Clearances (minimum):
 - 1. Top access clearance: Refer to the drawings; if not explicitly stated or shown, then the default shall be 12 inches (300 mm), minimum.
 - 2. Side access clearance: Refer to the drawings; if not explicitly stated or shown, then the default shall be 12 inches (300 mm), minimum.
 - 3. Between cable tray and fluorescent light fixtures, or other EMI sources: Refer to the drawings; if not explicitly stated or shown, then the default shall be 6 inches (150 mm), minimum.
 - 4. Between cable tray and any motor or transformer: Refer to the drawings; if not explicitly stated or shown, then the default shall be 48 inches (1,220mm), minimum.
 - 5. Between cable tray and any flue, hot water, steam line or other non-insulated heat sources: Refer to the drawings; if not explicitly stated or shown, then the default shall be 12 inches (300 mm), minimum.

1.5 SUBMITTALS

- A. General: Conform to Submittal requirements as described in section 270000.
- B. Submittal Requirements Prior to the Start of Construction:
 - 1. Product Data: Submit product data showing manufacturers, part numbers, dimensions, fabrication materials, fabrication details, finishes, capacities, and accessories.
 - 2. Shop Drawings: Submit shop drawings consisting of the following:
 - a. Cable tray layout/routes, supports locations, support details
 - b. Highlight proposed changes to pathways (routes, types, sizes, etc.) compared to the contract documents
 - c. Clearance variations and/or requests for exceptions
 - d. Load calculations for supports
 - e. Seismic bracing details (also see "Seismic Calculations" below)
 - f. Instances of penetrations through fire and smoke rated barriers, including calling out firestopping type/UL System, size, quantity, and other relevant information
 - g. Instances of seismic joints, including method and configuration to allowing independent movement, and other relevant information.
 - 3. Seismic Calculations: Refer to structural drawings for seismic bracing and supports type, quantities and locations.
- C. Submittal Requirements at Close Out:
 - 1. As-Built Drawings, showing the routes, dimensions, types, sizes, quantities, etc. (minimum)
 - 2. O&M Manual, including as-builts, parts list, repair information, and maintenance requirements
- D. Substitutions
 - 1. Requests for substitutions shall conform to the general requirements and procedure outlined in section 270000.

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of section 270000.
- B. Cable tray materials and parts shall be UL Listed and Labeled, and shall comply with CEC Article 392 and with NEMA VE 1/CSA C22.2 No. 126.1 "Metal Cable Tray Systems" for materials, sizes, and configurations.
 - 1. The terms "Listed" and "Labeled" shall mean as defined in CEC, Article 100.
 - 2. Listing and Labeling Agency Qualifications: a "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- C. Cable tray installation shall comply with CEC Articles 392 (for materials and installation) and 250.96 (for bonding) and with NEMA VE2.
- D. Assembled cable tray systems shall be UL Classified as an equipment ground conductor.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of section 270000.

1.8 WARRANTY

- A. Comply with Warranty requirements of section 270000.

PART 2 - PRODUCTS

2.1 CABLE TRAY – WIRE MESH TYPE

- A. Application: Suitable for the support and management of communications cables, either overhead or mounted vertically on a wall.
- B. Listing: Cable tray system (straight sections, fittings, splice kits, etc.) shall be UL-Classified as a grounding conductor. Cable tray shall be listed by a nationally recognized testing laboratory and shall bear the UL label. Markings shall be permanent.
- C. Material: Straight sections shall be fabricated from high strength steel wires meeting the minimum mechanical properties of ASTM A510 and formed into a standard 2-inch by 4-inch wire mesh pattern with intersecting wires welded together. Wire ends along sides (flanges) shall be rounded during manufacturing for safety of cables and installers. Longitudinal wires shall be straight (with no bends).
- D. Finish – straight sections: Straight sections shall be electro-plated zinc, in accordance with ASTM B633, Type II SC1 (or SC2).
- E. Splicing assemblies shall be the bolted-type using serrated flange locknuts. Hardware shall have SC2 yellow zinc chromate finish, in accordance with ASTM B633, or can be AISI Type 304 Stainless Steel.
- F. Size: Refer to Drawings for sizes.

- G. Manufacturers, or equal:
 - 1. B-Line (Eaton) "Flextray" series cable tray
 - 2. Chatsworth Products Inc "OnTrac" "Round" series cable tray
 - 3. WBT cable tray

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of section 270000.
- B. Install cable tray systems in accordance with manufacturers' instructions, with NEMA VE 2 and with recognized industry practices. Install cable tray systems compliant to requirements of NEC, applicable portions of NFPA 70B, and to NECA's "Standards of Installation" pertaining to general electrical installation practices.

3.2 PREPARATION

- A. Routes shown on the drawings are diagrammatic in nature. Plan routes and locations of pathway systems, and coordinate the installation (concrete drilling, anchors, supports, heights, clearances, access to the trays, interface with sleeves, etc.) with other trades/systems (ductwork, plumbing, electrical raceways, wall construction, ceilings, etc.). Field verify the planned route prior to installation.
- B. Pathway systems shall not unnecessarily cross other trade's work, shall not prevent removal of ceiling tiles or panels, and shall not block access to mechanical or electrical equipment. Offset trays as required to avoid obstruction of pathway systems with other trades.
- C. Prior to installation, examine areas to receive pathways systems to verify conditions are ready for work and to verify conformance with manufacturer and specification tolerances. Notify the Owner's Representative in writing of conditions that would adversely affect the installation, or subsequent utilization, of the system. Proceed with installation when unsatisfactory conditions are corrected.

3.3 INSTALLATION

- A. In general, install cable trays parallel or at right angles to the centerlines of columns and beams.
- B. Access and Clearances:
 - 1. Ensure clearance and access requirements to cable tray – above, below, and side, as shown on the drawings – are met. Coordinate with other trades to avoid other building infrastructure encroaching on access/clearance.
 - 2. Ensure no other trades/building systems conflict with cable tray systems and clearances. Other building infrastructure, such as columns, pipes, valves, etc., shall not route inside or through cable tray. Either relocate/alter other building infrastructure (preferred) or, if other building infrastructure cannot be altered, adjust the cable tray route to avoid conflicts other building infrastructure.
 - 3. Under no circumstance shall cable tray block or inhibit access to fire smoke dampers or other code-required access. All such conditions will require corrective actions be taken. Adherence to this requirement will be strictly enforced.

- C. Provide supports according to applicable codes, NEMA VE2, and approved shop drawings. Do not share supports with ductwork, piping, or other equipment hangers. Attach supports to the exterior of the cable tray. Do not install brackets, rods, etc., through the inside of the cable tray.
- D. Do not install more than one splice or junction between supports.
- E. Fabricate fittings (tee, cross, reducers, and 90-degree turns) in the field according to the manufacturer's instructions and to ensure the pathway system remains UL listed. Bends shall have a minimum of a 12-inch bend radius.
- F. At transitions to and/or interface with conduits and/or sleeves, align ends of cable trays directly underneath the conduits/sleeves or within the allowable offset ranges as shown in the drawings. Refer to the drawings for additional information.
- G. At rated partitions, either transition to an approved acoustically rated sleeve or penetrate the partition using an approved acoustically rated system.
- H. Remove burrs and sharp edges.
- I. Bonding
 - 1. Bond the cable tray system per "[Summary] Base Bid Work" requirements.
 - 2. If splice kits are not UL Listed, then provide bonding jumpers at each splice/junction.
 - 3. Bond completed cable tray systems to approved ground according to applicable codes.
 - 4. At connection points:
 - a. Thoroughly clean connection surfaces prior to attaching connection/termination components.
 - b. At painted surfaces, remove paint to completely expose metal – enough for the connector to make 100% contact by area with the surface.
 - c. Apply antioxidant joint compound to the surface prior to receiving connection/termination components.
 - d. Attach connection/termination components using hardware sets appropriate for the connector and receiving surface. Tighten hardware sets.
 - 1) For lugs at holes, use appropriately sized bolt, flat washer, Belleville or split washer, and nut.
 - 2) For lugs at studs, use appropriately sized flat washer, Belleville or split washer, and nut.
 - e. Connections shall be visible, accessible and verifiable.
- J. Protection: Protect installed system until completion of project. Touch-up, repair or replace damaged products before punch walk.

3.4 TESTING

- A. Test cable tray systems for electrical continuity throughout and its bonding connection to approved ground point(s).

3.5 FINAL INSPECTION AND CERTIFICATION

- A. Punch the work of this section compliant to the requirements of section 270000.
- B. Comply with system acceptance and certification requirements of section 270000.

END OF SECTION

SECTION 270811

COMMUNICATIONS TWISTED PAIR TESTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Testing of communications Backbone and Horizontal twisted pair cabling subsystem.
- B. Base Bid Work
 - 1. Testing of a completed communication infrastructure cabling system, which includes:
 - a. Submittals
 - b. Testing of the twisted pair cabling as follows:

Table 270811-1.1: Tests For UTP Cabling

Subsystem	Type	Test	Configuration	Notes
Backbone	ISP/Riser	*see "Notes"	-	Wire map, length
Horizontal	CAT6A	Category 6A	Permanent Link Channel	per TIA-568

- c. Record Documents, including test results.
- C. Work Provided Under Other Sections
 - 1. Backbone twisted pair cabling
 - 2. Horizontal twisted pair cabling
- D. Related Sections
 - 1. Comply with the Related Sections paragraph of section 270000.
 - 2. Section 271313, "Communication Backbone ISP Twisted Pair Cabling"
 - 3. Section 271513, "Communication Horizontal Twisted Pair Cabling"

1.2 REFERENCES

- A. Comply with the References requirements of section 270000.
- B. In addition to the References of section 270000, the following references apply to this specification:
 - 1. ANSI/TIA-1152, "Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling"

1.3 DEFINITIONS

- A. Refer to Definitions of section 270000, section 271313, and section 271513.
- B. In addition to those Definitions of section 270000, the following list of terms as used in this specification defined as follows:
 - 1. "CAT3": Shall mean Category 3 cabling (per TIA-568)
 - 2. "CAT6A": Shall mean Augmented Category 6 cabling (per TIA-568)

3. "Channel": Shall mean a testing configuration which includes the Permanent Link and the line cord (at the workstation), the equipment cord, and, if a full crossconnection is implemented, a patch cord and the crossconnect termination/connecting apparatus.
4. "Connect": Shall mean install all required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.
5. "Cord": Shall mean a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper" and "Lead".
6. "Permanent Link": Shall mean the 'permanent' portion of the Horizontal cabling to each outlet with the test cords de-embedded from the measurements; this includes cable, consolidation point (if used), termination/connecting apparatus in the IDF and the connector at the outlet.
7. "System Cord": Shall mean the cord used in the operating transmission circuit.
8. "Test Cord": Shall mean the cord certified for use in testing, as described in this section.

1.4 SYSTEM DESCRIPTION

- A. Refer to section 270000, section 271313, and section 271513 for addition system description information.

1.5 SUBMITTALS

- A. Comply with the Submittal requirements of section 270000.
- B. Submittal Requirements prior to the Start of Testing
 1. Testing Procedures Submittal: Submit as a PDF file the step-by-step procedures that the field technicians will follow during testing.
 2. Product/Equipment Submittal: Submit as a PDF file cutsheets of testing equipment and applicable accessories to be used. As applicable, note software/firmware versions and last factory calibrations.
 3. Schedule Submittal: Submit as a PDF file a proposed schedule of work. This schedule may be combined with the schedule developed for the work of Related Sections (listed above).
- C. Submittal Requirements at Closeout
 1. Test Reports and Measurement Data: After completing testing of cabling and before final closeout, submit test reports and measurement data. This report may be combined with the test reports of section 270821.
 - a. Test Reports Content and Organization
 - 1) Cover Page, with the following information:
 - a) Client/Owner Name
 - b) Project Name and Address
 - c) Report Name (e.g., "Test Reports for Horizontal Cabling System")
 - d) Date of Submittal – date format: **Month Day, Year** (e.g., "January 1, 2018")
 - e) Testing Company Name
 - 2) Table of Contents
 - 3) Warranty Certificate: include a certificate stating that the testing company warrants the validity of the test reports; this may be a letter on company letterhead or a traditional certificate format.
 - 4) Test Reports: report per link showing tested parameters and results from prescribed performance levels (e.g., CAT6A PASS); organize test reports by

backbone cabling/horizontal cabling, by building, by floor, and by telecom room.

- b. Test Reports Format
 - 1) Submit test reports as a PDF file. The Table of Contents shall have links to organized sections.
- c. Measurement Data
 - 1) Submit native measurement data format (for example, an *.FLW file from a Fluke tester); if native data format is not possible to submit, then submit measurement data as an exported Microsoft Excel compatible format. Include 'Viewer' software necessary to view, sort, filter, and print individual and summary test results from the native data format.
- d. Transmittal
 - 1) The preferred method of transmitting closeout submittals is via a cloud-based file transfer platform (such as Dropbox or similar).
 - 2) If by data storage disc (not preferred), 'burn' the test reports and measurement data onto one storage disc (e.g., CD-ROM or DVD). Clearly label the disc with the "Cover Page" information described above.

1.6 QUALITY ASSURANCE

- A. Comply with the Quality Assurance requirements of section 270000.
- B. Under no circumstances shall any cable's and/or conductor's test results be substituted for another's. If an instance of falsification is confirmed, the Contractor is liable for a complete retest of the cabling system at no additional cost to the Owner. This includes the retaining the services of a neutral party to observe all retesting.

1.7 WARRANTY

- A. Warrant the validity of the test results.

PART 2 - PRODUCTS

2.1 CATEGORY 6A HORIZONTAL CABLE TESTER

- A. Certification: Test equipment and accessories (adapters, cords, etc.) shall be independently verified to and compliant with ANSI/TIA-1152-A Level 2G field tester accuracy requirements to 2000 MHz.
- B. Test Standards (minimum): TIA-568 Category 6A under a permanent link, MPTL, and channel configuration; IEEE 802.3 100Base-TX, 1000Base-T, and 10Base-T; screen continuity along path of cabling;
- C. Equipment, or equal:
 - 1. Fluke Networks
 - a. #DSX-5000 or DSX-8000 (or DSX2-8000); "CableAnalyzer" test kit (main unit, remote unit, CAT6A permanent link adapters, CAT6A channel adapters, CAT6A patch cord adapters, accessories), loaded with the latest firmware version.
 - b. "LinkWare" PC management software, latest version of and documentation software

PART 3 - EXECUTION

3.1 SCHEDULING

- A. Prepare a testing schedule based on the construction schedule developed in sections 271313 and 271513 for the testing activities. Update testing schedule when changes in the cabling schedules occur.

3.2 FIELD QUALITY CONTROL

- A. Calibrate test sets and associated equipment per the manufacturers printed instructions at the beginning of each day's testing and after each battery charge. Fully charge the test sets prior to each day's testing to ensure proper operation.
- B. Ensure test equipment and test cords are clean and undamaged during testing activities. At the Engineer's discretion, halt testing activity and clean testing equipment, test cords, and related apparatus.

3.3 BACKBONE TWISTED PAIR CABLING TESTING REQUIREMENTS AND PROCEDURES

- A. Precautions
 - 1. Adhere to the equipment manufacturer's instructions during all testing.
 - 2. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
 - 3. Fully charge power sources before each day's testing activity
- B. Testing Requirements
 - 1. Test backbone multipair cabling per "Base Bid Requirements" in Part 1 of this Section.
 - 2. The installation will be accepted when testing has indicated availability of 100% terminated pairs.
- C. Testing Procedures
 - 1. Test continuity and wire map for all pairs.
 - 2. Test length for 2% of pairs of each cable. Pairs shall be from different 25-pair binder groups.
- D. Acceptable Test Result Measurements
 - 1. Overall:
 - a. Links which report a Fail, Fail* or Pass* for any of the individual tests shall result in an overall link Fail. All individual test results must result in a Pass to achieve an overall Pass.
 - b. Any reconfiguration of a link components required as a result of a test Fail, must be re-tested for conformance.
 - c. Remove and replace any cabling links failing to meet the criteria described in this specification, at no cost to the Owner, with cables that prove, in testing, to meet the minimum requirements.
 - 2. Length
 - 3. Wire Map: Provide continuous cable link and terminate all pairs correctly at both ends. No exceptions accepted.

4. Attenuation: The acceptable attenuation measurements for any CAT3 cabling link is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3 and as adjusted to length measurement.
5. Worst Pair-to-Pair Near End CrossTalk (NEXT) Loss: The acceptable worst pair-to-pair NEXT loss no greater than that listed in ANSI/EIA-568-C.2, 6.3 for CAT3 cabling.

3.4 HORIZONTAL CATEGORY 6A TESTING PROCEDURES

A. Precautions

1. Adhere to the equipment manufacturer's instructions during all testing.
2. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
3. Fully charge power sources before each day's testing activity

B. Test Equipment Set Up

1. Set up the tester to perform a full CAT6A test, as a Permanent Link Channel configuration.
2. If the tester has cable-specific test parameters pre-loaded, set up the tester as product-specific setting. If not, set as generic CAT6A.
3. Set the tester to save the full test results (all test points, graphs, etc.).
4. Save the test results with the associated cable link identifier.
5. Calibrate the test set per the manufacturer's instructions.

C. Acceptable Test Result Measurements

1. Overall Test Results:
 - a. The Owner shall accept only individual test results that result in a Pass.
 - b. Links which report a Fail, Fail* or Pass* for any of the individual tests shall result in an overall link Fail.
 - c. Any reconfiguration of link components required as a result of a test Fail, must be re-tested for conformance.
 - d. Remove and replace any cabling links failing to meet the criteria described in this specification, at no cost to the Owner, with cables that prove, in testing, to meet the minimum requirements.
2. Wire Map: Correctly terminate all pairs of the cabling link at both ends. Provide only continuous pairs. No exceptions.
3. Length: Ninety-four meters is the maximum acceptable electrical length measurements for any cabling link measured under a Permanent Link configuration, including test cords.
4. Insertion Loss: The acceptable insertion loss measurements for any CAT6A cabling link is that which is no greater than that listed in TIA-568.1-D.
5. Worst Pair-to-Pair Near End CrossTalk (NEXT) Loss: The acceptable worst pair-to-pair NEXT loss for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.
6. Power Sum NEXT Loss: The acceptable power sum PS-NEXT loss for any CAT6A cable is that which is no greater than that as listed in TIA-568.1-D.
7. Worst Pair-to-Pair ELFEXT and FEXT Loss: The acceptable worst pair-to-pair ELFEXT and loss for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.
8. Power Sum ELFEXT and FEXT Loss: The acceptable PS-ELFEXT and loss for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.
9. Alien Near End CrossTalk (ANEXT) Loss: The acceptable ANEXT loss for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.

10. Alien Far End CrossTalk (AFEXT) Loss: The acceptable AFEXT loss for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.
11. Return Loss: The acceptable return loss measurements for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.
12. Propagation Delay and Delay Skew: The acceptable propagation delay and delay skew measurements for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.

3.5 TEST REPORTS

- A. Permanently record measurements and test results.
- B. Submit test results to the Engineer after testing for approval. The Engineer will check these test reports for a format acceptable to the Owner, or Owner's Representative. Each cabling link test record shall contain the following information:
 1. Project name and address
 2. Testing Company's name and Operator's name
 3. Date of measurement/test
 4. Test equipment, including the following:
 - a. Manufacturer, model, and serial number
 - b. Date and time of last calibration
 5. Cable identification and (as applicable) pair identification
 6. Overall test result
- C. Cable and pair identifiers of the test reports shall match the identifiers as labeled in the field – i.e., use the ID on the cable label/termination label in the test reports.

END OF SECTION

SECTION 270821

COMMUNICATIONS FIBER OPTIC TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Testing of telecommunications fiber optic cabling.

B. Scope Of Work of this Section

1. Pre-Testing Submittals (also see "Submittals" for more details)
2. Inspection of completed fiber optic passive link segment(s) per IEC 61300-3-35.
3. Testing of completed fiber optic passive link segment(s) per the following table (also see "Part 3" for elaboration of testing requirements), according to ANSI/TIA-568-C.0 Annex E:

Subsystem	Type	Test	Direction	Wavelength
Backbone	Multimode	Tier 1, Method B (per TIA-526-14-B)	Both^	850nm and 1300nm
Backbone	Singlemode	Tier 1, Method A.1 (per TIA-526-7)	Both^	1310nm and 1550nm

4. Pre-Acceptance Submittals

C. Work Provided Under Other Sections

1. Fiber optic cabling and patching

D. Related Sections

1. Comply with the Related Sections paragraph of Section 270000.
2. Section 271323, "Communication Backbone ISP Fiber Optic Cabling"

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

B. In addition, the following standards are referenced to this Section:

1. American National Standards Institute (ANSI) Z136.2, "American National Standard for the safe use of optical fiber communication systems utilizing laser diode and LED sources"
2. ANSI/TIA-455-50B, "Light Launch Conditions For Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurements"
3. TIA-455-77, "Procedures To Qualify A Higher-Order Mode Filter For Measurements On Singlemode Fibers"
4. TIA-455-78A, "Spectral-Attenuation Cutback Measurement for Singlemode Optical Fibers"
5. EIA-455-95, "Absolute Optical Power Test for Optical Fibers and Cables"
6. EIA-455-171A, "Attenuation By Substitution Measurement – For Short-Length Multimode Graded-Index And Single-Mode Optical Fiber Cable Assemblies"
7. TIA-526-7, "Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant"
8. TIA-526-14-B (TIA-455-526-14B), "Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant"

9. TIA-TSB-4979, "Practical Considerations for Implementation of Multimode Launch Conditions in the Field"
10. ISO/IEC 14763-3, "Testing of Optical Fibre Cabling"
11. IEC 6100-3-35 (end faces)
12. IEC 61300-3-35, "Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-35: Examinations and measurements – Fibre optic connector endface visual and automated inspection"
13. IEC 61280-4-1
14. IEC 61280-4-2, "Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant"
15. BICSI Telecommunication Distribution Methods Manual (TDMM)

1.3 DEFINITIONS

- A. Refer to Definitions of sections 270000, 271323. The definitions of these sections apply to this section.
- B. In addition to those definitions in referenced sections, the following list of terms as used in this specification defined as follows:
 1. "Adapter" (associated with fiber connectivity): a connecting device that joins 2 fiber connectors, either like or unlike
 2. "Approved cleaning equipment": includes dry "one-click" probe type cleaners and/or other approved cleaning apparatus; also see "Cleaning Apparatus under Pat 2
 3. "Connect": install all required test cords, patch cords, system cords, etc. to complete an optical circuit
 4. "Cord": a length of cordage (simplex, duplex, or ribbon) having connectors at each end; the term "Cord" is synonymous with the term "Jumper"
 5. "Defect": detectable (via microscope) non-linear features on the end face of a fiber including particulates, debris, pits, chips, edge chipping, etc. as defined in 3.1 of IEC 61300-3-35 Edition 1
 6. "High Resolution" (microscope): as defined in 4.4.3 of IEC 61300-3-35 Edition 1
 7. "Jumper": see "Cord"
 8. "Low Resolution" (microscope): as defined in 4.4.2 of IEC 61300-3-35 Edition 1
 9. "OLTS": Optical Loss Test Set
 10. "Scratch": detectable (via microscope) permanent linear surface features on the end face of a fiber as defined in 3.1 of IEC 61300-3-35 Edition 1
 11. "Segment": cabling (cable, splices, couplings, splitters, connectors, etc.) between termination points / 2 endpoints or between points of access to the conductors within the cabling sheath, including the termination apparatus/components
 12. "System Cord": the cord used in the operating electrical or optical circuit
 13. "Test Record": a record (electronic and/or printed) of a the measured performance of a conductor against a standardized set of metrics
 14. "Test Report": a report containing a set of test records meeting a defined scope
 15. "Tier 1": testing of installed fiber optic cabling for loss (optical link power loss) with an OLTS, and verifying the cabling length and polarity – also refer to ANSI/TIA-568-C.0 Annex E
 16. "Test Cord": the cord certified for use in testing, and meeting the requirements of this section

1.4 SYSTEM DESCRIPTION

- A. Refer to section 271323for description of cabling systems.

1.5 SUBMITTALS

- A. Comply with the Submittal requirements of section 270000.
- B. Pre-Testing Submittal Requirements: Prior to the start of testing, submit the following:
 - 1. Product Data, submitted at least 8 weeks in advance the start of field measurements
 - 2. Testing Procedures, submitted at least 8 weeks in advance the start of field measurements
 - 3. Pre-Testing Loss Calculations, submitted at least 4 weeks in advance the start of field measurements
 - 4. Testing Schedule, submitted at least 4 weeks in advance the start of field measurements
- C. Pre-Acceptance Submittal Requirements: Prior to owner's acceptance, submit the following:
 - 1. Test Reports: Submit test reports in a format acceptable to the Owner or Engineer. Submit one electronic copy and one printed copy of test reports. This may be combined with the reports of Section 270811.
 - 2. Warranty Certificate: Submit warranty certificate in a format acceptable to the Owner.
- D. Submittal: Product Data
 - 1. Testing equipment ('mainframes', modules, remotes, etc.) including the following information (minimum):
 - a. Manufacturer and model number
 - b. Serial number
 - c. Date of last factory calibration
 - d. Software/firmware versions (as applicable)
- E. Submittal: Testing Procedures
 - 1. Describe step-by-step procedures the technicians will use in the field during actual testing – standards-based test methods, test equipment including the test cords and conditioners used, equipment configuration, how the reference gets established, etc. – something to which the engineer could compare the testing witnessing (observe testing technicians actually following these written step-by-step procedures).
- F. Submittal: Pre-Testing Loss Calculations
 - 1. Calculate the loss of each segment (not necessarily each fiber strand). The cable length may be based on the footage markings printed on the cable jacket. Include a brief description of each segment (such as endpoints).
- G. Submittal: Schedule
 - 1. Consists of proposed schedule of work (this schedule may be combined with the schedule developed for Division 27)

H. Submittal: Test Reports

1. Each test record shall include information per test as noted following:

CONTENT	LOSS – MMF	LOSS – SMF	CHARACTERIZATON
Owner/Project Name and Address	X	X	X
Contractor (Company) Name and Technician (test equipment operator) name	X	X	X
Date of Test	X	X	X
Test Equipment, including Serial Numbers (must match pre-testing submittal)	X	X	X
Test Procedure	X (e.g., OFSTP-14A, Method B)	X (e.g., OFSTP-7, Method A.2)	X
Test Cords – Type and Length	X	X	–
Test Cords – Measured Loss	X	X	–
Launch Fiber – Type and Length	–	–	X
Fiber/Strand Identifier and Fiber Type (e.g., “OM3”)	X	X	X
Test Equipment Set Up Parameters: wavelength, pulse width, refractive index, event threshold	–	–	X
End Locations and Measurement Direction	X	X	X
Wavelength	X	X	X
Reference Power Level	X	X	–
Optical Loss Measurement / Overall Loss	X	X	X
Characterization Trace	–	–	X
Fiber Length	X	X	X

2. Cable and fiber identifiers of the test reports shall match the identifiers as labeled in the field – i.e., the ID stored with the test result shall be the same ID as on the cable label/fiber port label.
3. Test Report Format – Electronic Submittal of Tier 1 Testing:
- Submit test report files as native data format (for example, an *.FLW file from a Fluke tester) and printed to PDF format assembled into a single file. Organize reports by backbone cabling, by floor, and by IDF.
 - For the native data format files, include the ‘Viewer’ or ‘Reader’ software necessary to view, sort, filter, and print individual and summary test results.
 - Organize the test records by (in this hierarchy): backbone cabling , by floor, by IDF, by sheath and by strand.
4. Test Report Format – Printed Submittal of Tier 1 Optical Loss Testing:
- Submit printed test reports, on 8.5”x 11” paper, color, one cabling link per page
 - Assemble prints into a 3-ring binder
 - Include a Table Of Contents at the beginning that lists the contents
 - Organize the test records by (in this hierarchy): backbone cabling, by floor, by IDF, by sheath and by strand. Include tabbed separators for improved navigation through the manual. Per tabbed section, sort records in ascending cable ID order.

- I. Submittal: Warranty Certificate
 - 1. Submit one printed copy of warranty certificate warranting the accuracy and validity of the test reports.

1.6 QUALITY ASSURANCE

- A. Comply with the Quality Assurance requirements of section 270000.
- B. Test equipment shall be fully functional and in proper working order (not broken adapters, connectors, buttons, battery cover, etc.). Test equipment shall have loaded the latest firmware/operating software.
- C. Calibration: Test equipment shall be factory calibrated within the manufacturer's published calibration period. The manufacturer, where applicable, shall calibrate test equipment against National Institute of Standards and Technology (NIST) standards.
- D. Technician Training: Technicians that operate test equipment shall have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR, and shall have obtained a certificate as proof thereof. Training may have been conducted by any of the following:
 - 1. Manufacturer of the test equipment used for the field certification
 - 2. Manufacturer of the fiber optic cable system
 - 3. Training organizations (such as BICSI)
- E. Cleaning: Throughout testing, clean connector end faces and adapter alignment sleeves using an approved cleaner and cleaning method – also refer to "Field Quality Control" in Part 3.

1.7 WARRANTY

- A. Warrant the validity of the test results and that no test measurements have been falsified. Issue such warranty in writing. Under no circumstances shall any cable's and/or optical conductor's test results be substituted for another's. If an instance of falsification is confirmed, the Contractor will be liable for a complete retest of the cabling system at no additional cost to the Owner. This includes the retaining the services of a neutral party to observe all retesting.

PART 2 - PRODUCTS

2.1 DIGITAL INSPECTION MICROSCOPE

- A. Digital inspection microscope shall be suitable for inspecting and certifying connector end faces. The microscope shall be a digital video camera type with probe tips (to permit inspection through adapters) and shall be capable of storing the end face images for inclusion in the test reports.
- B. Microscope shall be compatible with IEC 61300-3-35, particularly 4.2 "Method B: video microscopy".
- C. Microscope shall have adapters that match/are compatible with the connector(s) being inspected.

- D. Magnification: low resolution or high resolution
- E. Manufacturer, or equal:
 - 1. AFL
 - a. "FOCIS PRO"; fiber optic connector inspection system, including a #DFS1 digital inspection microscope and a #DFD1 touchscreen tablet preloaded with 'SimpleView PRO' fiber inspection software
 - b. #DFS1; 'FiberScope' digital inspection microscope with USB connection used in conjunction with 'SimpleView PRO' fiber inspection software on a laptop or with Link WiFi unit and FOCUS MOBILE app loaded on an iPhone, iPad, or Android mobile device
 - 2. Corning
 - a. #VIPROBE-DUAL; video inspection probe (for use with OV-1000 V2 OTDR mainframe)
 - 3. Fluke Networks
 - a. #FI-7000; 'FiberInspector Pro' series digital inspection microscope

2.2 OPTICAL LOSS TEST SET (OLTS) – SINGLE STRAND TESTING

- A. OLTS can be an integrated set or separate light source and power meter. The test equipment shall, either as an integrated set or as separates, meet the following specifications/requirements.
- B. Multimode Light Source: The light source used for testing multimode fibers shall meet the requirements of ANSI/TIA-526-14-B, 3.1. Additional requirements:
 - 1. Type: LED
 - 2. Central wavelengths: 850nm \pm 30 nm, 1300nm \pm 20 nm
 - 3. Output stability: +/- 0.40 dB from 0 to 50 degrees C
 - 4. Long term output stability: +/- 0.10 dB at 25 degrees C
 - 5. Output power: -20 dBm, minimum
 - 6. Encircled Flux: light source shall meet the encircled flux launch requirements of TIA-455-526-14B, ISO/IEC 14763-3, and IEC 611280-4-1 for 50/125 um at the source's optical connector.
- C. Singlemode Light Source: The light source used for testing singlemode fibers shall meet the requirements of TIA-526-7, 3.1.1. Additional requirements:
 - 1. Type: laser
 - 2. Central wavelengths: selectable to 1310 nm \pm 20 nm, 1550 nm \pm 20 nm
 - 3. Output stability +/- 0.40 dB from 0 to 50 degrees C
 - 4. Long term output stability +/- 0.10 dB at 25 degrees C
 - 5. Output power: -10 dBm, minimum
- D. Power Meter
 - 1. Type: multi-wavelength photodetector
 - 2. Measurement wavelengths: selectable to 850 nm, 1300 nm, 1310 nm, and 1550 nm
 - 3. Measurement range: -60 dBm to +10 dBm
 - 4. Measurement resolution 0.01 dB
 - 5. Measurement accuracy: +/-10% at +10 to 0 dBm, +/- 5% at 0 to -50 dBm, and +/-10% at -50 to -60 dBm
 - 6. Measurement uncertainty: +/- 0.25 dB
 - 7. Storage: internal data storage for reference power measurement and test measurements
 - 8. Connections (for data transfer to computer): serial and/or USB

- E. Length Measurement: The OLTS should be capable of measuring the optical length of the fiber.
- F. Manufacturer, or equal:
 - 1. AFL
 - 2. Corning
 - a. OTS-600 series optical loss test set
 - 3. Fluke Networks
 - a. DSX-5000 CableAnalyzer series test set equipped with fiber modules
 - b. CertiFiber Pro series test set
 - 4. Fluke Networks MultiFiber Pro series test set
 - a. #MFPOWERMETER; MultiFiber Pro optical power meter
 - b. #MFMULTIMODESOURCE; MultiFiber Pro 850 nm multimode source
 - c. #MF1310SOURCE; MultiFiber Pro 1310 nm singlemode source
 - d. #MF1550SOURCE; MultiFiber Pro 1550 nm singlemode source
 - 5. Fluke Networks CertiFiber Pro series test set
 - 6. JDS Uniphase
 - 7. Softing
 - a. WX4500; WireXpert test set with below test kit
 - 1) WX_AD_EF_MM2 kit for testing on single strand multimode links
 - 2) WX_AD_SM2 kit for testing on single strand singlemode links

2.3 FIBER OPTIC TEST CORDS AND LAUNCH CORDS

- A. The fiber of the test cords and launch cords shall match as closely to the fiber of the segment-under-test as possible. At a minimum, the fiber type and performance (e.g., OS2) shall match and, ideally, the fiber should be by the same manufacturer.
- B. Connectors of the test cords shall be compatible with (the same type as) the equipment (light source, power meter) and with the segment-under-test.
- C. Test cords shall meet the following:

REQUIREMENT	MULTIMODE	SINGLEMODE
TIA Compliance	TIA-526-14-B, 3.3	TIA-526-7, 3.1.3
ISO/IEC Compliance	ISO/IEC 14763-3	ISO/IEC 14763-3
Reference Grade	Yes (per ISO/IEC 14763-3)	Yes (per ISO/IEC 14763-3)
End Face Compliance	IEC 6100-3-35	IEC 6100-3-35
Loss Performance, per Connector	≤ 0.1dB at 850nm and 1300nm	≤ 0.2dB at 1310nm and 1550nm
Loss Measurement Technique	Per FOTP-171 D2	Per FOTP-171 D3
PC Finish	Not required	Connectors shall inhibit Fresnel reflections (i.e., have a "PC" finish)
Length for Tier 1 Loss	1 m to 5 m	1 m to 5 m

2.4 CLEANING APPARATUS

- A. Cleaning apparatus shall remove skin oil, isopropyl alcohol, graphite, dust, and other contaminants from connector end faces, and shall be able to clean both unattached connectors and connectors inserted into adapters.

- B. Manufacturer, or equal:
 - 1. AFL
 - a. #8500-05-0002MZ; one-click cleaner for 1.25mm ferrules (LC/MU)
 - 2. Corning
 - a. CLEANER-PORT-LC
 - 3. Fluke
 - a. #NFC-IBC-1.25mm; IBC OneClick cleaner, for 1.25 mm ferrules (LC, MU connectors)

PART 3 - EXECUTION

3.1 SAFETY

- A. Safety: Operate test equipment that contains a laser or LED in accordance with ANSI Z136.2.
- B. Adhere to the precautions described in TIA-526-14-B, 5.1.
- C. Adhere to the equipment manufacturer's instructions during testing.

3.2 FIELD QUALITY CONTROL

- A. Charge test equipment's batteries to full capacity prior to each day's testing to ensure proper operation.
- B. Cleaning:
 - 1. Only use approved cleaning apparatus and methods.
 - 2. Keep test equipment, connectors and adapters/coupling alignment sleeves clean at the test points prior to and during testing activities and measurements. During testing, clean connector end faces with each reconnection. The Engineer may, at their discretion, request the contractor halt testing activity and have the technician clean testing equipment, test cords, launch cords, connectors of the cables under test, and related apparatus.

3.3 TEST CORD VERIFICATION

- A. Visual Verification: Prior to accepting test cords for use in testing, inspect cords and connectors.
 - 1. Visually inspect each cord to ensure the cordage has no damage and the connectors are firmly attached to the cordage. If the cordage is undamaged and the connectors are firmly and properly attached, then the connector end faces may be inspected (go to next step). Otherwise, the cord may not be used for testing.
 - 2. Visually inspect each connector end face using a digital inspection microscope to ensure each end face is clean (no contamination) and free of defects (scratches, pits, chips, etc.) that would adversely affect measurement and repeatability. If the connector end face is clean with no defects and meets IEC 6100-3-35, then the cord may be used for testing. Otherwise, go to next step.
 - 3. If contamination is seen during end face visual inspection (step described above), then clean the end face using equipment and methods of TIA-526-14-B 5.6 [for multimode] or TIA-526-7 5.7 [for singlemode]. After cleaning, visually inspect the connector end faces using a digital microscope. If the connector end face is clean with no defects and meets

- IEC 6100-3-35, then the cord may be used for testing. If, after cleaning, the end faces still exhibit scratches, pits, and/or other defects/imperfections, do not use this cord for testing.
4. Once the cord is acceptable and if the microscope has storage capability, record an image of the connector end face (for inclusion in the test report).

B. Test Cord Performance Verification

1. Validate performance of cords for testing only if no defects are observed during visual inspection.
2. Connect Test Cord #1 to the light source and to the power meter.
3. Store the measured light value into the power meter as the reference power (P_{ref}).
4. Disconnect Test Cord #1 from the power meter. Do not disconnect Test Cord #1 from the light source.
5. Connect the 'open' end of Test Cord #1 to an adapter (of matching connector type). Connect one end of Test Cord #2 to that adapter and the other end of Test Cord #2 to the power meter.
6. The value displayed on the power meter represents the test cord #2 connector loss at the adapter.
7. Flip the ends of Test Cord #2 so that the end connected to the power meter is now connected to the adapter (attached to test cord #1), and the end connected to the adapter is now connected to the power meter.
8. The value displayed on the power meter represents the test cord #2 connector loss at the adapter (opposite end as previous measurement).
9. Only accept and use test cords meeting the loss values noted in Part 2.
10. Repeat this test procedure from the beginning reversing the test cords in order to verify the performance of test cord #1.
11. Documentation of test cord verification is not required.

3.4 TIER 1 | OPTICAL POWER LOSS TESTING REQUIREMENTS AND PROCEDURES

A. Test Equipment Preparation

1. Bring test equipment to room temperature – approximately 72 degrees F.
2. Power on the OLTS (or light source and power meter) for at least 5 minutes prior to setting a reference or obtaining measurements.
3. Do not power off test equipment during testing activity. Should the test equipment power off, fully complete setting a reference.
4. Set the test routine parameters to meet the testing requirements of this section.

B. Connection Preparation

1. Prior to connecting test cords to the test equipment and to the cable-under-test, prepare connector end faces of the test cords and cable-under-test in accordance with IEC 6100-3-35 using approved cleaning equipment.

C. Visual Inspection:

1. Prior to connecting test cords, visually inspect each connector end face of the cable-under-test using a digital inspection microscope to ensure each end face is clean (no contamination) and free of defects (scratches, pits, chips, etc.) that would adversely affect performance. Once the connector end face is clean with no defects and meets IEC 6100-3-35, record the image for inclusion in the test report submittal.
2. If contamination is seen during end face visual inspection, then clean the end face using equipment and methods of TIA-526-14-B 5.6 [for multimode] or TIA-526-7 5.7 [for singlemode]. After cleaning, inspect the end faces using a digital inspection microscope. If the connector end face is clean with no defects and meets IEC 6100-3-35, then record the image for inclusion in the test report submittal. If, after cleaning, the end faces still

exhibit scratches, pits, and/or other defects/imperfections, remove the connector and reterminate the fiber with a new connector.

D. Setting a Reference

1. Follow the test equipment manufacturer's initial adjustment and set up instructions.
2. Set the light source and power meter to the same wavelength.
3. Set the power meter to relative power measurement mode
4. Set the meter to display power levels in dBm.
5. Upon a stable power reading, set this as the reference power level following the manufacturer's instructions.
6. Do not remove Test Cord #1 from the light source at any time (unless the test cord must be replaced, testing is complete, or the equipment is being put away for the evening).
7. Do not bend the test cords smaller than 20 times the cord diameter (this may induce loss into the cord, which will reduce the accuracy of the measurement).

E. Measuring Multimode Passive Link Insertion Loss

1. Only use cords that satisfy the test cord verification (see previous article) requirements. Do not use any cord with observed defects during testing.
2. Connect test equipment, test cords, and cable-under-test per the Method noted in the Table under article 1.01 of this section.
3. Do not disconnect the test cord from the light source. Should the test cord be disconnected from the light source, fully complete setting a reference.
4. Do not bend the test cord smaller than 20 times the cord diameter during testing activities (this may induce loss into the cord reducing the accuracy of the measurement).
5. Test each segment of installed cable plant according to the table under article 1.01 of this section.
6. Store the measured insertion loss per segment into the test equipment.

F. Measuring Singlemode Passive Link Insertion Loss

1. Connect test equipment, test cords, and cable-under-test per the Method noted in the Table under article 1.01 of this section.
2. Use launch conditions described in FOTP-78 and employ a method to remove high-order propagating modes. A method to select a mode filter is described in FOPT-77.
3. Do not disconnect the test cord from the light source. Should the test cord be disconnected from the light source, fully complete setting a reference.
4. Do not bend the test cord smaller than 20 times the cord diameter during testing activities (this may induce loss into the cord, which will reduce the accuracy of the measurement).
5. Test each segment of installed cable plant according to the table under article 1.01 of this section.
6. Store the measured insertion loss per segment into the test equipment.

G. Recorded Test Measurements.

1. Measurements shall carry a precision through at least one significant decimal place.

END OF SECTION

SECTION 271100
COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Base Bid Work
 - 1. Backboards:
 - a. Provide sheet hardwood/plywood and fasteners as a backboard within telecom rooms as shown on the drawings. If not explicitly shown, provide backboard on portions of walls greater than 18 inches.
 - b. Provide painting of the plywood as a finish and to improve space illumination.

1.2 REFERENCES

- A. Comply with the References requirements of section 270000.
- B. In addition to those codes, standards, etc., listed in section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. National Fire Protection Association (NFPA):
 - a. NFPA 255, "Standard Method of Test of Surface Burning Characteristics of Building Materials"
 - b. NFPA 703, "Standard for Fire Retardant—Treated Wood and Fire-Retardant Coatings for Building Materials"
 - 2. ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials"

PART 2 - PRODUCTS

2.1 SHEET HARDWOOD / PLYWOOD (AS BACKBOARD)

- A. Application: Sheet hardwood/plywood used as backboard in telecommunications rooms, "Use Category" UCFA per AWPA U1-17.
- B. Plywood shall be new and free from defects, and shall be interior "Type A" with a veneer grade of A-C.
- C. Size: 8' x 4' plywood sheets, 11/16" to 13/16" thick.
- D. Plywood shall be fire retardant treated with a flame spread rating of 25 or less / Class A, when tested in accordance with ASTM E84. Plywood shall be:
 - 1. Chemically treated and pressure impregnated
 - 2. Kiln dried after treatment to maximum moisture content of 15%.
 - 3. Stamped with the fire rating and the certifying lab.

- E. Plywood shall not contain VOCs, urea formaldehyde or formaldehyde, halogens, sulfates, chlorides, or ammonium phosphate.
- F. Manufacturers, or equal:
 - 1. Hoover Treated Wood Products, Inc. "Pyro-Guard" plywood

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the "Execution" requirements of section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Prior to installation, verify rooms are suitable for the construction scope of this section. Schedule work to prevent damage caused by other trades during their construction.
- B. Prepare surfaces, such as walls, for permanent installation of products, such as plywood.

3.3 INSTALLATION

- A. Plywood Backboards
 - 1. General
 - a. Complete work in a neat, high quality manner. The final conditions shall conform to applicable codes, BICSI's TDMM, TIA's 569 standard, and telecom utility standards.
 - b. Coordinate the plywood installation with the outlets to result in a clean finish.
 - 2. Preparation
 - a. Prior to installing wood materials, condition wood to the prevailing humidity conditions in installation areas.
 - 3. Plywood Installation
 - a. Install plywood in accordance with WIC Custom or Premium Quality Standard, as scheduled. Ensure work complies with applicable codes and recognized standards.
 - b. Install plywood as indicated on Drawings to the dimensions shown. In lieu of no dimensions, install plywood from +0'-6" to +8'-6" above the finished floor.
 - c. Install plywood plumb, level, true, and straight with no distortions. Shim as needed using concealed shims.
 - d. Trim plywood around electrical and telecommunications outlets to result in a clean finish.
 - e. Install plywood such that the fire rating stamp is visible.
 - f. Install plywood to a tolerance of 1/8" in 8' for plumb and level; and with 1/16" maximum offset in flush adjoining, 1/8" maximum offsets in revealed adjoining surfaces.
 - g. Do not install plywood that has defects or is not new.
 - h. Do not install pieces of plywood that are too small for the area (thus resulting in an excessive number of joints).
 - 4. Fasteners
 - a. Install plywood using screws, concrete anchors, or other fasteners suitable for the purpose/ required for application/mounting substrate.

- b. Do not use aluminum fasteners.
 - c. Install fastener such that fastener heads are flush with and not protruding from the plywood finished surface. Countersink fastener heads as needed.
5. Painting
- a. Paint plywood with a low-gloss, white (or similar bright color) paint.
 - b. Mask the plywood's fire rated stamp from the paint such that the stamp is still visible after painting.
6. Cleaning, Finishing, and Protection
- a. Clean exposed surfaces. Touch-up finishes to restore damaged or impaired areas.
 - b. Protect and maintain protection to ensure finished work will be without damage. Repair or replace finished work and materials defaced or destroyed prior to acceptance.

END OF SECTION 27 11 00

SECTION 271313

COMMUNICATIONS BACKBONE ISP TWISTED PAIR CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Backbone ISP (inside plant/indoor) twisted pair cabling.
- A. Base Bid Work
 - 1. Provide pre-construction services (e.g., submittals, coordination with other trades, etc.), materials, apparatus, labor, tools, equipment, and transportation required for complete communications backbone twisted pair cabling described in this section and shown on related drawings.
 - 2. The related drawings are diagrammatic in nature.
 - 3. In general, the base bid work includes:
 - a. Submittals
 - b. Backbone inside plant (riser) twisted pair (copper) cables and termination apparatus
 - c. Cable management
 - d. Cable identification tags and system labeling
 - e. Closeout documents
 - f. Warranty
- B. Related Sections
 - 1. Comply with the Related Sections requirements of section 270000.
 - 2. 270526, "Communications Grounding and Bonding"
 - 3. 270811, "Communications Twisted Pair Testing"
 - 4. 270528, "Communication Building Pathways"
 - 5. 270536, "Communication Building Pathways – Cable Trays"
- C. Work Covered Under Other Sections
 - 1. Pathways: The communications pathways (backbone conduits, riser sleeves, cable tray, etc.) work will be covered under another section. Refer to the drawings for size/capacity and route information.
 - 2. Rooms: Build out (e.g., backboards, overhead and vertical cable runway, etc.) of the rooms (BDFs, IDFs) will be covered under another section. Refer to the drawings for build out information.
 - 3. Testing: The backbone twisted pair cabling testing requirements are covered under another section. Refer to section 270811 for testing requirements.

1.2 REFERENCES

- A. Comply with References requirements of section 270000.

- B. In addition to the codes and standards listed in section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 444, "Communications Cables"
 - b. UL 497B, "Protectors for Data Communications and Fire-Alarm Circuits"
 - c. UL 1581, "Reference Standard for Electrical Wires, Cables, and Flexible Cords"
 - d. UL 1666, "Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts"
 - e. UL 1863, "Communications-Circuit Accessories"
 - 2. Insulated Cable Engineers Association (ICEA)
 - a. ANSI/ICEA S-90-661, "Category 3, 5, and 5e Individually Unshielded Twisted Pair Indoor Cable for Use In General Purpose and LAN Communication Wiring Systems"
 - 3. Telcordia
 - a. GR-111, "Generic Requirements for Thermoplastic Insulated Riser Cable"

1.3 DEFINITIONS

- A. Refer to section 270000 for Definitions.
- B. In addition to those Definitions of section 270000, the following list of terms as used in this specification defined as follows:
 - 1. "ALVYN": sheath type consisting of corrugated polymer-coated aluminum shield with and adhered flame retardant jacket
 - 2. "ARMM": Bell system cable type (shielded riser)
 - 3. "CMR": Communications Media Riser [NEC riser/non-plenum rating]
 - 4. "ISP": Inside Plant [cabling]
 - 5. "PE": Polyethylene
 - 6. "PIC": Plastic Insulated Conductor
 - 7. "PVC": Polyvinyl Chloride
 - 8. "PVDF": Polyvinylidene fluoride

1.4 SYSTEM DESCRIPTION

- A. Backbone twisted pair cabling shall consist of the cabling from the main telecommunications room to the telecommunications rooms or other locations that require analog, digital, or other non-network telecommunications services. Refer to the associated drawings for graphic representation of the system requirements, cabling routes, and quantities.
 - 1. Refer to other sections for pathways and cable support.
 - 2. Refer to other section for testing.

1.5 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of section 270000.
- B. Quantity: Furnish quantities of each submittal as noted in section 270000.
- C. Substitutions: Conform to substitutions requirements and procedures in section 270000.

- D. Submittal Requirements Prior To Start Of Construction:
 - 1. Product Data submittal, indicating specifications and conformance with CEC, UL, TIA listings, and other applicable certifications.
 - 2. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.
 - 3. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations.
- E. Submittal Requirements at Closeout:
 - 1. As-built drawings
 - 2. O&M Manuals
- F. Substitutions
 - 1. Requests for substitutions shall conform to the general requirements and procedure outlined in section 270000.

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of section 270000.
- B. Contractor Qualifications
 - 1. In addition to the Contractor Qualifications requirements of section 270000, the Contractor shall be manufacturer certified to install the proposed and submitted cabling system and to provide an extended warranty. Provide satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid submission.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of section 270000.

1.8 WARRANTY

- A. The telecommunications cabling system, as specified in this section, shall carry a 15-year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover electrical performance of cabling system to the specific category per TIA-568 performance criteria for backbone cabling.

PART 2 - PRODUCTS

2.1 UNSHIELDED TWISTED PAIR CABLES CAT5E – PLENUM

- A. Application:
 - 1. Cable suitable for indoor installation, within conduit system and between floors in vertical riser system
 - 2. Each cable run shall be a continuous single cable, homogenous in nature; splices are not permitted.

3. Twisted pair PIC type, air core cable.
- B. Conductors:
1. Annealed solid copper, 24 AWG
 2. Fully insulated, consisting of FEP or other thermoplastic.
 3. Conductors twisted into pairs are stranded into 25-pair bundles.
 4. Color Coding: Twisted pairs and units individually color-coded to industry standards (ANSI/ICEA Publication S-80-576, and EIA-230).
- C. Core and Sheath:
1. Cable sheath shall consist of an overall flame-retardant PVDF, or equivalent, jacket.
 2. NEC rated as CMP and UL listed as such.
- D. Performance:
1. Electrical performance of the twisted pairs and overall cable shall comply with the performance requirements of TIA-568 for Category 5e "Backbone Cable Transmission Performance".
- E. Certifications
1. UL 444, UL 1666
 2. C22.2 No. 214-02
 3. ETL Listed, or equal
- F. Manufacturers, or equal:
1. Berk-Tek
 - a. #10089521; Category 5e (Power Sum), 25 pair, 24 AWG, white, CMP rated

2.2 TERMINATION APPARATUS – CAT5E PATCH PANEL, PUNCH DOWN TYPE

- A. Application: Patch panels shall be suitable for installation within a TR for the termination of the horizontal cables specified herein. Panels shall be horizontally oriented for a rack-mounted configuration. Panels shall be capable of supporting, organizing, labeling and patching/crossconnecting between the horizontal termination field and the equipment termination field.
- B. Patch panel shall have punch down type termination (general 110-type), and shall be compatible with the specified horizontal cables both electrically and physically.
- C. Mechanical Performance: Each port shall be an 8-position modular jack, compliant to ANSI/TIA-568.
- D. Electrical Performance: Each port shall meet or exceed TIA-568 standard series and ISO/IEC 11801 requirements for CAT5E U/UTP cabling through the cable termination and patch cord connection.
- E. Manufacturer, or equal:
1. Leviton
 - a. #5G596-U24; flat patch panel, 1U, top labeling, 24 CAT5E ports

2.3 LABELS

- A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.
- B. Labels for Cables
 - 1. Labels shall be adhesive-backed and have a self-laminating feature.
 - 2. Labels shall fit the backbone cables listed above (i.e., shall fully wrap around the cable's jacket).
 - 3. Printable area should be 1 inch wide x 0.5 inch high, or larger.
 - 4. Printable area color shall be white.
 - 5. Manufacturer, or equal:
 - a. Panduit
 - 1) #S200X400YAJ; labels for 25 to 100 pair cables [0.32" (8.09mm) - 0.95" (24.26mm) dia.]
 - 2) #S200X650YAJ; labels for 100 to 400 pair cables [0.48" (12.13mm) – 1.59" (40.43mm) dia.]

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Rooms: Prior to installation, verify equipment rooms are suitable to accept the backbone twisted pair cables and terminations.
- B. Pathways: Prior to installation verify that pathways and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, "True Tape" the conduits).
- C. Cable Integrity: Prior to installation, verify the twisted pair cable is fully operational – both cable sheath and twisted pair conductors. Documentation of pre-installation testing is not a close out requirement and is the responsibility of the Contractor.

3.3 INSTALLATION

- A. Backbone Cable Installation and Routing
 - 1. Cable runs shall have continuous sheath continuity, homogenous in nature; splices are not permitted.
 - 2. Maximum cable length of 500 meters from the termination within the Entrance Facility to the termination in Telecommunications Room.
 - 3. Placement
 - a. Place cables within designated pathways.

- b. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.
 - c. Maintain pulling tension within manufacturer's limits.
 - d. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables if damaged during installation
 - e. Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of the pull rope.
4. Routing
- a. When routing horizontally within telecommunications rooms, utilize the overhead cable support. When routing vertically within telecommunications rooms, utilize the vertical cable support and provide cable ties every 24 inches on center using.
 - b. Route cables a minimum of 6" away from power sources to reduce interference from EMI.
5. Termination
- a. Provide 15 feet cable slack loop at each end of the run. Store slack in wall mounted storage ring cable support or as noted on drawings.
 - b. Properly relieve strain from cables at termination points per manufacturer's instructions.
 - c. Terminate twisted pairs onto the termination apparatus in accordance with manufacturer's latest instructions and TIA-568 standard installation practices.
 - d. Perform post-installation testing as described in section 270811.
- B. Termination Apparatus
- 1. Provide accessories required for a complete installation.
 - 2. Install the termination apparatus to the dimensions shown on the drawings. If the dimensions are not shown, install the termination apparatus such that the bottom row of terminations is no lower than 24 inches (+/- 3") AFF and the top row of terminations is no higher than 60 inches (+/- 3") AFF.
 - 3. Mount termination apparatus plumb and square.
- C. General Requirements
- 1. Labeling and identifier assignment and the label colors shall conform to the TIA-606 Administration Standard and as approved by Owner or Owner's Representative before installation.
 - 2. Provide permanent and machine-generated labels; hand written labels will not be accepted.
- D. Cable Labels
- 1. Label Format:
 - a. Label type shall be wrap-around self-laminating.
 - b. Label color shall be white background with clear laminating window.
 - c. Text color shall be black; text height shall be 1/8" high, minimum, or #12 font size.
 - 2. Provide labels on both ends of cables. Fully wrap label around the cable jacket. Install labels no more than 4 inches from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.
- E. Termination Apparatus Labels
- 1. Use labels included in the product packaging. For substitutions, request approval by the Engineer.
 - 2. Label color shall be white for respective field type, per TIA-606.
 - 3. Text color shall be black, 3/32" high, minimum, or #10 font size.

F. Identifier Assignment

1. General: Separate label fields of the identifier with a hyphen.
2. Backbone ISP Twisted Pair Cables
 - a. The first field: the originating MDF/BDF room identity; for example: "AD1.1".
 - b. The second field: the destination BDF/IDF room identify; for example: "AD3.1".
 - c. The third field: the cable type; for example: "C25" (copper 25 pair).
 - d. The fourth field: beginning pair count served from originating room; for example: "01".
 - e. The fifth field: ending pair count served from originating room; for example: "25"
 - f. Identifier Example: "AD1.1-AD3.1-C25-01-25"

3.4 FINAL INSPECTION AND CERTIFICATION

- A. Punch the work of this section compliant to the requirements of section 270000.
- B. Remove and replace with new, at no cost to the Owner, cables or conductors failing to meet the indicated standards and not passing the testing requirements of section 270811. The Owner, or Owner's Representative, will not accept the installation until testing has indicated a 100% availability of all cables and conductors or the Owner or Owner's Representative has approved any deviation from this requirement.
- C. Comply with system acceptance and certification requirements of section 270000.

END OF SECTION

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SECTION 271314

COMMUNICATIONS BACKBONE OSP TWISTED PAIR CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Backbone OSP (outside plant) twisted pair cabling.
- B. Related Sections
 - 1. Comply with the Related Sections requirements of Section 270000.
 - 2. Section 270811, "Communications Twisted Pair Testing"

1.2 REFERENCES

- A. Comply with References requirements of Section 270000.
- B. In addition to the codes and standards listed in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 497, "Protectors for Paired-Conductor Communication Circuits"
 - b. UL 497A, "Secondary Protectors for Communications Circuits"
 - c. UL 497B, "Protectors for Data Communications and Fire-Alarm Circuits"
 - d. UL 497C, "Protectors for Coaxial Communications Circuits"
 - e. UL 1863, "Communications-Circuit Accessories"
 - 2. Insulated Cable Engineers Association (ICEA)
 - a. ANSI/ICEA S-107-704-2012, "Broadband Buried Service Wire, Filled, Polyolefin Insulated, Copper Conductor Technical Requirements"

1.3 DEFINITIONS

- A. Refer to Section 270000 for Definitions.
- B. In addition, define the following list of terms as used in this specification as follows:
 - 1. "BEP": Building Entrance Protection [systems]
 - 2. "CMP": Communications Media Plenum [NEC plenum rating]
 - 3. "CMR": Communications Media Riser [NEC riser/non-plenum rating]
 - 4. "HDPE": High Density Polyethylene
 - 5. "ISP": Inside Plant [cabling]
 - 6. "LDPE": Light Density Polyethylene
 - 7. "OSP": Outside Plant [cabling]
 - 8. "PE": Polyethylene
 - 9. "PIC": Plastic Insulated Conductor
 - 10. "PVC": Polyvinyl Chloride

1.4 SYSTEM DESCRIPTION

- A. Work Provided Under Other Sections
 - 1. Telecommunications Pathways
 - a. Pathways (underground conduits, maintenance holes, pull boxes, pull ropes, etc.) will be provided under other Sections.
 - b. Refer to the Drawings for size/capacity and route information.
 - 2. Telecommunications Rooms
 - a. Buildout (e.g., backboards, overhead and vertical cable runway, etc.) of the telecommunications rooms (MDF, BDFs, IDF) work will be covered under another Section.
 - b. Refer to the Drawings for buildout information.
- B. Base Bid Work
 - 1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working telecommunications backbone twisted pair cabling system installation described in these specifications and shown on related Drawings.
 - 2. The Drawings are diagrammatic in nature.
 - 3. Consider Backbone cabling as shown on Drawings as base bid work, unless otherwise noted. This includes terminations at both ends.
 - 4. In general, the base bid work includes:
 - a. Submittals
 - b. Backbone outside plant (interbuilding) twisted pair (copper) cables and terminations
 - c. Cable management
 - d. Crossconnects
 - e. Cable identification tags and system labeling
 - f. Record Documents
 - g. Warranty

1.5 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.
- B. Submittal Requirements Prior To Start Of Construction:
 - 1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
 - 2. Schedule Submittal, consisting of proposed schedule of Work. This schedule may be combined with the schedule developed for other Sections within Division 27.
 - 3. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations.
- C. Submittal Requirements at Closeout:
 - 1. As-Built Drawings.
 - 2. Crossconnection records/cut sheets.
 - 3. O & M Manuals.

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of Section 270000.

- B. Contractor Qualifications
 - 1. In addition to the Contractor Qualifications requirements of Section 270000, the Contractor shall be manufacturer certified to install the proposed and submitted cabling system and to provide an extended warranty. Provide satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid submission.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

- A. The communications cabling system, as specified in this Section, shall carry a 15-year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover electrical performance of cabling system to the specific category per ANSI/TIA-568-C performance criteria for backbone cabling.

PART 2 - PRODUCTS

2.1 UNDERGROUND CABLES – DUCT/CONDUIT

- A. Application:
 - 1. Cable shall be suitable for underground conduit installations.
 - 2. Each and every cable run shall be a continuous single cable, homogenous in nature. Splices are not permitted anywhere.
 - 3. Cable type shall be PIC twisted pair, filled core, with an “ALPETH” sheath and compatible with Bell System type “ANMA” or RDUP type “PE89-AL”.
- B. Conductors:
 - 1. Solid, annealed copper, 24 AWG
 - 2. Fully insulated conductors consisting of an inner layer of expanded polyolefin, covered with an outer layer (skin) of solid polyolefin
 - 3. Conductors twisted into pairs. Twisted pairs are stranded into 25-pair bundles and into units (and super units, if required by pair count)
 - 4. Color Coding: Twisted pairs and units (supper units, if necessary) individually color-coded to industry standards (ANSI/ICEA Publication S-80-576, and EIA-230)
- C. Core & Sheath:
 - 1. Cable core shall have a tape applied longitudinally (wrapped around its entirety)
 - a. Tape Material: non-hydrosopic dielectric (polypropylene) film, or equivalent
 - 2. Cable core and sheath flooded (interstices between the pairs and under the core tape) with filling compound to protect against moisture penetration
 - a. Filling compound: 80°C ETPR compound, or equivalent
 - 3. Sheath Type: “ALPETH”. Sheath consists of a shield and an outer jacket
 - a. Shield: Corrugated bare 8 mil aluminum tape applied longitudinally over the core wrap
 - b. Outer Jacket: PE, black, with UV inhibitors, bonded to shield

- D. Standards Compliance:
 - 1. UL 444
 - 2. RoHS-compliant

- E. Manufacturers:
 - 1. Superior Essex
 - a. #09-100-77; 50 pair, 24 AWG, filled core, ALPETH/ANMA

2.2 LABELS

- A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.

- B. Labels for Cables
 - 1. Labels shall be adhesive-backed and have a self-laminating feature
 - 2. Labels shall fit the backbone cables listed above (i.e., shall fully wrap around the cable's jacket).
 - 3. Printable area should be 1 inch wide x 0.5 inch high, or larger
 - 4. Printable area color shall be white
 - 5. Manufacturer:
 - a. Panduit
 - 1) #S200X400YAJ; labels for 25 to 100 pair cables [0.32" (8.09mm) - 0.95" (24.26mm) dia.]
 - 2) #S200X650YAJ; labels for 100 to 400 pair cables [0.48" (12.13mm) – 1.59" (40.43mm) dia.]
 - b. Or equal

2.3 DUCT PLUGS

- A. Plug shall create a watertight seal.

- B. Manufacturer:
 - 1. Tyco
 - a. #40S136S; simplex plug for 4-inch conduit, cable OD 1.19-1.36
 - b. #40S196SB; simplex plug for 4-inch conduit, cable OD 1.38-1.96
 - c. #40S256SB; simplex plug for 4-inch conduit, cable OD 1.92-2.56
 - d. #40S291SB; simplex plug for 4-inch conduit, cable OD 2.56-2.91
 - e. #40S327SB; simplex plug for 4-inch conduit, cable OD 2.91-3.27
 - f. #40B167S; "triplex" plug for 4-inch conduit, with 3 ports
 - g. #40Q136S; "quadplex" plug for 4-inch conduit with 4 ports
 - 2. Carlon
 - a. #MATPG3; "triplex" duct plug for 4-inch conduit, with 3 ports (1.53"-1.67")
 - 3. Or equal

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Rooms: Prior to installation, verify equipment rooms are suitable to accept the backbone twisted pair cables and terminations.
- B. Pathways: Prior to installation verify that pathways and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, "True Tape" the conduits).
- C. Cable Integrity: Prior to installation, verify the twisted pair cable is fully operational – both cable sheath and twisted pair conductors. Documentation of pre-installation testing is not a close out requirement, and is the responsibility of the Contractor.

3.3 INSTALLATION

- A. OSP Interbuilding Backbone Cable
 - 1. Cable runs shall have continuous sheath continuity, homogenous in nature, between either termination points or designated splices points. Only splices as noted on the Construction Documents are permitted.
 - 2. Maximum cable length of 1,500 meters between termination points.
 - 3. Placement
 - a. Place cables within designated pathways.
 - b. Maintain a minimum bend radius of 6 times the cable diameter during installation.
 - c. Maintain pulling tension within manufacturer's limits. Only use UL approved cable-pulling compounds when necessary to reduce pulling tensions.
 - d. Protect cable during installation. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cable if damaged during installation.
 - e. Neatly dress and organize cables in the cable routing facilities, and fastened to support devices via tie wraps.
 - f. Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of the pull rope.
 - 4. Routing:
 - a. When routing horizontally within telecommunications rooms, utilize the overhead cable support; route backbone cables to avoid crossing over horizontal cabling or horizontal cabling crossing backbone cabling. When routing vertically within telecommunications rooms, utilize the vertical cable support and provide cable ties every 24 inches on center using.
 - b. Route cables a minimum of 6" away from power sources to reduce interference from EMI.
 - 5. Duct Plugs
 - a. Provide duct plugs into each duct port in maintenance holes/pullboxes and building entrances.
 - 6. Termination
 - a. Provide 15 feet cable slack loop at each end of the run. Store slack in overhead cable support or as noted on Drawings.
 - b. Properly strain relieve cables at designated points per manufacturer's instructions.
 - c. Terminate copper pairs at both ends on the specified termination apparatus. Perform terminations in accordance with manufacturer's instructions and ANSI/TIA-568-C standard installation practices.
 - 7. Labeling

- a. Provide labels on each end of the cable, no more than 4" from where the cable enters the specified termination apparatus.
- b. Place labels such that they are visible by a technician from a normal stance.

B. Termination Apparatus

1. Install the termination apparatus such that the bottom row of terminations is at a height as shown on the Drawings. If no height is shown, install bottom at 24" AFF (+/- 3").
2. Provide accessories required for a complete installation.
3. Mount blocks plumb and square.

C. Crossconnects

1. In the MDF, provide one 1-pair crossconnect to length from the equipment field to the backbone field based on the records from the IDF crossconnections.
2. Utilize the horizontal and vertical management components to properly route the crossconnect wire.
 - a. Splices in crossconnect wire are prohibited.

3.4 LABELING

A. General Requirements

1. Labeling and identifier assignment and the label colors shall conform to the TIA/EIA-606-A Administration Standard and as approved by Owner or Owner's Representative before installation.
2. Provide permanent and machine-generated labels; hand written labels will not be accepted.

B. Cable Labels

1. Label Format:
 - a. Label type shall be wrap-around self-laminating.
 - b. Label color shall be white background with clear laminating window.
 - c. Text color shall be black; text height shall be 1/8" high, minimum, or #12 font size.
2. Provide labels on both ends of cables. Fully wrap label around the cable jacket. Install labels no more than 4 inches from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

C. Protection and Termination Apparatus Labels

- a. Use labels included in the product packaging. Request approval by the Engineer for substitutions.
- b. Label color shall be for respective field type, per TIA/EIA-606-A.
- c. Text color shall be black, 3/32" high, minimum, or #10 font size.

D. Identifier Assignment

1. General: Separate label fields of the identifier with a hyphen.
2. Cables
 - a. The first field shall identify the cable type: "CBT" (for Cable, Backbone, Twisted pair).
 - b. The second field shall identify the originating termination room identifier as shown on the plans; e.g., "MDF1.1".
 - c. The third field shall identify the ending termination room identifier as shown on the plans; e.g., "BDF2.1".
 - d. The fourth field shall identify the beginning and ending pair counts.
 - e. Identifier Example: "CBT-MDF1.1-BDF2.1-0401-0600"

3. Termination Positions on the BEP Terminal Cover
 - a. The first field shall identify the opposite end's room; for example "TO BDF2.1".
 - b. The second field shall identify the pair count range; for example, "0401-0500"
 - c. Identifier Example: "TO BDF2.1 0401 - 0500"

3.5 FINAL INSPECTION AND CERTIFICATION

- A. Punch the Work of this Section compliant to the requirements of Section 270000.
- B. Remove and replace with new, at no cost to the Owner, cables or conductors failing to meet the indicated standards and not passing the testing requirements of Section 270811. The Owner, or Owner's Representative, will not accept the installation until testing has indicated a 100% availability of all cables and conductors or the Owner or Owner's Representative has approved any deviation from this requirement.
- C. Comply with system acceptance and certification requirements of Section 270000.

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SECTION 271323

COMMUNICATIONS BACKBONE ISP FIBER OPTIC CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Backbone ISP (indoor) fiber optic cabling.
- B. Related Sections
 - 1. Comply with the Related Sections paragraph of Section 270000.
 - 2. 270821 Communication Fiber Optic Testing

1.2 REFERENCES

- A. Comply with References requirements of Section 270000.
- B. In addition to the codes and standards listed in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 1569, "Metal-Clad Cables"
 - b. UL 1651, "Optical Fiber Cable"
 - 2. Insulated Cable Engineers Association (ICEA)
 - a. ANSI/ICEA S-83-596-1994, "Fiber Optic Premises Distribution Cable"
 - 3. Telcordia
 - a. GR-20-CORE, Issue 3, "Generic Requirements for Optical Fiber and Optical Fiber Cable"
 - b. GR-409-CORE, Issue 2, "Generic Requirements for Indoor Fiber Optic Cable"

1.3 DEFINITIONS

- A. Refer to Section 270000 for Definitions.
- B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
 - 1. "MM": Multimode [fiber type]
 - 2. "OFCP": Optical Fiber Conductive Plenum, plenum rating
 - 3. "OFCR": Optical Fiber Conductive Riser, non-plenum riser rating
 - 4. "OFNP": Optical Fiber Non-conductive Plenum, plenum rating
 - 5. "OFNR": Optical Fiber Non-conductive Riser, non-plenum riser rating
 - 6. "OFN": Optical Fiber Non-conductive, general purpose indoor rating
 - 7. "PVC": PolyVinyl Chloride
 - 8. "SM": Singlemode [fiber type]

1.4 SYSTEM DESCRIPTION

- A. Work Covered Under Other Sections
 - 1. Pathways: The communications pathways (backbone conduits, riser sleeves, basketway, cable tray, etc.) work will be covered under another Section. Refer to the drawings for size/capacity and route information.
 - 2. Rooms: Build out (e.g., backboards, overhead and vertical cable support, etc.) of the telecommunications rooms will be covered under another Section. Refer to the drawings for build out information.
- B. Base Bid Work
 - 1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working telecommunications backbone fiber optic cabling system installation described in these specifications and shown on related drawings.
 - 2. The drawings are diagrammatic in nature.
 - 3. Consider Backbone cabling, as shown on drawings, as base bid work, unless otherwise noted, including terminations at both ends.
 - 4. In general, the base bid work includes:
 - a. Submittals
 - b. Backbone inside plant (riser) fiber optic cables and terminations
 - c. Bonding (cable armor, termination apparatus, etc)
 - d. Cable management
 - e. Crossconnections / patching.
 - f. Cable identification tags and system labeling
 - g. Record Documents
 - h. Warranty

1.5 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.
- B. Submittal Requirements Prior To Start Of Construction:
 - 1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
 - 2. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.
 - 3. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations
- C. Submittal Requirements at Closeout:
 - 1. Copy of the manufacturer's printed reel documentation, including the following.
 - a. Manufacturer's reel number
 - b. Manufacturer's traceable batch number
 - c. Length of the fiber cable on the reel
 - d. Maximum attenuation
 - e. Minimum bandwidth
 - 2. As-Built Drawings
 - 3. Crossconnection records/cut sheets
 - 4. O&M Manuals
- D. Substitutions
 - 1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of Section 270000.
- B. Contractor Qualifications
 - 1. In addition to the Contractor Qualifications requirements of Section 270000, the Contractor shall be manufacturer certified to install the proposed and submitted cabling system and to provide an extended warranty. Provide satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid submission.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

- A. The backbone fiber optic cabling system, as specified in this section, shall carry a 15-year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover optical performance of cabling system.

PART 2 - PRODUCTS

2.1 FIBER OPTIC CABLE – INTERLOCKED ARMOR PLENUM RATED

- A. Application:
 - 1. Cable shall be suitable for indoor installation, between floors in vertical riser system, under access flooring, and through overhead ceiling space (in basketway, cable tray, conduit, and/or hangers).
 - 2. Optical transmission performance shall not be significantly affected by environmental fluctuations, installation, or aging.
 - 3. Materials shall not evolve hydrogen in quantities that will increase light attenuation.
- B. Multimode 50/125 μm fiber strands shall meet or exceed the following geometry criteria:
 - 1. Core diameter = 50 μm , $\pm 3.0 \mu\text{m}$
 - 2. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$
 - 3. Core/Cladding Concentricity = $\leq 3 \mu\text{m}$
 - 4. Minimum Tensile Strength = 100,000 psi
- C. Multimode 50/125 μm fiber strands shall meet or exceed the following performance criteria:
 - 1. Attenuation = 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm wavelengths, maximum
 - 2. Overfilled Bandwidth = 1,500 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum
 - 3. Effective Modal Bandwidth = 2,000 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum
- D. Singlemode fiber strands shall meet or exceed the following geometry criteria:
 - 1. Core diameter = 8.3 μm

2. Mode field diameter = 8.8 μm , $\pm 0.5 \mu\text{m}$
3. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$
4. Core/Cladding Concentricity = $\leq 0.8 \mu\text{m}$
5. Minimum Tensile Strength = 100,000 psi

- E. Singlemode fiber strands shall meet or exceed the following performance criteria:
1. Attenuation = 0.7 dB/km at 1310 nm and 0.7 dB/km at 1550 nm wavelengths, maximum
 2. Cutoff wavelength = 1260 nm
 3. Dispersion = 3.5 ps/nm•km at 1285-1330 nm and 18 ps/nm•km at 1550 nm
 4. Singlemode fiber shall meet the specifications of the following:
 - a. International Telecommunication Union (ITU) ITU-T G.652.D classification for low water peak (LWP) singlemode fiber
 - b. International Electrotechnical Commission (IEC) 60793-2-50 "Sectional Specification for Class B single-mode fibres", Class B1.3
- F. Primary Coating:
1. Each fiber shall be completely covered with a "primary coating" (acrylate material).
 2. Coating diameter = 250 μm , $\pm 5 \mu\text{m}$
- G. Buffering:
1. Each coated fiber shall be fully covered with a material extruded over and directly onto the coating. This shall be the tight buffer. Tight buffer diameter = 900 μm , $\pm 5 \mu\text{m}$. Material = PVC, or equivalent flame retardant thermoplastic.
 2. Buffered strands shall be individually color-coded to meet the requirements of ANSI/TIA/EIA-598-A-1995. (Also, ref. ANSI/ICEA S-83-596-1994, and EIA-230)
- H. Cable Sheath:
1. Strength Element: The cable shall have an internal strength element such as aramid yarn (e.g., Kevlar).
 2. Inner Jacket: The cable shall have a seamless inner jacket (material = PVC, or equivalent) applied to and completely covering the internal components (fiber strands, strength element, other).
 3. Armor: The cable shall have an interlocking metallic armor applied spirally and longitudinally to and completely covering the cable.
 4. Outer Jacket: The cable shall have a seamless outer jacket (material = PVC, or equivalent) applied to and completely covering the armor.
 5. Tensile Strength: The cable shall have a 150-lb, minimum, rated load.
 6. Flame Rating: NEC (Article 770) rated as OFCP, and UL listed as such.
- I. Manufacturer, or equal:
1. Berk-Tek
 - a. #PDPK012FB3010/F5-I/O-C4(AQU); 12 strand, 50/125 μm , interlock armor, aqua, OFCR rated
 2. Berk-Tek
 - a. #PDPK012AB0707-I/O-C4C5(YEL); 12 strand, singlemode, interlock armor, yellow, OFCR rated

2.2 TERMINATION APPARATUS – FIBER OPTIC PATCH PANELS

- A. Application:
1. Fiber optic patch panels shall be an enclosed housing for protecting, storing and organizing the termination of fiber cable(s) and fiber strands, shall provide means to

- strain relieve and support of the specified cables, shall contain facilities to store fiber slack, and shall provide patch cord management.
 - 2. Fiber optic patch panels shall be passive physical equipment and apparatus used in terminating, interconnecting, and cross-connecting fiber optic cabling, shall possess a minimum fire resistant rating of UL94V-1, and shall conform to existing OSHA Health and Safety Laws.
 - 3. Fiber optic patch panels shall be rack-mountable.
- B. Fiber optic patch panels shall come equipped with safety labels such as laser identification or warning labels as required by system considerations.
- C. Manufacturer, or equal:
- 1. Leviton
 - a. #5R1UH-S03; Opt-X 2000i SDX – 1RU Fiber Enclosure, sliding tray, accepts 3 adapter plates, (72 LC’s)
 - b. #5F100-2QL; Fiber Adapter plate – 12 Fiber LC 50um, OM3/4
 - c. #5F100-2LL; Fiber Adapter plate – 12 Fiber LC Single-Mode, OS2
 - d. #5F100-PLT; Fiber Adapter Plate - Blank

2.3 FIBER OPTIC CONNECTORS

- A. Multimode Fiber Optic Connectors – LC Type
- 1. Materials:
 - a. Ferrule: ceramic with pre-radiused finish/face
 - b. Connector Housing: Plastic
 - 2. Connector shall have an integral strain relief feature, including a bend limiting rear boot.
 - 3. Manufacturer, or equal:
 - a. Leviton
 - 1) #54PLC-M03; 1 – Fiber 50/125 um, OM4 LC, 3 meter
- B. Singlemode Fiber Optic Connectors – LC Type
- 1. Materials:
 - a. Ferrule: ceramic (zirconia or alumina) with pre-radiused finish/face
 - b. Connector housing: plastic
 - 2. Connector shall meet or exceed Ultra PC performance (LC-UPC).
 - 3. Connector shall have an integral strain relief feature, including a bend limiting rear boot.
 - 4. Manufacturer, or equal:
 - a. Leviton
 - 1) #UPPLC-S03; 1 – Fiber Single-Mode, OS2 LC, 3 meter

2.4 LABELS

- A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.
- B. Labels for Cables
- 1. Labels shall be adhesive-backed and have a self-laminating feature
 - 2. Labels shall fit the backbone cables listed above (i.e., shall fully wrap around the cable’s jacket).
 - 3. Printable area should be 1-inch wide x 0.5 inch high, or larger
 - 4. Printable area color shall be white
 - 5. Manufacturer:

- a. Brother P-Touch Labels
 - 1) #TZe231; .50" / 12mm Black on White, 110 Blocks, fiber enclosures
 - 2) #TZeFX241; .75" / 18mm Black on White, Flex Tape – Cable Rapping

2.5 MISCELLANEOUS

- A. Fiber Slack Storage Reel: Leviton #48900-OFR
- B. Velcro Cable Ties
 - 1. Width: .75".
 - 2. Color: Velcro cable ties the same color as the cable to which it is being applied.
 - 3. Manufacturers:
 - a. Panduit
 - 1) #HLS-15R-0 Black, 15' roll, cut to length.
 - b. Or equal

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Pathways: Prior to installation verify pathways (conduits, etc.) and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, "True Tape" the conduits).
- B. Rooms: Prior to installation, verify equipment rooms are ready for cables and terminations.
- C. Prior to installation, verify cables and conductors are fully operational – both cable sheath and fiber strands. Pre-installation testing is the responsibility of the Contractor, though documentation of pre-installation testing is not a close out requirement.

3.3 INSTALLATION

- A. Backbone Cable Installation, Routing, and Termination
 - 1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
 - 2. Do not exceed 500 meters optical conductor length from the termination within the Entrance Facility/BDF IDF.
 - 3. Placement
 - a. Place cables within designated pathways.
 - b. Maintain a minimum bend radius of 20 times the cable diameter during installation, and a minimum bend radius of 10 times the cable diameter after installation.
 - c. Maintain pulling tension within manufacturer's limits.

- d. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.
 - e. Do not use cable-pulling compounds for indoor installations.
 - f. Provide 20 to 30 feet of cable slack at each end within the Telecommunications Rooms; store slack in fiber slack storage reel mounted on the wall.
 - g. Place a pull rope along with cables where run in pathways and spare capacity in the pathway remains. Tie off ends of the pull rope.
4. Routing
- a. Within Telecommunications Rooms, neatly dress and organize cables on designated cable support apparatus (for example, overhead and vertical cable support), and fasten cables to cable support apparatus via tie wraps or Velcro-type straps.
5. Termination
- a. Properly relieve strain from cables at termination points (at/within the fiber optic termination panels) per manufacturer's instructions.
 - b. Bond cable armor to grounding point (busbar) – refer to section 270526 for additional information.
 - c. Terminate fiber strands via pigtail splicing at both ends using the specified fiber optic pigtail appropriate for the mode type of the fiber. Splicing type shall be fusion; mechanical splicing will not be accepted. Perform terminations in accordance with manufacturer's instructions.
 - d. Provide required accessories and consumables for the complete termination of fiber strands.
 - e. Provide 3 feet of unsheathed fiber (tight buffer) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the 'routing rings', per manufacturer's instructions. Include 'extension' slack loop/fold in the rear of the shelf to allow for the drawer to be pulled out without putting tension on the fibers.

B. Fiber Optic Cable Termination Panel

- 1. Provide fully assembled termination panel in designated equipment rack; locate per drawings (if not shown, locate at the top). "Fully assembled" includes installation and mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.
- 2. Provide accessories required for proper installation of each termination panel, including connector panels and adapters.
- 3. Bond termination apparatus to grounding point (busbar) – refer to section 270526 for additional information.

3.4 LABELING

A. General Requirements

- 1. Labeling, identifier assignment, and the label colors shall conform to the TIA/EIA-606-A Administration Standard and as approved by Owner or Owner's Representative before installation.
- 2. Provide permanent and machine generated labels; hand written labels will not be accepted.

B. Cable Labels

- 1. Label Format:
 - a. Label type shall be wrap-around self-laminating.
 - b. Label color shall be white background with clear laminating window.

- c. Text color shall be black; text height shall be 1/8" high, minimum, or #12 font size.
2. Provide labels on both ends of cables. Fully wrap label around the cable jacket. Install labels no more than 4 inches from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

C. Termination Apparatus Labels

1. Use labels included in the product packaging. For substitutions, request approval by the Engineer.
2. Label color shall be white for respective field type, per TIA/EIA-606-A.
3. Text color shall be black, 3/32" high, minimum, or #10 font size.

D. Identifier Assignment

1. General: Separate all label fields of the identifier with a hyphen.
2. Backbone ISP Fiber Optic Cables
 - a. The first field: the originating MDF/BDF room identity; for example: "AD1.1".
 - b. The second field: the destination BDF/IDF room identify; for example: "AD3.1".
 - c. The third field: the cable type; for example: "F6" (fiber optic, 50/125 multimode).
 - d. The fourth field: beginning strand count served from originating room; for example: "01".
 - e. The fifth field: ending strand count served from originating room; for example: "12"
 - f. Identifier Example: "AD1.1-AD3.1-F6-01-12"

3.5 FINAL INSPECTION AND CERTIFICATION

- A. Punch the Work of this Section compliant to the requirements of Section 270000.
- B. Remove and replace with new, at no additional cost, cables with conductors failing to meet the indicated standards and not passing the testing requirements of Section 270821. The Owner, or Owner's Representative, will not accept the installation until testing has indicated a 100% availability of cables and conductors or the Owner or Owner's Representative has approved in writing any deviation from this requirement.
- C. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION

SECTION 271324

COMMUNICATIONS BACKBONE OSP FIBER OPTIC CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backbone outside plant (OSP) fiber optic cabling
 - 2. Outside plant innerduct
 - 3. Conduit and innerduct plugs
- B. Related Sections
 - 1. Comply with the Related Sections paragraph of Section 270000
 - 2. 270821 Communication Fiber Optic Testing
 - 3. 271323 Communication Backbone ISP Fiber Optic Cabling

1.2 REFERENCES

- A. Comply with References requirements of Section 270000.
- B. In addition to the codes and standards listed in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 1651, "Optical Fiber Cable"
 - b. UL 1666, "Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts"
 - 2. Insulated Cable Engineers Association (ICEA)
 - a. ANSI/ICEA S-87-640-1999, "Fiber Optic Outside Plant Communications Cable"
 - b. ANSI/ICEA S-104-696-2001, "Indoor-Outdoor Optical Cable"
 - 3. Telcordia
 - a. GR-20-CORE, Issue 3, "Generic Requirements for Optical Fiber and Optical Fiber Cable"

1.3 DEFINITIONS

- A. Refer to Section 270000 for Definitions.
- B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
 - 1. "HDPE": High Density Polyethylene
 - 2. "LDPE": Light Density Polyethylene
 - 3. "MDPE": Medium Density Polyethylene
 - 4. "MM": Multimode [fiber type]
 - 5. "OSP": Outside Plant [cabling]
 - 6. "PE": Polyethylene
 - 7. "SM": Singlemode [fiber type]

1.4 SYSTEM DESCRIPTION

- A. Work Covered Under Other Sections
 - 1. Pathways: The communications pathways (underground conduits, maintenance holes, pull boxes, innerducts, pull ropes, etc.) work will be covered under another Section. Refer to the Drawings for size/capacity and route information.
 - 2. Rooms: Build out (e.g., backboards, overhead and vertical cable support, etc.) of the rooms (MDF, BDFs, IDF) will be covered under another Section. Refer to the Drawings for build out information.
- B. Base Bid Work
 - 1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working telecommunications backbone fiber optic cabling system installation described in this Section and shown on related Drawings.
 - 2. The Drawings are diagrammatic in nature, and require shop drawings to complete the detailed design of the telecommunications infrastructure.
 - 3. Consider Backbone cabling, as shown on Drawings, as base bid work, unless otherwise noted, including terminations at both ends.
 - 4. In general, the base bid work includes:
 - a. Submittals
 - b. Backbone outside plant (OSP) fiber optic cables and terminations
 - c. Innerduct
 - d. Cable management
 - e. Crossconnections / patching.
 - f. Cable identification tags and system labeling
 - g. Record Documents
 - h. Warranty

1.5 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.
- B. Submittal Requirements Prior To Start Of Construction:
 - 1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
 - 2. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.
 - 3. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations.
- C. Submittal Requirements at Closeout:
 - 1. Copy of the manufacturer's printed reel documentation, including the following.
 - a. Manufacturer's reel number
 - b. Manufacturer's traceable batch number
 - c. Length of the fiber cable on the reel
 - d. Maximum attenuation
 - e. Minimum bandwidth
 - 2. As-Built Drawings
 - 3. Crossconnection records/cut sheets
 - 4. O & M Manuals

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of Section 270000.
- B. Contractor Qualifications
 - 1. In addition to the Contractor Qualifications requirements of Section 270000, the Contractor shall be manufacturer certified to install the proposed and submitted cabling system and to provide an extended warranty. Provide satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid submission.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

- A. The communications cabling system, as specified in this Section, shall carry a 15-year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover optical performance of cabling system.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Comply with the Substitutions requirements of Section 270000.

2.2 FIBER OPTIC CABLE – INDOOR/OUTDOOR, NON-PLENUM/RISER RATED

- A. Application:
 - 1. Cable shall be suitable for outdoor installations within underground pathways system and/or within innerduct/sub-ducting, and for indoor installation, between floors in vertical riser system, under access flooring, and through overhead ceiling space (in basketway, cable tray, conduit, and/or hangers).
 - 2. Optical transmission performance shall not be significantly affected by environmental fluctuations, installation, or aging.
 - 3. Materials shall not evolve hydrogen in quantities that will increase light attenuation.
- B. Multimode 50/125 μm fiber strands shall meet or exceed the following geometry criteria:
 - 1. Core diameter = 50 μm , $\pm 3.0 \mu\text{m}$.
 - 2. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$.
 - 3. Core/Cladding Concentricity = $\leq 3 \mu\text{m}$.
 - 4. Minimum Tensile Strength = 100,000 psi.
- C. Multimode 50/125 μm fiber strands shall meet or exceed the following performance criteria:
 - 1. Attenuation = 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm wavelengths, maximum.

- D. Singlemode fiber strands shall meet or exceed the following geometry criteria:
1. Core diameter = 8.3 μm .
 2. Mode field diameter = 8.8 μm , $\pm 0.5 \mu\text{m}$.
 3. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$.
 4. Core/Cladding Concentricity = $\leq 0.8 \mu\text{m}$.
 5. Minimum Tensile Strength = 100,000 psi.
- E. Singlemode fiber strands shall meet or exceed the following performance criteria:
1. Attenuation = 0.5 dB/km at 1300 nm and 0.5 dB/km at 1550 nm wavelengths, maximum.
 2. Cutoff wavelength = 1260 nm.
 3. Dispersion = 3.5 ps/nm•km at 1285-1330 nm.
 4. Singlemode fiber shall meet the specifications of the following:
 - a. International Telecommunication Union (ITU) ITU-T G.652.D classification for low water peak (LWP) singlemode fiber
 - b. International Electrotechnical Commission (IEC) 60793-2-50 "Sectional Specification for Class B single-mode fibres", Class B1.3
- F. Sheath:
1. Sheath shall consist of a strength member and an outer jacket, with non-metallic component dielectric sheath.
 2. Strength Member: Aramid yarn (e.g., Kevlar®), or reinforced fiberglass rods.
 3. Jacket: Fluoropolymer Thermoplastic.
 4. Flame Rating: NEC (Article 770) rated as OFNR, and UL listed as such.
 5. Rated tensile load: 600 lb. maximum rated load.
 6. Operating Temperature Range: -40 to 158°F (-40 to 70°C)
 7. Installation Temperature Range: -22 to 140°F (-30 to 60°C)
- G. Manufacturer:
1. Leviton
 - a. #PDR12B036-I/O(BLA)FB3010/F5; Multimode - Bend Insensitive, gel-free outdoor/indoor OFNR cable, 36-strand 50/125 μm
 2. Leviton
 - a. # PDR12B048-I/O(BLA)AB0707; Singlemode - Bend Insensitive, gel-free outdoor/indoor OFNR cable, 48-strand
 3. Or equal

2.3 LABELS

- A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.
- B. Labels for Cables
1. Labels shall be adhesive-backed and have a self-laminating feature
 2. Labels shall fit the backbone cables listed above (i.e., shall fully wrap around the cable's jacket).
 3. Printable area should be 1 inch wide x 0.5 inch high, or larger
 4. Printable area color shall be white
 5. Manufacturer:
 - a. Panduit
 - 1) #S200X225YAJ; labels cables 0.24" (6.06mm) - 0.48" (12.13mm) dia.
 - 2) #S200X400YAJ; labels for cables 0.32" (8.09mm) - 0.95" (24.26mm) dia.
 - 3) #S200X650YAJ; labels for cables 0.48" (12.13mm) - 1.59" (40.43mm) dia.

- b. Or equal
- C. Fiber Slack Storage Reel: Leviton #48900-OFR, or equal
- D. Velcro Cable Ties
 - 1. Width: .75".
 - 2. Color: Velcro cable ties, same color as the cable to which it is being applied.
 - 3. Manufacturers:
 - a. Panduit
 - 1) #HLS-15R-0 Black, 15' roll, cut to length
 - b. Or equal

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Pathways: Prior to installation verify that duct banks, ducts, maintenance holes, pullboxes, and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, "True Tape" the conduits).
- B. Rooms: Prior to installation, verify equipment rooms are ready for cables and terminations.
- C. Prior to installation, verify cables and conductors are fully operational – both cable sheath and fiber strands. Pre-installation testing is the responsibility of the Contractor, though documentation of pre-installation testing is not a close out requirement.

3.3 INSTALLATION

- A. Backbone Cable Installation and Routing
 - 1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere, unless expressly shown on the Drawings or approved in writing by the Engineer prior to installation.
 - 2. Do not exceed 1,500 meters optical conductor length.
 - 3. Placement
 - a. Install cables within designated pathways. Place OSP cables in innerduct between points of termination throughout entire length (except at the fiber take up reel).
 - b. Maintain a minimum bend radius of 20 times the cable diameter during installation, and a minimum bend radius of 10 times the cable diameter after installation.
 - c. Maintain pulling tension within manufacturer's limits. Use a pulling tension meter when using mechanical assistance during installation. Record maximum pulling tension for each cable run, and submit to the Engineer for review if requested. Replace runs when manufacturer's maximum pulling tension is exceeded.

- d. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.
 - e. Only use UL approved cable-pulling compounds when necessary to reduce pulling tensions.
 - f. Provide 20 to 30 feet (minimum) cable slack at each end within the Telecommunications Rooms; store slack in fiber slack storage reel mounted on the wall.
 - g. Place a pull rope along with cables where run in pathways (e.g., conduit) and spare capacity in the pathway remains. Tie off ends of the pull rope.
4. Routing
- a. Within Telecommunications Rooms, neatly dress and organize cables on designated cable support apparatus (for example, overhead cable tray or vertical cable runway), and fasten cables to cable support apparatus via tie wraps or Velcro-type straps.
5. Termination
- a. Properly relieve strain from cables at termination points (at/within the fiber optic termination panels) per manufacturer's instructions.
 - b. Bond cable armor to grounding point (busbar) – refer to section 270526 for additional information.
 - c. Provide breakout kits to furcate fibers from buffer tubes.
 - d. Terminate/connectorize fiber strands at both ends using the specified fiber optic connectors appropriate for the mode type of the fiber. Perform terminations in accordance with manufacturer's instructions.
 - e. Provide required accessories and consumables for complete termination of fiber strands.
 - f. Provide 3 feet of unsheathed fiber (including buffer tube and broken out from the buffer tube) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the 'routing rings', per manufacturer's instructions. Include 'extension' slack loop/fold in the rear of the shelf to allow for the drawer to be pulled out without putting tension on the fibers.

B. Fiber Optic Cable Termination Panel

- 1. Provide fully assembled termination panel in designated equipment rack; locate per Drawings (if not shown, locate at the top). "Fully assembled" includes installation and mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.
- 2. Provide accessories required for proper installation of each termination panel, including connector panels and adapters.
- 3. Bond termination apparatus to grounding point (busbar) – refer to section 270526 for additional information.

3.4 LABELING

A. General Requirements

- 1. Labeling, identifier assignment, and the label colors shall conform to the TIA/EIA-606-A Administration Standard and as approved by Owner or Owner's Representative before installation.
- 2. Provide permanent and machine generated labels; hand written labels will not be accepted.

- B. Cable Labels
 - 1. Label Format:
 - a. Label type shall be wrap-around self-laminating.
 - b. Label color shall be white background with clear laminating window.
 - c. Text color shall be black; text height shall be 1/8" high, minimum, or #12 font size.
 - 2. Provide labels on both ends of cables. Fully wrap label around the cable jacket. Install labels no more than 4 inches from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

- C. Termination Apparatus Labels
 - 1. Use labels included in the product packaging. For substitutions, request approval by the Engineer.
 - 2. Label color shall be for respective field type, per TIA/EIA-606-A.
 - 3. Text color shall be black, 3/32" high, minimum, or #10 font size.

- D. Identifier Assignment
 - 1. General: Separate all label fields of the identifier with a hyphen.
 - 2. Backbone OSP Fiber Optic Cables
 - a. The first field shall identify the cable type: "CBF" (for Cable, Backbone, Fiber optic).
 - b. The second field shall identify the originating termination room identifier as shown on the plans; e.g., "MDFA.1".
 - c. The third field shall identify the ending termination room identifier as shown on the plans; e.g., "BDF1.1".
 - d. The fourth field shall identify the type and number of strands; for example, "Mxxx" where "M" stands for multimode and xxx stands for the ending fiber strand sequential count
 - e. Identifier Example: "CBF-MDFA.1-BDF1.1-M145-M192"
 - 3. Termination Positions at the Termination Panels
 - a. Make the first field of the identifier the destination room; for example "TO IDF2.2".
 - b. Make the second field of the identifier the strand count range; for example, "M025-M048"
 - c. Identifier Example: "TO BDF1.1 M145-M192".

3.5 FINAL INSPECTION AND CERTIFICATION

- A. Punch the Work of this Section compliant to the requirements of Section 270000.
- B. Remove and replace with new, at no cost to the Owner, cables or conductors failing to meet the indicated standards and not passing the testing requirements of Section 270821. The Owner, or Owner's Representative, will not accept the installation until testing has indicated a 100% availability of all cables and conductors or the Owner or Owner's Representative has approved any deviation from this requirement.
- C. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION

APPENDIX A – Laney College Conduit Survey (Following Page 8)

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SECTION 271513

COMMUNICATIONS HORIZONTAL TWISTED PAIR CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Horizontal twisted pair cabling
- B. Base Bid Work
 - 1. Provide pre-construction services (e.g., submittals, coordination with other trades, etc.), materials, apparatus, labor, tools, equipment, and transportation required for complete communications horizontal twisted pair cabling described in this section and shown on related drawings.
 - 2. In general, the base bid work includes:
 - a. Submittals
 - b. Horizontal cables, terminations, and outlets
 - c. Cable support and management
 - d. Patch cords, and cord management
 - e. Cable identification tags and system labeling
 - f. Closeout documents
 - g. Warranty
 - 3. Identifiers and Labeling: The scope of work herein includes the responsibility for assigning identifiers to each horizontal cabling link and related cabling media in addition to providing physical labeling to each component.
- C. Related Divisions and Sections
 - 1. Comply with the Related Divisions and Sections requirements of section 270000
 - 2. 270811, "Communications Twisted Pair Testing"
 - 3. 271313, "Communications Backbone Twisted Pair Cabling"
 - 4. 270528, "Communications Building Pathways"
 - 5. 270536, "Communications Building Pathways – Cable Trays"
- D. Work Provided Under Other Sections
 - 1. Pathways: Communications pathways (cable tray, conduits, stubs, etc.) are covered under another section. Refer to the drawings for type, size/capacity and route information. Refer to sections 270528 and 270536 and to the drawings for requirements, buildout information and layouts.
 - 2. Rooms: Telecommunications room buildout (e.g., backboards, rack bays, overhead and vertical cable support, etc.) is covered under another section. Refer to section 271100 and to the drawings for requirements, buildout information and layouts.
 - 3. Testing: The horizontal cabling system testing requirements are covered under another section. Refer to section 270811 for testing requirements.

1.2 REFERENCES

- A. Comply with the References requirements of section 270000.

- B. In addition to the codes and standards listed in section 270000, comply with the latest edition (or as noted) of the following applicable specifications and standards except as otherwise shown or specified:
1. National Fire Protection Agency (NFPA)
 - a. NFPA 255, "Standard Method of Test of Surface Burning Characteristics of Building Materials"
 - b. NFPA 259, "Standard Test Method for Potential Heat of Building Materials"
 - c. NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces"
 2. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 444, "Communications Cables"
 - b. UL 1863, "Communications-Circuit Accessories"
 3. Insulated Cable Engineers Association (ICEA):
 - a. ICEA S-116-732, "Standard for Category 6 and 6A, 100 Ohm, Individually Unshielded Twisted Pairs, Indoor Cables (With Or Without An Overall Shield) for Use in LAN Communications Wiring Systems"
 - b. ANSI/ICEA S-107-704, "Standard for Broadband Buried Service Wire, Filled, Polyolefin Insulated, Copper Conductor Technical Requirements"

1.3 DEFINITIONS

- A. The Definitions in section 270000 apply to this section.
- B. In addition, define the following list of terms as used in this specification as follows:
1. "Cabling": cabling consists of cables, connectors (jacks, plugs), termination apparatus (panels, blocks, outlets, etc.), consolidation points, connecting media (patch cords, line cords, etc.), and labeling/identification.
 2. "CAT6A": Category 6 Augmented performance grade
 3. "Channel": End to end transmission path; e.g., the Permanent Link and connecting media such as line cord (at the workstation), patch cord, and (if a full crossconnection is implemented) the crossconnect termination/connecting apparatus and equipment cord.
 4. "CMP": Communications Media Plenum [plenum rating]
 5. "FEP": Fluorinated Ethylene Propylene
 6. "F/UTP": twisted pair cabling with an overall foil shield
 7. "FTP": synonymous with "F/UTP", unless otherwise noted
 8. "ID": identifier
 9. "BDF": Building Distribution Facility
 10. "PE": Polyethylene
 11. "Permanent Link": Test configuration for a horizontal cabling link excluding patch cords, equipment cords, and line cords; e.g., the permanent portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used), termination/connecting apparatus in the telecommunications and the connector at the outlet.
 12. "PVC": Polyvinyl chloride
 13. "IDF": Intermediate Distribution Facility
 14. "U/UTP": twisted pair cabling with no shield
 15. "UTP": synonymous with "U/UTP", unless otherwise noted

1.4 SYSTEM DESCRIPTION

- A. Horizontal twisted pair cabling shall consist of the cabling from telecommunications rooms to outlets/connectors at work areas, to equipment, to devices, or other items that require network connections or other telecommunications services.
 - 1. Refer to other sections for pathways and cable support.
 - 2. Refer to other section for testing.

- B. Cabling Length Requirements: Note that cable length means the electrical length (pair length), not the sheath length. Also, length requirements must account for test equipment accuracy tolerances (for example, TIA568-C.2 allows for 10% uncertainty).
 - 1. The maximum electrical length of any permanent link shall not exceed 90 meters. If consolidation points or multi-user outlets are used, then the lengths shall not exceed those listed in the TIA-568 standard and the cabling system manufacturer's guidelines (whichever is shorter).
 - 2. The maximum electrical length of any channel shall not exceed 100 meters. If consolidation points or multi-user outlets are used, or if the total length of cords needs to exceed 10 meters, then the permanent link lengths shall not exceed those listed in the TIA-568 standard and the cabling system manufacturer's guidelines (whichever is shorter).
 - 3. The minimum electrical length of any permanent link shall be no shorter than as required by the manufacturer (as described in written guidelines).

- C. Jack Wiring: Jacks shall be wired to T568B configuration.

1.5 SUBMITTALS

- A. Comply with the Submittals requirements of section 270000.
- B. Quantity: Furnish quantities of each submittal as noted in section 270000.
- C. Substitutions: Conform to substitutions requirements and procedures in section 270000.
- D. Submittal requirements prior to the start of construction:
 - 1. Product Data submittal, indicating specifications and conformance with CEC, UL, TIA listings, and other applicable certifications.
 - 2. Schedule submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for 27xxxx series sections
 - 3. Shop Drawings submittal, consisting of proposed changes to cable routing, or termination locations/configurations

- E. Submittal requirements at closeout:
 - 1. As-Built Drawings: Submit a set of floor plans and (as appropriate) RCPs showing the location of every complement of cabling with its respective ID – these as-built drawings may be combined with those showing the pathways (cable trays, conduits, etc.). The IDs on the shop drawings shall exactly match the physical labeling applied to cabling components.
 - 2. Link ID –to– Office Number Key: Submit a “link ID-to-office number key” as an electronic format (such as an MS-Excel spreadsheet file or cloud-based medium) that lists every permanent link associated with the final location / office number.
 - 3. Crossconnection records/cut sheets

4. Operations and Maintenance (O&M) Manuals

F. Posted Documentation

1. Post one full size plot of as-built drawings, specifically the floor plans and (as applicable) reflected ceiling plans, within TRs showing each TR's serving area. Coordinate location with Owner.

1.6 QUALITY ASSURANCE

- A. Comply with the Quality Assurance requirements of section 270000.

B. Contractor Qualifications

1. In addition to the Contractor Qualifications requirements of section 270000, the Contractor shall be an approved member in good standing of the Leviton Certified Installer network. The Contractor shall maintain a certified RCDD on staff and utilize manufacturer trained, Union certified, or BICSI certified installers.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Delivery, Storage and Handling requirements of section 270000.

1.8 WARRANTY

- A. Provide to the Owner a Limited Lifetime Product and Performance Warranty covering all components of the horizontal cabling system (cables, jacks, panels, patch cords, equipment, workmanship, etc.). The warranty shall guarantee the cabling system performance to the Category specified herein. Submit a written warranty statement with system documentation. The warranty period shall begin on the system's first use by the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Berk-Tek Leviton Technologies cabling system (no other substitutions allowed)

2.2 SUBSTITUTIONS

- A. Comply with the Substitutions requirements of section 270000.

2.3 HORIZONTAL CABLE – CAT6A U/UTP PLENUM RATED (CMP)

- A. Application: Suitable for indoor installation, within ceiling space in primary and secondary pathways, within access/raised floor space.

- B. Conductors:
 1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = FEP, or similar).
 2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair) color-coded to industry standards (EIA-230).
- C. Cable Sheath:
 1. Shielding: none
 2. Outer Jacket: seamless outer jacket (material = LS-PVC, or similar) applied to and completely cover the internal components (twisted pairs).
- D. Flame Rating: CMP, UL listed as such, and the rating shall be printed on the jacket.
- E. Electrical and Mechanical Performance: Meet or exceed requirements of TIA-568 standard series, ANSI/ICEA S-116-732, ISO 11801 Class E_A Edition 2.2, and IEEE Std. 802.3an channel for CAT6A cabling.
- F. Limited Power: UL certified as “Limited Power (LP)”, and the rating shall be printed on the jacket.
 1. Listed to 0.5 A per conductor.
- G. Jacket marking: “CMP–LP (0.5A)”
- H. Manufacturer:
 1. Berk-Tek LANmark-SST CAT6A U/UTP Plenum Rated (CMP) Cable
 - a. #11101842; CAT6A 4 pair U/UTP cable, CMP, blue

2.1 HORIZONTAL CABLE – CAT6A U/UTP INDOOR/OUTDOOR PLENUM RATED (CMP)

- A. Application: Suitable for indoor installation, within ceiling space in primary and secondary pathways, within access/raised floor space.
- B. Conductors:
 1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = FEP, or similar).
 2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair) color-coded to industry standards (EIA-230).
- C. Cable Sheath:
 1. Shielding: none
 2. Filled: No, Dry core
 3. Outer Jacket: seamless outer jacket (material = LS-PVC, or similar) applied to and completely cover the internal components (twisted pairs).
- D. Flame Rating: CMP, UL listed as such, and the rating shall be printed on the jacket.
- E. Electrical and Mechanical Performance: Meet or exceed requirements of TIA-568 standard series, ANSI/ICEA S-116-732, ISO 11801 Class E_A Edition 2.2, and IEEE Std. 802.3an channel for CAT6A cabling.

- F. Limited Power: UL certified as “Limited Power (LP)”, and the rating shall be printed on the jacket.
 - 1. Listed to 0.8 A per conductor.
- G. Jacket marking: “CMP–LP (0.8A)”
- H. Color: White
- I. Manufacturer, or equal:
 - 1. General Cable:
 - a. #7141001

2.2 TERMINATION APPARATUS – CAT6A PATCH PANEL, PUNCH DOWN TYPE

- A. Application: Panels shall be suitable for installation within a TR for the termination of the horizontal cables specified herein. Panels shall be horizontally oriented for a rack-mounted configuration. Panels shall be capable of supporting, organizing, labeling and patching/crossconnecting between the horizontal termination field and the equipment termination field.
- B. Modular patch panel shall have 110-type termination, and shall be compatible with the specified horizontal cables both electrically and physically.
- C. Mechanical Performance: Each port shall be an 8-position modular jack, compliant to ANSI/TIA-568.
- D. Electrical Performance: Each port shall meet or exceed TIA-568 standard series and ISO/IEC 11801 requirements for CAT6A U/UTP cabling through the cable termination and patch cord connection.
- E. Manufacturer:
 - 1. Leviton 110-Style CAT6A Patch Panels
 - a. #6A586-U24; flat modular patch panel, 1U, 24 CAT6A ports
 - b. #6A586-U48; flat modular patch panel, 2U, 48 CAT6A ports

2.3 TERMINATION APPARATUS – CAT6A MODULAR 8-POSITION CONNECTORS, UNSHIELDED

- A. Application: Modular connectors, i.e., jacks and plugs, shall be used for the termination of 4-pair U/UTP cables, and shall be compatible – both electrically and physically – with the cables specified herein.
- B. Mechanical Performance: Modular connectors shall be 8-position, compliant to TIA-568 standard series.
- C. Electrical Performance: Modular connectors shall meet or exceed TIA-568 standard series and ISO/IEC 11801 requirements for CAT6A U/UTP cabling.

- D. Manufacturer:
 - 1. Leviton "Atlas-X1" Series CAT6A Jacks
 - a. #6AUJK-RL6; modular 8-position jack, CAT6A, blue

2.4 WORK AREA OUTLETS – FLUSH-MOUNT FACEPLATES

- A. Application: Faceplates shall be suitable for indoor installation for standard 1-gang and 2-gang flush-mount devices.
- B. Faceplates shall have 2, 4, or 6 ports, and shall include required accessories, such as icons, blank inserts, label windows and labels.
- C. Color: White
- D. Manufacturer:
 - 1. Leviton "QuickPort" Type, with label windows
 - a. #42080-2WS; "QuickPort" faceplate, 1-gang, 2 ports, white
 - b. #42080-4WS; "QuickPort" faceplate, 1-gang, 4 ports, white
 - c. #42080-6WS; "QuickPort" faceplate, 1-gang, 6 ports, white

2.5 WORK AREA OUTLETS – FACEPLATES FOR WALL PHONE OUTLETS

- A. Application: Faceplates shall be suitable for indoor installation for standard 1-gang flush-mount device equipped with 1 modular jack and two mounting studs for standard wall-mount telephones.
- B. Faceplates shall include required accessories, such as icons, blank inserts, label windows and labels.
- C. Color: Finish shall be stainless steel.
- D. Manufacturer:
 - 1. Leviton
 - a. #4108W-1SP; wall phone faceplate, stainless steel, recessed port
 - b. #4108W-0SP; wall phone faceplate, stainless steel

2.6 SURFACE MOUNT BACK BOXES – INDOOR

- A. Application: Surface mount back boxes shall be suitable for indoor installation for surface mounting to support an outlet or device.
- B. Color: White
- C. Manufacturer, or equal:
 - 1. Leviton
 - a. #42777-1WA; surface mount back box, 1 gang, 1.89"D, white
 - b. #42777-2WA; surface mount back box, 2 gang, 1.89"D, white

2.7 CONNECTOR ADAPTERS AND BRACKETS

A. Drop Wire Jack/Box Bracket

1. Application: Brackets shall retain and hold in place connectors and attach to a drop wire, such as within a ceiling space; brackets shall be fully compatible with the connectors/connector accessories specified herein.
2. Manufacturer, or equal:
 - a. Leviton
 - 1) #49223-CBC; QuickPort bracket with clip for drop wire, galvanized
 - 2) #49223-W10; Plenum Rated In-Ceiling Bracket

B. In-Box Jack Bracket

1. Application: Brackets shall retain and hold in place connectors within a back box; brackets shall be fully compatible with the connectors/connector accessories specified herein and with a standard gang ring.
2. Manufacturer, or equal:
 - a. Leviton
 - 1) #49223-BA5; QuickPort in-wall / in-box bracket, galvanized

C. Adapters for Poke-Thru Devices

1. Application: Adapters shall retain and hold in place connectors within a poke-thru floor device; adapters shall be fully compatible with both the poke-thru floor device and the connectors/connector accessories specified herein. An example use is a termination configuration serving a wireless access point (Wi-Fi WAP).
2. Manufacturer, or equal:
 - a. Wiremold
 - 1) #CM2-U2KEYA-WH; bezel adapter, accepts 2 keystone mount connectors, white

2.8 FACEPLATES FOR FURNITURE FEEDS

- A. Application: Suitable for indoor installation for standard 1-gang flush-mount device box with round opening allowing cables to freely exit (towards furniture system entry).
- B. Color: White
- C. Manufacturer, or equal:
 1. Leviton
 - a. #80704-W; faceplate with 1.4" round opening, white

2.9 LABELS

- A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.
- B. Labels shall be permanent, unless otherwise noted.

C. Cable and Wire Labels

1. Labels for cables and wires shall be either of the following types:
 - a. Tape – adhesive-backed, wrap-around, self-laminating
 - b. Strip – adhesive backed, under shrink-wrap
2. Face stock (print area) shall be white.
3. Size: as needed per cable size/diameter and to fit the full identifier (at least 1" wide).
4. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
 - 1) #S100X125YAJ; self-laminating cable label, white face stock (1"W x 0.38"W), for cable diameters 0.12"-0.28"
 - 2) #S100X150YAJ; self-laminating cable label, white face stock (1"W x 0.5"W), for cable diameters 0.16"-0.32"
 - 3) #S100X225YAJ; self-laminating cable label, white face stock (1"W x 0.75"W), for cable diameters 0.24"-0.48"

D. Patch Panel Labels

1. Application: For patch panels that do not have an integrated labeling feature and do not come packaged with labeling parts.
2. Patch panel labels shall be adhesive backed, and shall fit within the area suitable for labeling the ports on the panel.
3. Face stock (print area) shall be white.
4. Size: as needed.
5. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
 - 1) #C061X030FJJ; component label, laser/inkjet print, white face stock, 0.61"W x 0.3"H
 - 2) #C125X030FJJ; component label, laser/inkjet print, white face stock, 1.25"W x 0.3"H
 - 3) #C150X030Y1J; component label, laser/inkjet print, white face stock, 1.50"W x 0.3"H
 - 4) #C188X030FJJ; component label, laser/inkjet print, white face stock, 1.88"W x 0.3"H
 - 5) #C252X030FJJ; component label, laser/inkjet print, white face stock, 2.52"W x 0.3"H

E. Faceplate Labels

1. Application: For faceplates that do not have an integrated labeling feature and do not come packaged with labeling parts.

2. Labels for faceplates shall be adhesive backed, and shall fit within the area for labeling the faceplate.
3. Face stock (print area) shall be white.
4. Size: as needed.
5. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
 - 1) #C061X030FJJ; component label, laser/inkjet print, white face stock, 0.61"W x 0.3"H
 - 2) #C125X030FJJ; component label, laser/inkjet print, white face stock, 1.25"W x 0.3"H
 - 3) #C150X030Y1J; component label, laser/inkjet print, white face stock, 1.50"W x 0.3"H
 - 4) #C188X030FJJ; component label, laser/inkjet print, white face stock, 1.88"W x 0.3"H
 - 5) #C252X030FJJ; component label, laser/inkjet print, white face stock, 2.52"W x 0.3"H

F. Faceplate Port Labels

1. Application: For faceplates that do not have an integrated port identifying feature.
2. Labels for ports of faceplates shall be adhesive backed, and shall fit within the area suitable for applying a label per port on the faceplate.
3. Face stock (print area) shall be white.
4. Size: as needed.

G. Surface Outlet Labels

1. Application: For surface outlets that do not have an integrated labeling feature and do not come packaged with labeling parts.
2. Labels for surface mount outlets shall be adhesive backed, and shall fit within the area for labeling the outlet box and for labeling ports of the outlet box.
3. Face stock (print area) shall be white.
4. Size: as needed.
5. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
 - 1) #C061X030FJJ; component label, laser/inkjet print, white face stock, 0.61"W x 0.3"H
 - 2) #C125X030FJJ; component label, laser/inkjet print, white face stock, 1.25"W x 0.3"H

- 3) #C150X030Y1J; component label, laser/inkjet print, white face stock, 1.50"W x 0.3"H
- 4) #C188X030FJJ; component label, laser/inkjet print, white face stock, 1.88"W x 0.3"H
- 5) #C252X030FJJ; component label, laser/inkjet print, white face stock, 2.52"W x 0.3"H

2.10 MISCELLANEOUS COMPONENTS

A. Loom Tubing

1. Application: manage and protect cables from feed point to furniture system, or similar
2. Manufacturer, or equal:
 - a. Panduit
 - 1) #CLT100F-C20; split corrugated loom tubing (polyethylene), 0.91" ID, black
 - 2) #CLT125F-L20; split corrugated loom tubing (polyethylene), 1.28" ID, black
 - 3) #CLT150F-T20; split corrugated loom tubing (polyethylene), 1.58" ID, black
 - 4) #CLT188F-C20; split corrugated loom tubing (polyethylene), 1.85" ID, black

B. Velcro Cable Ties

1. Width: .75".
2. Manufacturer, or equal:
 - a. Panduit "Tak-Ty" series cable ties
 - b. Panduit
 - 1) #HLS-15R0; black, 15' roll, cut to length

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Rooms: Prior to installation, verify equipment rooms are suitable to accept the horizontal cables and terminations.
- B. Pathways: Prior to installation verify that pathways and supporting devices, provided under other sections, are properly and completely installed (at least the portions into which cables will be placed), and that temporary supports, devices, etc., have been removed. Cable tray shall be complete prior to placing cables within them, per CEC (at least the portions into which cables will be placed). Verify dimensions of pathways, including length (for example, "True Tape" the conduits) to ensure that the resulting cable lengths will not exceed the maximum allowable length specified herein.

- C. Cable Integrity: Prior to installation, verify the cable's integrity – both sheath and conductors. Documentation of pre-installation testing is not a close out requirement, and is the responsibility of the Contractor.

3.3 INSTALLATION

A. Cable Installation and Routing

1. No cable length shall violate the requirements stated in "System Description".
2. Cables shall have continuous sheath continuity. Splices are not permitted anywhere.
3. Install cables within the cable manufacturer's published installation temperature range.
4. Place cables within designated pathways, such as cable tray, cable hangers, etc. Do not fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc.), other systems (such as ceiling support wires, wall studs, etc.), or to the outside of conduits, cable trays, or other non-approved pathway systems.
5. Place and suspend cables during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination.
6. In general, route cables at 90-degree angles, along corridors (for improved maintenance and access).
7. Do not bend cables tighter than 2 inches during and after installation.
8. Do not exceed manufacturer's limits for pulling tension.
9. Do not use cable-pulling compounds / pulling lubricants for indoor installations.
10. Route cables under building infrastructure (such as ducts, pipes, conduits, etc.) – to result in easy accessibility to the cables for future maintenance.
11. Place cables at least 6 inches away from power sources – to reduce interference from EMI.
12. Neatly dress and organize cables using designated cable routing facilities, and fasten to support devices via Velcro-type straps.
13. When exiting primary pathways (such as cable tray) to the work area, exit via the top of the pathway.
14. Cable Ties: Install cables ties, where allowed, tight enough to keep cables organized/managed but loose enough to be moved about the cables/cable bundles. Cable ties shall not deform or cinch cables too tightly. Tie installed too tightly per the Engineer's opinion shall be subject to removal upon direction from the Engineer.

B. Cable Routing and Dressing within the TR

1. Place cables within the overhead cable support. When routing vertically, fasten the cables onto vertical cable support approximately every 24 inches using approved cable fastening means.
2. At the rack bay, route cables within the back of the vertical management sections (do not route cables into the front as this space is reserved for patch cords only). Divide the cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination. Dress and cut cables to length required to reach the designated termination point (maintaining bend restrictions) with no excess cable slack left in the horizontal cable manager (if used) and vertical management section.
3. Do not provide slack within the TR.

C. Termination in the TR

1. Install and assemble termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.
2. Properly strain relieve cables at termination points per manufacturer's instructions.

3. For OSP cables, apply sealant (such as B-sealant) where the pairs exit the cable jacket to seal the end of the cable and prevent water-blocking gel from leaking from the cable's sheath.
 4. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and TIA-568 series standard installation practices. Terminate cable pairs onto the termination apparatus. Terminate twisted pairs compliant to TIA-568 series standards and wired per 1.04 System Description.
 5. Patch Panels and Horizontal Management Panels
 - a. Quantity: Provide patch panels to support termination of cables. Provide horizontal management panels based on the quantity of patch panels.
 - b. Install and assemble discrete port patch panels and horizontal management panels according to the manufacturer's instructions.
 - c. Install the patch panels and the horizontal management panels as shown on the contract drawings. If configuration is not shown, install the patch panels in association with the horizontal management panels such that a management panel is mounted above and below given patch panel.
 6. Termination Sequence
 - a. Terminate the cables in sequential order using the link's identifier starting at the top left and completing a panel before moving to the next panel below.
- D. Cable Routing and Dressing at the Work Areas
1. Leave 2-4 feet sheathed cable slack (20 feet for WAPs and SEC WAPs) – length not to exceed permanent link maximum length requirement. Store slack within ceiling space neatly on a cable hanger.
 2. Routing to Type "B" Furniture-Mount Faceplates
 - a. While placing cables into furniture, exercise caution to prevent scraping, cutting, or other damage to cable's jacket.
 - b. Provide spiral wrap around cables from furniture-feed pathway (such as a wall feed to the point where cables enter furniture).
- E. Termination at the Work Areas
1. Mount faceplates plumb, square, and at the same level as adjacent device faceplates.
 2. Patch gaps around faceplates so that faceplate covers the entire opening.
 3. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and TIA-568 series standard installation practices and wired per 1.04 System Description.
- F. Perform post-installation testing as described in the Telecommunication Testing specification (refer to section 270811). Replace permanent links (cables, terminations and connectors) not passing the required tests.
- 3.4 LABELING
- A. General Requirements
1. Labeling, identifier assignment, and label colors shall conform to the TIA-606 standard and as approved by the Owner before installation.
 2. Label text shall be machine-generated; hand written labels will not be accepted.
- B. Label Formats and Text Attributes
1. Horizontal Cable Labels
 - a. Labels for cables shall be wrap-around self-laminating type.
 - b. Labels shall be permanent.

- c. Text Attributes: color: black; size: approx. 1/8" high (#12 font size).
- 2. Termination Field \ Patch Panel Labels
 - a. Labels for cables shall be adhesive-backed polyester (or similar) type.
 - b. Label color shall be white.
 - c. Text Attributes: color: black; size: approx. .35" high
- 3. Termination Field \ Termination Block Labels
 - a. Use labels included in the block kit packaging. Any deviation from this requirement must be approved in writing by the Owner
 - b. Label color shall be white.
 - c. Text Attributes: color: black; size: approx. .50" high.
- 4. Outlet Labels
 - a. Labels for cables shall be adhesive-backed polyester (or similar) type.
 - b. Label color shall be white.
 - c. Text Attributes: color: black; size: approx. .35" high.
- 5. Outlet Port Labels
 - a. (These labels are in the case that the faceplate/surface outlet does not have port numbers stenciled or molded into the product.)
 - b. Labels for cables shall be adhesive-backed polyester (or similar) type.
 - c. Label color shall be white.
 - d. Text Attributes: color: black; size: approx. .35" high.

C. Identifier System

- 1. General: Separate fields of the identifier with a hyphen.
- 2. Individual Ports at Patch Panels
 - a. First field: the end user room number; for example: "D107".
 - b. Second field: outlet port number, for example "D1".
 - c. Example: "D107-D1"
- 3. Outlets (Faceplates, Surface Outlets, etc.)
 - a. First field: the originating BDF/IDF room number; for example: "AD1.1".
 - b. Second field: the destination room number; for example: "D107".
 - c. Third field: a unique sequential number; for example: "01".
 - d. Example: "AD1.1-D107-01"
- 4. Individual Ports at the Outlets
 - a. The specified faceplate has individual port numbers molded into the product. However, if a substitution is accepted that does not have port numbers, provide port labels as follows.
 - b. First field: the cables intended service type followed by a unique sequential number, for example "D1".
- 5. Horizontal Cables
 - a. First field: the originating BDF/IDF room identity; for example: "AD1.1".
 - b. Second field: the destination room number; for example: "D107".
 - c. Third field: a unique sequential outlet number, for example "01".
 - d. Fourth field: a unique port number, for example "D1".
 - e. Fifth field: the cable type; for example: "CAT6A"
 - f. Example: "AD1.1-D107-01-D1-CAT6A"

D. Label Installation

- 1. Horizontal Cable Labels
 - a. Install labels on both ends of cables no more than 4" from the edge of the cable jacket.
 - b. Install labels such that they are visible during normal maintenance.
- 2. Termination Group\Patch panel ports
 - a. Install labels on the front and on left side.

- b. Install labels such that they are visible during normal maintenance.
- 3. Termination Port\Patch panel ports
 - a. If the patch panel does not have individual port numbers stenciled on the product, then install port labels at each port – above the top row and below the bottom row.
- 4. Outlet Labels
 - a. Install label in the top label window. Leave the bottom label window blank.
- 5. Outlet Port Labels
 - a. If the outlet does not have individual port numbers stenciled or molded into the product, then install port labels at each port – either to the sides (preferred) or above the top row and below the bottom row.

3.5 FINAL INSPECTION AND CERTIFICATION

- A. Punch the work of this section compliant to the requirements of section 270000.
- B. Remove cables and replace with new without impact to cost and schedule those failing to meet the indicated standards and not passing the testing requirements of section 270811. The Owner will not accept the installation until testing has indicated a 100% availability of cables and conductors. Any deviation from this requirement must be approved in writing by the Owner.
- C. Comply with system acceptance and certification requirements of section 270000.

END OF SECTION

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SECTION 272133

WIRELESS ACCESS POINTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Wireless network access system supporting multiple wireless services and consisting of access points/radios, switches, controllers, etc. – herein “System”.
- B. Base Bid Work
 - 1. Provide, whether specifically mentioned herein or not, equipment, materials, labor, on-site and remote project management, tools, transportation, storage, temporary protection, insurance, bonds, permits, taxes, software, licenses, integration, inspections, testing, training, warranties required for a complete, balanced and fully operational System. This specification and the associated drawings list major equipment but not every wire, connector, bracket, support, etc., needed to complete the work in a functional and professional manner. Coordinate the work of this section through the General Contractor with other trades.
 - 2. In general, the base bid work includes the following:
 - a. Project management
 - b. Wireless access points, including installation accessories (clips, brackets, hangers, etc.)
 - c. External antennas
 - d. External antenna cable extensions
 - e. In-line lightning arrestors (for exterior antenna connections)
 - f. Installation of patch cords for WAPs
 - g. Coordinate deployment with the construction team
 - h. Coordinate deployment and integration with the network integrator
 - i. Coordinate deployment and integration with the Owner
 - j. Coordinate integration with voice system integrator
 - k. Installation and system balancing
 - l. System acceptance testing and turn over to the Owner
 - 3. As requested by the Inspector of Record (IOR), produce and submit supporting, anchoring, and fastening details that demonstrate compliance with project requirements.
 - 4. Coordination requirements
 - a. Coordinate with the construction team at large to ensure equipment is installed properly, and that there will be no compromises due to, among other aspects, spatial conflicts or mounting incompatibilities.
 - b. Coordinate with the telecom contractor and other trades/contractors (as needed) the cabling to support WAPs and the patch cords.
 - c. Coordinate with the telecom contractor (or Owner) for locations within racks for installing equipment”
 - d. Coordinate with the Owner (or Owner’s network provider) for network configurations and/or settings required for the System’s proper or correct operation.
- C. Products furnished but not installed under this section
 - 1. None
- D. Products installed but not furnished under this section
 - 1. Network patch cords

- E. Work Provided Under Other Sections
 - 1. Communications cabling (cabling from telecommunications rooms to WAPs)
 - 2. Communications rooms, including equipment support/racks, power, cooling, and grounding
 - 3. Patch cords

- F. Related Sections: Review other sections and divisions; determine the extent and character of related work. Coordinate the work of this section with, but not limited to, the following:
 - 1. Comply with the Related Sections requirements of section 270000
 - 2. Section 271513, "Communications Horizontal Twisted Pair Cabling"

1.2 REFERENCES

- A. Comply with the References requirements of section 270000.

- B. In addition to the codes and standards listed in section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Federal Communications Commission (FCC) Title 47 of the Code of Federal Regulations (CFR):
 - a. Part 15, "Radio Frequency Devices"
 - b. Part 24, "Personal Communications Services"
 - c. Part 27, "Miscellaneous Wireless Communications Services"

1.3 DEFINITIONS

- A. Definitions as described in section 270000 shall apply to this section.

- B. In addition to those definitions of section 270000, the following list of terms as used in this specification are defined as follows:
 - 1. "802.11a": Wireless networking using 5 GHz frequency spectrum
 - 2. "802.11b/g": Wireless networking using 2.4 GHz frequency spectrum
 - 3. "802.11a/b/g/n": Wireless networking using both 2.4 GHz and 5 GHz spectrums
 - 4. "802.11ac": Wireless networking Wave-1 and Wave-2 using 5 GHz frequency spectrum
 - 5. "AP": access point
 - 6. "AWS": Advanced wireless services
 - 7. "BIM": Building Information Model
 - 8. "IOR": Inspector of Record
 - 9. "LAN": Local area network
 - 10. "LBS": Location based services
 - 11. "PCS": Personal communications service
 - 12. "RF": Radio frequency
 - 13. "RFID": Radio frequency identification
 - 14. "RSSI": Received signal strength indication
 - 15. "RTLS": Real time location services
 - 16. "WAP": Wireless Access Point (also, "AP")
 - 17. "Wi-Fi": Wireless Fidelity (synonymous with "System")
 - 18. "WVoIP": Wireless VoIP

1.4 SYSTEM DESCRIPTION

- A. The System shall reliably provide Wi-Fi wireless services and those wireless services listed under "Wireless Services" throughout designated spaces listed under "Wireless Coverage"

Areas” at minimum signal levels listed under “Signal Strength”. The System shall be implemented with proven and the most current technology that can seamlessly integrate with the rapid evolution of wireless technologies and business applications.

- B. The System shall comply with FCC requirements.
- C. Frequency Ranges: The System’s radios shall operate at the 2.4 GHz and 5 GHz frequency spectra compatible with IEEE 802.11a/b/g/n/ac standards.
- D. Wireless Services: The System shall be able to simultaneously support the wireless services the Engineer’s Predictive Wireless Report and the following wireless services, applications, and/or technologies:
 - 1. 802.11a/b/g/n (2.4 and 5.8 Ghz) / Wi-Fi – data
 - 2. 802.11ac (Wave-2)
 - 3. WVoIP phone handsets that use 802.11a/b/g/n
- E. Wireless Coverage Areas: The System shall provide RF coverage at levels meeting or exceeding performance criteria the Engineer’s Predictive Wireless Report and throughout the areas of the building(s) as outlined as follows:
 - 1. Floor areas – accessible and usable
 - 2. Stairwells (signal bleed from adjacent areas)
 - 3. Elevators (signal bleed from adjacent areas)
 - 4. General use spaces (lobbies, corridors, restrooms, etc.)
 - 5. Staff use spaces (offices, work rooms, etc.)
 - 6. Restrooms
 - 7. MEP and other building facility rooms
 - 8. Exterior public spaces such as Terrace on Level 2
- F. Signal Strength: The System shall deliver signal at the following levels (measure signal strength using an industry-standard tool such as AirMagnet or Ekahau calibrated test equipment or equal):
 - 1. Wi-Fi -85 dBm or stronger within 100% of the specified coverage areas for all systems, services, applications, and/or technologies.
 - 2. Wi-Fi -65 dBm or stronger within 90% of the wireless coverage areas for Wi-Fi signals with an RSSI without creating undesirable side-effects such as co-channel interference.
- G. The System shall have the capability for separate control over each frequency (aka channels) to allow the ability to adjust and control power levels without disturbing other services.
- H. The System shall support multiple services in a modular architecture so services can be added or removed without requiring new infrastructure, without readjustment of signal power levels, or disturbing existing services.
- I. The System shall enable services to be added without requiring additional cable plant or antenna systems.
- J. The System shall not impede any management features or functionality of any attached network and/or device management system. The System shall allow for proactive management and end-to-end alarming of active electronics. The System shall be able to engage with 3rd party SNMP-based element management systems and provide fault management information.
- K. The System shall have the ability to locate wireless 802.11 rogue WAPs, clients, and other 802.11a/b/g/n devices within the defined coverage areas.

- L. The System shall not have co-channel interference stronger than -85dBm within 90% of the specified wireless coverage areas.
- M. The System shall support the following IEEE 802.11n-2008 standards: Multiple Input Multiple Output (MIMO), 40 MHz channel bonding, and Modulation, Coding Scheme (MCS) values 0 through 15.
- N. The System shall provide sufficient capacity to support a minimum of 12 wireless clients per WAP radio throughout the specified coverage areas for Wi-Fi.
- O. The System shall provide sufficient multiple WAP signal strength within coverage areas for VoIP.
- P. The System shall support Wi-Fi management applications and advanced WAP features provided by the selected WAP manufacturer.
- Q. To maintain performance as usage increases, the System shall have dynamic mechanisms for adding WAP capacity and segmenting the Wi-Fi coverage into smaller areas.
- R. The System shall maintain a balanced link budget with the downlink (WAP-to-client device) limited to match an assumed uplink (client device-to-WAP) signal strength of 35mW.
- S. The System shall leverage Auto Cell / ARM / RRM features for channel and power level control.

1.5 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of section 270000.
- B. Submittal Requirements Prior to Start of Construction:
 - 1. Product Data Submittal
- C. Submittal Requirements Prior to Acceptance Testing:
 - 1. Submit a spreadsheet listing the installed System equipment, including location, serial number, MAC address, IP address, and switch port.
 - 2. Acceptance Testing Procedures Submittal: Submit procedures (describing in detail) for testing system performance and balancing signal strength, including a description of the test data (or an example of the test report).
- D. Submittal Requirements at Close Out:
 - 1. Operations and Maintenance (O&M) manual
 - 2. Inventory in spreadsheet format that includes serial numbers, MACs, locations and labels
- E. Substitutions
 - 1. Conform requests for substitutions to the general requirements and procedure outlined in section 270000.

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of section 270000.
- B. Manufacturer Qualifications: The manufacturer(s) shall demonstrate that a quality assurance program is in place to assure that the specifications are met.

- C. Contractor Qualifications:
 - 1. The Contractor shall be certified by the manufacturer to install the proposed and submitted system.
 - 2. The Contractor shall be certified by the manufacturer to warrant the System.
 - 3. Submit satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the proposal.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of section 270000.

1.8 WARRANTY

- A. Warrant the System for the period as noted in Division 1>.
- B. Warrant the System to perform as described within this section under normal use and service, including installed hardware, programming, signal balancing, etc., to be free of defects and faulty workmanship during the warranty period. Keep the System in operating condition at no additional material or labor costs to the County during the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cisco – matching district preferred Catalyst 91xx models

2.2 WAP ENCLOSURES

- A. Manufacturers, or equal:
 - 1. Oberon
 - 2. Terra-Wave

2.3 IN-LINE LIGHTNING ARRESTORS

- A. Application: for use with cabling links to outdoor locations
- B. Manufacturers, or equal:
 - 1. Cisco AIR-ACC245LA-R Aironet lightning arrester for RP-TNC connectors
 - 2. Cisco AIR-ACC245LA-N lightning arrester for N-type connectors

2.4 SUBSTITUTIONS

- A. Comply with the Substitution requirements of section 270000.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of section 270000.
- B. Project Management Services: Assign a single-point-of-contact (“PM”) to this project with overall responsibility for communications and, ultimately, delivery of the work (equipment, installation, performance criteria, and services). This PM shall be responsible for interfacing with the owner, engineer, general contractor, trade contractors, and their own subcontractors. The PM shall present the design iterations to the owner, coordinate cable routes with the engineer, coordinate on-site construction activities with the general contractor, oversee installation of materials and equipment, coordinate integration of the wireless network into the overall network, integrate wireless services onto the wireless network, and close out the project with the owner.

3.2 INSTALLATION

- A. Examination and Preparation: Prior to the start of installation, examine communications rooms, pathways, and cabling (specifically serving WAPs) for completeness, compatibility with the work/equipment of this section, and readiness for connections with the work/equipment of this section.
- B. Coordinate the installation and schedule with other disciplines (such as telecom cabling, ceiling activities, network, etc.).
- C. Mount WAPs at each location shown in drawings. Adapt the exact location and installation method to best suit each instance.
- D. Mount external antenna at each location shown on the approved shop drawings or narrative. Install antenna cable extensions where needed that meet manufactures specifications and recommendations. Install in-line lightening arrestors for exterior antenna at the earliest opportunity upon entering the building.
- E. Cabling Patching
 - 1. Connect WAPs to designated telecom outlets. Use appropriate length patch cord as per Section 271513 and Telecom Outlet Schedule.
 - 2. Within the telecom rom, connect links/patch panel ports (to WAPs) to designated LAN ports. Use appropriate length patch cord as per Section 271513 and Telecom Outlet Schedule.
- F. Coordinate with the network integrator the integration of 802.11 wireless services, such as wireless LAN access points. Coordinate with the network integrator and owner to ensure access control and authentication is enabled and functional.
- G. Change default passwords in accordance with manufacturer’s recommendations and owner’s direction.
- H. Install latest security patches in accordance with manufacturer and owner recommendations.
- I. Disable unused communication ports, protocols and access accounts in accordance with manufacturer and owner recommendations.

- J. Provide equipment and components required to support the wireless services and to make adjustments to the System necessary for full operation.
- K. System Balancing: Balance system component (e.g., antenna) signal strength to the device signal levels.
- L. Assist with other technology systems needing Wi-Fi integration. This may include but not limited to support help with Wi-Fi base security, AV, BMS, digital signage devices, etc.

3.3 LABELING

- A. Permanently label equipment, components, and patch cords.
- B. Labeling, identifier assignment, and label colors shall conform to the ANSI/TIA-606-C standard, and shall meet the Engineer's and/or Owner's approval.
- C. Submit a labeling plan to the Engineer for approval prior to labeling work.
- D. Label Format
 - 1. Labels shall be permanent.
 - 2. Label text shall be machine-generated; hand written labels will not be accepted.
 - 3. Labels on cables and cords shall fully wrap around cable jacket with a self-laminating feature.
- E. Label Placement:
 - 1. Equipment and WAPs: Affix label onto equipment and WAPs so that it is visible in whole by a technician in a normal stance and does not cover any accessible component (such as attachment screw, etc.).
 - 2. Cables and Cords: Affix label as close as practical to each end of cables and cords.

3.4 FINAL INSPECTION, SYSTEM ACCEPTANCE TESTING AND TURN OVER

- A. Complete the acceptance testing as described in the accepted Testing Procedures submittal. Comply with system acceptance and certification requirements of section 270000.
- B. Punch the work of this Section compliant to the requirements of section 270000.
- C. Present the completed system and wireless services to the owner and Engineer, and demonstrate operation, functionality, features, and signal strength (at select locations) – essentially, demonstrate the System and desired services have been successfully deployed and tested.
- D. Turn over 1 set of electronic records and 1 set of printed records.

3.5 OWNER TRAINING

- A. Provide a minimum of 4 hours of training at the project site (or other location designated by the Owner) by a qualified instructor (equipment manufacturer as needed) covering operation and maintenance of the System. Training shall include (at a minimum): design, equipment, configuration, wireless settings and configurations, ongoing maintenance, and warranty procedures.

- B. Comply with training requirements of section 270000.

3.6 EXTENDED SUPPORT SERVICES

- A. Provide cost for additional service levels beyond the warranty period as follows:
 - 1. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and same-day issue response
 - 2. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and 24-hour issue response
 - 3. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and 48-hour issue response

END OF SECTION

SECTION 274116

INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Audiovisual systems – presentation systems, conference systems, distributed audio systems distributed video systems, control systems, and interface with other systems. Refer to article 1.4 “System Description” for more information.
- B. Base Bid Work
1. Provide equipment and materials, whether specifically mentioned herein or not, needed for a complete and operating audiovisual systems to satisfy the requirements of this section and related drawings. This specification lists major equipment but not every wire, connector, extender, converter, fastener, etc., needed to complete the work.
 2. Equipment racks or enclosures:
 - a. Plenum enclosures: Provide plenum-rated equipment enclosures, including frame, side panels, top panels, access doors, anchorage and seismic bracing, integrated power outlets and cooling provisions as required.
 - b. Provide standard or custom accessories and mount adapters for equipment installed in equipment racks or enclosures as needed to properly mount equipment, power supplies, accessories, components, and the like. Provide cable management to properly route and mind wires, cables, and cords.
 - c. Provide power receptacle strips in quantities needed to supply power to the equipment within the rack.
 - d. Provide spare rack mounting screws. Determine based on rack mount units (RUs) – 1 spare screw per 2 RU installed, minimum.
 - e. Provide bonding for racks, cabinets, equipment, equipment support and cable/wire management to an approved grounding point.
 3. Cooling provisions
 - a. Provide cooling provisions (means to move heat out of enclosed spaces to prevent temperatures from exceeding equipment manufacturer’s specified maximums). Ensure equipment operates within manufacturer’s cooling guidelines. Provide only code-compliant cooling provisions (e.g., exhausting from one space to another).
 - b. In racks, enclosures, millwork, cabinets, and other spaces where equipment will be installed and prone to heat buildup, provide thermostatically-controlled active cooling devices to create adequate airflow through the enclosed space. Examples of active cooling devices include vent fans. At a minimum, ensure airflow by installing active cooling devices or systems such as fans.
 4. Provide power controllers (such as an IP power strip connected to the network or controllable through the room control system) to devices that cannot inherently be remotely controlled for power cycling. Verify functional operation for specified control operations.
 5. Provide audio transformers, whether or not explicitly shown on the drawings, with appropriate impedance ratios and power handling capacities as required for the intended function of the System.
 6. Provide networks and pads, whether or not explicitly shown on the drawings, as required to achieve proper impedance matching and levels. Provide networks and pads that are balanced and constructed from 0.5 watt, 5% resistors, soldered to fixed connection points at each end.

7. Labeling: Provide labeling for audiovisual system components. The components include, but are not limited to, the following:
 - a. Equipment racks and equipment enclosures
 - b. Rack-mounted equipment and devices: Provide a label on the back of each piece of equipment. If a serial number (of a given piece of equipment) is not visible in a final installed condition, provide a label on the equipment on a visible location duplicating the serial number.
 - c. Wall-mounted equipment and devices: Provide an equipment label on the back of each piece of equipment. If a serial number (of a given piece of equipment) is not visible in a final installed condition, provide a label on the equipment on a visible location duplicating the serial number.
 - d. Provide an equipment plate for each piece of equipment.
 - e. Provide a label for each control that is not inherently labeled, such as those in racks and user spaces.
 - f. Wires and cables: Provide a cable label at each end of each piece of wire, cable and cord.
 - g. Terminal blocks, patch panels, and other termination apparatus: Provide a label on each termination block, piece of termination apparatus and termination position on patch panels.
 - h. Handheld, lavalier, wireless, and other microphones and associated equipment (such as receivers)
 - i. User interface devices/plates
 8. Coordination Requirements
 - a. Coordinate with the construction team at large to ensure that equipment and other system components will be installed properly, and that there will be no compromises due to, among other aspects, spatial conflicts or power service incompatibilities.
 - b. Coordinate with the electrical contractor for power requirements and service connection to the System's equipment.
 - c. Coordinate with the telecom contractor and other trades/contractors (as needed) placement of cables and wires when sharing pathways (such as cable tray) with other low voltage systems. Do not place cables and wires into pathways provided by others without permission.
 - d. Coordinate with the telecom contractor (or Owner) for locations within racks for installing equipment"
 - e. Coordinate with the Owner (or Owner's network provider) for network configurations and/or settings required for the System's proper or correct operation.
- C. Related Divisions and Sections: Consult other divisions, determine the extent and character of related work. Coordinate the work of this section with, at least but not limited to, the following divisions and sections:
1. Division 0 (for Bidding Requirements, Contract Forms, and Conditions of Contract) and Division 1 (for General Requirements) – provisions listed or specified therein apply to work under this section.
 2. Section 270000, "Communications Basic Requirements"
 3. Division 26, "Electrical Systems"
 4. Division 23, "Heating, Ventilating, and Air Conditioning Systems"
 5. Section 271513, "Communications Horizontal Cabling"
 6. Section 270811, "Communications Twisted Pair Testing"
 7. Section 270821, "Communications Fiber Optic Testing"
- D. Products Installed but not Furnished Under this Section
1. Owner-furnished equipment
 2. Network patch cords

- E. Products Furnished and Installed Under Another Section
 - 1. Rough-in (device boxes, conduits, and related accessories)
 - 2. Electrical service (e.g., 120 VAC); refer to division 26
 - 3. Telecommunication cabling; refer to section 271513
 - 4. Telecommunication pathways; refer to section 270528.
 - 5. Network switches, with Power over Ethernet (PoE)

1.2 REFERENCES

- A. Comply with the References requirements of section 270000.
- B. In addition to the references listed in section 270000, perform work in accordance with applicable requirements of governing codes, rules and regulations including the following minimum standards, whether statutory or not:
 - 1. National Fire Protection Agency (NFPA)
 - a. NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces"
 - 2. Underwriters Laboratories (UL)
 - a. UL 969, "Marking and Labeling Systems"
 - b. UL 1419, "Professional Video and Audio Equipment"
 - c. UL 60065, "Audio, Video and Similar Electronic Apparatus – Safety Requirements"
 - 3. AVIXA
 - a. A102.01, "Audio Coverage Uniformity in Listener Areas"
 - b. ANSI/AVIXA D401.01:201X "Standard Guide for AV Systems Design and Coordination Processes"
 - c. V201.01:2018, "Projected Image System Contrast Ratio"
 - d. F501 01, "Cable Labeling for Audiovisual Systems"
 - 4. "Sound Systems Engineering", 3rd Ed., Davis and Davis
 - 5. Electronic Components Industry Association (ECIA)
 - a. EIA/ECA-310, "Cabinets, Racks, Panels, and Associated Equipment"

1.3 DEFINITIONS

- A. Refer to section 270000 for definitions. The definitions of section 270000 apply to this section.
- B. In addition to those definitions of section 270000 and Division 01, the following terms used in this specification are defined as follows:
 - 1. "ACEG": alternating current equipment ground (an example of this is a ground bus within an electrical panel)
 - 2. "Approved Grounding Point": an approved grounding point is one that satisfies the applicable electrical code and provides a low impedance path to earth. Examples include the following though may manifest in different means: a telecommunications grounding busbar (such as for bonding an equipment rack within a telecom room), the ACEG of the electrical panel serving the equipment requiring bonding to ground (such as for bonding a credenza rack within a conference room), or the ground conductor of a branch circuit (such as for bonding a single piece of equipment).
 - 3. "A/R": Indicates that the quantity of an item is as required to meet the design criteria indicated in the audiovisual drawings and specifications.
 - 4. "A/S": Indicates that the quantity of an item is as shown on the drawings.
 - 5. "Audience Area": the portion of a presentation space intended to be occupied by an audience. An audience area includes the primary seating and standing spaces and may include the adjacent circulation spaces. An audience area generally excludes spaces reserved for presenters.

6. "Custom" indicates systems or components the Contractor fabricates based on these specifications and drawings
7. "EDID": Extended display identification data
8. "HDCP": High-bandwidth digital content protection
9. "HDMI": High-definition multimedia interface
10. "OFE": Owner Furnished Equipment
11. "Or equal" indicates an item that is equal in function and performance to the specified device or system
12. "RU": rack unit, as defined in EIA/ECA-310
13. "Shall" denotes a mandatory requirement
14. "Should" denotes an advisory statement
15. "SPL": sound pressure level
16. "THD": total harmonic distortion
17. "Will" denotes an informative statement
18. "Project": The scope of work defined by this specification and its related drawings
19. "Software": Any executable programs, parameter files, user interfaces, or other coded content that are required to operate, control, or maintain the audiovisual systems in this Project
20. "Custom Created Software": Any software, parameter files, user interfaces, or other coded content created for the control or operation of the audiovisual systems in this Project
21. "Third-party software:" Any programming developed by a party other than the AV Contractor and the Owner to be used to operate, control, or maintain the audiovisual systems in this Project
22. "System": The audiovisual components, cabling, and programming incorporated in the descriptions and equipment lists herein

1.4 SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS

- A. General
 1. In circumstances where the specifications and drawings conflict, the drawings govern quantity and the specifications govern quality.
 2. The contract drawings and specifications convey design intent. They are not intended to be used in lieu of shop drawings.
- B. ADA Compliance: Provide the following:
 1. Display of closed captioning content
 2. Accessible control systems
 3. Assistive listening systems
- C. Audio System Performance Criteria
 1. Provide echo cancellation for microphones in audio and video conferencing systems.
 2. Frequency Response:
 - a. Program audio system: 100 Hz to 12,000 Hz. 3 dB per octave roll off below 100Hz and above 12 kHz.
 - b. Distributed audio system: 125 Hz to 10,000 Hz. 3 dB per octave roll-off below 125 Hz and above 10 kHz.
 3. Total Acoustical Harmonic Distortion:
 - a. Program audio system: less than 2% at 90 dBC (1 kHz reference) at four feet (1,220 mm) above finished floor in the middle of the room.
 - b. Distributed audio system: less than 2% at 85 dBC (1 kHz reference) at four feet (1,220 mm) above finished floor in the middle of the room.
 4. Signal to noise ratio (mixer input to amplifier output): 75 dB from 50 Hz to 15 kHz minimum.

5. Frequency response with equalizers bypassed: less than ± 1 dB from 50 Hz to 12 kHz.
 6. Distortion: less than 0.5% at 1 kHz at the equipment's rated input signal level.
 7. Output levels (in audience areas without objectionable distortion, rattles, or buzzes, employing as test signals several different samples of recorded music and microphones applied at each system input):
 - a. Program audio: not less than 95 dB
 - b. Speech reinforcement: not less than 85 dB
 8. Hum and Noise: inaudible (below the background noise level of the space) under normal operation observed in audience areas.
- D. Video System Resolutions
1. System component minimum resolution: capability of 1920 X 1080.
 2. Supported resolutions: 1,280 x 720, 1,920 x 1,080, 1,920 x 1,200, 3840 X 2160, and 4096 x 2160.
- E. Wireless Systems
1. Ensure that wireless AV systems do not create radio frequency interference to other systems.
 2. Demonstrate at AV acceptance testing that wireless AV systems are not adversely affected by AV-related nor other radio frequency sources.
- F. Control Systems
1. Provide user interfaces, such as control panels, that respect ergonomics and varying levels of technical ability among users. Follow these guidelines:
 - a. Avoid abbreviations
 - b. Size lettering at 1/8" minimum
 - c. Maintain background to lettering contrast
 2. Positive logic: Avoid conditions which may cause command synchronization conflicts (i.e., alternate action (toggling) on/off without power reset or feedback. Provide power sensors or other devices where necessary to ensure that positive logic conditions are maintained.
 3. Timing: Prevent two or more commands being sent simultaneously to the same piece of equipment.
 4. Linking: Provide linking of functions to require the fewest number of user actions to effectively control the equipment.
 5. Clearing: Ensure that each media selection clears the previous audio and visual selection (e.g., selecting COMPUTER clears the audio and video section of the previous Blu-ray disk selection).
 6. Defaults: Establish default power-up conditions for the system including device audio levels, warm-up routine, power conditions, switcher status and other default conditions as required by the Owner or the Owner's representative.
 7. Volume Memory: Provide easy-to-use memory for volume settings associated with each source device. Unless directed otherwise in this document, provide programming that maintains these settings between alternate selections during each use – through power-on and power-off.
 8. Status indication: Program buttons for both touch panels and pushbutton panels to provide clear status indication using illumination when back-lighting is available or by changing color.
 9. Failsafe: Provide program that ensures that no operation or sequence of operations causes the control system to become inoperable or interferes with further processing, correct operations or execution of commands.
- G. Centralized Management Procedure
1. Provide server-based software for the management of the AV systems deployed in the facility and the District. Include the following:

- a. Help-desk functionality
- b. Enterprise-wide scheduling and monitoring
- c. Time-stamped AV systems data collection for reporting

1.5 ROOM TYPES

A. General

- 1. The audiovisual systems design and documentation in this set of contract documents are based on standard room types.
- 2. Each room to receive audiovisual systems is shown on the drawings with a type designation.
- 3. For each room, adapt the audiovisual system to best suit the architectural layout such that each room of a certain type is similar to others of its type, with minor layout differences to accommodate architecture.
- 4. Refer to the drawings for the quantities of each type of room and for specific audiovisual interface information per room.

B. Group Study Rooms

- 1. Group Study rooms include three sizes: small, medium, and large. These spaces will be used by student and faculty members for meetings and working sessions.
- 2. Provide a wall-mounted display for users to share content from personal devices. Refer to the overall floor plan drawings for the required display size for each room.
- 3. Provide hardwired, HDMI laptop connection to the display via 2.5" diameter brushed stainless grommet in the table.
- 4. Provide a soundbar in the small and medium rooms for program audio. Provide ceiling-mounted loudspeakers in the large room for program audio.
- 5. Provide an Assistive Listening System to meet Code requirements.
- 6. Provide a wall-mounted button panel for system control including on/off, volume up/down, and source selection.

C. Meeting Rooms

- 1. Meeting rooms are available for faculty member meetings and include software-based video conferencing system. These spaces will support audiovisual presentations and collaboration. Provide a scaled input to the display.
- 2. Provide a wall-mounted display for users to share content from personal devices.
- 3. Provide hardwired, HDMI laptop connection to the display via 2.5" diameter brushed stainless grommet in the table.
- 4. Provide wall-mounted camera/microphone for software-based video conferencing hosted on laptop.
- 5. Provide ceiling-mounted loudspeakers for program audio.
- 6. Provide a shared- portable RF Assistive Listening System to meet Code requirements.
- 7. Provide a wall-mounted control panel for system control including on/off, volume up/down, and source selection.

D. Office of IT Director

- 1. The Office of the IT Director is a private office with a basic AV system.
- 2. Provide a wall-mounted, annotative display for users to share content from personal devices.
- 3. Provide hardwired, HDMI laptop and USB connections to the display.

E. Classroom Type 1

- 1. This classroom will be used for lecture style sessions.
- 2. Provide projection system with short-throw projector and wall-mounted projection screen.
- 3. Provide a wall mounted equipment enclosure near wall-mounted projector

4. Provide technology connection points at the instructor lectern containing:
 - a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio via 2.5" diameter brushed stainless grommet in the furniture.
 - b. Document camera
 - c. Owner-furnished, all-in-one computer
5. Provide wireless sharing device
6. Provide supporting AV presentation system, including switching and amplification functions
7. Provide ceiling-mounted, pendant loudspeakers
8. Provide wireless instructor microphone
9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
10. Provide a shared portable Assistive Listening System as required by Code

F. Classroom Type 2

1. This classroom type is flexible in configuration.
2. Provide two flat panel displays. Both displays will show content from the instructor input location.
3. Provide a plenum-rated ceiling equipment enclosure the display in the accessible ceiling
4. Provide two technology connection points at the wall for an instructor:
 - a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio
 - b. Document camera
 - c. Owner-furnished, all-in-one computer
5. Provide wireless sharing device
6. Provide supporting AV presentation system, including switching and amplification functions
7. Provide ceiling-mounted loudspeakers
8. Provide wireless instructor microphone
9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
10. Provide a shared portable Assistive Listening System as required by Code

G. Classroom -Type 3

1. This classroom will be used for lecture style sessions
2. Provide short throw projection system with projector and projection screen.
3. Provide a wall mounted equipment enclosure near wall-mounted projector
4. Provide two technology connection points at the front of the room for an instructor lectern containing:
 - a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio via 2.5" diameter brushed stainless grommet in the furniture
 - b. Document camera
 - c. Owner-furnished, all-in-one computer
5. Provide wireless sharing device
6. Provide supporting AV presentation system, including switching and amplification functions
7. Provide ceiling-mounted loudspeakers
8. Provide wireless instructor microphone
9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
10. Provide a shared portable Assistive Listening System as required by Code

H. Classroom -Type 4

1. This classroom will be used for lecture style sessions
 2. Provide projection system with projector and projection screen.
 3. Provide a ceiling mounted equipment enclosure at projector
 4. Provide two technology connection points at the front of the room for an instructor lectern containing:
 - a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio via 2.5" diameter brushed stainless grommet in the furniture
 - b. Document camera
 - c. Owner-furnished, all-in-one computer
 5. Provide wireless sharing device
 6. Provide supporting AV presentation system, including switching and amplification functions
 7. Provide ceiling-mounted loudspeakers
 8. Provide wireless instructor microphone
 9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
 10. Provide a shared portable Assistive Listening System as required by Code
- I. Tutoring Lab
1. This classroom type is flexible in configuration
 2. Provide two flat panel displays and connection points for OFE mobile display carts at four floor locations. All displays will show the instructor's content.
 3. Provide terminated HDMI extension RJ45 connectors at four floor locations for mobile cart connections.
 4. Locate AV equipment in lectern
 5. Provide two technology connection points at the front of the room for an instructor lectern containing:
 - a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio via 2.5" diameter brushed stainless grommet in the furniture
 - b. Document camera
 - c. Owner-furnished, all-in-one computer
 6. Provide wireless sharing device
 7. Provide supporting AV presentation system, including switching and amplification functions
 8. Provide ceiling-mounted loudspeakers
 9. Provide wireless instructor microphone
 10. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
 11. Provide a shared portable Assistive Listening System as required by Code
- J. Instructional Lab
1. This classroom type is flexible in configuration
 2. Provide dual flat panels systems
 3. Provide a ceiling, plenum-rated equipment enclosure near displays in accessible ceiling
 4. Provide two technology connection points at the wall for:
 - a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio
 - b. Document camera
 - c. Owner-furnished, all-in-one computer
 5. Provide wireless sharing device
 6. Provide supporting AV presentation system, including switching and amplification functions
 7. Provide ceiling-mounted loudspeakers

8. Provide wireless instructor microphone
 9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
 10. Provide a shared portable Assistive Listening System as required by Code
- K. Writing Center lab
1. None
- L. Library Reading Open Area
1. Library Reading area is flexible space with a single projection system (projector and projection screen).
 2. Provide projector and projection screen
 3. Provide a ceiling mounted equipment enclosure near ceiling-mounted projector
 4. Provide a technology connection point at the wall for:
 - a. Connection for laptop, including HDMI with multiple adaptors for DisplayPort, and Mini DisplayPort for legacy support including audio
 - b. Document camera
 - c. Owner-furnished, all-in-one computer
 5. Provide wireless sharing device
 6. Provide supporting AV presentation system, including switching and amplification functions
 7. Provide ceiling-mounted loudspeakers
 8. Provide wireless instructor microphone
 9. Provide a control system, self-contained, with push-button style panel, to control all functions of the AV systems
 10. Provide a shared portable Assistive Listening System as required by Code
- M. Design Suite
1. Provide infrastructure to support owner-furnished systems
- N. Room scheduling
1. Provide room scheduling device outside all AV-enabled rooms to display room reservation information and the room's occupancy status.
 2. Each room scheduler will require a single network/data drop.
 3. Integrate with Laney's calendaring system.
- O. Digital Signage
1. The digital signage software system and hardware are owner-furnished.
- P. Overhead networked audio paging system
1. Furnish an overhead audio paging system consisting of headend, network enabled equipment, ceiling loudspeakers and supporting equipment.
 2. Paging will be performed via Laney's IP phone system and 3rd floor reception paging microphone.
 - a. Physically secure paging microphones from tampering
 3. Provide ceiling mounted loudspeakers to provide uniform audio distribution coverage throughout the building.
 4. Zone the system to include the following:
 - a. Entire building
 - b. Library only
 - c. LRC only
 - d. Each floor individually
 - e. Confirm zoning requirements with Laney during wiring and programming
 5. Provide end of line modules at the end of each loudspeaker chain.
 6. Connect the audio paging system to the fire/life safety system and security system.

1.6 SUBMITTALS

- A. Comply with the Submittal requirements of section 270000.
- B. Bid Submittal: Submit bids in accordance with the project's overall bidding requirements, and include the following requirements of this section.
 1. Site visit: As possible, visit the site before submitting your bid. Coordinate site visit arrangements with the General Contractor. Include date of site visit in the bid submittal.
 2. Firm information and qualifications: Include detailed information about the firm, including but not limited to the following, in the bid:
 - a. Firm's history – how long the firm has been in business, how long the firm has offered audiovisual systems integration services, etc.
 - b. Annual revenue for the three most current years
 - c. Bonding capacity and bonding insurance agent contact information
 - d. Three successfully completed projects of similar scope within the past 24 months. For each project, include the owner/client name, contact information (person's name, position, and telephone number or email address), project location, type of systems installed, total contract amount, date completed, and services included (e.g., engineering, installation, integration, maintenance, etc.).
 - e. Industry affiliations
 - f. Advanced certifications (CTS-I/D, DMC-D/E, ACE-D//P/RMS, XTP, etc.)
 - g. Manufacturer certifications
 - h. Contractor license number for the state where the work will take place
 - i. Union affiliation(s)
 3. Personnel and Certifications: Include information on key personnel in the bid.
 - a. Include résumés and certifications for personnel who will be assigned to the project including but not limited to the Project Manager, Systems Engineer, Field Installation Supervisor, Lead Control System Programmer, and other key personnel.
 - b. Include résumé(s) of CTS-I (Certified Technology Specialist – Installation) certified personnel
 - c. Include résumé(s) of Extron Certified Professionals.
 - d. Include other relevant company-held industry, manufacturer, and educational certifications and designations for involved personnel
 4. Subcontract Information: Indicate in the bid, all subcontractors and their responsibilities and qualifications.
 5. Schedule of Values: Include a schedule of values in the bid. Break out the schedule of values into three areas – equipment costs, non-equipment costs, and service contract.
 - a. Equipment Costs: List equipment costs (each piece of equipment), including required modifications and accessories.
 - b. Non-equipment Costs: List non-equipment costs, such as the following:
 - 1) General and Administrative: shipping, insurance, and guarantees, etc.
 - 2) Fees: e-Waste/disposal, permits, etc.
 - 3) Engineering: design, drawings, run sheets, instruction manuals, etc.
 - 4) Pre-installation: fabrication, modification, assembly, rack wiring, etc.
 - 5) Installation: installation, coordination, supervision, testing, etc.
 - 6) Owner training: training session(s), manuals, etc.
 6. Alternates/Substitutions: Refer to section 270000 for alternate and substitution requirements. Submit bids based on the specified equipment. If the bid includes proposed alternates and/or substitutes, separate these from the costs of the equipment as specified and include for alternate equipment full technical information and cut sheets. Proposed alternate equipment will receive consideration if the differences between the specified and alternate/substituted equipment do not depart from the design intent and function of the system and are in the best interests of the Owner. If the inclusion of substituted equipment will result in a different connection configuration than that in the bid

documents, include drawings that illustrate how the proposed system would be connected.

7. System Enhancements: Include in the bid recommendations, if any, that will enhance the performance and/or functionality of the system or will reduce costs without loss of performance/functionality. Recommendations that are of value to the Owner will be taken into consideration in the evaluation of the bids. Make such proposed recommendations as "alternates", with the appropriate cost modifications shown separate and apart from the costs of the system "as specified".
8. Exceptions: In the bid, explain exceptions, if any, to these specifications and related drawings. In the absence of exceptions, these specifications and related drawings are binding in letter and intent.
9. Guarantee compliance with requirements and regulations in effect on the job site. Explicitly state any such non-compliances or conflicts in the bid submittal. The bidder has the responsibility to investigate potential contract, union, and scheduling issues, and to notify the general contractor of such.

C. Pre-construction Submittals

1. Product Data: Prior to purchase and installation, submit as a PDF file information (such as cut sheets, etc.) for equipment, components, products, etc., that will be installed as part of the work of this section.
 - a. Include in the submittal, a Table of Contents, listing equipment, components, products, etc., by room, by system, and/or by other logical designation. A continuous list of all products with no reference to where the products will be installed will be rejected. Incomplete lists will be rejected.
 - b. Indicate (arrow, highlight or other designator) on each product's cut sheet the manufacturer, model/part number, accessories (as applicable), options (as applicable), color (as applicable), and other information to indicate the exact item to be installed. Where this information is not already provided on the cut sheet, manually input this information and a brief description (as applicable).
2. Substitutions [refer to section 270000 for substitution requirements]: Submit substitution requests based on the specified equipment and including associated equipment costs separate from the costs of the equipment as specified.
 - a. Proposals for alternate equipment will receive consideration if the differences between the specified and alternate/substituted equipment do not depart from the overall intent of the design and operation of the system and are in the best interests of the Owner.
 - b. Include full technical information and cut sheets for the proposed substitutions.
 - c. If the inclusion of substituted equipment will result in a different connection configuration than that in the bid documents, produce drawings that illustrate how the proposed system would be connected.
3. Shop Drawings [refer to section 270000 for additional shop drawing requirements]: Submit shop drawings prior to installation and in accordance with the Conditions of Contract and Division 1, including the following.
 - a. Functional line diagrams for all systems – clearly tag each item with name, manufacturer, and manufacturer's model number (e.g., "Program Amplifier LabGruppen LUCIA 60/2M") and show the terminal number or input/output designation (e.g., "Mic 1-In", or "Record Out-Left").
 - b. Provide schematic diagrams of custom circuitry such as receptacle pin numbers and component callouts; show details of custom resistive attenuation and/or combining networks, filters, or pads which may be required in the assembly; show point to point wiring drawings for control system modules and interfaces, and for switches and relays in audio, video, or control systems
 - c. Equipment rack elevations and patch panel assignments – clearly and consistently label rack elevations, patch panels, and on equipment controls.

- d. Provide pushbutton and handheld remote control panel layouts –tag each button with function and ID matching installed labels
 - e. Factory and custom panels, plates, and designation strips, showing material, finish, color and engraving (exact lettering)
 - f. Custom designed consoles, tables, carts, support bases, and shelves
 - g. Equipment modifications (if any), including details of modifications that change or void manufacturers' warranties.
 - h. Cable run lists – clearly show at each terminal point the type of connector to be used; include typical wiring details of each connector; note where shields are connected and where they will float to ensure the integrity of the shielding system; indicate cable types and, where appropriate, color codes; assign wire numbers and patch bay locations to every wire and patch point in the drawing
 - i. Wattage tap setting per loudspeaker.
4. User Interface Menu Submittal:
 - a. Provide a PDF per system containing a page for each menu, submenu, and popup in that system's user interfaces. Include menus that are manually triggered and those that automatically appear as the result of events such as the connection of a source device. Ensure that the PDF is unlocked so that the Engineer may annotate it.
 - b. If the development environment allows, provide an executable menu simulation file or web link for control systems in addition to a PDF-based submittal.
 5. Network Coordination: Submit as an Excel file or cloud-based collaborative spreadsheet (such as Google Sheets) a list of equipment that will be connected to the network, including but not limited to the following (e.g., spreadsheet column headers):
 - a. Item number
 - b. Description
 - c. Manufacturer
 - d. Model/part number
 - e. MAC address
 - f. IP address type (DHCP or static)
 - g. Power-over-Ethernet (PoE) requirements (yes or no)
 - h. Specific network and/or subnet configuration requirements
 - i. Specific QOS requirements
 - j. Anticipated network traffic
 6. Samples: Submit sample panels, plates, and designation strips, including details relating to terminology, engraving, finish and color.
 7. Testing Equipment and Procedures:
 - a. Submit a list of test equipment, including manufacturer, model number, and description that will be used for testing and adjustment of the installed systems.
 - b. Submit testing procedures to be performed during pre-functional testing and acceptance testing, including the minimum acceptable outcome for each test.
- D. At the Completion of the Installation
1. Initial Testing and Tuning Report: After completing initial testing and tuning, checkout, settings, as-built drawings, and operational documentation, submit written notification to the Owner and Architect that initial checkout is complete. Include in this notification a completed Initial Testing and Tuning Report that satisfies the requirements of Part 3. In the Report, document the results for tests performed during initial testing and tuning. Organize the report per room, per system, and per test. Include the testing tools/equipment, manual and automated tests, testing procedures, and expected result per test. If the test equipment stores test results and has the capability to produce reports, also include these reports.
 2. Wireless Microphone Frequencies: Submit a list of wireless microphone frequencies and associated channels used for each microphone and system.

E. Closeout Submittals

1. Acceptance Testing Report: After completing final acceptance testing, final tuning and settings, submit an Acceptance Testing Report that documents the results for tests performed during final testing and tuning. Organize the report per room, per system, and per test. Include the testing tools/equipment, manual and automated tests, testing procedures, and expected result per test. If the test equipment stores test results and has the capability to produce reports, also include these reports. Include the system's normal settings.
2. As-built Drawings [refer to section 270000 for additional as-built drawing requirements]: Submit as-built drawings in accordance with the Conditions of Contract and Division 1, including the following.
 - a. System functional line drawings for all systems; clearly tag each item with name, manufacturer, and manufacturer's model number (e.g., "Program Amplifier LabGruppen LUCIA 60/2M") and show the terminal number or input/output designation (e.g., "Mic 1-In", or "Record Out-Left").
 - b. Point-to-point wiring diagrams for switches and relays in audio, video, and control systems; point-to-point wiring diagram for control system modules and interfaces
 - c. Schematic diagrams of custom circuitry such as receptacle pin numbers and component callouts; show details of custom resistive attenuation and/or combining networks, filters, or pads which may be required in the assembly
 - d. Equipment rack elevations and patch panel assignment drawings. Clearly label the rack elevations, patch panels, and equipment controls.
 - e. Cable run lists – clearly show at each terminal point the type of connector to be used; include typical wiring details of each connector; note where shields are connected and where they will float to ensure the integrity of the shielding system; indicate cable types and, where appropriate, color codes; assign wire numbers and patch bay locations to every wire and patch point in the drawing
 - f. Pushbutton and handheld remote-control panel layouts, including tagging each button with function and ID that matches installed labels
 - g. Factory and custom panels, plates, and designation strips, showing material, finish, color and engraving (exact lettering)
 - h. Wattage tap setting per loudspeaker.
3. System Operation and Maintenance (O&M) Manual:
 - a. Describe typical procedures necessary to activate each system for full functionality as required under the System Description.
 - b. Describe normal settings for equalizer, amplifier, signal processing, and user operated controls (as established during system check out) in tabular or pictorial form.
 - c. Outline a recommended maintenance schedule with reference to the applicable pages in the manufacturer's maintenance manuals. Where inadequate maintenance information is provided by the manufacturer, provide the information necessary for proper maintenance.
 - d. Outline a recommended plan for a normal maintenance period of at least one year, including a list of necessary and recommended replacement parts.
 - e. Assume the reader of this manual to be technically competent, but unfamiliar with this particular facility.
 - f. Submit equipment manufacturer's operation and maintenance manuals for each piece of equipment.
4. Programming/Software:
 - a. Submit the project's control system programming and audio processor configuration files – refer to "Software License" below.

1.7 QUALITY ASSURANCE

- A. Audiovisual Contractor Requirements: Demonstrate that your firm meets or exceeds the following requirements:
1. Five years' experience, minimum, with the design, engineering, assembly, installation, start-up and maintenance of audiovisual systems of similar or greater complexity to those identified in this specification
 2. Provide the necessary professional design, engineering, fabrication, installation, and project management personnel to execute the work of this section, and to guarantee a complete, functional system in compliance with the design intent
 3. Successfully completed in the past 24 months a minimum of three projects of similar scope
 4. Current state contracting license, as required to perform the work under this section
 5. Bondable to 100% of contract value
 6. Be an authorized supplier and installer for equipment listed in this section
 7. Maintain permanent fabrication, service and support facilities within 100 miles of the Project site.
- B. Audiovisual Contractor Certifications: Demonstrate that your firm has the following certifications:
1. An InfoComm CTS-I (Certified Technology Specialist-Installation) certified employee to actively manage this project – the Engineer will verify CTS credentials at the InfoComm website.
 2. An Extron Control Specialist-certified employee to be actively involved in the design, implementation and commissioning of systems in this project – the Engineer will verify Control Specialist with Extron.
 3. A QSC Q-Sys Level 2-certified employee to be actively involved in the design, implementation and commissioning of systems in this project – the Engineer will verify Q-Sys credentials with QSC.
- C. Manufacturer/equipment Supplier Requirements: Demonstrate that your firm meets or exceeds the following:
1. Operate their business for not less than five years
- D. Subcontractor Quality:
1. Specifically identify in the bid submission, for Owner, Architect, or Engineer's approval, all subcontractors that will be used.
 2. Regardless of any subcontract arrangement, your firm will have sole responsibility for the successful implementation of the work in this section.

1.8 PROJECT MANAGEMENT AND COORDINATION

- A. Comply with the Project Management requirements of section 270000.
- B. Assign a project manager to this project for the entire duration. They shall oversee the design, submittals, implementation, testing, and close out – the entire process from start to finish. The project manager shall also coordinate this work of this section with other trades.
- C. Report to the Engineer any conditions that would prevent the correct installation of the system as designed.

- D. This project requires an programming contractor. Definitions of the equipment programming responsibilities of each are defined below.
 - 1. Programming Contractor
 - a. Touch panel layout and user experience, coordinated with the Owner's representative and TEECOM.
 - b. Standard control and user interface development specific to the functionality of the audiovisual control systems and communication with controlled devices in the systems.
 - c. Installation and validation of the systems and UI code on-site.
 - d. Optimize and integrate Building Management System License with corresponding systems – room scheduling displays, HVAC, occupancy sensors, etc.
 - 2. Audiovisual Systems Contractor
 - a. Audio processor programming including signal routing, system optimization, and integration of control triggers.
 - b. Wireless microphone frequency coordination.
 - c. Video matrix configuration including routing, scaling, and EDID optimization.
 - 3. Coordination Requirements
 - a. Audiovisual contractor: provide a device table to the independent programming contractor including an IP address table, source input connections in matrices and output connections in matrices and corresponding end points.
 - b. Audiovisual contractor and independent programming contractor: conduct coordination meetings every two weeks and supply meeting notes to TEECOM and the Owner.
 - c. Audiovisual contractor and independent programming contractor: conduct collaborative on-site troubleshooting and system tuning sessions for the Project.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage, and Handling requirements of section 270000.

1.10 WARRANTY

- A. Warrant the System for a minimum of one year from the date of system acceptance by the Owner. Honor component warranties per manufacturers' terms if greater than one year.
 - 1. Include service as described in 3.13 "Maintenance and Extended Service" in the warranty.
- B. Activate manufacturers' equipment warranties in the Owner's name. The warranty period shall commence on the date of System Acceptance by the Owner.
 - 1. In the case of contractor-modified equipment (where the manufacturer's warranty could be voided), warrant such equipment equivalent to that of the original manufacturer.
- C. Warrant the Software and version updates – see "Software" below.

1.11 SOFTWARE LICENSE

- A. Nondisclosure
 - 1. During or after the termination of this Agreement, the Owner agrees not to disclose any proprietary information provided by the AV Contractor, to maintain such information as confidential and not use such information provided in Project documents for any purpose other than maintenance and support of in-house systems. This does not apply to any of

the information that becomes generally known to the public due to publication or other legal means and through no fault of the Owner.

B. Obligations Governing the Software

1. The AV Contractor shall own the copyright of any custom created software/parameter files ("Software") and hereby grants the Owner a royalty-free, non-exclusive license to use the Software for use with the audiovisual and other connected systems in this project. This license cannot be transferred.
2. The Owner shall not rent, loan or re-license rights to use the Software to any third party.
3. Any Third-party software provided or made available to the Owner by the AV Contractor, but not created by the AV Contractor, is sublicensed to the Owner through the AV Contractor. The AV Contractor agrees that such sublicense is granted with consent of the third-party at no cost to the Owner, and the Owner shall be entitled to use such software under the same terms as the AV Contractor.
4. The AV Contractor and third-party suppliers are not restricted from licensing the Software or any portion thereof to other customers.
5. At acceptance testing, provide the source code for custom created software, applications required to use the source code, descriptions of the required equipment, and instructions detailing the modification and installation of the Software to the Owner.

C. For project and custom Software, the following apply.

1. Provide the source code to the Owner either directly via file transfer or make it available through other means, such as cloud storage, an FTP site, etc. Maintain older versions within a folder structure and make them available to the Owner at the Owner's request. At the end of the warranty period, release the current and older versions of the source code to the Owner. If the AV contractor ceases to exist during the warranty period, release the source code to the Owner upon termination of the business.
2. Provide the Software in a form suitable for immediate access by the System.
3. The AV contractor grants the Owner the right to modify and to enhance the Software as furnished and licensed under the terms of this Agreement at its own risk and expense, and further agrees such modifications and enhancements developed by the Owner to be the property of the Owner. Any changes to the custom created software parameter files do not affect copyright ownership.
4. During the warranty period, if the Owner discovers that the Software is no longer functioning in the same manner as had been approved at the beginning of the warranty period, they shall document the fault in sufficient detail to allow errors to be reproduced, and they will notify the AV contractor. Within two business days of this notification, update the software, provide or post updated Software files as detailed above, demonstrate that the error has been resolved, and maintain updated Software files as detailed above.
5. Defend any suit brought against the Owner and pay any damages due to the resulting judgment from any suit brought against the Owner as it pertains to a violation of copyrights or patents of the Software or licenses. The Owner shall notify the AV contractor in writing promptly and give authority, information and assistance at the AV Contractor's expense.
6. The AV contractor at its own expense and option shall, if able, procure for the Owner the right to continue to use the Software as licensed or to replace it with a non-infringing release. This shall not include any agreement by the AV Contractor to accept liability for patent or copyright infringement for beyond the Software as licensed and furnished for the Project. This also excludes any agreement by the AV contractor to accept liability for patent or copyright infringements for methods and processes to be carried out by using said Software except those inherent in the furnished System.
7. All contracts with Third-party software suppliers will transfer from the AV Contractor to the Owner at Project acceptance by the Owner.
8. The Owner shall apprise the AV Contractor of activities it takes with Third-party software providers during the warranty period. Included activities would include discontinuing the

use of any Software component, installing updated or alternate versions of the Software, revising the configuration of affected systems.

9. The Owner can contact the AV Contractor for questions at no additional cost during the warranty period, providing:
 - a. The queries are related to the audiovisual systems defined in this document.
 - b. The query is asked by the Owner's staff or an authorized representative.
 - c. The inquirer has attended the AV Contractor's or the manufacturer's training in the use of the systems defined in this document.
 - d. The question is not intended as design consultation.
10. The Owner can only make copies as backup files of the Software and they are required to include the AV Contractor's copyright notice. The Owner shall make a reasonable effort to secure this Software to prevent theft or unlicensed usage.

D. Software License Terms

1. The Software license is granted by the AV Contractor for the devices provided for the Systems. If any devices in the system fails, the license can be transferred to a replacement device on a temporary or permanent basis if the original device is to be phased out. The transference may only occur with written notification to the AV Contractor.
2. Additional licenses or changes to the Software are subject to a supplemental agreement between the AV Contractor and the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Comply with the Products requirements in section 270000.
- B. Provide products, equipment and software that are the latest version of the specified model or type available at the time of procurement, providing the updated devices provide the same or better capabilities and performance required by the system design.
- C. Only where denoted "or equal", equal products will be considered. The manufacturers, product numbers, and types listed at those instances establish minimum performance.
- D. Substitutions: The Engineer may consider substitutions for certain equipment if the Contractor demonstrates that the substitution meets or exceeds the functional requirements described in the System Description and Performance Standards. Follow the requirements of section 012500 "Substitutions" for substitution requests.

2.2 EQUIPMENT SCHEDULE

- A. Quantities: Quantities are either listed herein with a number, as "A/S" (as shown), or as "A/R" (as required). If listed as A/R or the quantity is marked with an asterisk, determine quantities as required for a fully operational system. Confirm the quantity listed here against the drawings. If the quantity is different than shown on the drawings, the drawings govern quantity and the specifications govern quality.
- B. Centralized Software-Based Management
 1. Provide a web-based AV resource management and remote control application to manage, monitor, and control AV equipment and other devices using a standard TCP/IP network.

- a. Extron Global Viewer/Global Configurator
 - b. Or Equal
- C. Provide AV signal extension as required.
- D. Provide plenum-rated equipment, enclosures, and cables where required.
- E. Provide secure mounting/tamper-proof attachments for all accessible AV devices to prevent theft.

F. **Group Study Rooms – Typical Small**

Description	Make	Model	Qty.	Notes
Category: Audio				
Soundbar	Extron Or Equal	60-1737-11	1	No camera, provide wall bracket
Audio extractor	Extron Or Equal	60-1681-01	1	Mount behind display
Volume control module	Extron Or Equal	60-1090-01	1	Mount behind display
Category: Video				
Video display	NEC Or Equal	C432	1	
Display mount	Chief Or Equal	MTM1U	1	
Category: Control				
Control panel	Extron Or Equal	MLC62 RS D	1	
Category: Accessories				
Interface plate	Custom		1	
Misc. cables				

G. **Group Study Rooms – Typical Medium**

Description	Make	Model	Qty.	Notes
Category: Audio				
Soundbar	Extron Or Equal	60-1737-11	1	provide wall bracket.
Video conference camera	Logitech Or Equal	C920	1	Provide in two video conference enabled rooms (typical of 200 and 289A)
Audio extractor	Extron Or Equal	60-1681-01		Mount behind display
Volume control module	Extron Or Equal	60-1090-01	1	Mount behind display
Category: Video				
Video display	NEC Or Equal	C551	1	
Display mount	Chief Or Equal	LTM1U	1	
Category: Control				
Control panel	Extron Or Equal	MLC62 RS D	1	

Description	Make	Model	Qty.	Notes
Category: Accessories				
HDMI Interface plate	Custom		1	Provide HDMI and USB for video conference enabled rooms (typical of 200 and 289A)
Misc. cables				

A. **Group Study Rooms – Typical Large**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling loudspeakers	Extron Or Equal	60-1310-03	A/S	
Power amplifier	Extron Or Equal	60-1449-01	1	Mount behind display
Category: Video				
Video display	NEC Or Equal	C651	1	
Display mount	Chief Or Equal	LTM1U	1	
HDMI extension TX	Extron Or Equal	60-1586-52	1	Install in floor box
HDMI extension RX	Extron Or Equal	60-1631-53	1	
Category: Control				
Control panel	Extron Or Equal	MLC62 RS D	1	
Category: Accessories				
Misc. cables				

B. **Typical Meeting Rooms**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling loudspeakers	Extron Or Equal	60-1310-03	A/S	
Power amplifier	Extron Or Equal	60-1449-01	1	
Volume controller	Extron Or Equal	60-1090-01	1	Mount behind display
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	
Tabletop microphone	Biamp Or Equal	Parlé TTM-XEX	A/R	Confirm color with Architect. Secure mount to table
Category: Video				
Video Display	NEC Or Equal	C751Q	1	
Wall Mount	Chief Or Equal	LWRIWUB	1	
Wide angle Camera	Logitech Or Equal	C930E	1	Provide wall mount
VC Hub	Biamp Or Equal	Devio SCR-20	1	Mount under table

Description	Make	Model	Qty.	Notes
Category: Control				
Wall mounted control panel	Extron Or Equal	MLC62 RS D	1	

C. Office of IT Director

Description	Make	Model	Qty.	Notes
Category: Video				
Annotative video Display	Sharp Or Equal	PN-L401C	1	
Wall Mount	Chief Or Equal	MTM1U	1	
Category: Accessories				
Input plate	Custom		1	

D. Classroom Type 1

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1736-02	A/R	Coordinate color with Architect
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Audio Distribution	RDL Or Equal	ST-DA3	1	
Category: Video				
Short-throw video Projector	Epson or Equal	V11H878520	1	
Projector wall mount and equipment enclosure	Extron Or Equal	USFM 100 and UPB 125	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	2	Coordinate lectern mounting with architect
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Table mount kit	Extron Or Equal	SMB113	1	Coordinate color with architect
Category: Accessories				
Projection Screen, wall mount, 16:10, 130" diagonal	Da-Lite Or Equal	Tension Contour Electrol	1	

Description	Make	Model	Qty.	Notes
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	Coordinate lectern mounting with architect

E. Classroom Type 2

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1736-02	A/R	Coordinate color with Architect
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Category: Video				
Display	NEC or Equal	C981Q	2	
Display mount	Chief or Equal	PNRIWUB	2	
Ceiling equipment enclosure	Extron Or Equal	PVM220	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video distribution w/ audio out	Crestron or Equal	HD-DA-2	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	2	
HDMI extension to displays	Extron Or Equal	DTP 2 200 series	A/R	Provide wall plate at display location
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Category: Accessories				
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	

F. Classroom Type 3

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1736-02	A/R	Coordinate color with Architect
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Audio Distribution	RDL Or Equal	ST-DA3	1	

Description	Make	Model	Qty.	Notes
Category: Video				
Short-throw video Projector	Epson or Equal	V11H878520	1	
Projector wall mount and equipment enclosure	Extron Or Equal	USFM 100 and UPB 125	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	A/R	Coordinate lectern mounting with architect
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Table top kit	Extron of Equal	SMB 113		Coordinate color with architect
Category: Accessories				
Projection Screen, wall mount, 16:10, 130" diagonal	Da-Lite Or Equal	Tension Contour Electrol	1	
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	Coordinate lectern mounting with architect

G. Classroom Type 4

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1310-03	A/R	
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Audio Distribution	RDL Or Equal	ST-DA3	1	
Category: Video				
Video Projector	Panasonic Or Equal	PT-RZ570	1	
Projector ceiling mount and equipment enclosure	Extron Or Equal	Pole Vault Digital	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	1	Coordinate lectern mounting with architect

Description	Make	Model	Qty.	Notes
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Tabletop kit	Extron Or Equal	SMB 113	1	Coordinate color with architect
Category: Accessories				
Projection Screen, ceiling mount, 16:10, 130" diagonal	Da-Lite Or Equal	Tension Contour Electrol	1	
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	Coordinate lectern mounting with architect

H. **Tutoring Lab**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1736-02	A/R	Coordinate color with Architect
Instructor microphone	Extron Or Equal	VLME 3001	1	
Category: Video				
Display	NEC or Equal	C981Q	2	
Display mount	Chief or Equal	PNRIWUB	2	
Presentation System with amplifier	Extron Or Equal	60-1382-23	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	DTP 330 series	A/R	Provide wall plate behind display
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control panel	Extron Or Equal	TLP Pro 725T NC	1	Coordinate color with architect
Category: Accessories				
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	
Poe injector	Extron or Equal		1	

I. **Instructional Lab**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1310-03	A/R	
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Audio Distribution	RDL Or Equal	ST-DA3	1	
Category: Video				
Display	NEC or Equal	C981Q	2	
Display mount	Chief or Equal	PNRIWUB	2	
Ceiling equipment enclosure	Extron	PVM220	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video distribution w/ audio out	Crestron or Equal	HD-DA-2	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	A/R	
HDMI extension to displays	Extron Or Equal	DTP 2 200 series	A/R	Provide wall plate at display location
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Document Camera, HDMI, interactive	Elmo Or Equal	TT-12F	1	
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Category: Accessories				
Audio plate for portable ALS	C2G Or equal	Stereo RCA wall plate	1	

J. **Library Open Reading Area**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling mounted loudspeakers	Extron Or Equal	60-1310-03	A/R	
Instructor microphone	Extron Or Equal	VLM 3001	1	
Power amplifier	Extron Or Equal	XPA 2001-70V	1	
Audio Distribution	RDL Or Equal	ST-DA3	1	
Category: Video				
Video Projector	Panasonic or Equal	PT-RZ570	1	

Description	Make	Model	Qty.	Notes
Projector ceiling mount and equipment enclosure	Extron	Pole Vault Digital	1	
Presentation System	Extron Or Equal	PVS407D	1	
Video Extender Set, HDMI, shielded CAT6 interconnect	Extron Or Equal	PVT HDMI	1	
Collaboration System, Wireless	Extron Or Equal	Sharelink500	1	Coordinate with Laney IT
Category: Control				
Control Keypad	Extron Or Equal	MLC Plus 200	1	
Category: Accessories				
Projection Screen, ceiling mount, 16:10, 130" diagonal	Da-Lite Or Equal	Tension Contour Electrol	1	
Audio plate for portable ALS	C2G Or Equal	Stereo RCA wall plate	1	

K. Room Scheduling

Description	Make	Model	Qty.	Notes
Category: Video				
Room scheduling display	Extron Or Equal	60-1563-10x	A/R	Confirm finish with architect
Display mount	Extron Or Equal	SMK 2	A/R	

L. Portable Assistive Listening

Description	Make	Model	Qty.	Notes
Category: Audio				
Assistive Listening System	Listen Technologies or Equal	LT-800-072-P1	A/R	
Receivers	Listen Technologies or Equal	LR-4200-072, LA-402 LA-430	A/R	
Charging station	Listen Technologies or Equal	LA-381-01	A/R	

M. Overhead paging system

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling loudspeaker - pendant	Atals IED Or Equal	PM4FA	A/S	In open ceiling areas. Coordinate finish with architect
Ceiling loudspeaker - can	Atals IED Or Equal	FAP62T	A/S	

Description	Make	Model	Qty.	Notes
Power amplifiers	Atals IED Or Equal	DPA804	A/R	
End-of-Line Module	Atals IED Or Equal	IED54XXEOL	A/R	Provide at the end of each speaker run
Paging microphone	Atals IED Or Equal	IPCSD-TOUCH-G	1	
Paging system controller	Atals IED Or Equal	IP108-D Globalcom.IP	A/R	
Category: Accessories				
Network switch				Coordinate model selection with owner IT

2.3 CABLES AND WIRES

- A. Provide cables and wires that are continuous - without splices.
- B. For CATEGORY-type UTP cabling (cables, termination apparatus and installation requirements), refer to section 271513.
- C. Cable Selection:
 1. Refer to functional diagrams for signal type between equipment.
 2. Select a cable with the appropriate rating and configuration required by the applicable building code, electrical code, AHJ, and applicable codes and regulations governing the installation.
 3. For cables that will be installed in conduit within on-grade concrete, select a cable rated for underground construction.
 4. For cables that will be installed outdoors in underground conduit, aerial, and/or corrosive environments, select a cable rated for outdoor construction.
 5. For signal extenders, use extender the manufacturer's recommended cable type and within the maximum cable run length to be used.
- D. Unless otherwise called for in these specifications and drawings, the following cables are approved for the associated application or signal type. Ensure the chosen cable is appropriate for the signal type, available pathway capacity, and run length.

Application	Non-Plenum Product, or equal	Plenum Product, or equal
Ethernet	Refer to section 271513	Refer to section 271513
HDBaseT	Belden 2183R West Penn 4246F Extron XTP DTP 24 Superior Essex 6H-246-xA Windy City Wire CAT6S	Belden 2183P West Penn 254246F Extron XTP DTP 24P Superior Essex 6H-246-xB Windy City Wire CAT6SP
Control cable (AMX AXLink, Crestron Cresnet)	Belden 1502R West Penn 77350, C4215 Liberty LLINX-U Windy City Wire CRESCOM	Belden 1502P West Penn D25350 Liberty LLINX-U-P Windy City Wire CRESCOMP
Microphone and line-level audio cable	Belden 9451 West Penn 454 Liberty 20-2C-SH-GRY Windy City Wire 22-1PREZ-BLK	Belden 9451P West Penn 25291B Liberty 20-2C-PSH-GRY Windy City Wire 22-1PREZP-BLK

Application	Non-Plenum Product, or equal	Plenum Product, or equal
Program loudspeaker cable	Belden 5000UE West Penn 227 Liberty 12-2C-GRY Windy City Wire 12-02-GRY	Belden 6000UE West Penn 25227B Liberty 12-2C-P-BLK Windy City Wire 12-02P-BLK
Distributed loudspeaker speaker cable	Belden 5300UE West Penn 224 Liberty 18-2C-GRY Windy City Wire 18-02-BLK	Belden 6300UE West Penn 25224B Liberty 18-2C-P-BLK Windy City Wire 18-02P-BLK
ALS emitter	See Antenna cable (wireless microphone) – 50-ohm, below	
Antenna cable (wireless microphone) – 50-Ohm	West Penn 813 Liberty RG8-CMR-BLK RG8-BLK Or equal by Belden	West Penn 2598G8 Liberty RG8-CMP-BLK RG8P-BLK Or equal by Belden
Antenna cable (wireless microphone) – 75-Ohm	See CATV trunk and drop cables, below	
Analog video coaxial cable, RG59-type	Extron 815 Liberty RG59-CCTV-CM-BLK Windy City Wire RG59-BLK	Extron 25815 Liberty RG59-CCTV-PL-BLK Windy City Wire RG59P-BLK
Serial digital coaxial cable	West Penn 819 Liberty 20-CMR-VIDEO-BLK Windy City Wire RG59HD-BLK	West Penn 25825 Liberty 20-CMP-VID-COAX-BLK Windy City Wire RG59HDP-BLK

2.4 CUSTOM REMOTE-CONTROL PANELS AND INTERFACE PLATES

- A. For custom remote-control panels and interface plates, use 1/8 inch (3mm) thick #6061 T6 aluminum, with a brushed, anodized, black finish (or as approved by the Architect via submittals).

2.5 EQUIPMENT PLATES

- A. For equipment plates, utilize 1/32" to 1/16" thick by 1/4" high aluminum with a brushed anodized black finish.
- B. Provide engraved lettering 1/8" to 3/16" high.

2.6 LABELS

- A. General: Labels shall meet UL 969 product requirements.
- B. Equipment Labels:
 1. Equipment labels shall be machine printable, shall be polyester (or similar) adhesive-back type, and shall be permanent.
 2. Face stock (print area) shall be white.
 3. Size: as needed.
 4. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino

- d. Panduit
 - 1) #C150X075YJJ; component label, laser/inkjet print, white face stock 1.5"W x 0.75"H
- e. Thomas and Betts

C. Cable and Wire Labels:

1. Cable and wire labels shall be machine printable, shall be permanent, and shall be either of the following types:
 - a. Tape – machine-printable, wrap-around, self-laminating, permanent adhesive-backed tape
 - b. Machine-printable, shrink-wrapped labels
2. Face stock (print area) shall be white.
3. Size: as needed per wire/cable size (approximately 1" wide).
4. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
 - 1) #S100X075YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.08"-0.16"
 - 2) #S100X125YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.12"-0.28"
 - 3) #S100X150YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.16"-0.32"
 - 4) #S100X225YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.24"-0.48"

D. Loudspeaker Labels:

1. Loudspeaker labels shall be polyester (or similar) adhesive-back type, shall be permanent, and shall be machine printable with a printer.
2. Face stock (print area) shall be white.
3. Size: as needed.
4. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
 - 1) # C075X050YJJ; component label, laser/inkjet print, white face stock 0.75"W x 0.5"H

2.7 RACK BONDING

- A. Refer to section 270526 for approved bonding products.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of section 270000.
- B. Perform work in accordance with the standards and best practices defined by the AVIXA coursework for Installation 1: System Fabrication and Installation 2: Setup and Verification.

- C. Install products per manufacturers' instructions.
- D. Install panels, equipment, boxes, etc., plumb and square.
- E. Seismic Safety:
 1. Mount, anchor and/or brace permanently-installed equipment to the building structure using anchors, fastenings, supports, and methods approved by structural engineer with a safety load factor of at least 1.5. Provide installations that meet the most stringent of applicable codes and regulations to minimize potential damage to personnel and equipment from foreseeable seismic events.
 2. Brace hanging audiovisual and associated equipment both to minimize sway and to prevent detachment from the overhead structure in accordance with applicable codes.
 3. Firmly secure equipment in place unless requirements of portability dictate otherwise.

3.2 EXAMINATION

- A. Prior to starting the work of this section, examine areas to receive system components and pathways to receive cabling to verify conditions are ready for work of this section and to verify conformance with manufacturer and specification tolerances.
 1. Verify that pathways, including conduit, junction boxes, cable trays, ceiling enclosures, etc., are in place prior to placing cables into pathways and as required by applicable codes.
 2. Verify that rough-in (including conduit, device boxes, floor boxes, and the like) is ready to receive wiring, cabling, devices, equipment, and the like prior to installing into the rough-in.
 3. Verify that electrical power service is ready and stable prior to connecting equipment.
 4. Verify that support infrastructure, including equipment racks, are in place prior to installation.
 5. Check ceiling types, ceiling heights, and clearances above ceilings to ensure conditions are appropriate per manufacturer's installation requirements.
- B. Verify that the network is operational and ready to receive connection from and configuration for the System. "Ready" includes settings on the network required for the System to function properly. Coordinate with the network contractor as needed to ensure the network settings have been adjusted to support full functionality of the System.
- C. Proceed with installation work only after unsatisfactory conditions are corrected.

3.3 INSTALLATION

- 1. Furniture connections
 - a. Provide 2.5" diameter brushed stainless grommets at Av furniture locations. Coordinate AV requirements with furniture vendor.
- B. Displays and Mounts
 1. Wall-Mounted Displays: Install mounts using fasteners approved for the mounting substrate. For framed walls, firmly engage fasteners into backing or, if no backing is present, into framing studs.
 2. Ceiling-Mounted Displays: Install mounts to structure using fasteners and mounting accessories approved for the mount and mounting substrate. Install seismic restraints as appropriate for the installation location. Conceal cabling within mounting columns where feasible.
 3. Securely install displays onto mounts. Complete final connections (power, signal, control, etc.).

4. Install accessories onto mounts or displays using approved attachment methods that guarantee the longevity of the installation. Accessories may be attached mechanically, if allowed by the display/mount manufacturer, or by using 3M TB3571/3572 hook and loop fastener tape or an approved equal.
 5. Dress cables; ensure they are maximally concealed yet serviceable.
 6. Adjust each display and mount to attain a true, square, and level installed result.
- C. Video Walls (arrays of individual displays assembled to create a larger composite image)
1. Position all displays physically to align in a common plane.
 2. Position all displays to have equal gaps between them. Provide gaps per the display manufacturers' specifications.
 3. Verify consistent gapping by displaying full-screen images with horizontal, vertical, and diagonal lines. The evidence of proper alignment will be zero line offsets between adjacent displays.
 4. Adjust displays or video wall processors for proper bezel compensation.
 5. Verify correct bezel compensation by displaying full-screen images with diagonal lines. The evidence of proper adjustment will be an absence of line offsets between adjacent displays.
- D. Projection Systems
1. Projector Supports
 - a. Anchor poles to structure using means approved by a structural engineer.
 - b. Install lateral and/or transverse bracing to poles for seismic bracing as required.
 - c. Securely install mounts onto poles using compatible adapting components.
 2. Projectors
 - a. Securely install projectors to mounts.
 - b. Fully assemble and install projectors, lenses, and mirrors such that the final condition will be no observable movement in the image induced by motor vibration or other mechanical operations.
 - c. Install accessories onto mounts or projectors using approved attachment methods that guarantee the longevity of the installation. Accessories may be attached mechanically, if allowed by the projector/mount manufacturer, or by using 3M TB3571/3572 hook and loop fastener tape or an approved equal.
 3. Align projection systems so projected images fill the viewing areas of the associated projection screens and exhibit no geometric distortion.
 4. Only use physical and/or optical adjustments to correct geometric distortion.
 5. Only use electronic or digital correction when called for in this document package.
 6. Confirm that the total averaged light output from all projectors, in lumens, is at least 85% of that specified by the projector manufacturer.
 7. Confirm that the light falloff from the center of the projected image to four corners, as measured at the projected image plane, does not exceed 50%.
- E. Ceiling Microphones
1. Review field conditions, and coordinate with the Architect or Engineer to resolve conflicts with other trades' devices conflicting with microphone locations.
 2. Route analog microphone cabling away from other cabling types. Where this cabling must cross other cabling types, install it at a 90° angle.
 3. Install microphone preamplifiers, conversion devices, and other back boxes using safety wires attached to the building structure.
 4. Prior to acceptance testing, confirm microphones do not produce audible buzz and/or noise.

- F. Table Microphones
1. Review table drawings, and coordinate with the Architect and Engineer to resolve conflicts with other tabletop or through-table devices conflicting with microphone locations.
 2. Coordinate microphone locations and installation activities with the Architect and Engineer prior to installing through-tabletop microphones and microphone receptacles.
 3. Route analog microphone cabling separated from other cabling types to prevent signal interference. Where this cabling must cross other cabling types, cross it at a 90° angle.
 4. Install microphone preamplifiers and other microphone-related conversion devices neatly, square to the table, and as hidden from view as possible. Coordinate the locations of these devices with the Architect and Engineer.
 5. Label and dress all cables neatly and with approved cable management products.
 6. Prior to acceptance testing, confirm microphones produce no audible buzz and/or noise.
- G. Wireless Microphone Systems
1. Mount antennas external to equipment racks.
 2. For wireless microphone systems using multiple antennas, space them per manufacturers' recommendations.
 3. For VHF and UHF wireless systems, use RF coordination software (such as Shure Wireless Workbench) to scan and coordinate frequencies of all wireless microphone systems to be installed into the project.
 - a. Avoid local public safety channels when assigning frequencies.
 - b. Verify frequency assignments do not interfere with each other and are free from dropouts
- H. Antennas
1. Use antennas designed specifically for the frequency bands they will carry.
 2. For antennas extended from the attached equipment, use cabling appropriate for the frequency and distance.
 3. Use extender devices (preamplifiers) and distribution amplifiers per cabling lengths and manufacturers' recommendations.
 4. Install cabling per manufacturers' bend radius guidelines.
 5. Locate and orient antennas to ensure coverage throughout the room(s). Verify this by walk-testing systems.
- I. Loudspeaker Tap Settings
1. Where loudspeaker tap wattages are specified in the design documents, set transformers per these. Otherwise, set taps per best practices.
 2. Set taps such that the total wattage of a series of loudspeakers will not exceed 75 percent of the associated amplifier's rated wattage.
 3. Record tap settings per loudspeaker for inclusion on the as-built drawings.
- J. Loudspeakers, Wall, Surface-Mounted
1. Install loudspeakers per manufacturers' recommendations and the design documents.
 2. Install loudspeakers plumb and square.
 3. Use security mounting hardware where loudspeakers will be mounted below 10' AFF.
 4. Provide security cables per codes and best practices.
 5. Where manufacturer labels are visible on loudspeaker grills and are rotatable, align these to read correctly.
 6. Where loudspeakers will be exposed to humidity or water spray, ensure water will not be able to penetrate cable connections.
- K. Loudspeakers, Acoustical Tile, Ceiling-Mounted
1. Coordinate ceiling tile work (such as cutting holes) with the ceiling contractor.

2. Unless directed otherwise, center ceiling loudspeakers to ceiling tiles and evenly space loudspeakers.
 3. Cut ceiling tiles to fit loudspeaker such that no gaps are visible after the loudspeaker cover/grille is installed.
 4. Install ceiling loudspeakers with safety wires attached to the building structure per applicable codes and best practices.
 5. Use tile rails and other support components to ensure loudspeakers do not sag.
 6. Where manufacturer labels are visible on loudspeaker grills and are rotatable, align these consistently.
 7. Replace ceiling tiles damaged during loudspeaker installation work.
- L. Loudspeakers, Gypsum (hard lid) Ceiling-Mounted
1. Coordinate ceiling work (such as cutting holes) with the framing contractor.
 2. Unless directed otherwise, align and evenly space loudspeakers.
 3. Cut wallboard to fit loudspeaker such that no gaps are visible after the loudspeaker cover/grille is installed.
 4. Install ceiling loudspeakers with safety wires attached to the building structure per applicable codes and best practices.
 5. Where manufacturer labels are visible on loudspeaker grills and are rotatable, align these consistently.
- M. Room Scheduling Displays
1. Coordinate with the general contractor and specialty contractors to conceal cabling in glazing system frame members.
 2. Room Scheduling displays will be provided in the future. Provide cabling to support future system.
 3. Provide service loops to allow displays to be removed prior to disconnection.
- N. Digital Signage
1. Digital signage software and hardware are owner furnished
 2. Make digital signage players accessible and controllable via the network and via web access.
 3. Coordinate with the Owner to determine configuration and/or initialization files are required by players/receivers to be managed by the Owner's local or cloud-hosted management platform.
 4. Coordinate with the Owner's Representative to ensure a successful implementation of this requirement.
- O. Cabling and Wiring at Racks
1. Do not use electrical tape for bonding, splicing, joining, or any other purpose.
 2. As a general practice, run power cables, control cables, and other cables with higher voltage levels on the left side of an equipment rack as viewed from the back; run other cables with lower voltage levels on the opposite side. Where wiring issues or wire routing facilities preclude this configuration, it is acceptable to deviate from the directions above, if separation is maintained between signal and electrical power cables.
 3. To reduce signal contamination, group cables per the signals being carried. Maintain appropriate distances between cable groups, especially between high-current (power; loudspeaker) and low-current (microphone) groups. Form separate groups for the following cables/signal types:
 - a. Power
 - b. Control
 - c. Analog video
 - d. Digital audio and video
 - e. Analog microphone audio
 - f. Analog line audio

- g. Loudspeaker audio
- h. Radio frequency
- 4. Within racks, install wires and cables with service loops. Provide sufficient cable to allow each piece of equipment to be removed from the front of the rack for servicing.
- 5. At boxes or points of termination, install wires and cables with service loops. Provide sufficient cable to allow each piece of equipment to be removed and laid flat on a surface for servicing.
- 6. At slide-out equipment racks, dress cables to allow racks to be extended to the maximum length of the rack slides. For slide-out rotating racks, provide sufficient cable to allow full extension and rotation.
- 7. For cables that interface with racks, cabinets, consoles, or equipment modules, use screw-type terminal blocks, terminal strips, or connectors. Telephone-style punch-down blocks (e.g., 110 blocks) are not acceptable.
- 8. Do not bend any cable or wire tighter than the manufacturer's minimum bend radius.
- 9. Install wires and cables such that the cable exerts no strain on its termination.
- 10. Label wires and cables, regardless of length, using a cable label with a unique number or letter per the instructions below under "Labeling".
- 11. Cable Shield Bonding: For cables with shields, connect them using approved connectors per an approved grounding topology.
- 12. Encase umbilicals (groups of bundled cables) connecting moveable racks and cabinets to walls and other fixed locations in braided sleeving. Where racks and cabinets are installed in view of non-technical people, coordinate sleeving colors with the Architect.

P. Cabling and Wiring – Overhead Distribution

- 1. Use cabling appropriate to loudspeaker impedance, cabling distance, and installation conditions (such as plenum versus non-plenum).
- 2. The use of electrical tape for bonding, splicing, joining, or any other purpose is prohibited.
- 3. Provide cable runs between termination points that are continuous, with sheath continuity. Splices are not permitted anywhere.
- 4. Place cables within designated pathways, such as cable tray, cable hangers, etc. Do not fasten cables to other building infrastructure (such as ducts, pipes, etc.), other systems (such as ceiling support wires, wall studs, etc.), or to the outside of conduits, cable trays, or other non-approved pathway systems.
- 5. Protect cables from physical interference and damage during installation and termination. Install cables with no kinks or twists.
- 6. Install HDBaseT cables within manufacturers' length recommendations.
- 7. Comply with manufacturers' limits for pulling tension.
- 8. Do not use cable-pulling compounds for indoor installations.
- 9. Install cables within manufacturers' bend radius limits. If no minimum bend radius is given, then maintain a minimum bend radius of six times the cable diameter during and after installation.
- 10. Route cables under building infrastructure (such as ducts, pipes, conduits, etc.); do not route cables over building infrastructure. Install cables to provide accessibility for future service.
- 11. Place cables 6", minimum, away from power sources to reduce interference from EMI.
- 12. Connectors: Use the following connectors:

Category	Subcategory	Type	Acceptable Manufacturers			Comments
Audio	Low-level	RCA / S/PDIF	Switchcraft	Pomona		
Audio	Low-level	3.5mm TRS	Switchcraft	Neutrik	Amphenol	
Audio	Low-level	1/4" TS/TRS	Switchcraft	Neutrik	Amphenol	
Audio	Low-level	XLR	Switchcraft	Neutrik	ITT Cannon	

Category	Subcategory	Type	Acceptable Manufacturers				Comments
Audio	Low-level	Combo XLR/TRS	Neutrik				No substitutions
Audio	Low-level	TA-series (mini XLR)	Switchcraft				No substitutions
Audio	Low-level	Microdot	Lemo				
Audio	Microphone, no mute control	XLR-3	Switchcraft	Neutrik	ITT Cannon		
Audio	Microphone, with mute control	XLR-5	Switchcraft	Neutrik	ITT Cannon		
Audio	Microphone under table or desktop, no mute	R3F	Switchcraft	Neutrik	ITT Cannon		
Audio	Microphone under table or desktop, with mute	R5F	Microphone under table or desktop, no mute				
Audio	Low or high-level	Phoenix	Phoenix Contact				
Audio	High-level	Banana	Pomona	GC Electronics			
Audio	High-level	Speakon	Neutrik	Switchcraft			
Video	50-ohm	BNC	Kings	AMP - TE Connectivity	Trompeter	Amphenol	
Video		Triax	Trompeter				
Video		HDMI bulkhead barrel	Switchcraft	Cliff	Neutrik	Harting	
Video		HDMI cable	Extron	Crestron			
Video		DisplayPort cable	Extron	Crestron			
Video		Mini DisplayPort/Thunderbolt cable	Extron	Crestron	Apple		
Video	D-sub	HD-15 ("VGA") cable	Extron	Crestron	Cables to Go		
RF	75-ohm	BNC	Kings	AMP - TE Connectivity	Trompeter	Amphenol	
RF		F-type	Belden	Amphenol	Liberty	Digicon	
RF		UHF	Amphenol				
Control	D-sub	DB-9, DB-25	Amphenol	TE Connectivity			
Control	Phoenix		Phoenix Contact				Or as provided with equipment

Category	Subcategory	Type	Acceptable Manufacturers				Comments
Control	Modular	4p4c plug	Cinch Connectivity	Molex	TE Connectivity	Hirose	
Control	Modular	8-contact	Ortronics	Panduit	Belden	Molex	
Control	USB cable	A, B, C types	Extron	Crestron	Hosa	Belkin	
Control	Crimp	Fork lug	TE Connectivity	Molex	Phoenix Contact		
Control		XLR	Switchcraft	Neutrik	ITT Cannon		
Control		DIN	CUI	Hirose			
Control	etherCON	RJ45	Neutrik				
Fiber		FC	Molex	TE Connectivity	3M		
Fiber	opticalCON	Click-on duplex	Neutrik				
Fiber		LC	Molex	TE Connectivity	3M		
Fiber		LC Duplex	Molex	TE Connectivity	Conec		
Fiber		SC	Molex	TE Connectivity	3M		
Fiber		SC Duplex	Molex	TE Connectivity	3M		
Fiber		SMA	Industrial Fiberoptics	TE Connectivity	Phoenix Contact		
Fiber		ST	Molex	TE Connectivity	3M		
Fiber		TOSLINK	Tripp Lite				

Q. Terminations and Cords at Floor Boxes

1. Provide strain relief for cables. Use appropriate cable management products (such as hook and loop straps for UTP and STP cabling, and nylon cable ties for other cables) to group similar cable types.
2. Provide permanent labels on cables within 6" of terminations.
3. Provide permanent labels on receptacles within floor boxes to clearly identify terminations and services.
4. Encase umbilicals connecting moveable racks, cabinets, etc., to floor boxes in braided sleeving. Where racks and cabinets are installed in view of non-technical people, coordinate sleeving colors with the Architect.

R. Blank Panels: Provide blank trim plates in floor, wall and furniture-mounted boxes at unused termination positions. Fill each module opening filled, either with a receptacle, a receptacle plate, or a module of the type the opening is intended to house.

S. Patch Panels

1. Assignments: Wire patch panels so that signal sources appear on the upper row of a row pair; and destinations appear on the lower row of a row pair. Submit variations from this approach per the requirements in Submittals.
2. Designation strips: Utilize alphanumeric identifications and descriptive information on audio and video patch panel designation strips. Number the jack positions in each row

sequentially from left to right. Letter the jack rows sequentially from top to bottom. Include the alphanumeric identification of each jack on the functional block drawings. Mount reproductions of these drawings in an appropriate location near the patch bays.

3.4 EDID MANAGEMENT

- A. For each system, determine the maximum pixel resolution, frame rate, and color depth supported by all content displays, and designate this as the target resolution for the system. Omit digital signage displays from this process.
 - 1. Scalers: Configure video scalars as follows:
 - a. Input: Emulate the EDID configuration of the native resolution of the connected display or projector for both analog and digital inputs.
 - b. Output: Configure to match the native resolution of the display system and at the highest supported scan rate.
- B. Determine the system's maximum audio parameters – output channel count, LFE capabilities, etc.
- C. Configure the system's EDID management to ensure that these audio and video parameters are sent to source devices.

3.5 HDCP MANAGEMENT

- A. Include HDCP support in all equipment that incorporates copy protection for the transport of copyrighted media.
 - 1. Installation Requirements
 - a. Equipment capable of passing HDCP included in this project must support the same HDCP version (i.e. HDCP 1.4 or HDCP 2.2).
 - 2. Exceptions
 - a. HDCP may be defeated for educational institution projects per 'fair use' copyright terms.

3.6 NETWORK SECURITY

- A. Leave no network-connected device operating with its factory-default password.
- B. Obtain Owner-defined password changes for all network-connected devices. Program these passwords into the devices.
- C. Where available, enable two-factor authentication.

3.7 PROGRAMMING AND EQUIPMENT CONFIGURATION

- A. General Programming
 - 1. Install the most current version of manufacturers' firmware on devices.
- B. Audio Processor Programming
 - 1. The following instructions apply to all systems including programmable audio processors and microphones.

2. Set input devices (wireless microphones, ceiling microphones, video device audio, etc.) to unity gain.
3. Set output devices to unity gain.
4. Set amplifiers to maximum gain.
5. Set gains from microphones on analog and Dante/AES67 input blocks in audio processors to achieve input gains on meters around -15 to -20dBFS.
6. Set gains on analog and Dante/AES67 output components in audio processors to achieve required output gain from the loudspeakers.
7. Adjust gating auto-mixer settings so that room participants can be heard clearly with minimal room noise and echo, with no noticeable delay nor cutoff words when talkers begin to speak, and with minimal breathing and other artifacts after talkers stop speaking.
8. Adjust AEC settings so that no echo can be heard by far-end callers.
9. Balance program levels between HDMI program audio and USB bridge program audio to within 3 dB.
10. Coordinate AEC among all processing devices and software in the system so that only one processor in the audio chain, whether physical, such as a hardware DSP, or virtual, such as a software processor in collaboration software, has AEC enabled.
11. Make equalization and other room tuning adjustments to obtain the flattest and least colored result the system is capable of.
12. Make additional equalization and other room tuning adjustments to eliminate feedback when the microphones are at maximum system gain. Do not use feedback suppression components.

C. Control System and Touch Panels

1. Owner's Requirements
 - a. Meet with the Owner and document their functional and user interface requirements (backgrounds, color scheme, screens, menus, functions, etc.).
 - b. Develop programming and user interfaces based on the user requirements.
 - c. Submit touch panel layouts and menu flow documentation to the Owner and Engineer per submittal schedule.
 - d. Meet with the Owner and Engineer and present the control system programming and user interfaces. Obtain the Owner's approval on these items.
2. Programming Guidelines
 - a. Create initial screens (splash screens) that use a version of the Owner's logo, generated without visible scaling artifacts.
 - b. Only use red for alarm indicators and other screen elements of special significance.
 - c. Avoid use of technical terms, rather, use clear, everyday language. For example, instead of "System On", use "Turn System On"; instead of "Power Down", use "Turn Power Off", etc.
 - d. Ensure soft buttons are sized consistently and spaced evenly.
 - e. Ensure spelling, punctuation, and grammar are 100% correct.
 - f. Provide menus on both touch panels and control system web pages that appear and function consistently throughout the project.
 - g. Ensure items with similar functions appear consistently in all menus.
 - h. Provide soft button presses that display visual feedback, and if required by the Owner, audible feedback.
3. Tech Menus: Provide a "tech" (Technician-level) menu for each touch panel. Include in tech menus:
 - a. Volume control for button audible feedback
 - b. Screen brightness
 - c. A means to change the tech screen password; obtain from the Owner's Representative a default password for all touch panel tech menus or an alternative method for password management, such as the use of Active Directory.
 - d. Other technician-specific functions required for each system

4. Make IP control system devices (touch panels, controllers, processors, etc.) accessible and controllable via the network and via web access. For example, users and/or technicians shall be able to operate touch and pushbutton panel functions remotely. Coordinate with the Owner's Representative to ensure a successful implementation of this requirement.
5. In AV-equipped rooms with an operable partition, program the AV system to use signals from the rooms' partition sensors to automate audiovisual system combine/divide functions.

D. Power Control and Sequencing

1. Whether explicitly listed in this specification or not, provide power control interfaces, e.g., remotely controllable PDUs, for equipment and devices that are not equipped with integrated power control. Provide power control interfaces that are fully compatible with the specified control system. Follow this directive for devices, such as audio power amplifiers, which would not be adversely affected by external power controls. Omit such power controls for devices, such as transmitters and receivers, that should not be externally power controlled.
2. Configure non-controlling items to power off or go into a standby/low power-consumption mode when systems are powered off. At minimum, program the AV system to power off the following types of devices when not in use.
 - a. Audio processors
 - b. Audio amplifiers
 - c. Displays
 - d. Projectors
3. Configure devices that detect connection to user devices to stay in standby/low power-consumption mode when audiovisual systems are turned off.
 - a. Video switchers and processors
4. When turning systems on, use the following sequence for audio components.
 - a. Turn on source devices.
 - b. Turn on processing and routing devices.
 - c. Turn on amplifiers.
5. When turning systems off, use the following sequence for audio components.
 - a. Turn off amplifiers.
 - b. Turn off processing and routing devices.
 - c. Turn off source devices.

E. BMS Interfacing

1. Coordinate with the Owner's Representative regarding interfacing between AV power control and the building management system. Comply with the Owner's requirements for reporting power control and/or power usage.

F. Network Connection

1. Connect all network-connectable equipment and devices to the network. Program them to electronically issue notifications for preventative maintenance (e.g., replace a projector lamp).
2. Coordinate with the Owner's Representative which devices are to provide notification (e.g., email notification) immediately at the time of a fault and which devices will provide notifications on a daily or weekly report.
3. Coordinate with the Owner's Representative to obtain the default notification means (e.g., the email address for maintenance messages).
4. Ensure the Owner's Representative can revise the maintenance email address via a simple method – using a single address for all networked AV devices. Document this procedure in the Operations Manual.

- G. Equipment Configuration:
 - 1. Computer Interfaces, Signal Extenders and Transmitters with Integral Input Switching: Program devices and related system components so analog audio inputs are active regardless of which video input is selected.

3.8 LABELING

- A. Provide labeling identifiers that match closeout documentation (e.g., as-built drawings, O&M Manual, etc.).
- B. Clean and degrease surfaces receiving nameplates and labels prior to affixing labels.
- C. When creating labels for user-facing equipment and cables, use colored labels where possible. Example uses are floor boxes, table boxes, cameras, displays, and user-facing cables. Use color coding to relate labels to related components, i.e., match the text and color on each user-facing cable, its corresponding button on the button panel, and its corresponding input on the display. Example: HDMI 2 cable has a yellow label printed with "HDMI 2", the button panel at the table box has a yellow "HDMI 2" label and the input on the display has a yellow label printed with "HDMI 2".
- D. Interface Plate Designation:
 - 1. Provide wall-mounted interface plates with clearly engraved alphanumeric identification of input type (e.g., "MIC-1", "LINE IN", "SPEAKER", "VIDEO", etc.) and corresponding patch field designation.
- E. Equipment Racks and Cabinets:
 - 1. Install the label on the top of the rack or cabinet, centered horizontally.
 - 2. Example: line 1: "AV-01", line 2: "Audiovisual Devices".
- F. Equipment
 - 1. Rack-mounted equipment: Install labels in visible locations on equipment and devices on the front and back of the equipment.
 - 2. Field equipment: Install labels in visible locations on miscellaneous field equipment and devices.
- G. Wireless Transmitters and Receivers: Label wireless transmitters and receivers so users can clearly identify a given transmitter associated with its receiver.
 - 1. Use an identifier, such as a room number, that associates each transmitter with a given room or system.
 - 2. Example: RM.230–MIC.3–RCVR.1
- H. Wire and Cable:
 - 1. Comply with the Owner's labeling requirements. If the Owner does not have labeling requirements, conform with AVIXA F501.01.
 - 2. Provide labels with machine-generated text; hand-written labels will not be accepted.
 - 3. Use a numbering system with a consistent number of characters for each cable's unique identifier.
 - 4. Generate a unique identifier for each cable and wire using either the Owner's system or AVIXA F501.01. Include primary level data elements per F501.01; secondary level data elements are optional.
 - 5. Label Installation:
 - a. Install labels on both ends of cables at least 1" (25mm) and no more than 12" (300mm) from the connector strain relief or the heat shrink tube from which individual wires exit the cable jacket.

- b. Labels must be visible; they may not be concealed by strain relief elements or within bundles.
 - c. Install labels such that they are visible by a technician from a normal stance.
 - d. Install labels according to label manufacturers' guidelines.
6. Label Legibility:
- a. Text margins shall be a minimum of 1mm in the printable area.
 - b. Text shall not be obscured by any part of the label.
 - c. Primary text shall be all capitals, no less than 2.5mm tall. Bold is permitted; italics are not.
 - d. Secondary text shall be all capitals, no less than 2.1mm tall. Neither bold nor italics are permitted.
7. Label Consistency:
- a. All primary labels shall have the same width. All secondary labels shall also be the same width, but that width may differ from that of the primary labels.
 - b. All label shall be of sufficient height for the outer dimensions to meet the manufacturer's installation.
 - c. In environments and applications where additional physical protection is required to preserve label integrity and legibility for the specified design life, apply additional protective materials. In such cases, apply the additional materials to all labels in the system. If a specific design life is not otherwise specified, assume 10 years will be required.
 - d. Primary labels shall utilize the same font type, font size, font spacing, and margin spacing except in the case of user-accessible cable labeling. Secondary labels shall utilize the same font type, font size, font spacing, and margin spacing. The properties of the primary labels may differ from the secondary labels, but they shall be consistent within each label type.
 - e. Unless defined otherwise within the labeling schema, text shall be the same color. Text color shall present high contrast to the background color of the label. Black text on a white background is preferable, but where any other color scheme is used, a contrast of no less than 3:1 shall be achieved.

3.9 FIELD QUALITY CONTROL

- A. Initial Tests and Measurements: Prior to final adjustment and scheduling acceptance testing, perform initial tests and measurements. At minimum, include the following initial tests and measurements:
- 1. Adjust, balance, and align equipment for optimum quality and to meet manufacturers' published specifications.
 - 2. Perform the test procedure provided at the end of this specification and return the completed form no less than one week prior to the initial punch walk.
 - 3. For rack-mounted equipment with user-accessible controls, install 1/8" diameter vinyl "map dots" as indicators for nominal operating positions of rotary, slider, and other accessible controls. Provide multiple dots, adequately distinguished, for controls having more than one nominal operating position.
- B. Twisted-pair Cable Testing: Follow the following procedures to test CATEGORY-type twisted pair cabling.
- 1. Equipment, or equal:
 - a. Fluke DSX CableAnalyzer
 - 2. Test Procedure:
 - a. Configure the cabling and test set up as a permanent link.
 - b. Test each cable under a TIA-568 Permanent Link test script to match the category of the installed cabling.

- C. Fiber Optic Cable Testing: Follow the following procedures to test fiber optic cabling.
1. Equipment, or equal:
 - a. MicroCare Fiber Wipes, or equal
 - b. SPC FiberXP DI-200 Fiber Optic Inspection Scope, or equal
 - c. Fluke DSX-5000, AFL Noyes SMLP4-4 Fiber Optic Loss Test Kit, or equal
 2. Test Procedure:
 - a. Using approved materials, clean each connector end face before testing.
 - b. Using the inspection scope, inspect each connector end face.
 - c. Multi-mode Fibers:
 - 1) Set up the optical loss test set under either IEC 61280-4-1 Single Reference Cable Method or the TIA 526-14 OFSTP-14 Method B.
 - 2) Measure the insertion of each fiber. Record the measurements.
 - 3) Re-terminate or replace cables with fibers that exceed 3 dB at 850 nm and 1 dB at 1,300 nm end-to-end insertion loss.
 - d. Single-mode Fibers:
 - 1) Set up the optical loss test set per TIA-526-7 test method A.1 "One Jumper-Cable Measurement".
 - 2) Measure the insertion of each fiber. Record the measurements.
 - 3) Re-terminate or replace cables with fibers that exceed 1.5 dB at 1,310 nm and 1.5 dB at 1,550 nm end-to-end insertion loss.
- D. Digital Video Cabling: Follow the following procedure to test each provided digital video cable.
1. HDMI: Quantum Data 780, or equal
 2. DVI/SDI/HD-SDI: Quantum Data 882D, or equal
 3. DisplayPort: Quantum Data 882E-DP, or equal
 4. Test Procedure:
 - a. Test each cable.
 - b. Replace all cables that fail.
- E. Audio System Testing:
1. Loudspeaker Line Impedance: Measure the impedance at 63 Hz, 250 Hz, and 1 kHz and the resistance of each loudspeaker line leaving the sound equipment rack with the line disconnected from its normal driving source. For lines to full range distributed loudspeaker systems, measure impedance at 1 kHz.
 2. Hum and Noise Level:
 - a. Measure the hum and noise levels of the overall system for each microphone input channel and line level input channel.
 - b. Adjust gain controls for optimum signal to noise ratio so that full amplifier output is achieved with 0 dBm at a line level input.
 - c. Terminate line level inputs with resistors of 150 and 600 ohms, respectively, for these measurements.
 - d. Disconnect the loudspeaker lines and terminate the power amplifier outputs with power resistors for these measurements. Use load resistors within 5% of the nominal load impedance of the amplifier under test. Use resistors with power ratings equal to or greater than the power rating of the amplifiers.
 3. System Frequency Response: Measure audio system frequency response for the AV systems described in Part 1. Adjust systems to provide specified performance.
 4. Uniformity of Coverage: Using a calibrated testing device, measure octave bands using a pink noise test signal played through the loudspeaker system(s).
 5. System Power Output and Signal Level Adjustment:
 - a. Measure the electrical distortion of the overall system for each line level input channel.
 - b. Adjust gain control as for the tests specified herein.
 - c. Apply a 1 kHz sine wave signal from a test signal generator having less than 0.5% total harmonic distortion at the input tested, at a level required to produce full

- amplifier output. Note that a pad with 150-ohm output impedance is required for driving the microphone level input in accordance with the EIA standard.
- d. Use a distortion analyzer to measure the output level and total harmonic distortion of the audio equipment. In the absence of a distortion analyzer, a high input-impedance measuring device such as a DMM may be used to measure the output level.
6. Loudspeaker Polarity:
 - a. Perform loudspeaker line polarity checks using a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Confirm that loudspeaker lines are correctly polarized with respect to color coding.
 - b. Confirm loudspeaker polarity using a polarity tester.
 7. Freedom from Parasitic Oscillation and Radio Frequency Interference:
 - a. With systems set up for each mode of operation specified in the Part 1, confirm that systems are free from spurious oscillation and radio frequency pickup, in the absence of audio input signal and when the system is driven to full output at 100 Hz.
 - b. Confirm these tests audibly and by using an oscilloscope having at least 5 MHz bandwidth.
 - c. Apply a slow sine wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power amplifier output to each system. Listen carefully for buzzes, rattles and objectionable distortion.
 - d. Correct causes of these defects unless the cause is clearly from other than the sound amplification system's equipment and installation, in which case bring the cause to the attention of the Owner and Architect.
 8. Audio Test Signal Paths: Verify operation from source inputs through system components to signal destinations.
- F. Projection Systems:
1. For each projection system, measure light intensity at the screen's center and four corners. Take corner measurements 5% of the image area width and height in from image edges.
 2. Use a properly calibrated foot-candle (or lux) meter with cosine correction for the above measurements.
- G. Control Systems:
1. Verify all operational functions at each fixed control interface position.
 2. Verify all operational functions of provided wireless control devices.
 3. Verify all operational functions of the control system and interfaced devices.
- 3.10 CLEANING, PROTECTION AND REPAIR
- A. Comply with the cleaning requirements of section 270000.
 - B. During the installation and up to the date of final acceptance, protect finished and unfinished work against damage and loss. In the event of such damage or loss, replace or repair such damaged work.
- 3.11 SUBCONTRACTOR MANAGEMENT
- A. Continuously supervise subcontractors during the installation; intermittent supervision is not acceptable.

3.12 SYSTEM ACCEPTANCE TESTS

- A. Perform system acceptance tests after completion of initial system checkout and after submitting the Initial Testing and Tuning Report.
- B. Prior to setting up a demonstration and/or punch walk with the Engineer, ensure that the System/Systems are complete, operational, and fully functioning, and that pre-functional and functional testing have been completed. Fees for any additional punch walks resulting from incomplete and/or non-functioning Systems may be assessed.
- C. System acceptance tests consist of the following:
 - 1. Take a physical inventory of equipment on site and compare it to equipment lists in the contract documents.
 - 2. Demonstrate the operation of system equipment.
 - 3. Perform both subjective and objective tests to determine compliance with the specifications. Provide test equipment specified for these tests.
 - 4. Provide final, "as built" drawings, run sheets, manuals, and other required documents, as detailed in Part 1.
 - 5. Provide complete testing reports generated by subsystems that provide self-testing.
 - 6. Perform power on/off cycles to ensure these take place with no audible and only minimally visible artifacts, pops, etc.
- D. Initial Testing and Tuning Report
 - 1. Perform the following tests for each system unless otherwise noted in Part 1.
 - 2. Use additional pages as necessary to allow complete comments.
 - 3. Where blanks are provided in the checklist below, observe the associated value in parenthesis.

Test	Description	Result	Comment
1	Record equipment that was specified but is not present. Provide a reason why this equipment is not present.		
2	Confirm no sharp or jagged surfaces are accessible to users and technicians.		
3	Confirm that each active device's external temperature, measured using a non-contact thermometer, is within manufacturer's guidelines.		
4	Perform and log cable inspection. Confirm each cable is labeled, dressed, included in a bundle with cables with like signals, not under stress, is serviceable, is correctly strain-relieved, is not bent beyond manufacturer's recommended bend radius, does not have tie wraps tensioned excessively or used inappropriately. Confirm labels are positioned and oriented consistently and are legible and unambiguous.		
5	Demonstrate that the full inventory is new equipment, in full compliance with the specification, or as modified by approved submission. Record test results as pass/fail, and list exceptions.		

Test	Description	Result	Comment
6	Confirm rack elevation and single-line drawings, cable and other labels and engravings are an accurate model of the furnished system, and comply with latest revised specifications. Record test results as pass/fail.		
7	Confirm switcher inputs and outputs are labeled (wherever possible), so that users can easily make manual routes quickly without having to refer to the system drawings.		
8	Confirm amplifier channels are properly labeled, so technicians can make quick adjustments without having to refer to the system drawings.		
9	Confirm rack mounted equipment is labeled and that the labels match those on the drawings (equipment symbols and/or description), control system, field plates, patch panels, and any labels associated with the system.		
10	Confirm modular terminations are solid in their connectors.		
11	Confirm each coax cable respects the manufacturer's minimum bend radius or at least 5x the cable's diameter.		
12	Record ambient noise, A-weighted, slow.		
13	Confirm power amplifiers are working within rated load. <i>Record the impedance (and at what frequency) of each loudspeaker line on each power amplifier at 63, 250, and 1,000 Hz.</i>		
14	Using appropriate test signals, have the sound system produce a nominal operating level of __ (65) dB SPL for conference speech, __ (60) dB SPL for program material, "A" weighted at all listeners' ears \pm __ (2) dB ("Uniformity of Coverage") (or at least __ (15) dB above the ambient noise, A-weighted, whichever is greater), with the control system volume control indicating "normal" or default setting. <i>Record results for each channel and source.</i>		
15	Confirm the system is capable of producing an additional __ (15) dB above this level (__ (80) dB SPL) for each audio source, with less than 0.5% THD (Total Harmonic Distortion) plus noise. <i>Measure THD plus noise when source is at __ (15) dB above nominal operating level at each "destination", for all sources selected.</i>		

Test	Description	Result	Comment
16	Confirm the system develops a noise level that is electrically __ (55) dB below the normal operating level for all audio sources. "Noise" refers to the aggregate of hum, electrostatic noise, RF interference, etc. <i>Measure and record Signal to Noise ("signal" measured electrically at nominal operating level at each destination, for all sources selected).</i>		
17	Confirm program loudspeakers are connected in the same polarity, and speech reinforcement systems are polarized such that a positive acoustic pressure on a microphone results in a positive acoustic pressure at the loudspeaker ("Polarity Test").		
18	Confirm the system produces no more than a __ (1) dB variance in program source levels when each program source is playing audio from a calibrated medium (CD, test signal generator, etc.)		
19	Confirm there is no audible vibration caused by improper mechanical installation. <i>Use a continuous sweep signal at headroom level (from an audio test signal generator or test CD.) Provide a pass/ fail result and document which device fails and the frequency of these artifacts.</i> ("Buzzes and Rattles Test").		
20	Confirm speech reinforcement systems are stable, with no ringing nor feedback.		
21	For audio conference systems, adjust microphone input gain to demonstrate that a "standard talker" (60 dB SPL at 1 m), positioned at each talker position in the room, produces a 0 dB level at the input of the mixer bus of the audio conference DSP device. If there is local voice reinforcement ("mix-minus"), AGC and ALC may need to be restricted when performing this test. <i>Record test results as pass/fail. Record level across analog telephone line, if one is used. Inspect DSP mixer telephone line levels, both transmit and receive, when normal speech is encountered in the room.</i>		
22	For conferencing mode, at the __ (65) dB SPL listening level, confirm full duplex operation, with no reports of echo or "speech trails" as detected from the far end.		

Test	Description	Result	Comment
23	Confirm equalizers, whether hardware or virtual, are adjusted for best intelligibility, and in accordance with any preferred acoustic level response curves. <i>Record the “house curve” before equalization, as well as after the equalizers have been tuned, with and without microphone input filters. If requested by the Consultant, produce this documentation for systems without equalizers, as this test may apply to the preamp filter settings in cases where intelligibility can be improved.</i>		
24	If required, confirm system intelligibility, with a RSTI (Rapid Speech Transmission Index) greater than 0.85.		
25	For wireless microphone systems, with all wireless microphones turned on, confirm that throughout the specified operating area for the transmitter, there are no dropouts, intermodulation interactions between wireless systems, nor RF-caused artifacts.		
26	If required, for composite video sources, connect a test generator at each input and confirm 1 volt peak-to-peak to each destination $\pm 10\%$ (or 1dB). <i>Record results at each destination using NTSC/PAL bars, peak white, and five-step multiburst (0.5, 1.0, 2.0, 3.0, 3.58, and 4.2 MHz).</i>		
27	For NTSC sources, confirm optimum brightness, contrast, and color in displays using a SMPTE source with PLUGE display.		
28	Where several displays are visible in the same space, confirm picture tonal consistency across all of them. For composite video signals, use NTSC color bars with PLUGE signal to all. For digital video signals use a colorimeter and test color signal software to confirm consistent images		
29	Confirm projectors are focused, centered, and evenly illuminated. <i>If requested, confirm using a calibrated light meter that the brightest measurement locations are no more than +10% above average, and the dimmest locations no less than –5% below average measurement. If requested, document that geometric distortion is within 2% tolerance. Take actual measurements if necessary (top, bottom, left, right dimensions of white portion of screen) and photograph if necessary.</i>		
30	Confirm that the system displays with stability, and with no scaling-related visual artifacts when switching between, at a minimum, the resolutions specified in 1.04 D. Record test results.		

Test	Description	Result	Comment
31	<p>Where HDMI, DVI, or DisplayPort signals are included in the system, confirm that an acceptable signal is being displayed on the monitor from each source position. Use the Alt Pixel test image (pixel-on, pixel-off) for each resolution included in the design intent: 1,920x1,200@60, 1,920x1,080@60, 1,280x720@60, as required. Inspect each, leaving the signal on for three minutes. Confirm that no artifacts are visible.</p> <p>For systems including 4k displays, test also at 3,840 x 2,160 and 4,096 x 2,160.</p> <p>Note: If the signal is going to a codec, disable HDCP. If the signal is going to a display, enable HDCP unless specified otherwise in Part 1.</p>		
32	Using a signal generator, confirm scaler and display/projector configurations by successfully passing video at the resolutions defined in 1.04 D.		
33	Confirm HDCP is maintained from sources to destinations except as excluded above. Confirm EDID is managed correctly and that devices output at resolutions supported by the system.		
34	Confirm the control system controls all of the required equipment as specified. Confirm system performs with stability and in sync with the equipment being controlled without the need to reset any item of equipment. Confirm that user interface requirements dictated in Part 3 of the audiovisual specifications have been met.		
35	Confirm system is serviceable: all devices must be easily removable for repair by one person; all cables must be dressed neatly and be provided with adequate services looks, must be bundled in forms (refer to "Sound System Engineering", Davis and Davis, 1987 and "Audio Systems Design and Installation", Giddings, 1990) having no excessive pressure on cables at termination points and connectors, and each cable number must agree with the shop drawings and cabling run list.		
36	Confirm switches and receptacles are logically and permanently labeled.		
37	Confirm nomenclature for consistency: drawings, touch screen, wall plates, floor boxes, patch panels, equipment, etc.		
38	Confirm patch cables have cable numbers.		

Test	Description	Result	Comment
39	Where cameras are included in system, confirm each operates correctly and provides correct image quality.		
40	Confirm camera presets are programmed as specified by the user. In the absence of Owner direction, create and document presets that are logical for the room's layout.		
41	Confirm TV reception from all sources (OTA, CATV, etc.) and that all channel presets are accurate.		
43	Confirm and document the IP configuration information provided by the Owner is loaded into the equipment, including IP and MAC addresses, Dante device names, subnet masks, gateways, time server, gatekeeper, etc. Confirm that all network functions specified by the customer function properly on the customer's LAN.		
44	Confirm all web-based system control and monitoring features, and other IP system functionality (time servers, system-generated e-mail, etc.) are completely functional.		
45	Confirm that display devices have On-Screen Displays/Menus disabled. If the customer has directed otherwise, document from which person this direction came.		
46	Confirm that video projectors have blue screens or other images or colors displayed in the absence of an input signal disabled. If the customer has directed otherwise, document from which person this direction came.		
47	Log test conference calls (audio and video). Include in the log start time, line used, number called, status of connection (completed/failed, etc.) who was spoken with at the far end, success of full duplex, success of auto-disconnect, dB SPL in the room. Note static, jitter/packet loss, or any other artifacts, distortion, etc. Note if auto-disconnect functions as specified.		
48	Using a full-screen white test signal, confirm no direct view display nor projector has more defective pixels than specified in Part 1. Note number and location of lost pixels, if any. Provide photos of defects. Include room numbers and any other distinguishing information in photo file names.		
49	Check for excessive vibration on VC camera(s) at full telephoto position.		
50	Provide video recordings of all non-conformances and anomalies.		
51	Confirm all visible devices are installed square and plumb.		

Test	Description	Result	Comment
52	Confirm no dust, grease, scratches, or any other signs of handling are visible on any devices		
53	Confirm assistive listening systems work throughout intended listening areas		
54	Confirm closed captioning is functional on all displays		
55	Confirm control system user interfaces provide a means to enable and disable display of closed captions		

- E. If further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the Owner or Owner's representative.
1. If the need for further adjustments becomes evident during the demonstration and testing, continue work until the installation operates properly. Included in the continued work, changes to or installation of resistive pads, adjustment of loudspeaker aiming, adjustment of system processing, programming changes to the control system, convergence and/or alignment of the video projector, if these adjustments are required.
 2. If acceptance of the system is delayed because of defective equipment or because the equipment does not fulfill this specification, reimburse the Owner for time and expenses for these tests during extensions of the acceptance testing period.

3.13 OWNER TRAINING

- A. Provide a minimum of 16 hours of training on the audiovisual systems specified herein at the project site (or other location designated by the Owner) by a qualified instructor (equipment manufacturer as needed) covering operation and maintenance of the systems.

3.14 MAINTENANCE AND EXTENDED SERVICE

A. Warranty Maintenance

1. On a quarterly basis during the warranty period, execute a service visit to check and adjust equipment and systems such that they maintain the original performance. Coordinate visits directly with the Owner.
2. Pre-emptive Maintenance Minimum Requirements:
 - a. Clean filters, vents, and lenses, and dust the equipment.
 - b. Verify projector images fill screens appropriately and images are focused.
 - c. Test and verify that all system controls operate as labelled and that the controlled devices respond accordingly.
 - d. Document and photograph any conditions that may affect the continued function and long-term operation of the audiovisual system and report to owner.
 - e. Document and report projector lamp life to the Owner and replace lamps as directed.

B. Provide cost for additional service levels beyond the warranty period (as defined in this section) as follows:

1. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and same-day issue response
2. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and 24-hour issue response

3. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and 48-hour issue response
- C. Touch Panel Programming Updates
1. At a date determined by the Owner within six months following Substantial Completion, attend a single meeting with them regarding alterations or updates to the touch panel layouts or function. At a time approved by the Owner, implement those alterations or updates.
 2. Provide any training necessitated by these revisions.
 3. Provide documentation of these revisions to the Engineer.
 4. Provide the source code documentation according to “Software License” in this section.

END OF SECTION

SECTION 275133

TWO-WAY COMMUNICATIONS SYSTEM FOR ACCESSIBLE MEANS OF EGRESS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Two-way emergency communication system for accessible means of egress, including related infrastructure and functional requirements (addressing CBC Section 1007.8, 1009.8, 1009.9 {and subparagraphs}, NFPA 72 section 24.5.3 {and subparagraphs}, and NFPA 101 items 7.2.12.2.5 and 7.2.12.2.6).
- B. Related Sections
 - 1. Comply with the requirements of Section 270000

1.2 REFERENCES

- A. Comply with the References requirements of Section 270000.
- B. Section 10 14 00 SIGNAGE
- C. Section 28 31 11 DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM
- D. In addition or particular to the codes and standards listed in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. California Code of Regulations (CCR), Title 24
 - a. Volume 2, "California Building Code" (CBC), Section 1007 and referenced sections

1.3 DEFINITIONS

- A. Definitions of Section 270000 apply to this section.
- B. In addition to the Definitions article of Section 270000, the following list of terms as used in this specification defined as follows:
 - 1. "AOR": Area of Refuge (as defined in CBC Section 1007.6)
 - 2. "Cabling": refer to 270000 for definition
 - 3. "Calling Station": System functional unit that provides two-way voice communications between the occupancy space's egress path (such as an elevator landing or area of refuge on an accessible floor) and the central control point
 - 4. "Central Control Point": shall mean either the a location approved by the fire department to monitor the System or fire command center
 - 5. "Command Station": System functional unit that that receives and controls communicates with the calling stations
 - 6. "IEEE": Institute of Electrical and Electronics Engineers
 - 7. "IP": Internet protocol
 - 8. "LED": light emitting diode
 - 9. "PoE": "Power over Ethernet

10. "SIP": Session Initiation Protocol
11. "Telco": shall mean the telecom utility company
12. "UPS": Uninterruptable Power Supply
13. "VoIP": Voice over IP

1.4 SYSTEM DESCRIPTION

- A. Provide planning, coordination, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working two-way communications system (herein "System") described in this section and shown on related T-series drawings. The System shall consist of headend equipment, command station(s), calling stations, directions (instructional signage), rough-in, cabling, programming, labeling, and connection to the designated outside phone line(s). Refer to the drawings for locations of the command station(s) and call stations.
- B. System Requirements
 1. The System shall fulfill the requirements and intent of CBC section 1007, 1009.8, 1009.9 (primarily 1007.8), and all subparts and references relative to two-way communications.
 2. The System, including installation, shall meet applicable ADA requirements.
 3. The System headend or control station shall provide power to the calling stations; the calling stations shall not require power local to station.
- C. System Operation: The System shall operate as follows and/or feature the following:
 1. When a call is initiated from any calling station, the System shall establish a dedicated and uninterrupted hands-free, full duplex, two-way communications session between the calling station and a command station (effectively acting as an intercom).
 2. The call station shall produce a visual annunciation to indicate that a call has been placed. Annunciation may be fulfilled as an LED integrated into call station. The LED should illuminate as blinking when a call is placed and in queue, and should illuminate as solid when a call session has been established with the command station.
 3. The command station shall produce visual and audible annunciations to indicate an incoming call from a call station. Visual annunciation may be fulfilled as an LED integrated into the command station or a separate strobe. Audible annunciation may be fulfilled as a loud ring integrated into the command station or as a separate siren.
 4. The command station (or associated annunciation panel) shall display requisite information – identify the call station showing the station identifier, story/floor/level, and location on the given level.
 5. When the command station has an active conversation with one calling station, the System shall automatically queue additional calls from other calling stations and shall automatically put through the calls in order received when the previous call is completed.
 6. When the central control point is not staffed, the System shall automatically route calls from call stations to an emergency outside line. This will allow a call placed from a call station to ultimately reach a monitored rescue team.
 7. The System shall be able to initiate a call at the command station to any calling station.
- D. Coordinate the System with the VoIP system integrator. Support the VoIP integrator's programming of the System calling requirements for calling stations and command stations.
- E. Provide a UPS to power the System for at least 4 hours in the event of a loss of utility or normal power.
- F. Provide labeling and identification tags.

1.5 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.
- B. Substitutions: Comply with the Requests for Substitutions requirements and procedures of Section 270000.
- C. Submittal Requirements Prior to the Start of Construction:
 - 1. Product Data Submittal, consisting of production details (specifications, dimensions, connectivity requirements, etc.) and regulatory listings and certifications
 - 2. Shop Drawings Submittal, consisting of system configuration diagrams (for example, block diagram, riser diagram, and/or other diagrams), floor plans (showing station locations), installation details, and system labeling
 - a. The shop drawings shall show the dimensioned location where the control station and System equipment will be installed.
 - 3. Schedule Submittal, consisting of proposed schedule of work – this schedule may be combined with the schedule developed for division 27
- D. Submittal Requirements at Closeout:
 - 1. As-Built Drawings, consisting of floors plans (can be combined with telecommunications as-built drawings), block diagrams, and other drawings to accurately and fully describe the System – refer to section 270000 “Submittals” for more information
 - 2. Warranty statement and instructions (contact information, etc)
 - 3. O&M Manuals, consisting of product cut sheets, as-built drawings, and warranty information– also refer to section 270000 “Submittals” for more information

1.6 QUALITY ASSURANCE

- A. Comply with quality assurance requirements of Section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the delivery, storage and handling requirements of Section 270000.

1.8 WARRANTY

- A. Warrant the System as required in the general warranty.
- B. In addition, warrant the System for the manufacturer’s full period – 5 years minimum.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Equipment shall meet requirements of CBC section 1138A.4.
- B. System electrified components (such as headend equipment, control stations, and calling stations) shall be UL listed.

C. Communications shall be full duplex.

2.2 COMMAND CENTER AND DISTRIBUTION MODULE

- A. Manufacturer, or equal: Rath Communications Series 2500
1. #2500-12 RCF; annunciation panel, up to 12 zones

2.3 POWER SUPPLY

- A. Manufacturer, or equal: Rath Communications
1. #2500-PWRUPS; power supply with battery backup

2.4 CALLING STATION

- A. Manufacturer, or equal: Rath Communications Series 2400
1. #2400-808NSP; call station, push button, stainless steel, flush mount

2.5 CABLING

- A. Cabling for two-way communication system shall meet the applicable requirements for pathway survivability.
- B. Manufacturer, or equal: Rath Communications
1. # RPP66010002; 18 AWG-2 Conductor Shielded 2 Hour Fire-Rated UL Listed FPLR-CI-LS, CMR-CI-LS, PLTC-CI-LS, C(UL), CMR-LS & CSA FAS 90, cable ANSI/UL 2196 Certified.

2.6 IP INTERFACE

- A. Meets NFPA 72 supervision requirements
- B. Protocols and Connections
1. VoIP Protocols: SIP v2, SDP, RTP, and RFC 2833
 2. Network Protocols: IPv4, TCP, UDP, DHCP, SNTP, STUN, HTTP, and PPPoE
 3. Connections: FXS RJ11 and WAN RJ45 (10/100 BaseT)
- C. Manufacturer, or equal: Rath Communications
1. #2100-VOIP2CS

2.7 COMMAND SYSTEM SUPERVISOR

- A. Manufacturer, or equal: Rath Communications
1. #2500-12SPRVS

2.8 CALL STATION SIGNAGE

- A. Call station signage shall comply with CBC 1009.8.2.
- B. Call station signage provided by signage consultant, per specification Section 10 14 00 SIGNAGE.

2.9 CABLE, TERMINATION APPARATUS, AND CABLE LABELS

- A. Refer to section 271513 for cable, termination apparatus, and cable labeling requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Call Stations: Prior to installation:
 - 1. Confirm the installation dimensions of call stations and associated signage within each space (as the station may impact surrounding finishes).
 - 2. Verify that the rough-in is installed properly using the proper products.
 - 3. Verify locations are ready for the installation and that surfaces are suitable to accept the calling stations.
- B. Central Control Point: Prior to installation, verify the room is ready for the installation and that surfaces are suitable to accept the control stations and equipment.

3.3 INSTALLATION

- A. Call Stations
 - 1. Height: Install calling unit such that the call button is at 48" AFF.
 - 2. Fasteners: Install calling stations using tamper-proof screws; quantity and type as required by the manufacturer's installation instructions.
- B. Command Stations
 - 1. Install the command station onto the wall at the designated location at 60" AFF to the center of the cabinet.
 - 2. Install headend equipment at the designated location within the BDF, and make final connections. Dress wiring and cords within cable management apparatus.
- C. System Programming
 - 1. Program each calling station per the manufacturer's instructions to call directly to the command station.
 - 2. Program each command station/headend equipment with each call station's requisite information. Program each command station/headend equipment with the automatic roll-over number (number provided by the Owner).

- D. Fire Alarm Panel Connections and Coordination
 - 1. Provide all connections required to the fire alarm panel and coordinate with the fire alarm panel installer.
- E. Cabling: Refer to section 271513 for cabling installation and labeling requirements – placement, termination, patching/crossconnecting, identifier, and labeling.
- F. Cabling Testing: Refer to section 270811 for cabling testing requirements.
- G. Manufacturer's Installation Requirements
 - 1. Provide all hardware, cabling, and apparatus required for installation per the manufacturer's installation requirements.

3.4 PROTECTION

- A. After installation, protect in place call stations, signage, headend equipment, command stations, and related equipment/accessories to mitigate damage from other construction activities.
- B. Repair damaged call stations, signage, and related System equipment/accessories to a like-new condition. Replace products damaged beyond repair, at no cost to the Owner.

3.5 PRE-FUNCTIONAL TESTING

- A. Test cabling per the requirements of 270811.
- B. Test the emergency outside line. Ensure the line is active and successfully reaches a monitoring rescue team.

3.6 FUNCTIONAL TESTING

- A. Prior to acceptance testing, perform the functional testing and submit a functional testing report.
- B. Test 1: Calling Station Operation
 - 1. At each calling station, press the call button.
 - 2. While the call station is in the process of establishing a connection with the command station (e.g., dialing), confirm the call station illuminates the dialing-in-process light. Record the light operation.
 - 3. Confirm each station establishes a two-way communications link with the command station. Record each station's operation (establishing a two-way connection with the command station).
 - 4. While the call is established between the call station and the command station, confirm the call station illuminates the call-established light. Record the light operation.
- C. Test 2: Command Station Operation
 - 1. At the command station, call each calling station to confirm the command station has the ability to dial each calling stations. Record the command station operation.
- D. Test 3: Cueing Multiple Calls
 - 1. At 2 calling stations, press the call button at one station and then the call button at the other call station.

2. Confirm the first call station establishes a connection with the command station and the other call station gets put in cue. Record the System operation.
3. At the command station, disconnect the first call station. Confirm the second call station (the one that was in cue) establishes a connection with the command station. Record the System operation.

E. Test 4: Automatic Dial Out to Emergency Line

1. At a calling station, press the call button. At the command station, do not pick up the call – let the System roll the call over to the emergency outside line (to the monitoring rescue team). Record the System operation.

3.7 FINAL INSPECTION AND ACCEPTANCE TESTING

- A. Comply with system acceptance and certification requirements of section 270000.
- B. Punch the Work of this Section compliant to the requirements of section 270000.
- C. Demonstrate System's operation witnessed by the Owner, IOR, architect, engineer, general contractor, and System installer. The Owner will accept the System only after testing demonstrates 100% functionality of calling stations, command station(s), calling scenarios, and as accepted by the IOR. Demonstrate the following System operation:
 1. Calling station operation (operation, 2-way communications with command station, visual indicators)
 2. Command station operation (operation, receiving calls from calling station, station identification per call, cueing multiple concurrent calls)
 3. Automatic roll over to outside line / monitored rescue team
- D. Remove and replace with new, at no cost to the Owner, stations and/or other components failing to meet the requirements of this section until the System proves fully functional.

3.8 TRAINING

- A. Provide up to 3 half-hour sessions with the Owner to train the owner. Training should cover (at least): system configuration (general arrangement of system and components), cabling (cable type, routes, crossconnections), stations (detailed descriptions, features), system programming, emergency outside line (connection location, number, description of the monitoring rescue team), and other pertinent aspects.

END OF SECTION

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SECTION 28000
BASIC SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general administrative and procedural requirements for division 28 sections and supplements the requirements specified in Division 1.
- B. The requirements described herein include the following:
 - 1. References
 - 2. Definitions
 - 3. System Description and Existing Conditions
 - 4. Submittals
 - 5. Quality Assurance
 - 6. Permits and Inspections
 - 7. Coordination
 - 8. Project Management and Coordination Services
 - 9. Product Delivery, Storage, and Handling
 - 10. Warranty
 - 11. Maintenance
- C. Products Supplied But Not Installed Under This Section:
 - 1. None
- D. Products Installed But Not Supplied Under This Section:
 - 1. None
- E. Products Specified But Not Installed Under This Section:
 - 1. None
- F. Products Furnished and Installed Under another Section:
 - 1. 120V power
 - 2. Conduit, junction boxes, device boxes (essentially rough-in)
 - 3. Door hardware
 - 4. Network cabling and equipment
- G. Related Sections:
 - 1. Consult other sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation.
 - 2. Section 270528, "Pathways for Communications Systems"
 - 3. Section 280553, "Security System Labeling"
 - 4. Section 280800, "Security System Acceptance Testing"
 - 5. Section 281300, "Access Control and Alarm Monitoring System"
 - 6. Section 282300, "Video Surveillance System"
 - 7. Earthwork: Include trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, in-grade pull boxes, vaults, and bollard foundations.

8. Selective Demolition: Nondestructive removal of materials and equipment for reuse or salvage as indicated. Also dismantling electrical materials and equipment made obsolete by these installations.
9. Concrete Work: Include forming, steel bar reinforcing, cast-in-place concrete, finishing and grouting as required for underground conduit encasement, pedestal foundations, and curbs. [Also includes saw-cutting of existing slabs and grouting of conduits in saw-cut.]
10. Miscellaneous Metal Work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, equipment enclosures, cameras, and similar devices.
11. Miscellaneous Lumber and Framing Work: Include wood grounds, nailers, blocking, fasteners, and anchorage for support of security materials and equipment. Refer to Division 6, Rough Carpentry.
12. Moisture Protection and Smoke Barrier Penetrations: Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls. Tape and make vapor tight penetrations through vapor barriers at slabs on grade.
13. Division 8 Locking Hardware: Include interface to electronic hardware and door controllers on security related doors.
14. Access Panels and Doors: Required in walls, ceilings, and floors to provide access to security devices and equipment.
15. Painting: Include surface preparation, priming and finish coating as required for security cabinets, exposed conduit, pull and junction boxes, and devices where indicated as field painted in this Division.

1.2 REFERENCES

- A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies mean that latest edition of such publications adopted and published prior to submittal of the bid. Consider such codes or standards a part of this Specification as though fully repeated herein.
- B. Codes: Perform work executed under this section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
 1. California Code of Regulations (CCR):
 - a. Title 8, "Industrial Relations"
 - 1) Chapter 3.22, "California Occupational Safety and Health Regulations (CAL/OSHA)"
 - b. Title 24, "California Building Standards Code"
 - 1) Part 1, "California Building Standards Administrative Code"
 - 2) Part 2, Volumes 1 and 2, "California Building Code" (CBC)
 - 3) Part 3, "California Electrical Code" (CEC)
 - 4) Part 11, "California Green Building Standards Code" (CALGreen)
 2. National Fire Protection Agency (NFPA)
 - a. NFPA 70, "National Electrical Code" (NEC)
 - b. NFPA 75, "Protection Of Information Technology Equipment"
 - c. NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces", 2007
 3. Code of Federal Regulations (CFR) Title 47 "Telecommunication", Chapter I "Federal Communications Commission (FCC)":
 - a. Part 27, "Miscellaneous Wireless Communications Services"
 4. Other applicable national, state, and local binding building and fire codes

- C. Standards: Perform work and furnish materials and equipment in accordance with the latest editions of the following standards as applicable:
 - 1. Underwriter's Laboratories (UL): Applicable listing and ratings.
 - a. UL 294, "Access Control System Units"
 - b. UL 1076, "Proprietary Burglar Alarm Units and Systems"
 - c. UL 2044, "Commercial Closed-Circuit Television Equipment"

1.3 DEFINITIONS

- A. The Definitions of Division 1 apply to the sections of Division 28.
- B. In addition to those Definitions of Division 1, the following list of terms as used in this specification defined as follows:
 - 1. "ACAMS": Access Control & Alarm Monitoring System
 - 2. "As directed": As directed or instructed by Owner, or their authorized representative
 - 3. "Cabling": A combination of cables, wire, cords, and connecting hardware [e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling]
 - 4. "Connect": To install required patch cords, equipment cords, crossconnect wire, etc. to complete an electrical or optical circuit
 - 5. "Engineer": TEECOM
 - 6. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories
 - 7. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to Owner, parts, items, or equipment supplied by Contractor or others. Complete installation and make ready for regular operation
 - 8. "Owner": Laney College
 - 9. "Provide": furnish and install
 - 10. "Security System": the ACAMS, IDS, VSS, and Intercom systems collectively and integrated
 - 11. "SEC": Security Equipment Enclosure
 - 12. "VAC": volts alternating current
 - 13. "VDC": volts direct current
 - 14. "VSS": video surveillance system
 - 15. "VMS": visitor management system

1.4 SYSTEM DESCRIPTION

- A. Overview
 - 1. Laney College is constructing a 3-story multi-level library building.
 - 2. Security at the new facility consists of access control and alarm monitoring (ACAMS), and video surveillance (VSS). The ACAMS will automate opening and closing the buildings, control access through designated doors, and will restrict after-hours access to authorized cardholders.
 - 3. The new system will connect to Owner's existing head end located in the data center over the Owner's LAN/WAN.
 - 4. The System includes integration to the Fire/Life Safety system to disconnect power to magnetic door holders and automatically close doors after hours.
 - 5. The System includes elevator security and integration between the electronic security system and elevator controller.
 - 6. Refer to individual sections for detailed description of systems.

- B. Custom Device Requirements
 - 1. General: Provide a high level of coordination services to ensure the proper installation and functioning of the security system. Coordinate the installation of the security system with other trades. This may include: review of other trade's shop drawings, attendance at meetings, providing samples for mockup, and preparation & distribution of written documentation.

1.5 SUBMITTALS

- A. Submit required submittals in accordance with the requirements of section 013300 "Submittal Procedures".
- B. Required submittals include the following:
 - 1. Written detailed project description
 - 2. Project schedule as referenced in this section
 - 3. Product data sheets – clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories which are included and those which are excluded
 - 4. Estimated delivery lead times for products
 - 5. Voltage drop calculations demonstrating less than ten percent voltage loss to individual security devices
 - 6. Battery calculations showing backup support of security equipment and locks (except egress hardware with local power supplies) for 25 lock activations or 4 hours, whichever is greater
- C. Complete submittals are comprised of shop drawings and product data sheets as detailed below and related sections (covering specific security systems). Incomplete or partial submittals will be rejected.
- D. Shop Drawings
 - 1. Shop drawings shall document Contractor's intent to execute the work and shall include the following:
 - a. Title sheet and index
 - b. Floor plans showing device locations, cable routing, and pathways
 - c. System block diagrams
 - d. Point-to-point wiring diagrams
 - e. Specific wiring details and device mounting/installation details
 - f. Schedules:
 - 1) Building/floor
 - 2) Unique device name/number
 - 3) Security controller/location
 - 4) Interfaces, interlocks
 - 5) IP address
 - 6) Master/substation intercom calling locations
 - 2. Upon award of contract, request CAD release forms from TEECOM so that electronic files may be released for Contractor's use. TEECOM will release floor plans with devices; TEECOM will not installation details and block diagrams (Contractor shall develop their own diagrams and details for the shop drawings submittal package).
- E. Format: Furnish submittal data in electronic copy including table of contents with each section bookmarked by specification section listing materials.

- F. Label each submittal with the specification section number and provide a cover letter or stamp stating that the submittal has been thoroughly reviewed by Contractor and complies with the requirements of the contract documents. Failure to comply with this requirement will constitute grounds for rejection of the submittal.
- G. Resubmittals: Provide a cover letter with the resubmittal that lists the action taken and revisions made to each product submittal in response to submittal review comments. Failure to include this cover letter will constitute rejection of the resubmittal package and no review will occur.
- H. Drawings
 - 1. Prepare shop and as-built drawings using software compatible with AutoCAD and/or Revit per project standard.
 - 2. Drawing requirements:
 - a. Sheet size: match the project's contract drawings size and use the project's title block
 - b. Text size: minimum 3/32 inches high when plotted at full size
 - c. Symbology: match the project's contract drawings symbols
 - d. Backgrounds: screen background information to allow pertinent drawing information to stand out.
 - e. Line Weights: Use appropriate line weights for devices, raceways, and text to stand out against background information.
 - f. Floor Plans: 1/8 inch scale floor and site plans showing the locations of devices and cable routing paths with cable types and quantity called out.
- I. Contractor Qualifications: Submit the following for review and comment at the beginning of the project.
 - 1. Resumes of the project manager, general foreman, and lead technician(s) indicating role, years of experience, product certifications and training, listing of similar projects the individual performed the role proposed for this project along with client contact information for each.
 - 2. Certification letters from manufacturers of major system components stating Contractor is an authorized reseller, installer, and extended warranty provider for the specified security systems.
- J. Samples
 - 1. Submit samples as required for proper coordination and installation of custom mounted equipment. Examples of samples that may be required include:
 - a. Screen shots showing graphical floor plan maps indicating:
 - 1) Active functional icons
 - 2) Secure areas/zones
 - b. Camera field of views

1.6 QUALITY ASSURANCE

- A. General
 - 1. Provide new and unused materials, equipment, and parts comprising the units specified herein of current manufacturer and of highest grade.
 - 2. Only use products and applications listed in this Division on the project.
- B. Bid Discrepancies
 - 1. In the event of discrepancies within the contract documents, notify Engineer within 5 days prior to the bid opening to allow the issuance of an addendum.

2. If, in the event that time does not permit notification or clarification of discrepancies prior to the bid opening, the following applies: The drawings govern in matters of quantity, and the specifications govern in matters of quality. In the event of conflict within the drawings involving quantities, or within the specifications involving quantities, or within the specifications involving quality, the greater quantity and higher quality apply. Note such discrepancies and clarify in the bid. We will make no additional allowances because of errors, ambiguities, or omissions, which reasonably should have been discovered during the preparation of the bid.

C. Substitutions

1. Conform to the general requirements and procedure outlined in section 012500 "Substitution Procedures".
2. Where products are noted as "or equal", a product of equivalent design, construction, and performance is considered. Include in the product data submittal: catalog cuts, product information, and pertinent test data required to substantiate that the product is in fact equivalent to that specified.
3. Only one substitution allowed for each product specified. Do not provide substituted material, processes, or equipment without written authorization from Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by Engineer, are at the sole risk of Contractor.
4. The burden of proof rest with Contractor that the substituted product is equivalent or better than the specified product. When Engineer accepts a substitution in writing, it is with the understanding that Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Approved substitutions do not relieve Contractor of responsibilities for the proper execution of the work, or from provisions of the Specifications.
5. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the contract documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when "or equal" follows the manufacturers' names or model number(s).
6. Whenever material, process or equipment is specified in accordance with a Federal specification, an ASTM standard, an ANSI specification, UL rating or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by Engineer, submit support test data to substantiate compliance at no additional cost.
7. Pay expenses, without additional charge to Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, Subcontractor's or other Contractor's work.

D. Electronic Control Systems Contractor Qualifications

1. A current, active, and valid and C7 or C10 license registered with the Contractors State License Board (CSLB)
2. Minimum five years of experience in installation and service of access control, video surveillance, and intrusion detection systems
3. Minimum five completed projects similar to scope and cost
4. Evidence of technicians qualified for the work in the form of current manufacturer's training certification

E. Materials

1. Provide new materials and equipment without defects.

2. Provide only specified products and equipment, or products and equipment that have been approved in writing.

F. Regulatory Requirements

1. Work and materials to conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Perform work under these specifications conforming to the most stringent of the applicable codes.
2. Provide the quality identified within these specifications and drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The contract documents address the minimum requirements for construction.

G. Drawings

1. Layout: Follow the general layout shown on the contract drawings except where other work may conflict with the contract drawings.
2. Accuracy: The contract drawings show a diagrammatic representation of the system within the constraints of the symbology applied.
3. Detail: The contract drawings represent the design intent and do not represent the entire installation for the System. Contract drawings indicate the layout and location of control panels, devices (i.e. card readers, door locks and contacts, and duress stations) and other components. The contract drawings do not show conduits, wire and cabling between every system component, equipment, or device.
4. Complete the details necessary for point-to-point design. This allows the Contractor to attain the design intent while applying their own means and methods.

H. Role of Engineer

1. During the construction phase of the project, Engineer will work with Contractor to provide interpretation and clarification of project contract documents, process and reply to relevant Requests for Information (RFI), and act as an interface between Contractor and Owner.
2. Owner has retained Engineer's services to observe the work for general compliance with the contract documents.
3. In summary, Engineer will perform the following specific services during the design phase:
 - a. Review product submittals and shop drawings for general compliance with the contract drawings and specifications.
 - b. Review changes as they arise and confirm that the proposed solutions maintain the intended functionality of the system.
 - c. Interpret field problems for Owner and translate into understandable language.
 - d. Review the testing procedures to confirm compliance with industry-accepted practices.

1.7 PERMITS AND INSPECTIONS

- A. Obtain and pay for permits and inspections required for the work.
- B. Furnish materials and workmanship for this work in conformance with applicable legal and code requirements.
- C. Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of legal authority having jurisdiction.

- D. Obtain review from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with requirements of reference codes indicated herein.

1.8 PROJECT MANAGEMENT AND COORDINATION SERVICES

- A. Provide a project manager for the duration of the project to coordinate the security system work with other trades. Coordination services, procedures and documentation responsibility include at a minimum, the items listed in this section.
- B. Review of Shop Drawings prepared by Other Subcontractors:
 - 1. Obtain copies of shop drawings for equipment and systems provided by others that require connections or interface with the security system work. Thoroughly review those shop drawings to confirm compliance with the interface requirements.
 - 2. Document discrepancies or deviations:
 - a. Prepare memo summarizing the discrepancy.
 - b. Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy.
 - 3. Prepare and maintain a shop drawing review log indicating the following information:
 - a. Shop drawing number and brief description of the system/material.
 - b. Date of your review.
 - c. Indication if follow-up coordination is required.
- C. Scheduling: Prepare work schedules for each floor indicating the following information:
 - 1. Submittals
 - 2. Cable Installation
 - 3. SEC Build Out
 - 4. Device Installation
 - 5. Programming
 - 6. Testing
 - 7. Training
 - 8. Other tasks included under the alternate work section of these specifications
- D. Job Conditions
 - 1. Protection: Keep conduits, junction boxes, outlet boxes and other openings closed to prevent entry of foreign matter. Cover equipment, devices, and apparatus to protect them against dirt, paint, water, chemical or mechanical damage, before and during construction period. Prior to final acceptance, restore to original condition fixture, apparatus or equipment damaged including restoration of damaged factory applied painted finishes. Protect bright finished surfaces and similar items until in service. No rust or damage will be permitted.
 - 2. Supervision: Personally, or through an authorized and competent representative, supervise the work from beginning to completion and, within reason, keep the same foreman and workmen on the project throughout the project duration.
- E. Weekly Status Reports: Prepare weekly status reports throughout the entire course of the project containing the following information:
 - 1. Current / up-to-date 2-week look ahead schedule
 - 2. Progress during prior week
 - 3. Work expected to be completed during the upcoming week
 - 4. Delivery dates for equipment
 - 5. Coordination status for each device requiring coordination with other subcontractors
 - 6. Summary of the information owed to Contractor, who is responsible for providing the information, and due date for the information

- F. Weekly Meetings: Conduct or attend weekly coordination meetings with the electrical and other specialty subcontractors to coordinate the installation of the security systems.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery
 - 1. Do not deliver security system components to the site until protected storage space is available.
 - 2. Replace equipment damaged during shipping and return to manufacturer at no cost to Owner.
- B. Storage
 - 1. Store materials in a clean, dry, ventilated space free from temperature extremes. Storage outdoors covered by rainproof material (for example, a tarp) is not acceptable.
 - 2. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
 - 3. Provide heat where required to prevent condensation or temperature related damage.
- C. Handling
 - 1. Handle in accordance with manufacturer's written instructions.
 - 2. Prevent internal component damage, breakage, denting and scoring. Do not install damaged equipment. Replace damaged equipment and return equipment to manufacturer.

1.10 WARRANTY

- A. Provide the Security System as described in this specification with a one-year parts and service warranty at no additional cost to Owner.
- B. Include in the warranty package, at a minimum, the following:
 - 1. Emergency maintenance service on regular working hour basis
 - 2. Service by factory trained and employed service representatives of system manufacturer
- C. Maintain regular service facilities and provide a qualified technician familiar with this work at the site within four hours of receipt of a notice of malfunction including weekends and holidays. Provide material, devices equipment and personnel necessary for repairs. Install approved temporary, alternate equipment if required by Owner, complete and operational within 24 hours after notification of a malfunction, at no additional cost.
- D. Conduct warranty repairs and service at the job site unless in violation of manufacturer's warranty; in the latter event, provide substitute systems, equipment and/or devices, acceptable to Owner, for the duration of such off-site repairs. Transport warranty substitute and/or test systems, equipment, devices, material, parts and personnel to and from the job site at no additional cost.
- E. Warranty period shall commence upon written final acceptance by Owner or Owner's designated representative.

1.11 MAINTENANCE

- A. Extra Materials
 - 1. Deliver extra materials to a secured location determined by Owner.
 - 2. Provide a complete bill of materials listing quantities, part numbers, and descriptions for each device for Owner to sign indicating receipt of equipment.
 - 3. Provide new and unused spare parts in their original packing materials upon delivery.
- B. Maintenance Service
 - 1. For the first year of service, conduct quarterly system performance review meetings to review system operation problems and/or defects that occurred during the preceding 3 months. During these performance review meetings, perform the following:
 - a. Visual checks and operational tests of the central processor, local processors, monitors, keyboards, system printers, peripheral equipment, security equipment and devices, power supplies, and electrical and mechanical controls.
 - b. Clean system equipment, including interior and exterior surfaces.
 - c. Perform diagnostics on equipment.
 - d. Check and calibrate each device.
 - e. Run system software and correct diagnosed problems.
 - f. Resolve previous outstanding problems.
 - 2. Provide software and firmware updates issued free of charge by the manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Material and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the included systems. Where a particular material, device, equipment or system is specified directly, the current manufacturer's specification for same is a part of these specifications, as if completely elaborated herein.
- B. Use standard, regularly manufactured, materials and equipment for this and/or other similar systems, and not custom designed especially for this project. Provide systems and components thoroughly tested and proven in actual use. Provide subsystems of one manufacturer.

2.2 EQUIPMENT ENCLOSURES AND JUNCTION ENCLOSURES

- A. Application: For indoor use to house panels and equipment, and to house terminations, relays, and other components local to controlled doors and other field devices
- B. Type: NEMA type 1 enclosure
- C. Description:
 - 1. Solid steel enclosure with solid, continuous-hinged door
 - 2. Finish: ANSI 61 gray polyester powder paint finish inside and out
 - 3. Lockable / equipped with a lock kit (lock kits shall be keyed alike with other security enclosures throughout the project)
 - 4. Perforated back panel within enclosure (for mounting control boards, relays, terminal strips, etc.)
 - 5. One tamper switch per enclosure

6. One 5" electric fan with a screen at the port per enclosure that houses electrically-powered devices/equipment

D. Size:

1. For use as Security Equipment Enclosure: 36"L x 24"W x 6"D minimum
2. For use as Security Junction Enclosure: 12"L x 12"W x 6"D minimum

E. Manufacturer, or equal:

1. Eaton Cooper B-Line
 - a. #36246-1PP; 36"L x 24"W x 6"D enclosure with back panel and lock kit
 - b. #12126-1PP; 12"L x 12"W x 6"D enclosure with back panel and lock kit
2. Hoffman
 - a. #A36N24M; 36"L x 24"W x 6"D enclosure
 - b. #A36N24MPP back panel for 36" x 24" enclosure
 - c. #A12N126; 12"L x 12"W x 6"D enclosure
 - d. #A12N12PP; back panel for 12" x 12" enclosure
 - e. # AL12AR; lock kit
3. Wiegmann
4. SquareD

2.3 SLOTTED WIRING DUCT

- A. For indoor use inside equipment enclosures to manage/mind wiring.

B. Description:

1. Type: Lead-free PVC with narrow finger design
2. Color: Light gray

C. Manufacturer, or equal:

1. Panduit Type-F narrow slot wiring duct
2. Iboco #T1-1010 wiring duct

2.4 WIREWAYS

- A. For indoor use with equipment enclosures to manage and route wiring and cabling.

- B. Type: NEMA type 1 screw cover 'gutter' wireway and accessories

C. Description:

1. Wireways shall have open top assembly and closure plates/end caps (to secure end of wireway sections).
2. Finish: ANSI 61 gray polyester powder paint finish inside and out
3. Size: 4" x 4", minimum

D. Manufacturer, or equal:

1. Eaton Cooper B-Line #4448-G-NK; lay-in painted wireway without knockouts
2. Hoffman #F44T148GVP lay-in painted wireway without knockouts

2.5 INTERFACE RELAYS

- A. Application: lock power switching and interfacing with other high-voltage powered equipment, i.e. gates, high-voltage locks, etc. (not for use at the output contacts on the access controllers since their rating is not adequate)
- B. Type: Standard industry control, plug-in type with LED indicator lights to indicate when the relay is energized.
- C. Contacts: Rated for 10 amps at 120VAC.
- D. Coil Operating Voltage: as required, with 24VDC as first choice
- E. Features:
 - 1. Color-coded test button
 - 2. Mechanical flag
 - 3. Snap-on label
 - 4. Pilot light
 - 5. 2mm test jacks
 - 6. Dual contact markings
 - 7. Snap-on number and letter markers
 - 8. Solid bus-bar socket construction
- F. Relay bases shall be mountable on standard mounting rails
- G. Manufacturer, or equal:
 - 1. Releco
 - 2. Idec

2.6 TAMPER RESISTANT HARDWARE

- A. Tamperproof hardware shall be used in locations below 10' exposed to the public.
- B. Hardware exposed in public spaces shall be pinned-allen type.
- C. Hardware used in specialty metal surfaces shall have a similar finish color.

2.7 WIRE CONNECTORS

- A. Wire connectors shall be heat activated, gel filled.
- B. Twist and solder/taped or wire nut connections are not acceptable.
- C. Manufacturer, or equal:
 - 1. Dolphin
 - 2. 3M Terminals
 - 3. Fastenal Sealed Crimp and Solder connector

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Conditions: Verify existing conditions, which have been previously provided under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
- B. Pathways: Verify that pathways and supporting devices, which have been previously provided under other sections, are properly installed, and that temporary supports and devices have been removed.
- C. Field Measurements: Verify dimensions of pathways, including length of pathways. For example, "True Tape" the conduits to verify cable distances.

3.2 FIELD QUALITY CONTROL

- A. Staffing: Provide a qualified foreman who is in charge of the work and who is present at the job site at times work is being performed. Perform the work using skilled technicians under the direction of the foreman. Supervise the work force executing the work. Perform the installation within the restraints of the construction schedule. Do not change the supervisor during the project without prior written approval from Owner.
- B. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion, and inspection as required.

3.3 INSTALLATION

- A. Perform this work in accordance with acknowledged industry and professional standards and practices and the procedures specified herein.
- B. Provide a complete, operating system. Include devices specified including basic components and accessories, interconnecting wiring and other equipment and installation devices necessary for a complete system as specified.
- C. System Password Management:
 - 1. Change default passwords.
 - 2. Create a base administrator account for Owner's use/login.
 - 3. Install the latest security patches (for the operating system and each individual piece of equipment).
 - 4. Disable unused communication ports or protocols.
 - 5. Perform quarterly software security patch updates for the client during the warranty period.
 - 6. Contractor to turn over all source media including installation discs, manuals, drives, dongles, and licensing keys and codes.
- D. Manufacturer's Instructions:
 - 1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
 - 2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite.

- E. Boxes, Panels, and Enclosures
 - 1. Install boxes, panels, and enclosures square and plumb.
 - 2. Set flush-mounted units with the face of the cover, bezel, or escutcheon in the same plane as the surrounding finished surface.
 - 3. Mount boxes, panels, and trim so that there are no gaps, cracks, or obvious lines between the trim and the adjacent finished surface; ready them to receive final finish, as applicable.
 - 4. Install insulating terminations in signal circuit boxes, panels, wireways, or enclosures.
- F. Painting
 - 1. Custom paint devices as indicated on the drawings.

3.4 REPAIR/RESTORATION

- A. Replace or repair work completed by others that you deface or destroy, and at no cost to Owner.
- B. Punch List:
 - 1. Inspect installed work and develop a punch list for items needing correction.
 - 2. Submit punch list to Engineer for review prior to performing punch walk with Engineer.
- C. Re-Installation:
 - 1. Make changes to the system such that defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.
 - 2. Repair defects prior to system acceptance.
- D. Painting: Repaint surfaces altered during installation of the security system to match previous conditions.

3.5 CLEANING

- A. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment.
- B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.
- C. Repair or replace damaged installed products.
- D. Legally dispose of debris in an environmentally friendly manner.
- E. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

END OF SECTION

SECTION 280513
SECURITY SYSTEM CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Cables and wires for security systems
- B. Related Sections:
 - 1. Consult other sections; determine the extent and character of related work and properly coordinate work executed under this section with that specified elsewhere to produce a complete and operable system.
 - 2. Section 280000, "Basic Security Requirements"
 - 3. Section 280553, "Security System Labeling"
 - 4. Section 260533, "Raceway and Boxes for Electrical Systems"
 - 5. Section 270528, "Pathways for Communications Systems"
 - 6. Section 271513, "Horizontal Cable"

1.2 REFERENCES

- A. Comply with the References requirements of section 280000.
- B. In addition to those codes, standards, etc., listed in section 280000, products and work shall comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces"

1.3 SUBMITTALS

- A. Submittal Requirements at Start of Construction:
 - 1. Product Data: Submit product information, including manufacturer, part number, description, use/application, jacket rating, outside diameter, etc.
- B. Submittal Requirements at Closeout:
 - 1. Include wire and cable types in As-Built Drawings
 - 2. Include wire and cable information in O&M Manuals

1.4 SCOPE OF WORK

- A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation as described in these specifications.

- B. Cables for Security System
 - 1. Provide wires and cables sized to allow for voltage drop of 12VDC and 24VDC power service from power supplies in equipment rooms to field devices.
 - 2. Provide cables effectively shielded for video signal cable within the same conduit to mitigate interference or signal noise.
 - 3. Provide plenum rated jacket (type CL2P, CL3P, or CMP) on cables installed indoors where required.
 - 4. Provide PVC or PE jacket, flooded cables to prevent water intrusion where installed outdoors, underground, and/or within slab-on-grade. Provide transition of outdoor/underground cables to indoor cables when entering a building.
 - 5. Provide surge protection when cables enter buildings from outdoors where required by NEC.

- C. Cable Supports and Pathways for Security System Cabling
 - 1. Provide dedicated cable support for security cables when not within primary pathways (such as cable tray). Coordinate work with Division 27 – particularly for use of pathways/cable support.

PART 2 - PRODUCTS

2.1 INDOOR PLENUM MULTI-CONDUCTOR CABLES

- A. Application: Indoor use, for ACAMS, and VSS
- B. Type: multi-conductor or paired, unshielded and shielded
- C. CMP (plenum) rated
- D. Manufacturers, or equal:
 - 1. Belden
 - a. #6500UE; 22AWG/2C, unshielded
 - b. #6502UE; 22AWG/4C, unshielded
 - c. #1325A; 22AWG/2PR, individually shielded
 - d. #6502FE; 22AWG/4C, overall shielded
 - e. #6504FE; 22AWG/6C overall shielded
 - f. #3004A; 22AWG/8C overall shielded
 - g. #6300UE; 18AWG/2C, unshielded
 - h. #6302UE; 18AWG/4C, unshielded
 - i. #6302FE; 18AWG/4C, overall shielded
 - j. #6100UE; 14AWG/2C, unshielded
 - 2. West Penn
 - a. #25221B; 22AWG/2C, unshielded
 - b. #25241B; 22AWG/4C, unshielded
 - c. #D25510B; 22AWG/2PR, individually shielded
 - d. #253241B; 22AWG/4C, overall shielded
 - e. #253270B; 22AWG/6C overall shielded
 - f. #253271B; 22AWG/8C overall shielded
 - g. #25224B; 18AWG/2C, unshielded
 - h. #25244B; 18AWG/4C, unshielded
 - i. #253244B; 18AWG/4C, overall shielded
 - j. #25226B; 14AWG/2C, unshielded

3. Windy City Wire
 - a. 444362; 22AWG/2C, unshielded
 - b. 444381; 22AWG/4C, unshielded
 - c. 4150102; 22AWG/2PR, individually shielded
 - d. 4443440; 22AWG/4C, overall shielded
 - e. 444351-03; 22AWG/6C overall shielded
 - f. 444352-08; 22AWG/8C overall shielded
 - g. 442363; 18AWG/2C, unshielded
 - h. 442384; 18AWG/4C, unshielded
 - i. 442344; 18AWG/4C, overall shielded
 - j. 447960; #6100UE; 14AWG/2C, unshielded

2.2 IP CAMERA CABLE AND IP ACAMS CABLE

- A. Application: Suitable for indoor installation within conduit
- B. Refer to Section 271513 for product requirements.

2.3 MISCELLANEOUS COMPONENTS

- A. Cable Ties
 1. Width: 0.75 inches
 2. Color: Black
 3. Manufacturers, or equal:
 - a. Panduit #HLS-15-R-0 Black, 15 feet roll, cut to length

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cable Installation and Routing
 1. Install cables and wires continuously (splices will not be permitted without written approval from the Engineer) for the entire length of run between connections and/or terminations.
 2. Place and suspend cables within designated pathways, such as cable hangers, cable tray, etc. Do not fasten or attach cables (such as with cable ties) to other building infrastructure (such as ducts, pipes, conduits, etc.), other systems (such as ceiling support wires, wall studs, etc.), or to the outside of conduits, cable trays, or other non-approved pathway systems.
 3. Place and suspend cables during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.
 4. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.
 5. Route cables under building infrastructure (such as ducts, pipes, conduits, etc.) so the installation results in easy accessibility to the cables in the future.
 6. Do not exceed manufacturer's limits for pulling tension.
 7. Do not use cable-pulling compounds for indoor installations.

8. Dress and secure cables without stress and/or deformation. Dress and bind cabling with cable ties every 24" minimum. Within telecommunications spaces and covered wireways, provide Velco-style cable ties on security cabling.
9. Install shielded wiring or route in separate raceways as recommended by the manufacturer's current requirements.
10. Place cables a minimum of 6" away from power sources to reduce interference from EMI.
11. Do not run signal wire and cable in parallel to power (120VAC).
12. When connecting to screw-type barrier blocks, terminate wires with insulated crimp-type spade lugs. Size lugs properly to assure high electrical integrity, i.e., low resistance connections.
13. Follow manufacturers recommended guidelines for installation.
14. When exiting the primary pathway (such as cable tray) to the device, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.
15. When routing cables vertically in conduit for continuous distances greater than 30 feet, secure cables as the cables exit the vertical pathways. Secure cables using screw-flange nylon cable ties or similar approved ties. Provide symmetrical clamping devices with split, circular, or other wire conforming, nonmetallic bushings for coaxial cables.
16. Within telecom rooms, route and dress cables on the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on-center using cable ties.

B. Cable Support

1. Coordinate cable support work with sections 270528 and 270536 for indoor pathways such as cable hangers.
2. Above ceilings, support cables at intervals no greater than 5 feet.
3. Anchor cable support system/components to structure.
4. Vertical Support on floor space, not in riser system
 - a. Route cable from below suspended ceiling devices to above ceiling when possible.
 - b. When routing cable in fire-rated wall assemblies, provide conduit and firestopping.
 - c. When routing cable on concrete tilt up style walls from below ceiling devices to above ceiling, provide conduit – either surface or recessed (depending on wall construction).
 - d. For cable routed vertically from devices with no suspended ceiling, provide conduit stub from device junction box to 14 feet, minimum, above finish floor.
5. Vertical Support in riser system
 - a. In vertical riser systems, route cable within conduit.
 - b. Terminate conduit at each stacked closet in a lockable junction box. Size junction box as required per conduit size and quantity – 12" x 10" x 8", minimum.
 - c. Support cables within the junction box at every other floor or approximately every 24 feet utilizing cable ties equipped with eyelets designed to accept screws for fastening or approved equivalent method.
6. Label cables in accordance with section 280553, "Security System Labeling".

END OF SECTION

SECTION 280553
SECURITY SYSTEM LABELING

PART 1 - GENERAL

1.1 SUMMARY

- A. General: Furnish labor, materials, tools, etc., as required to complete security system labeling.
- B. Section Includes:
 - 1. Labeling of wire, cable, security devices, enclosures, and raceways.
- C. Related Sections:
 - 1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
 - 2. Section 280000, "Basic Security Requirements"

1.2 SUBMITTALS

- A. Product Data: Submit the following:
 - 1. Product information for components specified herein.
 - 2. List of equipment (wire, cable, devices, enclosures, and raceways) and the corresponding text for the label.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Engraved, plastic laminated nameplates, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Use white letters for engraved nameplates and punch for mechanical fasteners.

2.2 WIRE AND CABLE LABELS

- A. General
 - 1. Self-laminating adhesive laser labels.
 - 2. Machine printable with a laser printer.
 - 3. Cable size: 0.16 – 0.32" OD
 - 4. Color: white with black lettering
- B. Manufacturer, or equal:
 - 1. Brady #WML-211-295 and #WML-311-292 wire marking labels

2.3 DEVICE LABELS

- A. Self-laminating, type on tape, adhesive labels. Use Helvetica 12 pt text

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Requirements

1. Label the security system components. The components include, but are not limited to, the following:
 - a. Equipment Enclosures
 - b. Conduits
 - c. Security Devices
 - d. Batteries
 - e. Wires and Cables
 - f. Equipment Racks
 - g. Terminal Blocks
 - h. Relays
 - i. Patch panels, and the termination positions within the patch panels.
2. Labels shall coincide with device IDs used on the record drawings.
3. Degrease and clean surfaces to receive nameplates and labels.
4. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using machine screws.

B. Equipment Cabinets

1. Label SEC enclosures associated with the security system with a nameplate.
2. Mount label on exterior of door, centered horizontally, and positioned one-third of the door height vertically from the top.
3. Example:
Line 1 [1/2 inch high letters]: "SEC-01"
Line 2 [1/4 inch high letters]: "Security Equipment Cabinet"

C. Conduits

1. Write the destination for every conduit entering a junction box, SEC, and CEC enclosure, or wireway using a black permanent ink marker next to the conduit inside the box.
2. Example: "To SEC-01"

D. Security Devices

1. Label devices associated with the security system with a permanent machine generated, laminated, label. Use 12 point Helvetica text with a clear background. Use white or black lettering depending upon the color of the device.
2. Label each device in a concealed location with the system point number and address.

E. Batteries

1. Label power supply batteries with the month and year they were installed.
2. Example: "April 2016"

F. Wire and Cable

1. Identify wire and cable clearly with permanent machine-generated labels wrapped about the full circumference within 1 inch of each connection.
2. Indicate the cable ID designated on the associated field or shop drawings or run sheet, as applies.

3. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable to carry the same labeled designation over its entire run, regardless of intermediate terminations.
4. Provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; locate labels within 6 inches of the point of exit.
5. Positional labels so they are clearly visible without the need to remove wire management or other obstructions.
6. Label cables at both ends of a run and within pull and junction boxes using machine generated wrap-around labels.

3.2 CABLE LABEL FORMAT

A. Text: Helvetica font, 12 point (minimum size, unless otherwise specifically stated)

B. From Panel to Field Device

1. Line 1: Device Type and Device Number
2. Line 2: Panel ID – Port Number
3. Example: CR 001

PANEL 2 – CR5

4. Standard Device Types
 - a. CR = Card Reader
 - b. K = Camera
 - c. ET = Entry Telephone
 - d. R = Relay Output
 - e. A = Alarm Point
5. Standard Port Numbers
 - a. CR = Reader
 - b. M = Monitored Input
 - c. R = Relay Output

C. From Door Junction Box to Card Reader

1. Line 1: Device Type and Device Number
2. Line 2: Panel ID – Port Number
3. Example: CR 001

PANEL 4 – CR3

D. Miscellaneous Examples:

1. From Door Junction Box to Door Contact
 - a. CR001
 - b. DC
2. From Door Junction Box to Rex Alarm
 - a. CR001
 - b. REX ALM
3. From Panel to Rex
 - a. CR001
 - b. REX PWR
 - c. 12 VDC
4. From Panel to Lock
 - a. CR001
 - b. LCK PWR
 - c. 24 VDC

SECTION 280800

SECURITY SYSTEM ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, and transportation required to test a completed security system installation as described in these and the related Specifications.
- B. Base Bid Work
 - 1. Comprehensive testing for all systems installed as part of the project in two distinct phases which includes:
 - a. Functional Testing
 - b. Acceptance Testing
 - 2. Produce and submit for review and approval the test results documentation for each of the two distinct phases of testing.
- C. Related Sections:
 - 1. Section 280000, "Basic Security Requirements"
 - 2. Section 280513, "Security System Cabling"
 - 3. Section 280553, "Security System Labeling"
 - 4. Section 280800, "Security System Acceptance Testing"
 - 5. Section 281300, "Access Control and Alarm Monitoring System"
 - 6. Section 282300, "Video Surveillance System"

1.2 SUMMARY OF ACCEPTANCE TESTING ACTIVITIES

- A. Overview
 - 1. The purpose of these testing activities is to ensure the security system operates properly and per the Owner's requirements. Security systems are very complex from both an equipment and programming standpoint and thorough testing is necessary to ensure correct operation.
 - 2. Perform testing activities after-hours or on weekends when the system is not being actively utilized and the building is generally unoccupied. This will minimize the amount of irrelevant activity in the system activity reports that will be used as a record of the Functional Testing and Acceptance Testing test results documentation.
- B. Functional Testing
 - 1. Functional Testing represents a complete and documented test of the security systems. At a minimum, Functional Testing shall demonstrate proper operation of security system components, including: devices, sensors, switches, power supplies, controllers, input/output boards, relays, network communications, tamper switches, initiating circuits, and associated accessories and appurtenances required for system functionality.
 - 2. Perform Functional Testing of security systems to verify correct operation prior to scheduling the Acceptance Testing.
 - 3. Document the results of the Functional Testing and submit to the Engineer along with system activity reports for approval.

4. Functional Testing test results documentation shall be reviewed and approved prior to scheduling the Acceptance Testing.

C. Acceptance Testing

1. Acceptance Testing represents a final walk test with the Engineer and Owner to demonstrate proper operation of security system components including system integration, programming, operational capabilities, and functional performance.
2. Perform Acceptance Testing of the security systems in the presence of the Engineer and Owner to demonstrate fully functional and completely operational security systems.
3. Submit Acceptance Testing test results documentation and punch list/deficiencies corrections, prior to Owner approval of Substantial Completion and the start of the Warranty period.

1.3 SUBMITTALS

A. Functional Testing test results documentation submittal

B. Acceptance Testing test results documentation submittal

C. Operation and Maintenance (O&M) Manuals: Submit O&M Manuals for review and approval at the completion of the project consisting of the following:

1. Warranty letter: copy of Warranty letter reflecting start and end dates, and instructions covering warranty procedures.
2. Functional Design Manual: includes a detailed explanation of the operation of the system.
3. Hardware Manual, which includes:
 - a. Pictorial parts list and part numbers
 - b. Pictorial and schematic drawings of wiring systems including devices, control panels, instrumentation, and annunciators
 - c. Telephone numbers for the authorized parts and service distributors
 - d. Service bulletins
4. Software Manual, which includes:
 - a. Use of system and applications software
 - b. Initialization, start-up, and shut down procedures
 - c. Alarm reports
5. Operator's Manual, which fully explains procedures and instructions for the operation of the system and includes:
 - a. Computers and peripherals
 - b. System start up and shut down procedures
 - c. Use of system, command, and applications software
 - d. Recovery and restart procedures
 - e. Graphic alarm presentation
 - f. Use of report generator and generation of reports
 - g. Data entry operator commands
 - h. Alarm messages and reprinting formats
 - i. System access requirements
 - j. Service maintenance call procedures
6. Maintenance Manual, which includes:
 - a. Instructions for routine maintenance listed for each component, and a multi-page summary of component's routine maintenance requirements
 - b. Detailed instructions for repair of the security system
 - c. A summary of the software licenses, including license numbers, quantity of clients, summary of the software options provided, and database capabilities

- d. A list of IP addresses used and with which system component they are associated, including MAC address
- e. A list of gateway addresses, subnet masks, DNS servers, and host name information
- 7. Test Results Manual which includes the document results of tests, required under this Specification, organized by System, Floor, and Door.
- 8. As-Built Drawings, which includes 11"x17" prints of the as-built drawings.

D. As-Built Drawings

- 1. Submit As-Built Drawings for review and approval at the completion of the project.
- 2. As-Built Drawings shall fully and accurately represent installed systems and conditions, including: actual locations of devices and components, actual cable and terminal block numbering, and actual wire routing and wiring (wire type, gauge/size, rating, etc).
- 3. Record changes in the work during the course of construction on blue or black line prints. Transfer construction mark-ups to AutoCAD or Revit format drawings at the completion of the project.
- 4. Include the following additional information:
 - a. Device addresses and IP address information
 - b. Settings for each camera (lens specs, mm setting, auto shutter setting, and other available camera settings, etc.)
- 5. Include approved Shop Drawings.
- 6. Final acceptance requires the Engineer's approval of the As-Built Drawings.

- E. Owner's acceptance, Substantial Completion, and start of the Warranty period requires all submittals above be approved and punch list deficiencies be corrected.

1.4 QUALITY ASSURANCE

- A. Provide a project manager to coordinate the security system acceptance testing work with other trades.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SCHEDULING

- A. Coordinate the security system Functional Testing and Acceptance Testing acceptance testing specific activities into the overall project construction schedule.
- B. Provide the Engineer and Owner with a minimum one week notice prior to scheduling Functional Testing and Acceptance Testing activities.

3.2 TESTING REQUIREMENTS

A. Site Tests

1. At a minimum, security system testing requirements shall include the following tests (where applicable to the project):
 - a. Building Perimeter Test: Test doors, cameras, and devices related to securing the perimeter of the building.
 - b. IDF Test: Test devices related to securing the MDF and IDFs . Inspect system panels, power supplies, and other related security equipment located in these areas.
 - c. Access Control System Test: Test the software for correct programming and setup. Verify correct integration with the Intrusion Detection System and Video Surveillance System.
 - d. Video Surveillance System Test: Test the system for correct programming, operation, and alarm camera call-up.
 - e. Video Recording System Test: Test the recording system for correct programming, alarm recording, and event retrieval. Verify correct integration with the ACAMS and IDS system for alarm call-up. Test and verify the system is viewable from client workstations.
 - f. Video Camera Test: Review cameras for proper coverage, quality of video, focus, configuration, etc.
 - g. Other Readers/Door Test: Test remaining card readers and doors not included in the above tests.
 - h. Battery and UPS Load Test: Disconnect AC power to security system equipment to verify battery operation functions and system remains fully operational.
 - i. Door Hardware Test: Coordinate with the Division 08 door hardware contractor to resolve electrified locking door hardware failures and door alignment or door closer problems.

B. Site Tests Preparation

1. Provide device identification numbers that differ from or were not included on the original Construction Drawings.
2. Provide a complete systems point list.
3. Provide paper and toner for the printer so that an event log can be printed out and attached to the test reports as verification of test sequence and systems response.
4. During testing, provide technicians familiar with the installation to assist with the test. Stage the technicians as follows: one at the host, one at the device being tested, and one runner responsible to furnishing tools, step ladders, etc.
5. Provide radios for use by the Engineer and Owner during testing.
6. Provide pre-programmed access cards for use during testing. Provide one authorized card for each access level. Provide one card with no access authorization. Provide keys for lockset mechanical key override.

3.3 TEST PROCEDURES

- A. Follow manufacturer's written test procedures for each type of device and system.

3.4 FIELD DOCUMENTATION

- A. Provide printed system documentation containing detailed wiring diagrams for each security equipment enclosure. Documentation shall include, at a minimum, layout of equipment, elevation detail, complete parts list, and complete wiring diagrams for each security system controller, input / output board, relay, and power supply.
- B. Provide a printed service log for each security equipment enclosure. Service log shall include, at a minimum, columns for the following information: date of service, description of work performed, service technician(s), and service company.
- C. Neatly fold the printed system documentation and service log and place it inside a clear plastic pocket affixed to the inside door of the security equipment enclosure.

3.5 TRAINING

- A. Upon completion of the Acceptance Testing, provide training to the Owner's representatives, at times convenient to them, in the function and operation as well as the service and maintenance of the security systems.
- B. Utilize the production database for the training to give the users project-specific examples from which to learn.
- C. Provide 16 hours, minimum, of on-site training by a factory trained representative. Maintain a sign-in sheet with names and dates of persons trained and forward to Owner upon completion of training.
- D. Provide for designated Owner's representatives to attend off-site factory certification training for all systems installed as part of the project, including:
 - 1. Access Control and Alarm Monitoring System
 - 2. Video Surveillance System
 - 3. Intrusion Detection System
 - 4. Security Communications System

END OF SECTION

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SECTION 281300

ACCESS CONTROL AND ALARM MONITORING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. ACAMS, including access control units, input/output units, and card readers
 - 2. ACAMS power supplies
 - 3. Alarm initiating devices, including: magnetic switch contacts, request-to-exit sensors,
 - 4. Power supplies
 - 5. Local audible alarms/sounders
 - 6. Security operations center fixtures and furnishings
 - 7. Interface to electric door hardware, ADA door operators, and gate operators
 - 8. Interface to Fire/Life-Safety system

- B. Products Furnished but not Installed under This Section
 - 1. None

- C. Products Installed but not Furnished under This Section
 - 1. New electric feed-through power transfer hinges
 - 2. Electrified locking hardware cable and termination to transfer hinge and security system

- D. Products Specified but not Installed under This Section
 - 1. Access control devices inside elevator cabs, including card readers, interface relays, and reader modules.

- E. Products Furnished and Installed under Another Section
 - 1. 120VAC power
 - 2. Telecommunication pathways; refer to Section 270528 and/or 270532.
 - 3. Network switches, with Power over Ethernet (PoE)

- F. Related Sections
 - 1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a fully functional and completely operational system.
 - 2. Section 087100, "Door Hardware"
 - 3. Section 280000, "Basic Security Requirements"
 - 4. Section 280513, "Security System Cabling"
 - 5. Section 280553, "Security System Labeling"
 - 6. Section 280800, "Security System Acceptance Testing"
 - 7. Section 282300, "Video Surveillance System"
 - 8. Section 283100, "Fire Detection and Alarm"

1.2 REFERENCES

- A. Comply with the References requirements of Section 280000.

- B. In addition to the codes and standards listed in Section 280000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 497, "Protectors for Paired-Conductor Communication Circuits"

1.3 DEFINITIONS

- A. Definitions as described in Section 280000 shall apply to this Section.
- B. In addition to those definitions in Section 280000, the following list of terms as used in this specification defined as follows:
 - 1. "A" and "AMP": amperes
 - 2. "ACAMS": access control and alarm monitoring
 - 3. "IDS": intrusion detection system
 - 4. "LAN": Local Area Network
 - 5. "NC": Normally closed
 - 6. "NO": Normally open
 - 7. "REX": request to exit
 - 8. "SCS": security communications system
 - 9. "UPS": uninterruptable power supply
 - 10. "VAC": volts alternating current
 - 11. "VDC": volts direct current
 - 12. "VMS": video management system
 - 13. "VSS": video surveillance system

1.4 SYSTEM DESCRIPTION

- A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working Access Control and Alarm Monitoring system installation, as described in these specifications.
- B. Access Control and Alarm Monitoring System (ACAMS) Overview
 - 1. The ACAMS is utilized for electronically controlling access within the building for employees, visitors, delivery personnel, and persons.
 - 2. ACAMS consists of an ACAMS server card readers and alarm initiating devices (refer to the drawings for locations of field panels, card readers, and other devices). The server will communicate with the control panels via the Owner's LAN and/or hardwire connections. The control panels control the electronic door hardware allowing or disallowing passage through a controlled door or gate.
- C. ACAMS Server and Software
 - 1. Server (to host ACAMS software): Utilize the existing server to host ACAMS software package.
- D. Card Readers / Door Devices
 - 1. Provide wireless card readers, including rough-in, wiring, reader, and other components for a complete system and connect to the ACAMS.
 - 2. Provide door contacts and request-to-exit motion detectors for card reader controlled doors and connect to the ACAMS. Refer to drawings for configurations and instances.

3. Provide integrated door contacts for non-card reader controlled doors noted on drawings (such as ground floor perimeter doors) and connect to the ACAMS. ACAMS shall monitor these doors. Program the ACAMS to alarm should the monitored doors open when not authorized.
- E. Provide end of line resistors as required (e.g., on supervised lines).
- F. Provide interface to ADA automatic/power assist door operator and corresponding actuator push plates
- G. Fire/Life-Safety System Interface
1. Coordinate with Fire/Life-Safety system contractor to automatically drop power from stairwell, elevator vestibule lobby, and other doors within the path of egress upon alarm activation of the Fire/Life-Safety system.
 2. Coordinate with Fire/Life-Safety system contractor for scheduled release of electromagnetic door holders on designated card reader doors or scheduled unlocked doors as indicated on project drawings. Provide ACAMS output modules as necessary to interface with Fire/Life-Safety system to release electromagnetic door holders on doors that are required to close and lock on scheduled events.

1.5 SUBMITTALS

- A. Quantity: Furnish quantities of each submittal as noted in Section 280000.
- B. Contractor Qualifications: Submit certification letters for the manufacturer of the ACAMS.
- C. Product Data: Submit product information for components specified herein.
- D. Shop Drawings: Include the following, minimum:
1. Device placement on floor plans and RCPs
 2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
 - a. ACAMS control panel
 - b. ACAMS card reader
 - c. ACAMS power supplies
 - d. Card Readers
 - e. Door and lock position monitoring contact switches and request-to-exit sensors
 - f. Interface to electrified door hardware
 - g. Interface to Fire/Life-Safety system
 - h. Cable conductors (identify conductors on the point to point diagrams with the same tag as the installed conductor)
 - i. Miscellaneous control relays
 3. Block Diagram/Riser Diagram: Show ACAMS components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
 4. Schedules: Include schedules for ACAMS control panels that show each point ID with a description of the connected devices
 5. Include user interface graphics with icons and control buttons displayed.
 6. Include custom mounting details.
- E. Submittal Description: Training Submittal
1. Format: PDF

2. Contents:
 - a. Cover sheet, showing:
 - 1) Owner Name
 - 2) Project Name and Address
 - 3) Project Submittal Number
 - 4) Submittal Name
 - 5) System Name
 - 6) Specification Section Number (e.g., "Section 281300")
 - 7) Date of Submittal. Format: Month Day, Year (e.g., "January 1, 2016")
 - 8) Contractor Name
 - b. Table of Contents
 - c. Training Schedule
 - d. Training Course outline/ agenda
 - e. Course materials and training manuals for the following users as applicable:
 - 1) System Administrator
 - 2) Security staff
 - 3) Operator, and nurse/staff.

F. Submittal Requirements at Closeout:

1. As-Built Drawings: submit as-built drawings that includes approved block diagram, riser diagram, wiring diagram, security control room layout and elevations, floor plans, and reflected ceiling plans, and site plans showing device locations.
2. O&M Manual: submit O&M Manual as a binder or soft copy (bookmarked PDF) including the following, at a minimum:
 - a. Product data – approved submittals ('cleaned up') and electronic
 - b. As-built drawings, printed to 11x17 / tabloid landscape and electronic PDF files and native files (DWG or RVT) on storage media
 - c. Warranty statement and service protocol (guidelines, contact numbers, etc.)
 - d. Maintenance requirements
 - e. Station Matrix, printed to 11x17 / tabloid landscape and electronic PDF files and native XLSX file on storage media
 - f. Include information for the network switches and ports.

1.6 WARRANTY

- A. Warrant work and the system to perform as described within this Section for a period of one year from the date of system acceptance. The warranty shall cover system operation/performance, parts, and labor. During the warranty period, respond within 4 hours and correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Access Control and Alarm Monitoring System
 1. Secureall to match client's standards
- B. Card Readers
 1. Secureall to match client's standards

2.2 CARD READERS

- A. Description / Features:
 - 1. Capable of reading the following frequencies and card formats:
 - a. 125 kHz and 13.56 MHz
 - 2. Utilize a Wiegand protocol for communication for compatibility with standard access control systems.
 - 3. Multi-color LED and an audible sounder to indicate the status of the door
 - 4. For exterior locations, reader shall be fully weatherized with a rugged, polycarbonate enclosure, designed to withstand an operating temperatures of -22 to 150 degrees Fahrenheit (-30 to 65 degrees Celsius) and operating humidity of 5-95% non-condensing.
- B. Functions:
 - 1. Card reader shall continuous emit radio radiation with a continuous sensing of an access card.
 - 2. Upon reading an access cord, the card reader shall initiate a single transmission to the ACAMS controller.
 - 3. Upon receiving status from the ACAMS controller, the card reader shall change the state of the LED to the programmed state.
- C. Manufacturer:
 - a. SecuerAll #SA-CDR
 - b. SecuerAll #SA-CCR
 - c. SecuerAll #SA-GSW
 - d. SecuerAll #SA-MDR
 - e. SecuerAll #SA-PWR
 - f. SecureAll #SA-ROU
 - g. SecuerAll #SA-PHR

2.3 MAGNETIC CONTACT SWITCHES

- A. Magnetic contact switches shall be UL 634 Listed.
- B. Wood, Steel, and Hollow Metal Doors
 - 1. Description / Features
 - a. Mounting: Recessed
 - b. Switch Type: Double Pole, Double Throw
 - c. Gap Distance: 0.5" maximum
 - 2. Manufacturer, or equal:
 - a. Magnasphere #MSS-19CL; 3/4" dia., open loop contact switch, with leads
 - b. Magnasphere #HSS-L2C; UL 264 Level 2 high security recessed contact switch, with leads

2.4 INTERFACE RELAYS

- A. Refer to section 280000 for relay product requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Install equipment per manufacturer's instructions.
2. Install devices, stations, etc., square and plumb. Set flush-mounted units so that the face of the cover, bezel, or escutcheon matches the surrounding finished surface.
3. Install so that there are no gaps, cracks, or obvious lines between the trim and the adjacent finished surface.
4. Install to heights shown on drawings. Heights shall comply with applicable ADA requirements.
5. Provide supervisory and end of line resistors as required.

B. Card Readers

1. Install card reader to the rough-in, not directly to dry wall.
2. Connect readers directly to reader boards. Do not daisy chain readers together.
3. Wire the card reader's multi-color LED to indicate the following status of the door.
 - a. Red = the door is secure (locked).
 - b. Green = the door is unsecured (unlocked).
 - c. Yellow = the card reader is not functioning (off-line/trouble), is processing a read request, or has denied access.
4. Wire/program the card reader to produce an audible beep tone to indicate to the user:
 - a. The card was read and/or access was denied.
 - b. Door is being held open and needs to be closed.

C. Door Hardware

1. Setup and conduct a door hardware coordination meeting.
2. Coordinate the installation and termination of the security cable with the installation of the electric door hardware and transfer hinge.
3. Route power to electrically controlled locks on Life-Safety doors through fire alarm output to automatically unlock the door upon activation of Fire/Life-Safety system. Connect fire alarm output to the disconnect relay on the associated 24VDC lock power supply.
4. Provide cable and terminate wires to delayed egress devices for monitoring activation of delayed egress by the ACAMS system.

D. Door Contacts

1. Install 6" from latch side of door.

E. Request-To Exit Motion Detectors

1. Install motion detector on the secured (protected) side of door. Install so that its detection pattern is not obstructed by exit signs, light fixtures or other objects that would interfere with proper operation.
2. Adjust relay hold time and pattern to properly detect valid exit and allow shunting of door contact.
3. Adjust detection sensitivity to pulse.
4. Mask detector lens to provide a confined detection area limited to the door handle or push bar.
5. Run wire inside structural tube steel frame into back of conduit body for cage locations.

3.2 PROGRAMMING

- A. Prior to the completion of construction, schedule a meeting with the Owner to determine the programming criteria. Document the results of the meeting and perform necessary programming to achieve the Owner's requests. During the meeting, discuss the following:
 - 1. Access card levels and door groupings
 - 2. Alarm priority levels
 - 3. Schedules and time codes
 - 4. Holidays and holiday types (priorities)
 - 5. Action/responses from individual input points
 - 6. Standard and custom (expanded) reports
 - 7. Defining alarm messages and standard response messages applicable to site
 - 8. Routing of alarm points to selected pagers
 - 9. Routing of alarm points to operator's workstations, printers, and history files
 - 10. Owner's graphics – develop sample graphic complete with icons and text. Alarms to appear on building floor plans depicting the nature and location of alarms. Review and revise graphic layout as required by Owner.
 - 11. System database backup procedures
- B. Program and setup the system such that no additional programming other than entering new access cards is required. Include setup of available features of the software.
- C. Import Owner's cardholder database.
- D. Using CAD drawing files of floor plans, perform the following relative to system graphics:
 - 1. Delete non-applicable drawing layers and details to arrive at simple floor plans of the building as built.
 - 2. Convert drawings to a graphic file format compatible with the Owner's access control and alarm monitoring system.
 - 3. Load drawing files into the system.
 - 4. Apply new and predefined icons and other points on each graphic to indicate point and control status.
 - 5. Link graphic images/icons to represent reader, monitor, alarm initiating devices, and control points.
 - 6. Program device icons on plans with functionality.
 - 7. Create camera call-up events.
 - 8. The point names shown on the as-built drawings shall match the system point schedule.
- E. Program ACAMS such that alarm events generate email notification to offsite addresses via the Internet. Also, as required by the Owner, program ACAMS such that alarm events generate pages.
- F. Program customized client workstation log-ins (restrict functions by user privileges).
- G. Program routing of monitor and control points. Route activations and restore messages to one or more of the following locations as directed by the Owner's Representative:
 - 1. One or more system workstations
 - 2. One or more system printers
 - 3. One or more alphanumeric pagers
 - 4. History files in addition to the above
 - 5. History files only

- H. Program the system such that reliance on a remote host for routine building operations, such as scheduled door commands and conditional events, are minimized to the greatest extent possible and decisions are made at the local building controller.
- I. System Operation, Alarm and Reporting Function: Program door control panel tamper switches to immediately report as a separate "tamper" point to the system resulting in an alarm condition displayed in both text and graphic form on the applicable workstation(s) and an alarm message transmitted to the appropriate pager(s).
- J. Program the system in a manner that minimizes the amount of time required for the users to make updates and maintain the system on a daily basis especially updates that impact card holder record updates. Nested programs, such as reader groupings used in access codes, shall be used to the greatest extent possible such that single actions are required to update an entire card data population. If there is a question regarding the appropriate approach to programming, given the flexibility of most systems, contact the Engineer prior to any initial programming
- K. Perform 2 full system back-ups at completion of initial programming and deliver one copy to owner with letter of Transmittal explaining information included in back-up and brief description of recovery procedures. Label the second removable storage device and store onsite. Perform back-ups on a regular bases through the remainder of the project.
- L. Customize menus with the assistance of the factory to "gray-out" features not used on project (such as elevator control).
- M. Perform field software changes after the initial programming session to "fine tune" operating parameters and sequence of operations based on revised operating requirements.
- N. Password management – refer to Section 280000.

3.3 EXTRA MATERIALS

- A. Furnish extra materials to Owner. Produce a transmittal with an itemized list including quantities, recipient, and receipt date. Submit copy of Owner-signed transmittal with project closeout documents.
- B. Place fuses inside each equipment/panel and power supply enclosure.
- C. Turn over keys (equipment enclosures, low voltage power supplies, security junction boxes, rack cabinets, etc.) to the Owner. Produce a transmittal with an itemized list of keys, recipient, and receipt date. Submit copy of Owner-signed transmittal with project closeout documents.

3.4 TRAINING

- A. Combine training on the ACAMS with training on the VSS (Section 282300).
- B. Training Requirements
 - 1. Security Staff/System Operators:
 - a. Prior to the first day of business at the new facility, provide 1 day of training, 4 hours per day.
 - b. Two months later, provide 1 day of training, 4 hours per day.

3.5 TESTING

- A. Test ACAMS in accordance with Section 280800.

END OF SECTION

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SECTION 282300
VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Video Surveillance System (complete system)
 - 2. Video Management System (software)
 - 3. Network Video Recorder and Storage (hardware)
 - 4. Fixed cameras, lenses, mounts, and housings
 - 5. Panoramic cameras, lenses, mounts, and housings
 - 6. Power Supplies
 - 7. Network switches, with Power over Ethernet (PoE)

- B. Products Furnished But Not Installed Under This Section
 - 1. None

- C. Products Installed But Not Furnished Under This Section
 - 1. None

- D. Products Specified But Not Installed Under This Section
 - 1. None

- E. Products Furnished And Installed Under Another Section
 - 1. 120VAC power
 - 2. Telecommunication cabling between telecom room and cameras; refer to Section 271513.
 - 3. Network switches, with Power over Ethernet (PoE)

- F. Related Sections
 - 1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
 - 2. Section 271513, "Communications Horizontal Cabling"
 - 3. Section 280000, "Basic Security Requirements"
 - 4. Section 280800, "Security System Acceptance Testing"
 - 5. Section 280513, "Security System Cabling"
 - 6. Section 280553, "Security System Labeling"
 - 7. Section 281300, "Access Control and Alarm Monitoring System"
 - 8. Section 282600, "Security Communications System"

1.2 REFERENCES

- A. Comply with the References requirements of Section 280000.

- B. In addition to the codes and standards listed in Section 280000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 497, "Protectors for Paired-Conductor Communication Circuits"

1.3 DEFINITIONS

- A. Definitions as described in Section 280000 shall apply to this Section.
- B. In addition to those definitions in Section 280000, the following list of terms as used in this specification defined as follows:
 - 1. "A" and "AMP": amperes
 - 2. "ACAMS": access control and alarm monitoring
 - 3. "CCD": charge-coupled device
 - 4. "CMOS": complementary metal oxide semiconductor
 - 5. "DSP": digital signal processing
 - 6. "FC": foot candles
 - 7. "FPS": frames per second
 - 8. "IDS": intrusion detection system
 - 9. "KVM": keyboard, video, mouse switch
 - 10. "NAS": network-attached storage
 - 11. "NVR": network video recorder
 - 12. "PoE": Power over Ethernet
 - 13. "PTZ": pan-tilt-zoom
 - 14. "RAID": redundant array of independent disks
 - 15. "SAN": storage area network
 - 16. "VAC": volts alternating current
 - 17. "VDC": volts direct current
 - 18. "VMS": video management system
 - 19. "VSS": video surveillance system

1.4 SYSTEM DESCRIPTION

- A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services as required to make a complete working video surveillance system, as described in this specification.
- B. Video Surveillance System (VSS) Overview
 - 1. The VSS is an enterprise-wide system generally comprised of fixed cameras (with associated mounting apparatus, housings, cabling, etc.), video management system (software), and network video recorder and storage (hardware), that provides live video feeds for real-time surveillance and monitoring, recorded video for forensic analysis.
 - 2. The VSS serves as the video component of the facility's overall security and safety program. Camera deployment and their respective field-of-views are strategically determined to coincide with points of security and access control as well as surveillance of open and high-security spaces.
 - 3. The VSS interconnects and integrates with the ACAMS, IDS, and security/emergency communications system such that alarms/events generated within the other systems (generally carried through the ACAMS) cause VSS and the VMS to behave in a programmed manner.

- a. Program active icons in graphic user interface map in the ACAMS to allow camera call up based on the selection of icon.
- C. Video Surveillance System (VSS) Scope
- 1. Server (to host VMS software): Provide server to host VMS software package.
 - 2. Video Storage hardware / Network Video Recorder (NVR): Provide server to store video.
 - 3. Video Management System Software: Provide VMS software package, including loading the VMS package onto the VMS server and integrating the software onto the network and integrating the video storage hardware into the VMS. Coordinate with the Owner's IT department for network integration and other IP-related requirements. Provide VMS licenses in a quantity sufficient to support the project's cameras plus 20% (minimum, round up to nearest whole number).
 - 4. Program the software system to meet the project requirements including programming recording input points, video call up, and other aspects of the system. Provide software interface to the ACAMS for alarm call up of cameras on predefined alarm events.
 - 5. Provide cameras as shown on the drawings. Provide outdoor housing and mounts for exterior cameras.
 - 6. Provide power supplies to supply power to cameras. Do not combine with ACAMS power supplies.
- D. Surge Protection: Regardless of who provides the cabling to outdoor cameras, ensure that the connection infrastructure for outdoor cameras receive proper protection against transient voltages. Installations shall comply with NEC 800.47, NEC 800.50 and NEC 800.90.
- E. Extra Materials
- 1. Furnish 10% spare parts of total installed the following (round up to the next complete device):
 - a. Fixed cameras

1.5 SUBMITTALS

- A. Contractor Qualifications: Submit certifications for the manufacturers of the video surveillance equipment.
- B. Product Data: Submit product information for components specified herein.
- C. Shop Drawings:
 - 1. Device placement on floor plans.
 - 2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
 - a. Video surveillance system, monitors, and recording equipment
 - b. Network Switches
 - c. Devices connected to the system
 - d. Miscellaneous control relays
 - e. Conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)
 - 3. Camera Matrix: Submit as an Excel-compatible spreadsheet a matrix that includes each camera. The matrix, using the same ID as shown on the as-built drawings, shall include the following column headers, at a minimum:
 - a. Device
 - b. Device Identifier
 - c. Location
 - d. MAC Address

- e. IP Address
 - f. IDF Room
 - g. Network Switch
 - h. Switch Port
4. Block Diagram/Riser Diagram: Show the video surveillance system components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
 5. User interface graphics with icons and control buttons displayed.
 6. Custom mounting details
- D. Submittal Requirements at Closeout:
1. As-Built Drawings (this may be combined with the ACAMS as-built drawings): submit as-built drawings that includes block diagram, riser diagram, wiring diagram, and reflected ceiling plans, and floor plans and site plans showing camera locations (tagged with a unique ID per camera), security console (with video monitors).
 2. Camera Matrix: submit as an Excel-compatible spreadsheet a matrix that includes each camera. The matrix, using the same ID as shown on the as-built drawings, shall include the following column headers, at a minimum:
 - a. Camera Type
 - b. Camera ID (shall match the as-built plans)
 - c. Camera manufacturer and model (shall match the approved product data submittal)
 - d. Camera lens manufacturer and model (shall match the approved product data submittal)
 - e. Location
 - f. MAC Address
 - g. IP Address
 - h. IDF Room
 - i. Network Switch
 - j. Switch Port
 - k. Maintenance requirements
 3. O&M Manuals: submit O&M Manual as a binder or soft copy (bookmarked PDF) including the following, at a minimum:
 - a. Product data – approved submittals ('cleaned up') and electronic
 - b. As-built drawings, printed to 11x17 / tabloid landscape and electronic PDF files and native files (DWG or RVT) on storage media
 - c. Warranty statement and service protocol (guidelines, contact numbers, etc.)
 - d. Maintenance requirements
 - e. Station Matrix, printed to 11x17 / tabloid landscape and electronic PDF files and native XLSX file on storage media
 - f. Network switches and ports configuration information

1.6 WARRANTY

- A. Warrant the system for a period of one year from the date of system acceptance. The warranty shall cover system operation/performance, parts, and labor. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 NETWORK VIDEO RECORDER

A. Features

1. Complete network video platform that encompasses video recording, video viewing, reviewing recorded video, and storing video for indefinite periods of time.
2. Full control of camera selections, sequencing, and viewing modes
3. The system simultaneously records, displays live video, and plays back video. None of the video operations interfere with each other. Live view and video playback does not interrupt the recording process.
4. Recorders capture, digitize, and store video. Recorders may record full-time, in response to an alarm, or based on a user-defined schedule. Full-time recording refers to 24 hours per day, 7 days per week, 365 days per year.
5. Network: Internal network interface for connection to a 10/100BaseT LAN using TCP/IP network protocol
6. Web Access: Web-based remote access via browser

B. Recorders

1. Video Information
 - a. Store for each clip video source, capture date, start time, and stop time. Source identified as either a monitor or a camera. Information to be available during playback
 - b. Store alarm information in the database on the main server when the video is in response to an alarm condition.
2. Video Storage
 - a. Video stored in clips on the recorder's internal hard drive. As the hard drive becomes full, groom oldest clips to make room for new video.
 - b. Ability to utilize a variety of network storage devices such as external disk arrays, RAID and NAS/SAN devices, and external disk drives for exporting, backup, or sharing images.
3. Video Authentication
 - a. Fingerprint each video clip through a mathematical algorithm during the video capture process. The fingerprint becomes part of the clip and used by the playback software to verify the video has not been altered.
4. Alarm Recording
 - a. Recording Options
 - 1) Alarm condition via activation of an external alarm contact.
 - 2) Internal video motion detection
 - b. Recording programmable by camera and by time and date schedule.
 - c. Allow a mix and match of continuous recording and alarm recording, based on camera input and capture card connection.
 - d. Pre and post alarm recording
5. Video Motion Detection
 - a. Each video input capable of detecting activity from camera input and to initiate an alarm condition.
 - b. Video motion detection areas operator selectable for each camera input. If the scene changes within the alarm area, an alarm condition is initiated.
6. Viewing of both live and archived images, from multiple remote systems.
7. Remote event notification
8. Password protected via user authorization, with profiles assigned by the system administrator, and database tracking of events.

- C. Manufacturer, or equal:
 - 1. BCD Video
 - 2. DNF Security
 - 3. Dell

- D. Software:
 - 1. Milestone XProtect Corporate and camera licenses

2.2 CAMERAS

- A. Fixed IP Interior Dome Camera
 - 1. Type: Color, vandal-resistant
 - 2. Power: PoE
 - 3. Imager: 1/3 inch format, unless otherwise noted
 - 4. Lens Mount: Accept a "CS" mount auto or manual-iris lens
 - 5. Resolution: 1080p HD
 - 6. Minimum Light Level: 0.1 fc imager illumination at full video, unless otherwise noted
 - 7. Lens: 3 to 9mm, unless otherwise noted
 - 8. Frame Rate: 30fps at H.264
 - 9. Manufacturer, or equal:
 - a. Axis #P3346-V IP dome megapixel camera
 - 10. Accessories, or equal:
 - a. Axis #5502-781 ceiling mount kit
 - b. Axis #5502-401 mounting plate

- B. Fixed IP Exterior Dome Camera
 - 1. Type: Color, vandal-resistant
 - 2. Power: PoE
 - 3. Imager: 1/3 inch format, unless otherwise noted
 - 4. Lens Mount: Accept a "CS" mount auto or manual-iris lens
 - 5. Resolution: 1080p HD
 - 6. Minimum Light Level: 0.1 fc imager illumination at full video, unless otherwise noted
 - 7. Lens: 3 to 9 mm, unless otherwise noted
 - 8. Frame Rate: 30fps at H.264
 - 9. Manufacturer, or equal:
 - a. Axis #P3346-VE vandal resistant fixed dome with remote focus and zoom for outdoor use
 - 10. Accessories, or equal:
 - a. Axis #T91A61 wall bracket

2.3 LINE PROTECTORS

- A. For use on data cables serving exterior cameras.

- B. Manufacturer, or equal:
 - 1. Transtector #1101-994
 - 2. DITEK

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION PLANNING

- A. Prior to the completion of construction, schedule a meeting with the Owner and the Engineer to determine the system programming requirements, such as the following:
 - 1. Camera naming/numbering
 - 2. Field of view per camera
 - 3. Settings for contrast, wide dynamic range, and auto-iris
 - 4. Camera call-up and recording features, including video motion detection
- B. Camera Locations
 - 1. Prior to installation, coordinate/confirm camera locations. As needed, perform a field walk with the Owner. Obtain Owner signoff of camera locations and field of view per camera prior to installation.
 - 2. Prior to rough-in construction, coordinate rough-in locations and requirements per camera.

3.2 INSTALLATION

- A. Network Video Recorder
 - 1. Rack mount VSS equipment located in the data center.
- B. Network Switch
 - 1. Rack mount network switches located in the data center.
- C. Cameras
 - 1. Field determine exact placement of cameras to ensure complete coverage.
 - 2. Field determine fixed camera lens size to ensure complete coverage.
 - 3. For exterior cameras, provide liquidtight flexible metallic conduit from junction box to camera housing and connect from below.

3.3 PROGRAMMING

- A. Network Video Recorder
 - 1. Connect the servers/storage to the Owner's LAN/WAN to allow remote viewing from authorized workstations utilizing the VMS client viewing software. Configure the cameras and servers at the following initial requirements:
 - a. Codec: H.264
 - b. Resolution: 1080p
 - c. Storage: 30 Days (minimum)
 - d. Recording: Continuous
 - e. Frame Rate: 30fps
- B. Document the results of the meeting and perform necessary programming to achieve the Owner's requests.
- C. Setup and program the system such that no additional programming required.
- D. Use the camera naming convention agreed upon at in the programming meeting when programming point names into the system.

- E. Perform two full system back-ups at completion of initial programming and deliver one copy to the Owner with a letter of transmittal explaining information included in back-up and brief description of recovery procedures. Perform back-ups on a regular bases through the remainder of the project.

3.4 TESTING

- A. Test the video surveillance system in accordance with Section 280800.

3.5 SYSTEM OPERATION CONFIRMATION

- A. At 30 days after substantial completion, perform field review of video surveillance system software with the Owner to "fine tune" configuration settings for resolutions, recording, and frame rate to meet the storage and operational requirements.

END OF SECTION

SECTION 283111

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following systems for the building:
 - 1. Fire Alarm Systems.
- B. Drawings supplied with this specification shall be used as a reference for the requirement and location of system components.
- C. At the time of bid, all exceptions taken to these Specifications, variances from these Specifications and all substitutions of equipment specified shall be listed in writing and forwarded to Peralta Community College District (Owner). Any such exceptions, variances, or substitutions, which were not listed at the time of bid shall not be approved or considered.
- D. The Work includes all labor, materials, services, software, programming, tools, transportation, and temporary construction necessary to fabricate, install, program and test a fully operational and code compliant UL Listed and FM approved analog-addressable fire alarm system.
- E. The Work includes all fees and activities required to secure approvals for necessary State and Local permits.
- F. The Work includes submitting detailed Shop Drawing Plans, Wiring Diagrams, Calculations and Product Data to the Engineer and Owner for review in parallel to submitting to local officials (as required) for approval and permit as outlined in the specification and project documents.
- G. The Work includes performing field quality control activities.
- H. The Work includes documenting and submitting the results of integrity and functional testing.
- I. The Work includes performing overall system “Pre-Acceptance” test(s) for the Engineer’s approval with the Electrician and Programmer.
- J. The Work includes performing overall system “Final Acceptance” test(s) for Authority approval with the Electrician and Programmer.
- K. The Work includes submitting As-built Plans and closeout documentation in DWG and PDF format to the Engineer.

- L. The Work includes training Owner's personnel on the operation of the system, required maintenance tasks and frequencies, and the locations of all equipment necessary to maintain and operate the fire alarm system.

1.3 SYSTEM DESCRIPTION

- A. Noncoded, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.
- B. Fire alarm system.

1.4 ORDER OF PRECEDENCE

- A. Should conflicts arise out of discrepancies between documents referenced in this specification, the most stringent requirement shall apply; however, should a level of stringency be indeterminable, the discrepancies shall be resolved as follows:
 - 1. State and local codes shall take precedence over this specification.
 - 2. The National Fire Protection Association Standards shall take precedence over this specification.
 - 3. Drawing specific requirements as documented on the RFP drawing package.

1.5 PERFORMANCE REQUIREMENTS

- A. Comply with local and national codes and RFP package documents, including:
 - 1. California Fire Code
 - 2. NFPA 72 – *National Fire Alarm Code*
 - 3. NFPA 70 – *National Electric Code*
 - 4. Contract Documents
 - 5. Specification Documents
 - 6. DSA Guidelines
- B. 24 VDC closed-circuit, electrically supervised, addressable, analog, automatic fire alarm system. The system shall include, but not be limited to:
 - 1. Fire alarm control unit (FACU) and power supplies.
 - 2. Fire Alarm Annunciator (Simplex) including a point type annunciator with a minimum of 80 zones.
 - 3. Photoelectric, addressable analog automatic smoke detection system (in those environments suitable for proper smoke detector operation), as indicated in this section and where shown on the drawings.
 - a. Immediate Vicinity of Fire Alarm Control Equipment: System type, analog, addressable, photoelectric smoke detectors with standard bases located in the immediate vicinity of all fire alarm control equipment, including remote power supplies.
 - b. Elevator Lobbies, Shafts, and Machine Rooms: System type, analog, addressable, photoelectric smoke detectors with standard base located in common corridors, elevator lobbies.

- c. Where an area is environmentally unstable such that a smoke detector could experience high levels of dust or temperature variations above 100° F or below 32° F and the area in question is protected by an automatic sprinkler system, smoke detectors shall be omitted. If an automatic sprinkler does not protect the area, an addressable heat detector shall be installed.
- 4. Waterflow and Valve Supervisory Switches: Use conventional zone interface modules to monitor fire protection system alarm and supervisory functions as shown. Fire protection devices such as water flow and valve supervisory switches are furnished by the fire protection contractor. Provide necessary raceway, wiring and end of line devices to monitor.
- 5. Speakers and Speaker Strobes: Speakers installed to provide voice notification to all areas of the building. Standalone strobes or speaker strobes installed to provide visual notification to all common areas.

1.6 SUBMITTALS

A. General Submittal Requirements:

- 1. Submittals shall be approved by the Owner in parallel to submitting them to the authorities having jurisdiction.
- 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, Level IV minimum.

B. Product Data: For each type of product indicated. Submittal shall indicate listing and approvals, selected options and electrical characteristics.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

- 1. Furnish three complete sets of as built shop drawings. The drawings shall be prepared on uniform sized sheets not less than 36 by 48 inches in size. In addition, provide a USB flash drive containing AutoCAD (Version to be coordinated with Owner) DWG and PDF format of all as built drawings and schematics.
- 2. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
- 3. Include voltage drop calculations for notification appliance circuits.
- 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
- 5. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- 6. Equipment List: Identify type, quantity, make and model number of each piece of equipment (including spare components) included in submittal. Types and quantities of equipment indicated shall coincide with the types and quantities of equipment used in the battery calculations and those shown on the shop drawings.
- 7. Shop Drawing Plans: Minimum 1/8"=1'-0" scale floor plans and corresponding riser diagram inclusive of information required by NFPA 72 requirements. Conceptual riser diagrams are not permitted.

8. Wiring Diagrams: Point-to-point fire alarm control equipment installation diagrams inclusive of information required by NFPA 72 requirements; typical wiring diagrams are not acceptable.
 9. Battery Calculations: Prepared in accordance with NFPA 72 requirements and showing total standby power and total alarm power required to meet the specified system requirements. Include a complete list of current requirements during normal, supervisory, trouble, and alarm conditions for each component of the system.
 10. Sequence of Operation: A sequence of operation that describes how the system responds during an alarm, supervisory and trouble condition. The description shall include fire alarm control unit LEDs, audible and visible indications; initiating devices, notification appliances, and auxiliary functions. The description shall provide sufficient information so that the exact function of each installed device and appliance is known.
 11. Statement of Equipment Lifecycle: A written statement, signed by a representative of the equipment manufacturer stating that the equipment to be supplied is not at or near the end of its life cycle and that replacement components for all control equipment shall be available from the manufacturer for a minimum of fifteen (15) years from the date of installation.
- D. Qualification Data: For qualified Installer.
- E. Field quality-control reports.
- F. Final Acceptance Documentation:
1. As-Built Drawings: With final revisions per Engineer's comments.
 2. Final Record of Completion: Prepared in accordance with NFPA 72.
 3. Test Reports: From Pre-Acceptance testing; substantially in the format and inclusive of information required by NFPA 72.
- G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals, include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 5. Manufacturer's required maintenance related to system warranty requirements.
 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
- H. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician and shall be:
 1. Licensed in the State of California and be experienced in the installation of fire alarm systems in buildings similar to the Work described herein and has obtained design and inspection approvals for similar projects from authorities having jurisdiction.
 2. Foreman: Provide proof of competence of both their company and the individual foreman that will be assigned to this project, in the area of installing fire detection, alarm, and control systems for at least five (5) years and acceptable to the Owner. Once assigned, the Contractor's foreman shall not be changed without the approval of the Owner.
 3. Service Organization shall be capable of providing a minimum NICET Level III certified service technician on-site within 4 hours of a request for on-site service.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system where applicable.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. All control equipment shall have transient protection devices that comply with the requirements outlined in UL 864 9th Edition, Standard for Control Units for Fire-Protective Signaling Systems.
- F. All materials and equipment (initiating devices, notification appliances, etc.) shall be new and unused.
- G. All equipment supplied shall be first quality and the manufacturer's best type and latest model capable of complying with all requirements of this specification and shall have been in continuous production and in continuous service in commercial applications for at least one year. Obsolete equipment shall not be used.
- H. The requirements and recommendations of the latest published edition of the equipment manufacturers' product datasheets, technical specifications, installation instructions and wiring guidelines shall be followed.

1.8 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.9 SCHEDULING

- A. The Contractor's Foreman shall act as a primary point of contact and responsible-in-charge for coordinating the Pre-Acceptance Test with the other portions of the Work, Owner, and the Engineer.
- B. The Contractor's Foreman shall act as primary point of contact and responsible-in-charge for coordinating the Final Acceptance Test with the other portions of the Work, Owner, Engineer and Authorities.

1.10 EXTRA MATERIALS

- A. The manufacturer shall provide a suggested spare parts list with firm unit prices maintained for the duration of the manufacturer's warranty period as specified herein, for items such as power supplies, central processor units, fault isolator modules, monitor addressable modules, addressable control relay output modules and other modules that may be long lead replacement items. Firm costs for programming changes shall also be included. Firm prices shall be maintained for one year beyond the duration of the manufacturer's warranty period as specified herein.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 - 2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Distributors of acceptable manufacturer's equipment shall provide documentation indicating that they are authorized by the manufacturer to distribute and service the equipment and that the manufacturer has stated that they have satisfactorily completed all training courses offered by the manufacturer in relation to the equipment provided.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. The system shall include new control/communications equipment which is UL Listed to operate with the submitted manual fire alarm boxes, heat detectors and smoke detectors, and shall alert building occupants using audible and visible notification appliances, supervise each system for

conditions which would impair proper system operation, annunciate such abnormal conditions, and where applicable, control related equipment as indicated on contract documents.

B. ALARM CONDITION

1. The system operation shall be such that the alarm operation of any alarm initiating device shall not prevent the subsequent alarm operation of any other initiating device due to wiring or power limitations.
2. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 - a. Manual stations.
 - b. Heat detectors.
 - c. Smoke detectors.
 - d. Beam detectors
 - e. Automatic sprinkler system water flow.
 - f. Fire standpipe system water flow.
 - g. Fire pump running.
3. Fire-alarm signal shall initiate the following actions:
 - a. Continuously operate alarm-notification appliances.
 - 1) Activate Pre-recorded message or Temporal three evacuation signal as required.
 - b. Identify alarm at the fire-alarm control unit and remote annunciators.
 - c. Transmit an alarm signal to the remote alarm receiving station.
 - d. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - e. Record events in the system memory.

C. SUPERVISORY CONDITION

1. The control unit shall have a "SYSTEM SUPERVISORY" LED and a supervisory signal "ACKNOWLEDGE" switch.
2. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - a. Valve supervisory switch.
 - b. Duct detectors
3. System trouble signal initiation shall be by one or more of the following devices and actions:
 - a. Open circuits, shorts, and grounds in designated circuits.
 - b. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - c. Loss of primary power at fire-alarm control unit.
 - d. Emergency generator trouble.
 - e. Ground or a single break in fire-alarm control unit internal circuits.
 - f. Abnormal ac voltage at fire-alarm control unit.
 - g. Break in standby battery circuitry.

- h. Failure of battery charging.
- i. Abnormal position of any switch at fire-alarm control unit or annunciator.

D. TROUBLE CONDITION

1. When a trouble condition is detected, the following functions shall immediately occur:
 - a. An amber “SYSTEM TROUBLE” LED light shall light and the system audible signal shall steadily sound when any trouble is detected in the system. Failure of normal power, opens or short circuits on the signaling line circuits or the notification appliance circuits, disarrangements in system wiring, failure of the microprocessor or any identification module, or system ground faults shall activate this trouble circuit.
 - b. A trouble signal may be acknowledged by actuating the “ACKNOWLEDGE” switch. This shall silence the control unit trouble buzzer. If additional trouble conditions occur, the trouble circuitry shall resound.
 - c. During an “alarm” condition, all “trouble” signals shall be suppressed with the exception of lighting the amber “COMMON TROUBLE” LED steadily.
 - d. The display shall indicate all information associated with the trouble condition, including type of trouble point, it’s location within the protected premises, and the time and date of that activation.
 - e. All system output programs assigned via control-by-event equations to be activated by the particular point in trouble shall be executed, and the associated System Outputs (Trouble Notification Appliances and/or relays) shall be activated.

- E. System Alarm, Trouble and Supervisory Signal Actions: Annunciate at fire-alarm control unit, remote annunciators, and transmit the signal to the supervising station.

F. SYSTEM SUPERVISION

1. All wiring extending from the FACU enclosure to fire alarm system components shall be supervised for opens, shorts and grounds. Systems containing unsupervised wiring of any type shall not be acceptable.
2. The occurrence of any fault shall activate the system trouble circuitry but shall not interfere with the proper operation of any circuit that does not have a fault condition.
3. Incoming 120 VAC line power shall be supervised so that any power failure shall be audibly and visually indicated at the control unit.
4. Batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control unit.

G. SYSTEM RESET

1. A “SYSTEM RESET” button shall be used to return the system to its normal state after an alarm condition has been remedied. Printed messages shall provide operator assurance of the sequential steps (i.e.: “IN PROGRESS”, “RESET COMPLETED”) as they occur, should all alarm conditions be cleared.
2. Should an alarm condition continue to exist, the system shall remain in an abnormal state. System control relays shall not reset. The control unit “ALARM” LED shall remain on. These points shall not require acknowledgment if they were previously acknowledged.

2.3 FIRE-ALARM CONTROL UNIT

- A. The FACU shall provide power, English display status, supervision, control, and programming capability for the fire detection and alarm system.
- B. The control unit shall be located by the Owner and the Engineer, as shown on the drawings.
- C. The control unit shall store a record of alarm and trouble events in a nonvolatile history file. This file shall contain, at least, the most recent 500 events, with time and date of each event. It shall be possible to select the number of events to be viewed in the history file so that the entire file does not have to be downloaded. The history file shall remain intact in the event of a loss of AC and battery power.
- D. The control unit shall be modular in construction and receive supervised plug-in component boards to provide system functions as hereinafter specified and/or to accommodate future system expansions.
- E. The control unit shall be capable of being expanded in the future to support a minimum of 99 addressable points (inputs or outputs). The control unit shall be capable of being expanded and field reprogrammed at any time up to the predetermined maximum capacity of the system, without the requirement to return the operating system to the factory for program changes. All field programming shall be done by an authorized manufacturer's representative.
- F. The control unit shall contain a minimum of two (2) signaling line circuits. Each signaling line circuit shall support a minimum of 99 addressable input devices or addressable monitor modules and a minimum of 10 output devices. All addressable input and output devices shall be capable of being intermixed on the same signaling line circuit.
- G. The control unit shall accommodate all addressable input devices in alarm simultaneously and shall be capable of operating all output relays while all inputs are in alarm.
- H. A minimum of one (1) signaling line circuit per floor shall be used, with devices equally distributed on each circuit. Each signaling line circuit shall be loaded to no more than 75% of its manufacturer specified capacity. Additional SLCs shall be furnished and installed as necessary to comply with this requirement.
- I. The control unit shall supply power and communication protocol signals to the addressable input devices over a single pair of wires per signaling line circuit from the control unit. Signaling line circuits shall be field programmable for Style 6 operation.
- J. A minimum of three fault isolator modules shall be used on each signaling line circuit. One fault isolator module shall be installed at the point the SLC leaves the FACU. Fault isolator modules shall be placed in order to minimize loss of addressable devices. Fault isolator modules shall be placed at each floor, where the SLC spans multiple floors. No more than 25 devices shall be installed on a circuit between fault isolators.
- K. The control unit shall contain a minimum of one (1) visible (strobe) and one (1) audible notification appliance circuits (NAC) per floor to provide an evenly distributed number of notification appliances per circuit. Visible (strobe) notification appliance circuits shall be independent from the audible notification appliance circuit. Each circuit's power load shall not

exceed 75% of the individual circuit power available from the FACU and new installed circuits shall be Class B circuits. Additional NACs shall be furnished and installed as necessary to comply with this requirement.

- L. Power for all notification appliances shall come from integral power supplies in the control unit. Remote power supplies, if needed, shall be of the same manufacturer as the FACU. All locations containing remote control equipment (such as a power supply extender) shall be protected with a smoke detector, in accordance with NFPA 72.
- M. At a minimum, the FACU shall contain the following:
 - 1. Display. A minimum 80 character, highly readable, display. Upon input activation, the display shall provide the following indication:
 - a. A device address display.
 - b. A field programmed English label indicating the location of the device.
 - c. An English description of the type of device activated, such as smoke detector, manual fire alarm box, water flow switch, etc.
 - d. The status of the input: alarm, supervisory or trouble.
 - e. Multiple alarm conditions shall be sequentially displayed automatically at not more than a five (5) second interval until manually acknowledged by priority.
 - 2. Annunciation. Annunciation shall be an integral part of the control system and shall indicate alarm, supervisory and trouble conditions and the corresponding address. The following initiating devices shall be annunciated individually:
 - a. Smoke detectors;
 - b. Heat detectors; and
 - c. Other approved types of automatic fire detection devices.
 - 3. Battery voltage and ammeter readouts shall be available from the LCD display.
 - 4. Once acknowledged, individual alarms shall be viewed by operating a "next-alarm" switch.
 - 5. Communication Ports. Two supervised RS232C communication ports shall be provided to support a printer or MODEM. Each RS232C port output shall be programmable for printer or display output and shall be programmable to provide access to the control unit's EEPROM operating system to perform the following functions:
 - a. Listing and indicating status of all field devices.
 - b. Capability of performing alarm tests on any or all addressable smoke detectors and contact input devices.
 - c. Monitoring of the system from remote locations via printer, terminal, or computer.
 - 6. The control unit shall be provided with a "silent" walk test feature. This feature shall allow for testing of the fire alarm system without activating the notification appliances.
 - 7. Clock. A 24 hour clock shall be provided to continually provide the time of day and day of the week information. During normal standby conditions, the control unit shall display time and date.
 - 8. Any operation of an alarm silence, supervisory silence, trouble silence, acknowledge, lamp test, relay switches, or system reset switch shall cause a display indication of operation with time and date. These operations shall also be recorded in the system's history file.

- N. The functional operation of the control unit shall be established by programmable software.
1. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
- O. Access and control of the operating program shall be restricted to proper personnel designated by the Owner.
1. The control unit shall have a minimum of three (3) security levels, and they shall be designated: "ELECTRICIAN", "ALARM SYSTEM SERVICE TECHNICIAN", and "MANUFACTURER." Each level shall have individual passwords. Illegal access attempts shall be rejected by the system and shall be displayed and recorded in the history file with time and date.
 2. The "ELECTRICIAN" security level shall be the lowest security level and shall only allow access to the system status levels and lists and shall not impair system operation.
 3. The "MANUFACTURER" and "ALARM SYSTEM SERVICE TECHNICIAN" security levels shall allow access to the operating system.
 4. Accessing a programming function that disables normal system operation shall initiate a trouble sequence.
- P. Failure of the CPU(s) in the control unit module or a channel shall light the CPU Error LED and sound the control unit trouble buzzer. Alarms received while the control unit is in this state shall bypass the software and sound the general alarm signals and light the alarm LED.
- Q. The channel modules shall be field programmable to report wire-to-wire short conditions as either an alarm or trouble condition.
- R. The control unit shall be capable of locating input circuit openings by the associated address and initiate the proper display and trouble sequence.
- S. The system response to alarms shall be 2.5 seconds maximum for the first alarm.
- T. The control unit shall contain an integral standby battery to provide continuous power in the event of AC power failure.
1. The batteries shall be capable of providing 24 hours of backup power for the system (or 4 hours when using a backup generator) and enough remaining power to operate all notification appliances for 15 minutes at the end of the 24 hour period.
 2. The calculations for battery standby shall include a "safety factor" (reserve power estimate) of a minimum 20%.
 3. Transfer from AC to battery power shall be instantaneous when AC voltage drops below 85 percent input. Transfer to battery standby shall be indicated by display and recorded in the history file with time and date. The indication shall be "AC OFF".
 4. Loss of building power for the system shall automatically and immediately cause transfer of the system to battery power and cause all audible trouble signals to sound. Upon return of building power, the system shall automatically retransfer thereto, and the batteries shall automatically recharge.

5. During battery operation, the control unit shall process all inputs. However, the display shall provide five (5) seconds of indication for each new input condition, then turn off to conserve battery power.
 6. The control unit shall have a dual rate battery charger that shall maintain the batteries in a fully charged condition and shall provide recharge of the batteries to full capacity in forty-eight (48) hours.
- U. The control unit shall provide a nonprogrammable DPDT common alarm relay and common trouble relay both with contacts rated 2 AMP at 24 VDC.
- V. Output Function Modules. The control unit shall utilize output function modules to control output functions. The modules shall plug into the control unit motherboard. The functions and presence of each module shall be supervised, and “ELECTRICIAN” password shall enable the user to request a list that locates the module by panel and slot within system. All modules shall be individually programmable by circuit as hereinafter specified.
1. Addressable control relays shall be provided for each of the auxiliary functions; field verify quantities and locations.
- 2.4 Fire Alarm System Power Supplies
- A. System primary power
1. Primary power for the FACP and the secondary power battery chargers shall be obtained from a dedicated emergency power circuits. Circuit breakers shall be fitted with a suitable guard, requiring removal of a screw to open, and used only for fire alarm. Each circuit used for fire alarm purposes shall be permanently labeled for function.
- B. Secondary power supply
1. Emergency Diesel Generator.
 2. Provide sealed gelled electrolyte batteries as a backup for all fire alarm functions. The battery supply shall be calculated to operate loads in a supervisory mode for forty-eight hours with no primary power applied and, after that time, operate in alarm mode for two hours. Fifteen minutes of all call paging will be considered the equivalent of two hours normal paging use. Batteries shall be sized at 125% of the calculated size to compensate for deterioration and aging during the battery life cycle. Battery calculations shall be submitted to justify the battery size.
 3. Provide battery charging circuitry for each standby battery bank in the system. The charger shall be automatic in design, adjusting the charge rate to the condition of the batteries. All system battery charge rates and terminal voltages shall be read using the fire alarm control panel LCD display in the service mode, indicating directly in volts and amps. Meters reading in percentage are not acceptable.
- C. Equipment power supply capacity for each system shall be based on actual calculated load plus 25% excess capacity.

2.5 WIRING

- A. Wiring for the initiating devices, notification appliances and remote 80 character LCD display shall be solid or stranded copper and shall comply with the appropriate sections of NFPA 70, *National Electrical Code*. All system wiring size shall be as determined suitable by the manufacturer and in compliance with the *National Electrical Code*, yet they shall not be any smaller than as specified herein.
- B. Conductors shall be minimum #14-gauge solid copper, type FPLP or FPLR. All wiring shall be run continuously from device to device. Wiring size shall be increased as required to limit voltage drop in accordance with the lump sum method.
- C. Shielded wire shall be used as directed by the FACU manufacturer.
- D. All wiring shall be installed in metal raceway.

2.6 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be two-wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in low-profile twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
- B. Photoelectric Smoke Detectors:
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

2.7 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detection: Actuated by temperature that exceeds a fixed temperature of 135 deg F or a rate of rise detector. The temperature must be clearly printed on the detector.

- C. The detectors furnished shall have a listed spacing for coverage up to 2,500 square feet for use in environments as covered by Factory Mutual and UL (UQGS) and shall be installed according to the requirements of NFPA 72E for open area coverage.

2.8 DUCT SMOKE DETECTORS

A. General Requirements for Duct Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to Fire Alarm Control Panel.
4. Duct smoke detectors shall meet the requirements for photoelectric light scattering type detectors. Duct smoke detectors shall be UL listed for installation in air duct sampling housings for the detection of smoke in HVAC system ducts.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual Indicating Light: LED type indicating detector has operated and power-on status.

2.9 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Speakers: The operation of any automatic fire detector, sprinkler waterflow device or manual fire alarm box shall automatically sound an alert tone followed by voice instructions giving approved information and directions for a general or staged evacuation in accordance with the building's fire safety and evacuation plans.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall or ceiling mounted as indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

2.10 Notification Appliance Remote Power Supplies

- A. Remote power supplies shall power and supervise a minimum of 4 Class B NACs that shall be capable of synchronization on the same circuit, synchronization with notification appliance circuits on other power supplies, and synchronization with notification appliance circuits connected directly to the FACU.
- B. Remote power supplies shall have an auxiliary power output for providing remote power to fire alarm system devices other than notification appliances. Devices to be powered from auxiliary power output shall be approved by the Manufacturer and have been tested by a UL and/or FM.
- C. Remote power supplies shall be connected to FACU, supervised by and activated by a dedicated Class B notification appliance circuit or Class B connections from addressable monitor modules and addressable control relay output modules.
- D. Remote power supplies shall be supervised for loss of power, brownout, and battery trouble conditions. NACs shall be supervised for wiring faults including, opens, wire-to-wire short circuits and earth faults. Remote power supply Trouble signal(s) shall report on the FACU display. Additionally, remote power supply shall have visible indicators (LEDs) for displaying Trouble signal(s) and indicating which NAC is in Trouble at the power supply.
- E. All locations containing remote control equipment (such as a power supply extender) shall be protected with a smoke detector, in accordance with NFPA 72.

2.11 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.

3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare and submit a minimum of six (6) complete "Pre-Installation Documentation" submittal packages to the Engineer for review prior to submitting same to local officials (as required) for approval and permit. Resubmit portions or entirety of submittal to address Engineer comments prior to submitting package to local officials (as required) for approval and permit. See Part 1 "Submittals" for submittal content.
- B. Obtain Owner approval to deliver materials and begin installation once "Pre-Installation Documentation" review process is complete and necessary local approvals and permits have been secured.

3.3 GENERAL EQUIPMENT INSTALLATION

- A. Installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance with NFPA 72 and the local applicable codes.

3.4 MODULE AND REMOTE POWER SUPPLY INSTALLATION

- A. Install remote power supplies as indicated on drawings. Obtain Engineer approval for locations not previously identified (and approved) in submittal.
- B. Install addressable isolator modules as indicated on drawings. Obtain Engineer approval for locations not previously identified (and approved) in submittal.
- C. Install addressable monitor modules as indicated on drawings to supervise and monitor the status of each non-addressable device, such as conventional spot-type heat detectors. Obtain Engineer approval for locations not previously identified (and approved) in submittal.
- D. Install addressable control relay output modules as indicated on drawings. Obtain Engineer approval for locations not previously identified (and approved) in submittal.

3.5 INITIATING DEVICE INSTALLATION

- A. In general, automatic detectors shall be mounted on the structural ceiling or finished ceiling and not on the bottom or side of any type of construction or structure which extends down from the ceiling. Automatic detectors shall be installed as indicated on the plans and in conformance with all codes and Regulations and these specifications. The detectors shall be installed within five (5) feet of the location shown on the drawings to accommodate construction.
- B. Automatic detectors shall be located near points where air currents normally intersect. Detectors shall not be located in the direct path of the draft from an HVAC air supply grille, a door, window, or hallway. Detectors shall be installed a minimum of three (3) feet from an HVAC air supply diffuser, in accordance with NFPA 72.
- C. Addressable analog photoelectric smoke detectors shall be installed in areas according to the drawings. Unless otherwise shown on the drawings, detectors shall be spaced at thirty (30) foot centers, and in accordance with NFPA 72 and the manufacturer's installation instructions. Smoke detectors shall only be installed in those environments suitable for proper smoke detector operation.
- D. Addressable heat detectors shall be installed in environments appropriate for proper detection in accordance with NFPA 72 and the manufacturer's installation instructions.
- E. In un-sprinklered areas where the environment is not suitable for proper operation of addressable heat detectors, conventional spot-type heat detectors shall be furnished and installed. Conventional heat detectors shall be monitored and supervised by addressable monitor modules. Addressable monitor modules shall be installed in an area where the environmental conditions are suitable and the monitor modules' initiating circuits extended to the conventional heat detectors alarm contacts.

3.6 NOTIFICATION APPLIANCE INSTALLATION

- A. All wall-mounted combination audible/visible notification appliances shall be mounted such that that the entire strobe lens is not less than eighty (80) inches and not greater than ninety-six (96) inches above the finished floor, or six (6) inches below the finished ceiling, whichever is lower.
- B. All strobes shall be synchronized.

- C. All audible notification appliances shall sound the fire alarm emergency evacuation signal.

3.7 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Supervisory connections at valve supervisory switches.
 - 2. HVAC interface

3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.9 WIRING

- A. The wiring and raceway system for the fire alarm system shall be in accordance with the California Building Code and the California Electric Code. Device and appliance boxes shall be new and low-profile.
- B. All raceway shall be electrical metallic tubing (EMT) or rigid conduit. MC cable is not permitted.
- C. Furnish metal raceway, wiring, outlet boxes, junction boxes, cabinets, labels and similar devices necessary for the complete installation of the fire alarm system. Wiring shall be of the type as specified herein and recommended by the manufacturer and shall be installed in metal raceway throughout.
- D. Fire alarm system wiring within the building shall be installed in metal raceway with steel couplings and box connectors. Cast "LB" or "T" type connectors shall be permitted. An equipment-bonding conductor shall be provided in all flexible metallic raceways.
- E. All fire alarm system riser conduits shall be minimum 1-inch in diameter.
- F. All wiring shall be installed continuous from device to device.
- G. Terminal cabinets with hinged, lockable red covers, by Space Age Electronics, Marlboro, MA, or equal shall be provided at all junction points. All conductor splices shall be made on screw-type terminal blocks – wire nuts, butt, crimp or screw type connectors shall not be used. All terminals within a terminal cabinet shall be properly and permanently labeled. All junction box covers shall be painted red.
- H. Raceways containing conductors identified as "Fire Alarm System" conductors shall not contain other conductors, and no AC carrying conductors shall be allowed in the same raceway with the DC fire alarm detection and signaling conductors.

- I. The conductors for the notification appliance circuits shall not be installed in the same race-way as the conductors for signaling line circuits unless written certification from the manufacturer is supplied to the Engineer indicating that the inclusion of these circuits in the same raceway is acceptable and that no additional consideration is needed for these circuits.
- J. Notification appliance circuits and control equipment shall be arranged and installed so that loss of any one (1) notification appliance circuit shall not cause the loss of any other notification appliance circuit in the system.
- K. Color coding of conductors shall be approved by the Owner. Unless otherwise indicated, the color code for all fire alarm system conductors shall be as follows:
 - 1. Signaling line circuits and initiating device circuits shall be red and black. Red shall be positive and black shall be negative. (SLC/IDC)
 - 2. Audible notification appliance circuits shall be blue and white. Blue shall be positive and white shall be negative (NAC).
 - 3. Sprinkler circuits shall be red and black. Red shall be positive and black shall be negative.
 - 4. Smoke detector power circuits shall be brown and violet. Violet shall be positive and brown shall be negative.
 - 5. Auxiliary remote power supply circuits shall be brown and violet. Violet shall be positive and brown shall be negative.
 - 6. HVAC shut-down circuits shall be orange and yellow.
 - 7. Remote annunciator circuits shall be violet and numbered at each end.
 - 8. AC supply circuit to the main FACU shall be white, black and red. The black shall be one phase, and the red shall be the opposite phase, if required. The white shall be the neutral. If a separate feed is required for the battery charger, it shall be black and white unless the main FACU requires only one AC feed. In that case, the conductors to the battery charger shall be red and white.
- L. Exposed raceways shall be run parallel and perpendicular to the walls and ceilings. Wherever practical, exposed raceways shall be run on the ceiling as close as possible to a wall or as high as possible on a wall. Where exposed raceways shall cross under a structural beam or rib, they shall be run down on one side of the beam or rib, across its bottom, and up to the ceiling on the other side of the beam or rib. No spanning from beam to beam or rib to rib shall be permitted. The use of a raceway body on one side of a beam or rib shall be permitted provided it shall be readily accessible.
- M. Fault isolator modules shall be furnished as required and shall be mounted as directed by the manufacturer. The field location of the fault circuit isolators shall be labeled so that the devices may be easily located, and that location shall be noted on the point-to-point and as-built drawings.
- N. All wiring within the control unit shall be neatly served in the panel gutters and be secured by means of Thomas & Betts "Ty-Raps" or by other approved means.

3.10 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.11 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction and Engineer.
- B. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.12 AUTHORITY HAVING JURISDICTION FINAL ACCEPTANCE

- A. Prepare and submit a minimum of six (6) complete "Final Acceptance Documentation" submittal packages to the Engineer for review prior to submitting same to local officials for final system approval. Resubmit portions or entirety of submittal to address Engineer comments prior to submitting package to local officials. See Part 1 "Submittals" for submittal content.
- B. Submit reviewed "Final Acceptance Documentation" submittal package to authority and coordinate scheduling (minimum ten (10) business days notice) of common fire sprinkler and fire alarm system acceptance testing. If acceptable to the authority, the reviewed "Approval

Documentation” submittal may be submitted to the authority at the time of the final acceptance tests.

- C. Demonstrate system components to authority having jurisdiction as necessary.
- D. Reschedule testing where unsatisfactory results cannot be resolved such that testing can be completed to the satisfaction of the authorities. See Owner “General Agreement” for possible additional costs and penalties.
- E. Upon satisfactory completion of the tests, leave the fire alarm system in proper working order.

3.13 PROJECT CLOSEOUT PROCEDURES

- A. Prepare and submit a minimum of six (6) closeout documentation packages to the Engineer for review prior to scheduling Owner demonstration and training. Resubmit portions or entirety of submittal to address Engineer comments prior to scheduling demonstration and training. See Part 1 “Submittals” for submittal content.
- B. Schedule Owner demonstration and training with the Owner for each building. Provide at least five (5) working days notice.
- C. Demonstrate equipment, specialties, and accessories with the Owner. Review operating and maintenance information with the Owner.
 - 1. Electrician & Building Manager: Prior to final acceptance of the fire alarm system, provide operation training to each shift of the Owner's designated Building Manager. Each training session shall be a minimum of 1 hour and shall be conducted on shift or at a time acceptable to the Owner. Each session shall include an overview of the system and the devices connected to it, emergency procedures (including alarm, trouble and supervisory condition procedures), control panel operation, and safety requirements. Each session shall include a complete demonstration of the system.
 - 2. The manufacturer's technical representative shall also be required to instruct designated building and management personnel in the general operation of the system and to give the designated personnel an overview of the system functions when the system is in normal, supervisory mode, alarm mode, and trouble mode, as specified in this specification.

END OF SECTION 283111

SECTION 312000
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Specifications for the excavation, filling, recompacting, grading and disposal of excess material as approved by the Geotechnical Engineer.
- B. Excavated soil and land clearing debris to be 100% reused or recycled
- C. Related Sections
 - 1. Section 312324, "Trench Excavation and Backfill"

1.2 REFERENCED STANDARDS

- A. ASTM International
 - 1. ASTM C136-84a: Standard Method for Sieve Analysis of Fine and Coarse Aggregate
 - 2. ASTM D1557: Laboratory Compaction Characteristics of Soil Using Modified Effort
 - 3. ASTM D2922: Density of Soil and Soil-Aggregate in Place by Nuclear Methods
- B. Caltrans – State of California Standard Specifications; latest edition
- C. Geotechnical Investigation and Geologic Hazards Evaluation Laney College Library Learning Resource Center report prepared by Fugro dated February 28,2020
- D. DMM Design and Recommendations report prepared by Fugro dated June 22,2022

1.3 DEFINITIONS

- A. Compaction
 - 1. The degree of compaction is specified as percent compaction. Maximum densities refer to the maximum laboratory dry soil densities obtainable at optimum moisture content as determined by ASTM D1557.
 - 2. Percent compaction (relative compaction) is the ratio of the measured field dry density to the laboratory maximum dry density.
- B. Excavation Slope: Excavation slope shall be defined as an inclined surface formed by removing material from below existing grade.

1.4 SUBMITTALS

- A. Product Data
 - 1. Fill materials
 - 2. Source of recycle facility
- B. Test Reports
 - 1. Gradation (ASTM C136)
 - 2. Density-In-Place (ASTM D2922)

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. General:
 - 1. Fill material will be subject to approval of the Geotechnical Engineer.

2. For approval of imported fill material, notify the District's Representative at least 7 days in advance of intention to import material, designated proposed borrow area, and permit the Geotechnical Engineer to sample as necessary from borrow area for purpose of making acceptance tests to prove quality of material.
 3. The Geotechnical Engineer's report on acceptability shall be final and binding.
 4. During grading operations, soil types other than those analyzed in the geotechnical report for the project, may be encountered.
 5. Consult the Geotechnical Engineer to determine the suitability of these soils.
 6. Onsite soils (except Young Bay Mud) and fills can be used as new fills, with geotechnical approval.
- B. Engineered Fill Material:
1. New fills placed at the site shall consist of engineered fills that meet the requirements listed in the geotechnical report, except for landscaping materials which are placed on level ground.
 2. All engineered fills shall have an organic content of less than 3% by volume and shall not contain rocks or lumps larger than 4-inches in greatest dimension with not more than 15% larger than 2.5 inches.
 3. Onsite soils (native, except for Young Bay Mud) and fills may be used as new fills as approved by the geotechnical Engineer.
 4. Imported fills not used as non-expansive fill shall be predominantly granular, have a liquid limit less than 40%, and have a plasticity index not exceeding 20.
 5. Imported, non-expansive fills shall consist of sub-angular to angular particles, have a plasticity index not exceeding 12, and have a significant fine content.
 6. All imported fill shall not contain environmental contaminants or debris and shall be non-corrosive.
7. Native Fill Requirements:
1. Approved native materials shall have a particle size not exceeding 4 inches as determined by ASTM D422 with not more than 15 percent larger than 2.5 inches, at least 90 percent by weight passing the 1 inch sieve and less than 3 percent organic content by volume.
8. Per Section 321123 Aggregate Base and as indicated in plans.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. Surplus Material: Unless otherwise specified, surplus excavated material shall be disposed of off-site in accordance with applicable ordinances and environment requirements at the expense of the Contractor.
- B. Hauling
1. When hauling is down over highways or city streets, loads shall be trimmed and the vehicle shelf areas shall be cleaned after each loading.
 2. Loads shall be watered after trimming to eliminate dust.
- C. Subgrade:
1. Unless directed otherwise on the drawings, soil subgrades in areas to receive engineered fill, slabs-on-grade, or pavements shall be scarified to a depth of at least 12 inches, moisture conditioned to approximately 3 percent above optimum water content and compacted to the requirements for engineered fills.
 2. Locally weak fills and soils shall be excavated and replaced, or otherwise stabilized as recommended by the Geotechnical Engineer at the time of earthwork operations.
 3. The prepared subgrade surface shall be firm, unyielding, and kept moist during construction.
 4. The subgrade shall be protected from damage caused by weather and construction traffic. If the subgrades are left exposed to weather for extended periods of time or are disturbed by construction traffic, the Geotechnical Engineer shall be consulted for subgrade moisture

reconditioning and/or scarifying and recompacting to eliminate shrinkage cracks and disturbances.

- D. Fill Placement and Compaction:
1. Within the upper 5-feet of the finished ground surface, engineered fills shall be compacted to at least 90% relative compaction, as determined by ASTM D1557.
 2. Engineered fills below a depth of 5-feet shall be compacted to at least 95% relative compaction.
 3. The upper 6-inches of subgrade soils beneath pavements shall be compacted to at least 95% relative compaction.
 4. Fill material shall be spread and compacted in lifts not exceeding approximately 8-inches in uncompacted thickness.
 5. Engineered fills shall be moisture conditioned to approximately 3 percent above optimum water content. To achieve satisfactory compaction of fill materials, it may be necessary to adjust the water content at the time of earthwork operations. This may require that water be added to soils that are too dry, or that aeration be performed in any soils that are too wet. To achieve satisfactory compaction of on-site excavated soils from near or below the existing groundwater level will require drying at the time of construction.
- E. Finish Grading
1. Finish surfaces shall be smooth, compacted and free from irregularities. The degree of finish shall be that normally obtainable with a blade-grader.
 2. Finish grades shall be as specified on the plans, except where a local change in elevation is required to match existing conditions, or to ensure proper drainage.
 3. When the work is at an intermediate stage of completion, lines and grades shall be as specified within 0.1 foot or as necessary to provide adequate drainage.

3.2 FIELD QUALITY CONTROL

- A. Fill material shall be placed in horizontal layers and compacted with power tampers, rollers, idlers, or vibratory equipment. Within the upper 5 feet of the finished ground surface, engineered fills shall be compacted to at least 90% relative compaction, as determined by ASTM D1557, or as approved by the Geotechnical Engineer. The upper 6 inches of subgrade soils below pavements shall be compacted to 95% relative compaction or as indicated in the plans. Fill material shall be spread and compacted in lifts not exceeding 8-inches in uncompacted thickness.

3.3 TESTS

- A. Inspection Trenches
1. Owner will direct Contractor to construct inspection trenches in compacted or consolidated backfill to determine that Contractor has complied with these Specifications.

END OF SECTION

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SECTION 312319
DE-WATERING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Specifications and procedure for the de-watering of excavations and disposal of water.

1.2 SUBMITTALS

- A. Prior to installation of the de-watering system, submit shop drawings and design data indicating the following:
 - 1. The proposed type of de-watering system
 - 2. Arrangement, location and depths of system components
 - 3. Complete description of equipment and instrumentation to be used, with installation, operation and maintenance procedures
 - 4. Methods of disposal of pumped water
 - 5. Necessary permits for water disposal

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Furnish all materials, tools, equipment, facilities, and services as required for providing the necessary de-watering work and facilities.
- B. Provide backup equipment as necessary for the replacement and for unanticipated emergencies.

PART 3 - EXECUTION

3.1 DE-WATERING

- A. Keep excavation reasonably free from water during construction.
- B. Disposal of water shall not damage property or create a public nuisance.
- C. Have on hand pump equipment and machinery in good working condition for emergencies and workmen available for its operation.
- D. De-watering systems shall operate continuously until trenches are backfilled.
- E. Groundwater shall be controlled to prevent softening of the bottom of excavations, or formation of "quick" conditions.
- F. De-watering systems shall not remove natural soils.
- G. Control surface runoff to prevent entry or collection of water excavations.
- H. Release of groundwater shall be controlled to prevent disturbance of the natural foundation soils or compact fill.
- I. There shall be no discharge of turbid or hazardous water on site.
- J. Discharge or disposal of water shall be controlled to prevent erosion.

END OF SECTION

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SECTION 312324
TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Perform all excavation, shoring, dewatering, backfilling, compaction, pavement restoration, and grading necessary or required for the construction of the work as covered by these Specifications, Geotechnical Report, and indicated in the Drawings. The excavation shall include, without classification, the removal and disposal of all materials of whatever nature encountered, including water and all other obstructions that would interfere with the proper construction and completion of the required work.
- B. Related Sections
 - 1. Section 321123, "Aggregate Base"
 - 2. Section 321216, "Asphaltic Concrete Paving"
 - 3. Section 312319 "De-Watering"
 - 4. Section 331000 "Water Utilities"
 - 5. Section 333300 "Site Sanitary Sewerage System"
 - 6. Section 334000 "Storm Drainage System"

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM).
- B. State of California, Department of Transportation, Standard Specifications (Standard Specifications) July 1992.
- C. State of California, Department of Transportation, Manual of Test (California Test).

1.3 SUBMITTALS

- A. Submit the following:
 - 1. Sheeting and Shoring Plan: Refer to Paragraph 1.05 below.
 - 2. Potholing Report as described in Paragraph 3.02.
 - 3. Samples and Test Results: Furnish, without additional cost to the Owner, such quantities of import materials as may be required by the Owner's Representative for test purposes. Cooperate with the Owner's Representative and furnish necessary facilities for sampling and testing of all materials and workmanship. Submit test results for import materials. Tests shall have been performed within 60 days of submission. All material furnished and all work performed shall be subject to rigid inspection, and no material shall be delivered to the site until it has been favorably reviewed by the Owner's Representative, or used in the construction work until it has been inspected in the field by Inspector of Record.

1.4 QUALITY ASSURANCE

- A. Source Quality Control: Test import materials proposed for use to demonstrate that the materials conform to the specified requirements. Tests shall be performed by an independent testing laboratory.
- B. Field Quality Control:
 - 1. The Owner will:
 - a. Review and test materials proposed for use.
 - b. Inspect placement and compaction of fill.
 - c. Test soils during placement of fill.
 - 2. Contractor shall excavate holes for in-place soil sampling. Contractor shall be responsible for costs of additional inspection and re-resting resulting from non-compliance.

- C. Testing Methods:
 - 1. Durability Index: Manual of Test, State of California, Department of Transportation.
 - 2. Specific Gravity: ASTM D854.
 - 3. Laboratory Compaction: ASTM D1557, Method A or C.
 - 4. In-Place Density: ASTM D2922.
 - 5. Particle Size Analysis of Soils: ASTM D422.
 - 6. Plastic Limit and Plasticity Index: ASTM D4318.
 - 7. Soil Classification: ASTM D2487.
 - 8. In-Place Moisture Content: ASTM D3017.

1.5 EXCAVATION AND TRENCHING

- A. General Protection: Pursuant to Labor Code Sections 6705 and 6707, Contractor shall include in its base bid all costs incident to the provision of adequate sheeting, shoring, bracing or equivalent method for the protection of life and limb which shall conform to the applicable Federal and State Safety Orders.
- B. Before beginning any excavation five (5) feet or more in depth, submit to the Owner's Representative a detailed plan showing the design of shoring, bracing, sloping or other provisions to be made for worker protection from the hazard of caving ground during excavations. Comply with the Standards established by the State of California Construction Safety Orders Title 24 of the California Administrative Code. If the detailed plan varies from such shoring system Standards it shall be prepared by a registered civil or structural engineer whose name and registration number shall be indicated on the Drawing. If a dispute arises as to whether the plan must be prepared by a registered civil or structural engineer, the Owner's Representative's determination of the matter shall be final and conclusive. The cost of required engineering services shall be borne by the Contractor and shall be deemed to have been included in the amount of bid for the work as stated in the Agreement.
- C. Neither the review nor approval of any plan showing design of shoring, bracing, sloping or other provisions for worker protection shall relieve Contractor from his obligations to comply with Construction Safety order Standards and Title 24 CAC for design and construction of such protective work, and Contractor shall indemnify Owner and Owner's Representative from any and all claims, liability, costs, actions and a cause of action arising out of or related to the failure of such protective system. The Contractor shall defend the Owner, its officers, employees and agents and the Owner's Representative in any litigation or proceeding brought with respect to the failure of such protective systems.
- D. The Contractor shall comply with Section 382 of the Civil Code of the State of California relating to lateral, general and sub-adjacent supports wherever structures or improvements adjacent to an excavation may be damaged by such excavation.
- E. Contractors must still comply with the State of California Construction Safety Orders, Article 6 – Excavations, Trenches, Earthwork. The requirements of Article 6 apply whether the excavation, trench or earthwork is less than 5', or 5' or more.
- F. The Contractor shall select, install and maintain shoring, sheeting, bracing, and sloping as necessary to maintain safe excavations. The Contractor shall be responsible for ensuring such measures: (1) comply fully with 29 CFR Part 1926 OSHA Subpart P Excavations and Trenches requirements, (2) provide necessary support to the sides of excavations, (3) provide safe access to the Engineer's sampling and testing within the excavation, (4) provide safe access for backfill, compaction, and compaction testings, and (5) otherwise maintain excavations in a safe manner that shall not endanger property, life, health, or the project schedule. All earthwork shall be performed in strict accordance with applicable law, including local ordinances, applicable OSHA, CalOSHA, California Civil Code, and California Department of Industrial Safety requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Crushed Rock: ¾-inch maximum crushed virgin drain rock with a minimum durability rating of 58.
- B. Import Backfill: Class 2, ¾-inch maximum aggregate base, Standard Specifications Section 26. Paragraphs 26-1.06 and 26-1.07 are not applicable.
- C. Light Weight Backfill: Naturally-occurring volcanic rock with a maximum unit weight of 65 pounds per cubic foot, minimum Durability Index of 35 (California Test 229), minimum R-Value of 50 (California Test 301), wrapped in geotextile fabric, with the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
1-1/2 inch	100
1 inch	95 to 100
¾ inch	90 to 100
3/8 inch	15 to 85
No. 4	0 to 9

- D. Geotextile Fabric: Mirafi FW300 or equivalent
- E. Water: The water used shall be potable and free of objectionable quantities of silt, oil, organic matter, alkali, salts and other impurities. Water quality must be acceptable to the Owner's Representative.
- F. Sandy Clay Loam: Provide sandy clay loam backfill in the top 18 inches in unpaved areas, 85% compaction.
 - 1. Sandy Clay Loam Analysis: Submit a sample of sandy clay loam proposed for use to an accredited Soils Laboratory for "agricultural suitability" analysis report, including particle size, and evaluation of physical and chemical properties of soil and recommendations for adding amendments and fertilizers to the soil.
 - 2. Upon approval of the Laboratory's report by the Owner's Representative, the recommendations in the report shall become a part of the Specifications and the quantities of soil amendment, fertilizer and other additives shall be adjusted to conform with the report at no additional cost to the Owner. Request Testing Laboratory to send one copy of test results directly to Owner's Representative.
 - 3. Test Laboratory: Soil and Plant Laboratory, Inc. 352 Matthew Street (PO Box 153), Santa Clara, CA 95052, Tel. (408) 727-0330; or Root Zone Associates, PO Box 18911, San Jose, CA 95118, Tel. (408) 264-7024.
- G. Controlled Density Fill (CDF):
 - 1. Materials:
 - a. Cement: ASTM C150, Type II or V. A maximum of twenty (20) lbs. of cement per cubic yard.
 - b. Aggregate shall consist of fine aggregate, with our without coarse aggregate, with a maximum size of 1-inch, free of clay, organics, and other deleterious materials. Less than 10 percent by weight shall pass the No. 200 sieve, and materials passing the No. 40 sieve shall be nonplastic as determined in accordance with ASTM D4318.
 - c. Water: Potable.
 - d. Fly Ash: ASTM C618, Class F unless otherwise approved.
 - 2. Mix Design:
 - a. Performance Requirements: The CDF shall be proportioned to be a non-segregating, free flowing, self-consolidating, low shrink slurry.
 - b. Mix Design Requirements: The Contractor and its supplier shall determine the materials and proportions used to meet the requirements of these Specifications. Design the mixes far enough ahead of placement to allow completion of trail mix testing and submittal of test results. The mix design(s) shall be prepared for the range of aggregate gradations that is expected to be used. The Contractor shall make daily checks of the aggregate gradation and adjust the mix design as required to meet these Specifications.
 - c. Material Strength Requirements: The unconfirmed compressive strength at 28 days

shall be 100 psi as per ASTM D4832.

- H. Concrete: Concrete encasement used for conduit backfill shall be rated 4000 psi at 28 days and shall have red dye additive. Submit mix design for approval.
- I. Trench Plugs: Clayey soils as approved by the Geotechnical Engineer

PART 3 - EXECUTION

3.1 CONTROL OF WATER

- A. All excavations shall be kept free from water and all construction shall be in the dry.
 - 1. It should be presumed that the presence of groundwater will require dewatering operations. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering all excavations. At all times have on the project sufficient pumping equipment for immediate use, including standby pumps for use in case other pumps become inoperable.
 - 2. Provide a sufficient number of pumps so as to hold the groundwater level at an elevation of not less than 1 foot below the lowest elevation of the pipe, duct or other material to be placed.
 - 3. Dispose of water in such a manner as to cause no injury or nuisance to public or private property, or be a menace to the public health.
 - 4. The dewatering operation shall be continuous, so that the excavated areas shall be kept free from water during construction, while concrete is setting and achieves full strength, and until backfill has been placed to a sufficient height to anchor the work against possible flotation.
 - 5. Continue dewatering during backfilling operations such that the groundwater is at least 1 foot below the level of the compaction effort at all times. No compaction of saturated materials will be allowed.
 - 6. Dewatering devices must be adequately filtered to prevent the removal of fines from the soil.
 - 7. The Contractor shall be responsible for any damage to the foundations or any other parts of existing structures or of the new work caused by failure of any part of the Contractor's protective works. After temporary protective works are no longer needed for dewatering purposes, they shall be removed by the Contractor.
 - 8. If pumping is required on a 24-hour basis, requiring engine drives, then engines shall be equipped in a manner to keep noise to a minimum.
 - 9. Prevent disposal of sediments from the soils to adjacent lands or waterways by employing whatever methods are necessary, including settling basins and holding tanks for disposal off site
- B. The Contractor shall be responsible for furnishing temporary drainage facilities to convey and dispose of surface water falling on or passing over the site.

3.2 EXISTING UTILITIES

- A. General: The known existing buried utilities and pipelines except building connections are shown on the Drawings in their approximate location. The Contractor shall exercise care in avoiding damage to all utilities, as they will be held responsible for their repair if damaged. There is no guarantee that all utilities or obstructions are shown, or that locations indicated are accurate. Utilities are piping, conduits, wire, cable, ducts, manholes, pull boxes and the like.
- B. Check on Locations (Potholing):
 - 1. The Owner performed a limited investigation and has recorded those findings on the Contract Documents. The Contractor shall be responsible for all additional potholing to verify location of existing utilities as needed to complete the work indicated in the Contract Documents.
 - 2. The Contractor shall clearly paint the location of all affected utility underground pipes, conduits and other utilities on the pavement or identify the location with suitable markers if not on pavement. In addition to the location of metallic pipes and conduits, non-metallic

pipe, ducts and conduits shall also be similarly located using surface indicators and detection tape if present and shall then be similarly marked.

3. After the utility survey is completed, commence "potholing" to determine the actual location and elevation of all utilities where crossings, interferences, or connections to the new pipelines are shown on the Drawings, or indicated by surface signs. Prior to the preparation of piping shop drawings, or the excavating for any new pipelines or structures, the Contractor shall locate and uncover these existing utilities to a point 1-foot below the utility. Submit a report identifying each underground utility and its depth and station. Any variation in the actual elevations and the indicated elevations shall be brought to the Owner's Representative's attention.
 4. Excavations around underground electrical ducts and conduits shall be performed using extreme caution to prevent injury to workmen or damage to electrical ducts or conduits. Similar precautions shall be exercised around gas lines, telephone and television cables. Contractor shall be responsible for all coordination with the applicable utility agencies for work in and around existing utility mains.
 5. Excavations shall have surface dimensions of no more than 18" x 18". Air spades and vacuum excavators shall be used to limit the size of excavations and damage to adjacent facilities. Backfill after completing potholing. In existing streets, repave with project typical pavement section or match existing pavement section, whichever is greater.
- C. Interferences:
1. If interferences occur at locations other than shown on the Drawings, the Contractor shall notify the Owner's Representative, and a method for correcting said interferences shall be supplied by the Owner's Representative. Payment for interferences that are not shown on the plans, nor which may be inferred from surface indications, shall be in accordance with the provisions of the General Conditions. If the Contractor does not expose all required utilities prior to shop drawing preparation, he shall not be entitled to additional compensation for work necessary to avoid interferences, nor for repair to damaged utilities.
 2. Any necessary relocations of utilities, whether shown on the Drawings or not, shall be coordinated with the Owner if instructed to do so in writing from the Owner's Representative.
- D. Overhead Facilities: There may be existing overhead electric and telephone transmission lines on the site. These overhead utilities are not shown on the Drawings. Extreme caution shall be used when working in the vicinity of overhead utilities so as to prevent injury to workmen or damage to the utilities. The Contractor shall be required to comply with the applicable provisions of the California Construction Safety Orders when working anywhere on this project.
- E. Existing gas, water, sewer and communications laterals are not specifically shown on the Drawings but do exist along the existing utility corridors. Protect all service laterals from damage due to construction operations. If any laterals are damaged, notify the Owner's Representative immediately. The cost of repair shall be borne by the Contractor.

3.3 GENERAL CONSTRUCTION REQUIREMENTS

- A. Site Access: Access to the site will be over public and private roads. Exercise care in the use of such roads and repair at the Contractor's expense any damage thereto caused by Contractor's operations. Such repair shall be to the satisfaction of the Owner or agency having jurisdiction over the road. Take whatever means are necessary to prevent tracking of mud onto existing roads and keep roads free of debris. Contractor shall provide access plan for all phases of work for approval by Owner's Representative prior to trenching operations.
- B. Traffic Regulation: Provide such flagmen, lighted barricades, flares, lights, warning signs, and safety devices as may be required for control of traffic adjacent to all areas of work. A minimum of one 12-foot-wide lane of traffic shall be kept open at all times.
- C. Open Excavations: Provide chain link fence around all excavations left open during non-working hours in unpaved areas. In all paved areas (walkways and fire lanes) excavations left open during non-working hours shall be covered with steel plates.
- D. Access: Free access must be maintained to all fire hydrants, water valves and meters, and

- driveways.
- E. Open Trench Limitations: The Owner's Representative shall have the authority to limit the amount of trench to be opened or left open at any one time. In roads, excavation and pipe laying shall be coordinated to the end that a minimum of interference with public traffic will result. Trenches in streets and pathways shall be covered with trench plates at the end of each day. An open trench in existing streets shall be defined as any trench that has not been completely backfilled, satisfactorily compacted, and capped with the permanent pavement.
 - F. Demolition of Pavement: Where trenching or excavation occurs in paved areas, the pavement shall be scored and broken ahead of the trenching or excavation operation. The extent of paving removed shall be limited to the minimum necessary for the excavation. The final trench repair shall have sawcut edges.
 - G. Dust Control: Take proper and efficient steps to control dust.

3.4 TRENCH EXCAVATION

- A. There is no room on site for storing excavated material. All excavated material shall be disposed of off campus. All backfill material shall be imported.
- B. Excavation to the extent shown on the drawings and under the drip line of trees shall be hand excavated to a level below the root zone of the trees – **NO EXCEPTIONS**.
- C. Excavation for pipe and duct shall be in open cut. The trench shall be as wide as necessary for sheeting and bracing and the proper performance of the work up to the maximum width permitted by the typical cross-sections shown on the Drawings. The sides of the trenches shall be vertical in existing streets. The bottom of the trench shall be constructed to the grades and shapes indicated on the Drawings. Should the Contractor desire to use other equivalent methods, he shall submit his method of construction to the Owner's Representative for favorable review prior to its use.
- D. Take care not to overexcavate. Accurately grade the bottom of the trenches to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints, and as hereinafter specified. Dig bell holes and depressions for joints after the trench bottom has been graded, and, in order that the pipe rest on the bedding for as nearly its full length as practicable, bell holes and depressions shall be only of such length, depth and width as required for properly making the joint. Remove stones as necessary to avoid point bearing.
- E. Backfill and compact overexcavations to 95% of its maximum dry density with Class II Aggregate Base material. Provide filter fabric (Mirafi, or equal) above, below, and on both sides of aggregate base as directed by the Owner's Representative. There shall be no additional payment to the Contractor for overexcavations not directed by the Owner's Representative. Remove unsatisfactory material encountered below the grades shown as directed by the Owner's Representative and replace as directed. Payment for removal and replacement of such unsatisfactory material directed by the Owner's Representative shall be made in accordance with the provisions of the General Conditions.
- F. Grade trenches so that they are uniformly sloped between the pipe elevations shown on the Drawings. Comply with the minimum and maximum trench widths shown on the Drawings. Notify the Owner's Representative if the trench width exceeds the maximum allowable width for any reason.
- G. For all piping or conduits to be placed in any excavated and backfilled area, such as at manholes or for building connections, the structural backfill shall be first compacted to a level at least 3 feet above the top of the piping or conduit elevation and then retrenched to pipe grade.
- H. Provide ladders for access to the trench by construction and inspection personnel.

3.5 SAFETY BARRICADES AND LIGHTS

- A. Where required for protection of workmen, public safety, or as required by State Laws, substantial barricades shall be provided for the areas where excavation, trenching, construction and demolition work are being performed. Safety Barricades shall not be used in lieu of

required guardrails on temporary bridges crossing trenches, excavations or other openings. For protection of the *Visually Impaired*, safety barricades shall be joined together with 3" yellow *Caution* tape as follows:

1. Two strands of caution tape running continuous from barricade to barricade, one at the tops of the barricades and one at a height of from 4" to 12" above grade or mounting level.
2. In addition battery-operated warning lights shall be maintained on such barricades, whenever visibility is restricted, and at night.

3.6 BACKFILL AND COMPACTION

- A. Place bedding and backfill materials true to the lines, grades, and cross-sections indicated on the Drawings and compacted to the degree specified on the Drawings. Place bedding and backfill materials in horizontal lifts not to exceed 8 inches in thickness measured before compaction. The difference in level on either side of a pipe or duct shall not exceed 4 inches.
- B. Backfill material shall not be placed over the pipe or duct until after it has been inspected by the Owner's Representative.
- C. It shall be incumbent upon the Contractor to protect the pipe or duct from damage during the construction period. It shall be the Contractor's responsibility to repair broken or damaged pipe or duct at no extra cost to the Owner. Tamping of backfill over the pipe shall be done with tampers, vibratory rollers and other machines that will not injure or disturb the pipe or duct. Carefully place backfill around and over the pipe or duct.
- D. Do not allow construction traffic nor highway traffic over the pipe trench until the trench backfill has been brought back even with existing adjacent grade.
- E. Add water to the backfill material or dry the material as necessary to obtain the optimum moisture content for the compaction shown on the Drawings or specified. If the Owner's Representative determines that the nature of the ground in which the trench lies precludes compaction of the backfill to the specified density, the backfill shall be compacted to the maximum practicable density. Employ such means as may be necessary to secure a uniform moisture content throughout the material of each layer being compacted. After the material has been moisture conditioned, compact it with compaction equipment approved by the Owner's Representative to achieve specified compaction. The Contractor shall be responsible for obtaining the densities specified. Should the Contractor fail, through negligence or otherwise, to compact to specified density, or to backfill and compact to surface grade, thus permitting saturation of the backfill material from rains or from any other source, the faulty material shall be removed and replaced with approved material which shall be compacted to the specified density at optimum moisture content, and no additional payment will be made for doing such work or removal and replacement.
- F. Compaction by flooding, ponding or jetting will not be permitted.

3.7 CONTROLLED DENSITY FILL (CDF)

- A. Trench Backfill:
 1. Contractor can choose to backfill trench with CDF in place of Class II Aggregate Base. (See trench sections on drawings.)
 2. CDF shall be placed into the trench so that the CDF is placed evenly to prevent uneven loading of the pipe. CDF shall not be placed directly onto the pipe. The maximum depth of the first lift of CDF shall not allow the pipe to move or float. Subsequent lifts of CDF shall be placed so that that pipe does not shift or float. CDF placed in trenches with steep slopes shall be placed in lifts to prevent flotation of the pipe, and the Contractor shall install approved sand bags as needed to secure the pipe in place during placement of the CDF.
 3. The maximum temperature of the CDF shall be 74°F at the time of placement. The minimum temperature of the CDF shall be 40°F at the time of placement. CDF shall be placed in lifts not exceeding 6 inches. Each lift shall be allowed to cure long enough to lose its fluid properties before placing the next lift.

3.8 SUPPORT OF EXCAVATIONS

- A. Adequately support excavation for trenches and structures to meet all applicable requirements in the current rules, orders and regulations. Excavation shall be adequately shored, braced and sheeted so that the earth will not slide or settle and so that all existing structures and all new pipe and structures will be fully protected from damage. Keep vehicles, equipment and materials far enough from the excavation to prevent instability.
- B. Take all necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, or sliding soil resulting from the high groundwater table and the nature of the soil excavated. Attention is directed to Section 832 of the Civil Code of the State of California relating to lateral and subjacent supports, and wherever structures or improvements adjacent to the excavation may be damaged by such excavation, the Contractor shall comply with this law.
- C. The support for excavation shall remain in place until the pipeline, duct or structure has been completed. During the backfilling of the pipeline or structure, the shoring, sheeting and bracing shall be carefully removed so that there shall be no voids created and no caving, lateral movement or flowing of the subsoils.

3.9 FINISH GRADING

- A. Except where shown otherwise in the Drawings, restore the finish grade to the original contours and to the original drainage patterns. Grade surfaces to drain away from structures. The finished surfaces shall be smooth and compacted.

3.10 DISPOSAL OF EXCAVATED MATERIAL

- A. Dispose of all excavated material offsite in a legal manner.

END OF SECTION

SECTION 312513
EROSION CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Slope protection, erosion control, and rip rap placement shall consist of furnishing all labor, materials, tools, equipment, and maintaining all permanent and temporary erosion control features as indicated for the purpose of preventing on-site erosion and maintaining all sediments within the project boundaries and comply with the requirements of the District.

1.2 SCHEDULING

- A. Apply erosion control features within five days after completion of all other work in each area.
- B. Apply erosion control features as necessary for wet weather conditions and as directed by District.

1.3 REPLACEMENT

- A. Any area in excess of 100 square feet of dead or damaged erosion control material shall be replaced.
- B. The replaced erosion control shall be of the same formulation and quality as the original.

2 PRODUCTS

2.1 EROSION CONTROL BLANKETS

- A. Erosion control blankets shall be North American Green single net straw blanket, Western Excelsior excel SR-1, or equivalent.

2.2 FIBER ROLLS

- A. Fiber rolls shall be netted tubes, at least 12 inches in diameter, filled with straw or equivalent biodegradable product. Installation shall be in accordance with "Erosion and Sediment Control Field Manual" (latest edition) by the California Regional Water Quality Control Board, San Francisco Bay Region.

2.3 SILT FENCE

- A. Silt fence shall be per "Erosion and Sediment Control Field Manual" (latest edition) by the California Regional Water Quality Control Board, San Francisco Bay Region.

2.4 RIP RAP

- A. Rip rap shall conform to the weight requirement of Caltrans Section 72 for light rip rap.
- B. Geotextile fabric shall be Mirafi 600X Filter Fabric or equivalent.

C. Placing

1. The Contractor shall place a geotextile stabilization fabric over the areas to receive rip rap. Fabric edges shall overlap at least one and one-half feet.
2. Rip rap shall be placed to the line, grade and depth shown on the plans. Rip rap shall be placed in such a fashion (Caltrans Method A Placement) as not to puncture or tear the underlying fabric. The contractor shall replace torn sections of fabric with a piece of the same fabric. Fabric overlap in these areas shall be at least three feet.
3. Rip rap shall be placed in such a manner that the material does not segregate itself into areas of larger and smaller rip rap.

2.5 ROCK FILTER AND GRAVEL CONSTRUCTION ENTRANCE

- A. Rock to be used for the rock filters gravel construction entrance and for the protection of the construction entrance shall consist of Class 1, Type B Drain Rock conforming to Caltrans Section 13.7.03B Materials, unless otherwise noted.

2.6 EQUIPMENT, MATERIALS, AND FACILITIES

- A. Furnish all materials, tools, equipment, facilities, and services as required for providing the necessary erosion controls.

3 EXECUTION

3.1 APPLICATION

- A. Erosion Control Blankets: Shall be installed and staked according to manufacturer's recommendations for slopes.
- B. Silt Fences: Install to intercept and detain sediment prior to entering storm drainage.
- C. As erosion control measures near capacity for silt retention, the Contractor shall remove the silt materials. The Contractor shall remove the materials from the site or to an area that is designated by the Owner. The Contractor shall then reestablish the silt fences, fiber rolls, straw bales, or rip rap to its original state.

3.2 INSPECTION

- A. Silt fences, fiber rolls, and rip rap shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately, to the satisfaction of the Owner.

END OF SECTION

SECTION 31 32 13

DEEP MIXING METHOD (DMM) GROUND IMPROVEMENT

PART 1 - GENERAL

1.1 SCOPE

- A. The Deep Mixing Method (DMM) Contractor shall furnish all plant, equipment, labor, and materials required to construct and perform Quality Control of the DMM in accordance with the DMM Design Plans and Specifications.
- B. The purpose of DMM ground improvement is to reduce seismically induced slope displacements and settlements to acceptable levels and to provide vertical and lateral support for shallow foundation systems for the Laney College Library & Learning Resource Center (LLRC) building for both static and seismic loadings. The DMM ground improvement consists of continuous underground overlapping deep mixed (DM) columns forming a series of DM walls that are arranged in a grid pattern to form a series of DM walls and blocks. The dimensions and layout of DM grids and blocks are shown on the DMM Design Plans and are described in Section 3.2 of this Specification.
- C. This specification has been developed as a combination of performance and method specifications. The intent is that the DMM Contractor will select the means and methods for satisfying the acceptance criteria. The DMM Contractor will then demonstrate that the means and methods will satisfy the acceptance criteria using one or more test sections. Once the test section indicates satisfactory results, as determined by the Geotechnical Engineer, the DMM Contractor will follow the means and methods used to satisfy the acceptance criteria for all of the production DMM construction. If the DMM Contractor desires to change the means and methods during the course of production DMM, the changes need to first be approved by the Geotechnical Engineer and CGS. The Geotechnical Engineer may require additional test sections prior to approval of changes in means and methods.
- D. The DMM Contractor shall be responsible for performing Quality Control (QC) during DMM construction, which includes QC documentation preparation and submittal, and sample collection, storage, and transportation. Sample testing shall be performed by a DSA approved testing laboratory hired by the Owner to verify that the acceptance criteria are satisfied. The Geotechnical Engineer shall make the determination as to whether the acceptance criteria have been met.
- E. Upon completion of DMM installation, an as-built submittal package shall be prepared by the DMM Contractor and the Geotechnical Engineer to document that the installed DMM meets the project performance requirements. The as-built submittal package shall be submitted to CGS for approval. The submittal shall include test section results, daily quality control reports, DMM core and lab test results, as-built DMM record drawings, and any other information needed to document the work.

1.2 REFERENCES

- A. American Concrete Institute (ACI)
- B. American Society of Testing and Materials (ASTM)
- C. American Petroleum Institute (API)

1.3 DEFINITIONS

- A. Area Replacement Ratio (Ar): A ratio of the surface area of soil-cement to the total surface area of ground to be improved within a given Treatment Zone. The total area of each Treatment Zone is measured to the outer tangent lines of the DMM columns along the entire Treatment Zone perimeter.
- B. DMM: In situ ground treatment in which soil is blended with cementitious and/or other binder materials to improve strength, permeability, and/or compressibility characteristics (synonym terms include DSM, deep mixing, CDSM, and soil cement mixing).
 - 1. The DMM grids and blocks are formed by an arrangement of at least two soil mixing shafts with overlapping augers and blades (paddles), guided by a lead mounted on a crawler base machine.
 - 2. The mixing shafts shall be driven by a power source sufficient to provide torque for the wide range of expected drilling conditions, indicated by the available boring and CPT logs and other test data included in the Geotechnical Investigation Report (GIR) and planned future CPT logs prior to construction.
 - 3. As the mixing shafts are advanced into the soil, grout is pumped through the hollow stem of the shafts and injected into the soil at the shaft tips. Auger flights and mixing blades on the shafts blend the soil with grout in a pugmill fashion. When the design depth is reached, the mixing shafts are withdrawn while the mixing process is continued.
 - 4. The mixing shafts are positioned so as to overlap one another to form continuously mixed overlapping columns. After withdrawal, two (or more) overlapping soil-cement columns remain in the ground.
 - 5. The process is then repeated to form grids and blocks of overlapping DMM columns.
- C. DMM Design Addendum (DA): DMM Design Addendum No. 1 prepared by Fugro USA Land, Inc. dated June 10, 2022, and subsequent addenda.
- D. DMM Elements: DMM columns will be used to create DMM grids and DMM blocks of treated soil referred to as ground improvement. A DMM grid will consist of interconnected DMM walls formed by partially overlapping columns arranged in a grid pattern with a replacement ratio less than 100 percent. A DMM block used to support a building footing will consist of interconnected DMM walls formed by overlapping columns arranged in a parallel pattern with a replacement ratio of 100 percent or less as shown in project plans and drawings. For this project, individual DMM Element refers to the grouping of columns installed simultaneously during single penetration of the DMM rig.
- E. DMM Contractor: The firm performing the DMM construction.
- F. DMM Layout Plan: The alternate DMM construction layouts designed by the DMM Contractor, which satisfy the requirements of this Specification. The DMM Layout Plans shall be reviewed and approved by the Geotechnical Engineer and Structural Engineer.

- G. Cement Dosage: The amount of cement (in terms of dry weight) used to treat a given initial volume of in-situ soil.
- H. Cone Penetrometer Test (CPT): A geotechnical exploration tool, as defined in ASTM D 5778.
- I. Core Run: The total length reported by the driller as the actual depth penetrated by coring, including both recovered and unrecovered lengths.
- J. Geotechnical Investigation Report (GIR): Geotechnical Investigation Report prepared by Fugro USA Land, Inc. dated February 28, 2020, and subsequent addenda. Note the DMM Design Addendum No. 1 (DA) supersedes the GIR.
- K. Geotechnical Engineer: The geotechnical engineer of record responsible for the DMM design, who is hired by the Owner.
- L. Ground Improvement Area: The plan area contained within a single perimeter shown on the DMM Design Plans that surrounds:
 - 1. All planned soil-cement grids/blocks.
 - 2. Unmixed soil within the grids.
- M. Grout: A stable colloidal mixture of water, Portland cement, and admixtures. The purpose of the grout is to assist in loosening the soils for penetration and optimum mixing, and upon setting, to strengthen the in-situ soil.
- N. Grout-Soil Ratio: A volumetric ratio of grout to in-situ soil to be mixed.
- O. Owner: Peralta Community College District and its representatives.
- P. Structural Engineer: The structural engineer of record responsible for designs of structure foundations supported by DMM, who is hired by the Owner.
- Q. Testing Laboratory: The testing laboratory of record performing construction material testing, which is hired by the Owner and approved by the Geotechnical Engineer. The Testing Laboratory shall be selected from the DSA approved laboratory list.
 - 1. Treatment Zone: A spatial zone of soil targeted for ground improvement. The vertical and lateral (horizontal) extents of the Treatment Zones are defined on the DMM Design Plans.

1.4 SUBMITTALS

- A. Evidence of conformance to the referenced standards and requirements shall be submitted by the DMM Contractor to the Geotechnical Engineer for the following, but not limited to, in accordance with the requirements in this Specification.
 - 1. Cement: Certificate of compliance for each truck load delivery.
 - 2. Admixtures: If used, certificate of compliance for each load or lot of material delivered.
 - 3. Preliminary Mix Design: Proposed mix designs including all materials and quantities and documentation of calibration of the grout mixing plant.
 - 4. Proposed Test Section Program, Sampling Plan, and Laboratory Testing Program, conforming to the requirements described in this Section.
 - 5. Construction Schedule: Submit a detailed schedule that identifies start dates and duration of each major task in the work. The schedule shall at a minimum include information

- regarding equipment mobilization, equipment setup, soil-cement mixing test section, production installation, and verification testing.
6. Site Work Plan: Submit a site plan showing staging area for all on-site equipment, including anticipated sections of the streets which may require blocking of parking spaces or traffic clearances.
 7. DMM Layout Plans: Submit 1"=20' scale drawings showing proposed layout of DMM Elements (including test section(s) and production DMM), including column diameters, column overlap, grid sizes, tip elevations, top elevations, coordinates of the corners, foundations, and proposed column and element numbering scheme prior to site mobilization in hard copy and electronic format using the project coordinate system at least 14 calendar days prior to beginning DMM construction. The DMM Contractor must obtain the Geotechnical Engineer's approval of the proposed column layout prior to beginning DMM construction.
 8. Equipment and Procedures: Submit a detailed description of the equipment and procedures to be used during all DMM work including, but not limited to, construction of DMM test section(s), production DMM work, and collecting samples for laboratory confirmation testing. Procedures shall include methods for locating the DMM Elements in the field and confirming that the columns are plumb. In addition, while it is recognized that the specific responses to field difficulties are dependent on several factors, the DMM Contractor shall submit their anticipated responses to the following possible situations that could occur during construction and testing of the DMM columns including poor core sample recovery or inability to retrieve core samples, and failing production test results (e.g., repair and/or treatment of failed area and modification to approved procedures or mix design).
 9. The DMM Contractor shall also submit the anticipated cement dosages (proportions) to achieve the acceptance criteria outlined under acceptance criteria in Section 3.15 of this Specification.
 10. Quality Control Program, as outlined in the Execution Section of this Specification.
 11. Daily Quality Control Reports: Prior to construction, submit a proposed Daily Quality Control Report format for approval by the Geotechnical Engineer. Submit the Daily Quality Control Report at the end of the next working day. The report should be in conformance with quality control in Section 3.14 of this Specification.
 12. DMM Test Results: Submit all QC test results as outlined in quality control in Section 3.14 of this Specification.
 13. Calibrations: Submit all metering equipment calibration test results including mixing systems, delivery systems, alignment systems, and mixing tool rotational and vertical speed.
 14. Record Drawing: Submit record drawings prepared by the DMM Contractor indicating the as-built location and elevations of the DMM Elements in terms of project coordinates and vertical datum. The record drawings shall also indicate the above structure foundation designs and locations.
- B. Upon completion of DMM installation, the as-built submittal by the DMM Contractor to the Geotechnical Engineer, Structural Engineer, and CGS shall include test section results, daily quality control reports, DMM core and lab test results, DMM record drawings, and any other information needed to document the work.

PART 2 - PRODUCTS, MATERIALS, AND EQUIPMENT

2.1 MATERIALS

- A. Grout: The material added to the blended in situ soils shall be a water-based Portland cement grout. The purposes of the grout are to assist in loosening the soils for penetration and optimum mixing, and upon setting, to strengthen the in-situ soils. The grout shall be premixed in a mixing plant which combines dry materials and water in predetermined proportions.
- B. Cement used in preparing the grout shall conform to ASTM C150 "Standard Specification for Portland Cement Type II". The cement shall be adequately protected from moisture and contamination while in transit to and in storage at the job site. Reclaimed cement or cement containing lumps or deleterious matter shall not be used.
- C. Water: Fresh water, free of deleterious substances that adversely affect the strength and mixing properties of the grout, shall be used to manufacture grout.
- D. Admixtures: Admixtures are ingredients in the grout other than Portland cement, and water. Admixtures of softening agents, dispersions, pozzolans, retarders or plugging or bridging agents may be added to the water or the grout to permit efficient use of materials and proper workability of the grout. However, no admixtures shall be used except as approved by the Geotechnical Engineer.

2.2 EQUIPMENT

The DMM equipment shall meet the following requirements:

- A. The mixing tools shall have mixing augers and blades (paddles) configured in such a manner so that they are capable of thoroughly blending the in-situ soils and grout.
 - 1. Multi-shaft mixing equipment (machines with at least two soil mixing shafts with overlapping augers and blades) shall be used.
 - a. The mixing augers and blades shall be minimum 3 feet and maximum of 6 feet in diameter.
 - b. Allowable wear to mixing augers and blades will be limited such that equipment produces a column no less than the design diameter listed on the DMM Layout Plans.
 - c. The overlapping between any two adjacent DMM columns shall be at least 30 percent of the column diameter.
 - 2. The power source for driving the mixing shafts shall:
 - a. be sufficient to provide torque for the wide range of expected drilling conditions, indicated by available boring and CPT logs and other test data included in the Geotechnical Investigation Report (GIR) and DMM Design Addendum (DA).
 - b. be sufficient to maintain the required revolutions per minute (RPM) and penetration rate from a stopped position at the maximum depth required.
- B. The DMM rig shall be equipped with electronic sensors built into the leads to determine vertical alignment in two directions: fore-aft and left-right.
 - 1. The sensors shall be calibrated at the beginning of the project and the calibration data shall be provided to the Geotechnical Engineer. The calibration shall be repeated at intervals not to exceed three months per rig.

2. The output from the sensors shall be routed to a console that is visible to the operator and the Geotechnical Engineer during penetration and reported. The console shall be capable of indicating the alignment angle in each plane.
- C. The DMM equipment shall be adequately marked to allow the Geotechnical Engineer to confirm the penetration depth to within 6 inches during construction.
 - D. The grout shall be premixed in an on-site mixing plant, using a batch process, which combines dry materials and water in predetermined proportions. The mixing plant shall consist of a grout mixer, grout agitator, grout pump, batching scales, and a computer control unit.
 1. Dry materials shall be stored in silos. The dry materials shall be transported to the project site and blown into the on-site storage tanks using a pneumatic system.
 2. The air evacuated from the storage tanks during the loading process shall be filtered before being discharged to the atmosphere.
 3. Automatic batch scales shall be used to accurately determine mix proportions for water and cement during grout preparation.
 4. The dry admixtures, if used for mixing with water and cement, can be delivered to the mixing plant by calibrated auger. However, the DMM Contractor shall demonstrate that the calibrated auger can deliver the quantity of dry admixture with accuracy equivalent to that measured and delivered by weight.
 5. Calibration of mixing components shall be done at the beginning of the project and repeated at intervals not to exceed three months thereafter and after each move of the batch plant.
 - E. Positive displacement pumps shall be used to transfer the grout from the mixing plant to the mixing tool head. The grout shall be delivered to each slurry-injecting tool head by an individual positive displacement pump.
 - F. The DMM rig shall be equipped with sensors to continuously monitor and record the mixing tool penetration/withdrawal speed, mixing tool rotation speed, and injection rate.
 1. The output from these sensors shall be visible to the Operator and Geotechnical Engineer during penetration and withdrawal.
 2. The DMM Contractor may propose alternative display/monitoring systems; however, the systems shall first be reviewed and approved by the Geotechnical Engineer prior to use.
 3. Calibration of this equipment shall be performed at the beginning of the project and the calibration data shall be provided to the Geotechnical Engineer. The calibration shall be repeated at intervals not to exceed three months.

2.3 PRODUCTS

- A. DMM: The in-place grout mix together with the soils shall meet all of the acceptance criteria specified in Section 3.15 of this Specification, determined according to the quality control, sampling, and testing methods specified in Section 3.14 of this Specification.

PART 3 - EXECUTION

3.1 OBSERVATION OF WORK

- A. The work covered by these specifications shall be performed under the observation of the Geotechnical Engineer, who shall be retained and paid by the Owner. The Geotechnical Engineer will be present at the site during the conduct of work to observe the work, and to perform field and laboratory tests, as deemed necessary by the Owner. The DMM Contractor shall cooperate with the Geotechnical Engineer in performing the observations and tests. At the completion of their work, the Geotechnical Engineer shall submit a report to the Owner, including a tabulation of all tests performed. The Geotechnical Engineer's costs for observing the construction, testing, and the repair of unsatisfactory work performed by the DMM Contractor shall be billed to the Owner. The Owner shall pay them and then shall deduct the amount from monies due to the DMM Contractor.
- B. This work falls under the jurisdiction of the California Division of State Architect (DSA) who will review submittals and may observe portions of the work.

3.2 GENERAL

- A. The soil-mixing shall be constructed by the DMM Contractor to the lines, grades, and cross sections indicated on the DMM Design Plans example layouts or an alternate layout approved by the Geotechnical Engineer, Structural Engineer, and CGS. Revisions to the approved layouts shall be submitted to Geotechnical Engineer of Record (GEOR) for review and approval. DMM ground improvement within a single structure shall be arranged in an uninterrupted grid that follows the structure column lines and underlies all footings and moment frame grade beams, tie beams, and shear walls as shown on the DMM Design Plans.
- B. As shown on the DMM Design Plans, the DMM shall underlie the entire structure footprints and extend laterally to include any attached structures which are deemed to be essential parts of the structures.
- C. Grading after the site demolition may be required to provide suitable level ground for constructing the DMM. The DMM contractor is responsible for coordinating with the site grading operation to define the Drill-Through Zone.
- D. The minimum Area Replacement Ratio (A_r) for DMM grids and blocks and the maximum spacing for DMM grids depends on the specified unconfined compressive strength ($q_{dm,spec}$) as shown in Table A.1. Additional DMM Elements may be added within the untreated area to meet or reduce the slab free span distance as instructed by the Geotechnical and Structural Engineer.

Table A.1: Minimum DMM A_r and Maximum DMM Grid Spacing

Option	Specified Unconfined Compression Strength, $q_{dm,spec}$ (psi)	Minimum A_r (%)	Zone B Maximum DMM Center-to-Center Grid Spacing ¹	Zones A1 and A2 Maximum DMM Center-to-Center Grid Spacing ¹
1	125	50	3.2d	4.0d
¹ d = DMM column diameter				

- E. DMM elements shall extend to at least the elevations indicated on the DMM Design Plans based on the penetration of the shortest mixing shafts.
- F. The top of the DMM shall extend to the base of the ground floor slab section, the bottom of footings, the bottom of moment frame grade beams, and the bottom of elevator pits, as indicated in the DMM Design Plans.
- G. Any proposed plan and Area Replacement Ratio by the DMM contractor should be approved by the Geotechnical Engineer and CGS.
- H. Elevator pits shall be supported entirely by DMM.
- I. The DMM columns shall be essentially vertical columns as stated in this Specification, with a minimum diameter of 3 feet and a maximum diameter of 6 feet and shall extend from the top to the bottom of the Treatment Zone indicated on the DMM Design Plans.
- J. The overlapping between any two adjacent columns at ground surface shall be a minimum of 30 percent of column diameter.
- K. The completed DMM shall be a homogeneous mixture of grout and the in-situ soils. Mixing is to be controlled by shaft rotational speed, drilling speed, and grout injection rate.
- L. Monitoring of construction parameters and confirmation testing will be used to verify that the acceptance criteria have been satisfied.
 - 1. The DMM Contractor shall establish consistent procedures to be employed during DMM construction to ensure a relatively uniform product is created.
 - 2. These procedures are to be defined in the equipment and procedures submittal as defined in Section 1.4 of this Specification and subsequently modified, if necessary, based on the results of the pre-production testing or quality control testing.
- M. The DMM Contractor may request that the established grout mix/grout-soil ratio design, equipment, installation procedure, or test methods be modified. However, the Geotechnical Engineer may require additional testing, at no additional cost to the Owner, to verify that acceptable results can be achieved.
 - 1. The DMM Contractor shall not employ modified grout mix/grout-soil ratio design, equipment, installation procedures, or sampling or testing methods until approved by the Geotechnical Engineer in writing.
 - 2. The Geotechnical Engineer, at his sole discretion, may reject any modification proposed by the DMM Contractor.

3.3 CONSTRUCTION SITE SURVEY

The location of both active and abandoned buried utilities at the site can have significant impact on the design and construction of deep mixing works. Careful consideration of the presence and location of all utilities is required.

- A. Prior to bidding, the contractor should review the available subsurface information and visit the site to assess the site geometry, equipment access conditions, location of existing structures, and above-ground utilities and facilities.
- B. The contractor should field locate and verify the locations of all utilities prior to starting work. The contractor should maintain uninterrupted service for those utilities designated to remain in service throughout the work. The contractor should notify the engineer of any utility locations different

from those shown in the plans that may require relocation of deep mixed elements or structure design modification. Subject to owner's geotechnical engineer's approval, the contractor should be compensated for additional costs of element relocation and/or structure design modifications resulting from utility locations different from those shown in the plans.

3.4 SITE ACCESS FOR SOIL SAMPLES

- A. After award of the Contract, the DMM Contractor will have the option of accessing the jobsite to collect additional soil samples for use in mix designs with the following requirements:
 - 1. Prior to commencing with field work, the DMM Contractor shall obtain all necessary permits for sampling activities, including drilling permits from Alameda County Public Work Agency, if applicable.
 - 2. The DMM Contractor shall submit to the Geotechnical Engineer a sampling plan indicating in detail the sampling activities proposed, and the proposed methods for backfilling boreholes or excavations and restoring the site.
 - 3. Cement grout backfill for boreholes per Alameda County Public Work Agency is required.
 - 4. The soil sampling and testing will be performed by DMM Contractor. The costs of additional soil sampling and testing (if performed) are to be included in the project DMM construction costs.

3.5 TEST SECTIONS

- A. The DMM Contractor shall construct a minimum of one test section on site to demonstrate that the proposed mix design, equipment, and procedures will meet the specified requirements. The location(s) of the test section(s) shall be determined by the DMM Contractor with the approval of the Geotechnical Engineer.
- B. Additional test sections may be performed at the DMM Contractor's option to optimize the mix design and procedures.
- C. Each test section must extend at least to the deepest DMM design depth as indicated by the DMM Design Plans.
- D. The costs of the test section(s) are to be included in the project DMM construction costs.
- E. Each test section shall consist of at least two full strokes of the DMM equipment. For example, if the DMM rig uses three augers, then the test section shall consist of 2 strokes times 3 columns equal 6 columns.
- F. Test sections shall not be located directly below proposed footings, moment frame grade beams, and elevator pits. However, the test sections may be constructed in place of other production DMM columns, provided it is later demonstrated that the test sections meet all acceptance criteria. If the test sections are found to fail the acceptance criteria, the DMM Contractor shall make necessary repairs or replace the DMM Elements to the written satisfaction of the Geotechnical Engineer and CGS.
- G. During the time interval between construction of the test section(s) and the completion of laboratory test results, the DMM Contractor may proceed with production DMM installation at their own risk. Any production DMM found to fail the acceptance criteria must be repaired at the DMM Contractor's expense, to the written satisfaction of the Geotechnical Engineer and CGS.

- H. A minimum of two (2) full-depth cores shall be obtained from each test section, according to the procedures detailed in this Specification.
- I. Laboratory tests, as specified in this Specification, shall be performed on a minimum of ten samples per full-depth core or a minimum of one sample per core run, whichever is greater, from each test section, as selected by the Geotechnical Engineer. Additional cores may be performed to retrieve enough test samples.

3.6 HORIZONTAL ALIGNMENT

- A. The DMM Contractor shall accurately stake the location of DMM Elements using a surveyor before beginning installation. The main survey control for a given area shall be established by a California licensed surveyor; layout of individual DMM Elements does not require a licensed surveyor. Horizontal alignment of DMM columns shall conform to the geometric tolerances in the acceptance criteria of this Specification.
- B. The DMM Contractor shall provide an adequate method to allow the Geotechnical Engineer to verify the as-built location of the DMM during construction.
- C. Movement of the crawler base machine shall provide the preliminary alignment of the augers and the final alignment shall be adjusted by hydraulic manipulation of the leads.
- D. One stroke of the machine shall construct a DMM Element consisting of at least two overlapping columns.
- E. The DMM shall be advanced stepwise by overlapping the adjacent columns of the previous strokes.
- F. Following DMM construction, the DMM Contractor shall submit as-built drawings indicating the location of the DMM elements in terms of project coordinates and elevation datum.
- G. The DMM contractor should provide a construction plan at least two (2) weeks prior to the start of construction that includes the plan showing the numbering and location of the DMM columns, tip elevations or depths, and cut-off (top) elevations. The daily work plan should be provided to the Geotechnical Engineer at the beginning of workday and work progress should be checked and confirmed by the Geotechnical Engineer during and at the end of each day. The DMM contractor should provide a summary progress report to the Geotechnical Engineer at the end of each workday.
- H. The location of known obstructions or utilities at or near the treatment area should be marked on the project drawings and on the ground before construction begins. Existing obstructions within the treatment zone area should be removed prior to construction. It is not anticipated that drilling obstructions will be encountered within the Treatment Zone during DMM construction unless further site investigation reveals otherwise.
 - 1. If an obstruction preventing drilling advancement is encountered, the DMM Contractor shall investigate the location and extent of the obstruction using methods approved by the Geotechnical Engineer. The DMM Contractor shall propose remedial measures to clear the obstruction for approval by the Geotechnical Engineer.
 - 2. While the investigation for an obstruction is underway, the DMM Contractor shall continue to install columns in areas away from the obstruction location. No stand-by delay will be allowed for equipment and operations during the investigation of an obstruction.

3. The DMM Contractor will be compensated for removal or clearing of obstructions as a Changed Condition, paid in accordance with the General Conditions.
 4. The DMM Contractor will not be compensated for removal or clearing of obstructions without prior approval by the Geotechnical Engineer and the Owner.
- I. The DMM Contractor will not be compensated for DMM Elements that are located outside of the tolerances specified in the acceptance criteria.

3.7 VERTICAL ALIGNMENT

- A. The equipment operator shall control vertical alignment of the auger stroke. Verticality shall be monitored with respect to two orthogonal horizontal axes. Vertical alignment of DMM columns shall conform to the geometric tolerances in the acceptance criteria of this Specification.

3.8 DMM DEPTH

- A. DMM depths shall extend to the line and grades shown on the DMM Design Plans.
- B. The total depth of penetration shall be measured either by observing the length of the mixing shaft inserted below a reference point on the mast, or by subtraction of the exposed length of shaft above the reference point from the total shaft length.
1. For each stroke, the elevation of the reference point on the mast must be established within one inch using measurements from a surveyed control point.
 2. The final depth and bottom elevation of the stroke shall be noted and recorded on the Daily Quality Control Report by the DMM Contractor. The equipment shall be adequately marked to allow the Geotechnical Engineer to confirm the penetration depth during construction.
- C. If rigs with varying mixing shaft lengths are used, the shortest shafts shall extend to the minimum DMM depths indicated on the DMM Design Plans.

3.9 GROUT PREPARATION

- A. Dry material shall be stored in silos and fed to mixers for agitation and shearing. In order to accurately control the mixing ratio of grout, the addition of water and cement shall be determined by weight using the automatic batch scales in the mixing plant.
1. The admixtures, if used, for mixing with water and cement, can be delivered to the mixing plant by calibrated auger. However, the DMM Contractor shall prove that the calibrated auger can deliver the quantity of dry admixture with accuracy equivalent to that measured and delivered by weight.
- B. A minimum mixing time of one minute and a maximum holding time of four hours will be enforced for the grout.
1. The grout hold time shall be calculated from the beginning of the initial mixing.
- C. The specific gravity of the grout shall be determined during the design mix program for double checking grout proportions.
1. The specific gravity of the grout shall be checked by the DMM Contractor at least twice per shift per rig using the methods outlined in ASTM D4380.
 2. The specific gravity of the grout measured in the field should not deviate by more than 3 percent of the calculated specific gravity for the design cement ratio.

3. If the specific gravity is lower than that required by the design mix, the DMM Contractor shall add additional cement and remix and retest the grout at no cost or schedule impact to the Owner.
4. The specific gravity measurements shall be indicated on the Daily Quality Control Report.

3.10 SOIL-GROUT MIXING

- A. Installation of each column shall be continuous without interruption.
 1. If an interruption of more than one hour occurs, the column shall be remixed (while injecting grout at the design grout ratio) for the entire height of the element at no additional cost to the Owner.
 2. If an interruption of more than ten minutes occurs, the DMM Contractor shall inject a volume of grout equal to that required for three feet of auger penetration, while maintaining constant auger elevation. Once the specified volume of grout has been injected, auger penetration may continue.
- B. The completed CSDM shall be a uniform mixture of cement grout and the in-situ soils.
 1. Soil and grout shall be mixed together in place by the specially designed overlapping augers or blades on the mixing shafts.
 2. The grout shall be pumped through the mixing shafts and injected from the tip of the shafts. The shafts shall break up the soil and blend it with cement grout.
 3. The mixing action of the shafts shall blend, circulate, and knead the soil over the length of the column while mixing it in place with the grout.

3.11 SHAFT ROTATIONAL SPEED AND PENETRATION/WITHDRAWAL RATE

- A. The mixing shaft rotational speed (measured in RPMs) and penetration/withdrawal rates shall be established before beginning work. It may be adjusted with the approval of the Geotechnical Engineer to achieve adequate mixing.
- B. The contractor shall obtain the suitable shaft rotational speed during the installation of test section. The rotational speeds and penetration/ withdrawal rates shall be recorded on the Daily Quality Control Report.
- C. The established rotational speeds and penetration/withdrawal rates shall be used during the work. If these parameters are varied more than ten (10) percent from those determined during the test section(s), the Geotechnical Engineer may require additional testing, at no additional cost to the Owner, to verify that the acceptance criteria are met.
- D. The DMM Contractor may request that the established mixing parameters be modified during the production DMM installation. To verify acceptable results for the modified parameters, the Geotechnical Engineer may require additional testing at no additional cost to the Owner.

3.12 GROUT INJECTION RATE

- A. The grout injection rate per no more than three vertical feet of column shall be in accordance with the requirements of the design mix.
 1. The required mix design and grout-soil ratio shall be determined during the test section(s).
 2. The grout injection rate shall be constantly monitored and controlled.

3. The DMM Contractor shall record the volume of grout injected continuously for each column on the Daily Quality Control Report.
- B. If the volume of grout injected per three vertical feet of column is less than the amount required to meet the grout-soil ratio established during the test section, the DMM columns shall be remixed and additional grout injected (at the design grout-soil ratio) to a depth at least 3 feet below the deficient zone or until design depth is met, at no additional cost to the Owner.
 - C. The DMM Contractor may request that the established grout-soil ratio be modified during the production DMM installation.
 1. To verify acceptable results for the modified grout-soil ratio, the Geotechnical Engineer may require additional testing or a new test section at no additional cost to the Owner.

3.13 CONTROL OF SPOILS

- A. The DMM Contractor shall control and process all spoils created during the DMM construction.
 1. Prior to stockpiling materials greater than 10 feet in height, stockpile locations and heights shall be submitted for review and approval to Geotechnical Engineer. The DMM Contractor shall consider the locations of and avoid damage to existing utilities, structures, and other improvements, as well as recently constructed DMM Elements when stockpiling material. Lesser stockpile heights may be necessary in some areas.
 2. The spoils shall be processed until they have cured to a sufficient level to allow them to be stockpiled such that they will not reform a cemented mass in the stockpile. The DMM Contractor shall dispose of spoils in accordance with all local laws, codes, and ordinances in a manner acceptable to the Owner or coordinate with the project grading contractor for the spoils be reused as fills at the project site.

3.14 QUALITY CONTROL PROGRAM

- A. The DMM Quality Control Program shall be the responsibility of the DMM Contractor and shall include, as a minimum, the following components:
 1. An approved pre-construction test program on soils obtained from the project site, to establish appropriate design parameters such as cement dosage and water content.
 2. Field monitoring by the DMM Contractor of construction parameters during DMM construction.
 3. Sample collection including full depth continuous coring, sample storage, and sample transportation to the Testing Laboratory.
 4. Reporting of the field monitoring and sampling performed by the DMM Contractor.
 5. Reporting of the core strength testing performed by the Testing Laboratory.
- B. Prior to site mobilization, the DMM Contractor shall submit a detailed work plan for the Quality Control Program for review and approval by the Geotechnical Engineer. The work plan shall include, as a minimum:
 1. A description of all installation, monitoring, sampling, and testing procedures to be implemented. The proposed auger penetration and withdrawal rates shall be proposed by the DMM Contractor at this time.
 2. Descriptions of all sampling equipment.
 3. A list of parameters to be monitored.
 4. Tolerances for the parameters monitored.
 5. Names of any subcontractors.

- C. The DMM Contractor shall provide all the personnel and equipment necessary to implement the Quality Control Program. Contractor to provide the number of years/projects, project descriptions, and reference list for all cases below:
1. The DMM Contractor must have at least 7 (seven) years of previous successful experience with at least 5 (five) DMM projects for soil conditions and project scope similar to that of the project being bid.
 2. The DMM contractor must have a registered California Professional Engineer (PE) who have had at least 5 (five) years of experience with at least 3 (three) DMM projects.
 3. The DMM Contractor must have assign a project manager who have had at least 5 (five) years of experience on at least 3 (three) DMM projects.
 4. The DMM Contractor must have assign a project engineer/ supervisor who have had at least 3 (three) years of experience with at least 2 (two) DMM projects.
 5. The DMM Contractor must assign a full-time project superintendent with at-least 3 (three) DMM projects with at least 150,000 cubic yard of total treatment volume in DMM construction.
 6. The DMM equipment operator must have at least three years of experience with the equipment and DMM construction.
 7. Written requests for substitution of these key personnel must be submitted prior to personnel changes. Documentation must be submitted to the owner that demonstrates that the substitute meets the requirements listed. Substitution may not be made until written approval is provided by the owner.
- D. The Geotechnical Engineer will continuously observe the DMM construction. The Geotechnical Engineer will review DMM Contractor submittals to check that the Quality Control Program is being properly implemented.
- E. The established quality control procedures shall be maintained throughout the production DMM installation to ensure consistency in the installation and to verify that the work complies with all requirements indicated in the DMM Design Plans and Specifications, unless modifications to the procedures are approved in writing by the Geotechnical Engineer.
- F. DMM Contractor shall perform sample collection, storage, and transportation.
1. DMM Contractor shall collect one full-depth continuous coring should be made for every 3% of the total DMM elements or for every 900 square feet of treated ground, whichever produces the greater number of cores at locations specified by the Geotechnical Engineer.
 - a. The coring rig shall be a triple-barrel rig approved by the Geotechnical Engineer and capable of achieving the required recovery. The ability to achieve the recovery criteria is solely the Contractor's responsibility.
 - b. Full-depth samples obtained by the DMM Contractor shall have a diameter of at least 3 inches.
 - c. The continuous core sample shall extend from the top through the bottom of the Treatment Zone, and to at least 5 feet below the Treatment Zone to sample the foundation soil directly below the Treatment Zone.
 - d. Unless otherwise directed by the Geotechnical Engineer, the full-depth samples shall be obtained along an essentially vertical alignment located one-fourth of a column diameter from the column center and not within column overlaps.
 - e. The DMM Contractor shall perform all full-depth sampling in the presence of the Geotechnical Engineer.
 - f. Full-depth core samples shall be retrieved using triple tube continuous coring techniques after the soil-grout mixture has hardened sufficiently.
 - g. Each core run shall be a minimum 4 feet in length.
 - h. Following logging, the engineer will select at least five specimens from each full-depth continuous core for strength testing. Each test specimen should have a length-to-diameter ratio of 2 or greater.

- i. A minimum recovery of 85 percent for each 4-foot core run shall be achieved for cores from within the Treatment Zones. During coring, the elevation of the bottom of the holes shall be measured after each core run in order that the core recovery for each run can be calculated.
 - j. The DMM Contractor shall determine the time interval between column installation and coring except that the interval shall be no longer than required to conduct 28-day strength testing.
 - k. The DMM contractor should photograph each core run and submit to the Geotechnical Engineer for test sample selection.
 - l. Upon retrieval, the core runs shall be provided to the Geotechnical Engineer for logging, uniformity inspection, and test specimen selection.
 - m. Following logging and test specimen selection by the Geotechnical Engineer, the entire full-depth core, including the designated test specimens, shall be immediately sealed in plastic wrap to prevent drying and transported to the laboratory by the DMM Contractor. Alternatively, the DMM Contractor may transport only the selected test specimens to the laboratory and store the remaining core on-site in a humidity and temperature-controlled storage facility as described in this Specification.
 - n. All core holes shall be filled with cement grout that will obtain a 28-day strength equal to or greater than the strength of the DMM. However, the Contractor shall not grout the core holes until after acceptable core recover and uniformity has been confirmed by the Geotechnical Engineer.
 - o. The DMM Contractor shall notify the Geotechnical Engineer at least one business day (24 hours) in advance of beginning core sampling operations.
2. In addition to coring, the DMM Contractor should obtain wet grab samples from the DMM elements at the presence of Geotechnical engineer.
- a. 3 (three) wet samples from each mixed design used in each test section as directed by the geotechnical engineer.
 - b. One wet sample (i.e., one selected depth at one location) should be retrieved every 2 (two) production days or for every 2,500 cubic yards of treated soil, whichever produces the higher sampling frequency.
 - c. The contractor proposes locations for wet sampling as outlined in the QC program, considering input from the geotechnical engineer based on subsurface conditions, DMM layout, review of the QC results, and observation of the soil mixing operation.
 - d. The contractor should report all attempts, successful and unsuccessful, to obtain wet samples. Some deep mixed material may not be able to be sampled readily because either the mixture is too stiff or the material may not flow back into the void left after the sampler is extracted, possibly leaving a damaged element.
 - e. The sampling tool is inserted into the DMM column to a designated depth, filled with treated soil, and lifted to the ground surface. The treated soil material is then poured into a container, screened for oversized lumps (gravel versus unmixed soil), and placed in 3-inch (76-mm)- diameter, 6-inch (152 mm)- long molds. Eight test specimens should be prepared from each wet sample.
 - f. The wet treated material should be placed into the mold in three to five layers. After the placement of each layer, the specimens must be tapped or vibrated to remove trapped air bubbles. The specimens should be sealed to prevent moisture from entering or leaving the specimens, and the sealed specimens should be stored in a humid environment in accordance ASTM C192.
 - g. For field validation testing, unconfined compressive strength testing may be performed on specimens at 3, 7, 28, and 56 or more days. For full production work, unconfined compressive strength testing may be performed at 3, 7 and 28 days.
 - h. The DMM contractor should deliver the samples for testing to a local lab as directed by the geotechnical engineer.
 - i. If wet samples produce results that are consistently acceptable, the frequency of wet sampling can be reduced as the project progresses.

- j. The engineer may request additional test specimens for QA testing.
 - 3. Untested portions of the full-depth samples shall be retained at the laboratory until completion and acceptance of all DMM, for possible inspection and confirmation testing by the Geotechnical Engineer.
- G. The DMM Contractor shall be responsible for handling of test specimens, including storing of untested specimens and transporting test specimens to the Testing Laboratory.
 - 1. The laboratory testing shall be performed by the DSA accepted Testing Laboratory hired by the Owner and approved by the Geotechnical Engineer.
 - 2. The samples shall be stored in a moist room as specified in ASTM C 192 until the test date.
 - 3. Testing for 28-day unconfined compressive strength shall be conducted in accordance with ASTM D2166.
- H. In addition to confirmation tests performed by the Testing Laboratory, additional tests may be requested by the Geotechnical Engineer on samples collected by the DMM Contractor. Both the Testing Laboratory's testing and the Geotechnical Engineer's requested additional testing (if performed) shall demonstrate that the acceptance criteria are met prior to acceptance of the work.
- I. Daily Quality Control Report
 - 1. The DMM Contractor shall submit Daily Quality Control Reports to the Geotechnical Engineer at the end of the next working day. The Daily Quality Control Report shall document the progress of the DMM construction, present the results of the QC parameter monitoring, present the results of the strength testing, and clearly indicate if the columns have met the acceptance criteria. The DMM Contractor shall make all Daily Quality Control Reports available to the Geotechnical Engineer
 - 2. The Daily Quality Control Report shall include as a minimum the results of the following QC parameter monitoring for each column:
 - a. Rig number
 - b. Type of mixing tool
 - c. Date and time (start and finish) of column construction
 - d. Column number and reference drawing number
 - e. Column diameter
 - f. Column top and bottom elevations
 - g. Grout mix design designation
 - h. Slurry specific gravity measurements (refer to Section 3.9 for number of tests and tolerance)
 - i. Description of obstructions, interruptions, or other difficulties during installation and how they were resolved
 - 3. The Daily Quality Control Reports shall also include the following parameters recorded automatically for each column continuously and submitted in the form of either tables or figures (as agreed to by the Geotechnical Engineer):
 - a. Elevation in feet vs. real time
 - b. Shaft rotation speed in RPMs vs. depth
 - c. Penetration and withdrawal rates in feet per minute vs. depth
 - d. Grout injection rate in gpm vs. depth
 - e. The average quantity of grout in gallons per foot injected per 3-foot (or less) vertical increment of column vs. depth

3.15 ACCEPTANCE CRITERIA

- A. The Geotechnical Engineer and CGS shall make the sole determination as to whether the acceptance criteria have been satisfied. The in-place grout-soil mixture comprising the DMM Elements shall meet the following acceptance criteria:

1. The DMM within the Treatment Zone shall be installed within the following geometric tolerances:
 - a. The horizontal alignment of the DMM blocks shall be within 4 inches of the location shown on the approved DMM Layout Plans.
 - b. The vertical inclination of the DMM columns shall be no more than 1: 100 (horizontal to vertical).
 - c. Overlap between any two adjacent columns shall be a minimum of 30 percent of column diameter for the entire depth, as calculated based on depth of column embedment and measured auger lateral and longitudinal inclination.
 - d. The tops of the columns shall be at or higher than the elevations indicated on the DMM Design Plans.
 - e. The bottoms of the columns shall extend to or lower than the levels indicated on the DMM Design Plans.
 2. Two alternative specified unconfined compressive strengths are provided with corresponding minimum A_r and maximum grid spacing in Table A.1. The DMM Contractor shall select one of these options for the entire project.
 3. The unconfined compressive strength shall be determined by ASTM D2166 at 28 days on samples taken by coring of the constructed DMM.
 4. 80 percent of all unconfined compressive strength testing on core samples determined by ASTM D2166 from each tested deep mixed element shall equal or exceeds the specified strength. If a strength specimen falls below the specified strengths due to an obviously unrepresentative lump of unmixed soil in the specimen, the Geotechnical Engineer has the option to select another specimen from the same core run and allow the Testing Laboratory to test the replacement specimen and substitute the strength from the replacement specimen for the strength from the unrepresentative specimen that failed to satisfy the strength requirement. Only one such retest will be allowed per core run.
 5. 90 percent of all the test results on core samples across the site should equal or exceed the specified strength.
 6. To prevent a weak layer at one elevation in the DMM foundation system, strengths below the specified strength are not permitted within 10 feet of the same elevation in more than 2 nearby cored elements.
 7. Uniformity of mixing within the target zone shall be evaluated by the Geotechnical Engineer based on the full-depth samples recovered by the DMM Contractor from the columns.
 - a. Lumps of unimproved soils shall not amount to more than 15 percent of the total volume of any core run from a continuous full-depth core sample. For evaluating the volume of unimproved lumps of soil, all of the unrecovered core length shall be assumed to be unimproved soil.
 - b. Any individual or aggregation of lumps of unimproved soil shall not be larger than 12 inches in greatest dimension.
 - c. Continuous core recovery shall be at least 85 percent over any full-length core.
- B. If the acceptance criteria specified in this Specification are not achieved for production DMM, the failed section of DMM shall be rejected.
1. Unless otherwise determined by the Geotechnical Engineer, the failed section of DMM shall be considered to include all DMM columns constructed during all rig shifts that occurred between the times of construction when passing tests were achieved.
 2. The DMM Contractor may conduct additional sampling and testing to better define the limits of the failed area at no additional cost to the Owner.
 3. The DMM Contractor shall submit a proposed plan for remixing or repair of failed sections for review and approval by the Geotechnical Engineer and CGS.
 4. If the treated soil that failed to meet the uniformity criteria is concentrated in a narrow elevation range forming weak planes or zones, the contractor could propose re-drilling and remixing to 3 feet below and above the deficient zone. IF re-drilling and remixing cannot be done efficiently, the contractor must replace the elements to the full depth. If the treated

zone in the narrow elevation meets the uniformity criteria but fails to meet the strength criteria, the contractor could propose to redrill and remix the deficient zone or to assign a lower strength level to the deficient zone and install additional elements to compensate for the strength deficiency.

5. If the treated soil that failed to pass cannot be isolated in a specific zone, the contractor must provide remedial measures for all elements constructed during all rig shifts that occurred between passing elements.
6. Remedial measures are subject to coring and application of the specification acceptance criteria.

END OF SECTION

SECTION 316100

FOOTINGS

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of footings and related work, complete, in accordance with the Drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 014505
Concrete Reinforcement and Embedded Assemblies	Section 032000
Cast-In-Place Concrete	Section 033000
Thermal and Moisture Protection	Division 7
DMM Ground Improvement	Section 313213

1.4 CODES AND STANDARDS

A. Building Code: Footing work shall conform to the requirements of the Building Code identified on the structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 – Standard Specifications for Structural Concrete.
3. ACI 315 – Details and Detailing of Concrete Reinforcement.
4. ACI 318 – Building Code Requirements for Reinforced Concrete.
5. American Concrete Institute “Manual of Concrete Practice”, various committee reports as referenced herein.
6. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
7. AWS D1.4 – Structural Welding Code-Reinforcing Steel.

C. Definitions:

1. See Section 033000.

2. The term Owner's Geotechnical Engineer in this Specification is defined as the Owner's representative specifically authorized to perform the responsibilities defined herein.

1.5 CONTRACTOR QUALIFICATIONS

- A. The Footing Installer shall be a company which specializes in installing footings, with a minimum of 10 years of documented successful experience. Installation shall be performed by skilled workmen thoroughly experienced in the necessary execution.
- B. The Contractor's Field Supervisor shall have 10 years of experience in installing footings and provide full-time supervision.
- C. The Contractor's Professional Surveyor shall have 10 years of previous experience in laying out foundation locations to perform surveys, layouts, and measurements for footing work. The Contractor's Professional Surveyor shall be licensed California. Conduct layout work for each footing to lines and levels required before excavation, and actual measurements of each footing's horizontal location, top elevations, deviations from specified tolerances, and other required data.

1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

- (1) Submittal Schedule
- (2) Footing Construction Methods
- (3) Installer Qualifications
- (4) Shop drawings
- (5) Construction Log
- (6) Contractor's Survey Report
- (7) Submittals required by Related Documents
- (8) Mill Certificates
- (9) Owner's Concrete Testing Agency Reports
- (10) Product Data

1. Submittal Schedule: See Section 033000.
2. Footing Construction Methods: Submit for record, footing construction procedures developed by the Footing Contractor.
3. Installer Qualifications: Submit proof of qualifications as stated in the CONTRACTOR QUALIFICATIONS section of this Specification.
4. Shop drawings in accordance with 032000 and 033000, and as noted.
 - a) Concrete mix designs in accordance with Section 033000.
 - b) Footing reinforcement in accordance with Section 032000 and 033000.
 - c) Footing layout drawing showing the location of each footing (with respect to building gridlines), size and depth of footing, and top of footing elevation.

5. Construction Log: Testing Agency shall document, sign, and submit for record, a record of each footing construction, including:
 - a) Footing designation, top and where possible bottom elevation, and size of footing.
 - b) Size, length, and location of installed reinforcement.
 - c) Deviation of centerline plan location.
 - d) Actual allowable Deep Mixing Method column bearing capacity
 - e) Inspection and testing
 - f) Method of concrete placement, time of beginning and ending concrete discharge for each truck, (including any delays in concreting and location of construction joints in shafts) and any deviation from planned construction methods.
 - g) Volume of concrete supplied to footing and ratio of actual volume to theoretical volume.
6. Contractor's Survey Report: Submit for record plans sealed and signed by a Professional Surveyor licensed California, indicating as built plan locations of footing centerlines (with respect to building gridlines), top and where possible bottom elevations, and identifying deviations of footing centerlines from design plan locations. Footings that are outside of specified tolerances shall be specifically identified on the plan.
7. Submittals required by Related Documents.
8. Mill Certificates: Per Specification section 032000, submit for record certified reports for physical and chemical properties of following materials:
 - a) Reinforcement bars.
9. Owner's Concrete Testing Agency Reports: Submit for record
 - a) Reports of field observations.
 - b) Reports of field quality control tests, as related to concrete and reinforcement.
 - c) Immediately notify the Design Professionals of any deviations from the Drawings.
10. Product Data: Submit for record for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and ICC reports, where applicable, for products of each manufacturer specified in this section.

- B. Submittal Process: See Section 013300.
- C. SER Submittal Review: See Section 033000.
- D. Substitution Request: See Section 012513.
- E. Request for Information (RFI): See Section 033000.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Sections 032000 and 033000.

1.8 PROJECT SITE CONDITIONS

- A. Geotechnical Information: Contractor to examine site, records of test borings, soil samples, and Geotechnical Report and Addendum that are available from the Owner. Soil boring test results are provided by the Owner for information and are not guaranteed to represent conditions that are present at footing locations. Soil boring test results are not intended as representations or warranties of the continuity of the reported conditions. It is expressly understood that the Owner will not be responsible for interpretation or conclusions drawn by Contractor from the Geotechnical Report and Addendum. At no additional cost to the Owner, evaluate the available data and provide additional test borings and other investigations as necessary for installing footings.
- B. Site Survey: Survey of site, existing utilities, and existing construction available from the Owner represent conditions known to Owner. Other obstructions may be encountered.

1.9 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

- A. See Section 014505.

1.10 QUALITY CONTROL BY CONTRACTOR

- A. See Section 033000.
- B. The Contractor's Geotechnical Engineer shall be qualified to perform the type of work required by the Project. The Engineer shall be a Licensed Professional/Geotechnical Engineer in California. The engineer shall develop a site dewatering plan and advise on footing construction techniques, including assistance in the development of construction procedures and the development of solutions to construction problems.

1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

- A. See Section 033000.

1.12 PERMITS AND WARRANTY

- A. Permits: See Sections 007213 and 033000.
- B. Drawings and calculations prepared by the Contractor's Licensed Professional/Structural/Geotechnical Engineer in California for temporary shoring and/or earth retention shall be submitted to DSA for review.
- C. Warranty: See Sections 017836 and 033000.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. See Section 033000.

2.2 REINFORCEMENT

- A. See Section 032000.

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

- A. Before installing footings adjacent to known existing utilities, notify utility owner to ensure that protective work will be coordinated and performed by Contractor in accordance with requirements of the owner of utility or building. If any existing service lines, utilities, and utility structures to remain in service are uncovered or encountered during work, protect the uncovered element from damage and provide support where necessary.
- B. Should uncharted or incorrectly charted piping or other utilities be encountered during footing excavation, immediately notify the Owner, Design Professionals and utility owner. Cooperate with Owner and utility owner in keeping their respective services, utilities and facilities in operation. Repair damaged utilities to entire satisfaction of Owner and utility owner concerned.
- C. Do not interrupt existing utility service facilities occupied and used by Owner and others, except when permitted in writing by the Design Professionals and then only after acceptable temporary utility services have been provided.
- D. Protect structures, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by footing operations.

3.2 SITE DEWATERING

- A. Before installing footings, provide site dewatering based on the Contractor's site dewatering plan.
- B. Provide and maintain pumping equipment to keep excavations free of water before placing concrete. If excessive water is encountered and drilling operations must be halted, consult the Geotechnical Engineer before using alternate methods of construction.
- C. If excessive seepage is coming in from below the bottom of the footing excavation, removal by pumping within the excavation is inappropriate, as this may affect the Deep Mixing Method (DMM) columns and reduce the bearing soil capacity; therefore, an alternate means of dewatering will be required.

3.3 GENERAL FOOTING EXCAVATION

- A. Tolerances: Plan location tolerance is 2% of footing dimension but no greater than 2 inches (50 mm), whichever is greater, If indicated tolerances are exceeded, see "Footing Corrective Measures" in Part 3.
- B. Forming Sides of Footings:

1. Provide forms for footings and grade beams if soil or other conditions are such that earth trench forms are unsuitable.
 2. When trench forms are used, provide an additional 1" (25 mm) of concrete on each side of the minimum design profiles and dimensions indicated.
- C. Cleanup of Footing Bottom: Excavate bottom to a level plane. Remove loose materials or free water as determined by Owner's Geotechnical Engineer.

3.4 ADDITIONAL EXCAVATION AND FOOTING DEPTH

- A. If obstructions are encountered that interfere with new construction, remove such existing elements or develop corrective methods. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. Efforts shall be made to address obstructions at no additional cost to the Owner.

3.5 DISPOSAL OF EXCAVATED MATERIALS

Dispose excavated materials off site in a manner that will not interfere with other construction activities. Keep construction site at all times clean and free of soil and other debris that could affect progress of other construction activities.

3.6 FOOTING REINFORCEMENT

- A. Fabrication in accordance with 032000 from approved shop drawings.

3.7 FOOTING BEARING

- A. Footing Bearing and Verification
1. Footings shall be founded on Deep Mixing Method (DMM) columns with bearing capacity indicated on Drawings. Footings shall not be excavated until test results by Owner's Geotechnical Engineer confirm allowable bearing values indicated on Drawings, but shall be excavated immediately thereafter.
 2. DMM columns must be inspected and be acceptable to the Owner's Geotechnical Engineer before placing concrete

3.8 CORRECTIVE MEASURES

- A. If unforeseen field conditions require corrective installation methods, immediately notify the Design Professionals.
1. Where a change to the construction installation method result in an as-built footing in compliance with the Contract Documents, submit installation method for record.
 2. Where the as-built footing does not meet the design intent of the Contract Documents. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals.
- B. If footings are installed outside allowable tolerances, develop and provide corrective methods at no extra cost to the Owner including calculations based on actual locations of footings, taking into account eccentricity between final centerline of footing and design

location of column centerline. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. Calculations shall be sealed and signed by a Professional/Structural/Geotechnical Engineer licensed California.

- C. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION

SECTION 320100
LANDSCAPE MAINTENANCE PERIOD

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Weed Control and Prevention.
 - 2. Pest Control and Prevention.
 - 3. Disease Control and Prevention.
 - 4. Fertilization.
 - 5. Pruning of Plant Material.
 - 6. Replacement of Dead or Unhealthy Plant Material.
 - 7. Repair of Staking and Guying System.
 - 8. Watering Plant Material.
 - 9. Mowing.
 - 10. Monitoring, Adjustment and Repair of Irrigation System.
 - 11. Monitoring Changing Soil Moisture and Weather Conditions Relative to Plant Material Water Requirements.
 - 12. Adjusting Length of Watering Cycles According to Changing Soil and Weather Conditions.

- B. For Irrigation, see Section 328400.

- C. For Grasses, see Section 329200.

- D. For Soil Preparation and Soil Mixes, see Section 329113.

- E. For Planting Area Finish Grading, see Section 329119.

- F. For Plant Material, see Section 329300.

1.2 DEFINITIONS

- A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of District’s representative in writing.

- B. IPM — Integrated Pest Management: An approach to pest control that utilizes regular monitoring to determine if and when treatments are needed and employs physical, mechanical, cultural, biological and educational tactics to keep pest numbers low enough to prevent intolerable damage or annoyance. Least-toxic chemical controls are used as a last resort.

1.3 REFERENCES

- A. ANSI — American National Standards Institute:
 - 1. Z60.1 — American Standard for Nursery Stock. Most current edition.
 - 2. A300 – Pruning. Most current edition.
- B. NAA — National Arborist Association:
- C. Pruning Standards for Shade Trees. Most current edition.
- D. ICBN — International Code of Botanical Nomenclature.
- E. ICNCP — International Code of Nomenclature of Cultivated Plants.
- F. ISA — International Society of Arboriculture.

1.4 SUBMITTALS

- A. Product Purchase and Delivery Documentation:
 - 1. Fertilizer: Within 5 working days of each application submit purchase orders, invoices and receipts showing supplier name and address, person who sold product, date of purchase, specific product purchased, quantity purchased, and delivery date.
- B. Manufacturer's Current Printed Instructions:
 - 1. Fertilizer.
 - 2. Required chemicals.
- C. Documentation of Accepted Conditions: Within 7 working days after District's acceptance of maintenance, submit color photographs and a written report documenting the accepted conditions of the plant material.
- D. Inspection Reports:
 - 1. Monthly plant inspection report documenting signs of stress.

1.5 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. Maintenance Contractor: Minimum 10 years experience in maintenance of commercial landscape projects.
 - 2. Maintenance Supervisor: Minimum of 10 years experience in landscape maintenance supervision, with experience and training in integrated pest management, turf management, entomology, pest control, soils, fertilizers and plant identification.
 - 3. Labor Force: Thoroughly familiar and trained in the work to be accomplished and perform the task in a competent, efficient manner acceptable to the District.
 - 4. Supervision: Directly employ and supervise the Work force at all times.
- B. Notification of Change in Supervision: Notify District of changes in supervision.
 - 1. Identification: Provide proper identification for landscape maintenance firm's labor force.

C. Regulatory Requirements:

1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
2. Provide for inspections and permits required by Federal, State, or local authorities in furnishing, transporting, and installing of chemicals.
3. Submit a record of herbicides, insecticides and disease control chemicals used to the County Agricultural Commissioner's Office as required by law.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Plant Material: Meet requirements of Section 329300.

1.7 SITE CONDITIONS

A. Environmental Requirements:

1. Do not apply chemicals during windy conditions.

1.8 SEQUENCING AND SCHEDULING

A. Work Schedule:

1. Perform maintenance during hours accepted by District.
2. Be present at the project site at least once a week and as often as necessary to perform specified maintenance.

B. Chemical Applications:

1. Notify District in advance of required chemical applications.
2. Obtain District's approval of application schedule.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Gro-Power Products:

1. Gro-Power Co. – www.gropower.com.
2. Or equal.

B. Other Fertilizers:

1. Agri Tab Corporation – www.agritab.com.
2. Delta Bluegrass Company, www.deltabluegrass.com.
3. Or equal.

C. Rock Mulch:

1. Lyngso. – www.lyngsogarden.com
2. Or equal.

D. Herbicide:

1. Avenger Organic – www.avengerorganics.com.
2. Or equal.

- E. Polymer:
 - 1. Complete Green, El Segundo, CA, www.completegreencompany.com
 - 2. Or equal.

2.2 MATERIALS

- A. Replacement Plant Material:
 - 1. Match existing genus, species, cultivar and size.
 - 2. Meet requirements of Section 32 9300.
 - 3. Meet requirements of ANSI Z60.1, ICBN and ICNCP.
- B. Seed or Sod: Match existing genus, species and cultivar.
- C. Fertilizers:
 - 1. Gro-Power Plus 5-3-1.
 - 2. Gro-Power Hi-Nitrogen (14-4-9) and Gro- Power Premium Hi-Nitrogen 18-3-7.
 - 3. Gro-Power Controlled Release 12-8-8.
 - 4. Bolero Lawn Food.
 - 5. Or equal.
- D. Fertilizer Tablets for Replacement Plants:
 - 1. Gro-Power 21 Gram Planting Tablets 20-10-5.
 - 2. Or equal.
- E. Gypsum: Agricultural grade product containing 80-percent minimum calcium sulfate.
- F. Herbicides, Insecticides, and Fungicides:
 - 1. Legal commercial quality nonstaining materials with original manufacturers' containers, properly labeled with guaranteed analysis, least toxic required.
- G. Mulches:
 - 1. Same as original installation.
- H. Polymer: Soil drain / PAM.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of Existing Conditions:
 - 1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
 - 2. Provide barricades, fences or other barriers to protect existing conditions from damage during maintenance operations.
 - 3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants.
 - 4. Submit written notification of damaged plants and structures to District and District's representative immediately.

3.2 GENERAL MAINTENANCE

- A. Maintenance Period for Trees, Shrubs, Groundcover, Vines, Perennials, Grasses, Turf Lawn and Hydroseeded Grasses: Continuously maintain each plant and each portion after installation, during progress of work, and for a minimum period of 90 days after Final completion until District accepts maintenance.
- B. Integrated Pest Management: Employ principles of integrated pest management for each aspect of maintenance.

3.3 TREE AND SHRUB MAINTENANCE

- A. Watering:
 - 1. Using a soil sample tube, check rootball moisture and surrounding soil moisture at representative plants at least twice a week.
 - 2. Maintain watering basins around trees and shrubs so that enough water can be applied to establish moisture through root zones.
 - 3. In rainy season, open basins to allow surface drainage away from the root crown where excess water may accumulate.
 - 4. Restore watering basins at end of rainy season.
 - 5. Adjust frequency and length of time for watering cycles according to changing soil and weather conditions.
 - 6. For supplemental hand watering of watering basins, use a water wand to break the water force.
 - 7. Do not permit crown roots to become exposed to air through dislodging of soil and mulch.
 - 8. Maintain depth of mulch to reduce evaporation and frequency of watering.
- B. Settled or Leaning Plants: Reset plants to proper grades or upright position.
- C. Weed Control:
 - 1. Keep mulched areas between plants and watering basins weed free.
 - 2. As a last resort use least toxic herbicides.
 - 3. Avoid frequent soil cultivation that destroys shallow roots.
- D. General Pruning:
 - 1. Meet requirements of Pruning Standards for Shade Trees.
 - 2. Prune trees to eliminate diseased or damaged growth.
 - 3. Reduce toppling and wind damage by thinning out crowns.
 - 4. Prune trees to maintain growth within space limitations, maintaining a natural appearance and balancing crown with roots.
 - 5. Retain lower branches in a "tipped back" or pinched condition to promote caliper trunk growth.
 - 6. Do not cut back to fewer than six buds or leaves on branches.
 - 7. Prune damaged trees or those that constitute health or safety hazards at any time of year.
 - 8. Make cuts clean and close to the trunk, without cutting into the branch collar.
 - 9. Make larger cuts (one inch in diameter or larger) parallel to shoulder rings, with the top edge of the cut at the trunk or lateral branch.

- E. Fertilizing Acid Loving Plants:
 - 1. Feed 1 tablespoon of 3-12-12 fertilizer per each foot width of plant.
 - 2. Spread evenly around plant and water thoroughly.
 - 3. Start feeding when buds have formed until the plant is finished blooming at approximately 4 week intervals.

- F. Replacement of Plants: Replace, without cost to District, and as soon as weather conditions permit, plants not in a vigorous, thriving condition, during and at the end of the maintenance period.

3.4 GRASSES MAINTENANCE

A. First three weeks after installation.

- 1. Watering:
 - a. For the first three weeks after installation, keep the sod and soil moist throughout the day but never allow the soil to become soggy.
 - b. Apply water slowly so as to penetrate the entire root zone, without erosion of soils. Pending weather and soil conditions, water four to six times during the day, for approximately five to six minutes each time until roots have become fully established. Adjust watering length and cycle as required to not overwater or underwater the turf. If water is standing under the sod for more than a few minutes after an irrigation set has finished or if the soil is soggy, reduce the amount of water being applied.
 - c. Root establishment will usually begin within seven to fourteen days depending on the time of year and microclimate.
 - d. Reduce the frequency of watering cycles just before the first mowing to allow the soil to firm up prior to the first mowing.
 - e. Water at night or early mornings.
- 2. Mowing:
 - a. Approximately 14 days after the sod has been installed, mow approximately 1/3 of the grass blades.

B. Three weeks and beyond after installation:

- 1. Watering:
 - a. Reduce the frequency of watering at a gradual pace.
 - b. Validate the establishment of roots by pulling up a corner of the sod. Once resistance is found, eliminate the last irrigation set of the day. Adjust accordingly in response to temperature, length of day, season, rainfall and soil types.
 - c. Once the roots have gotten firmly established, add a couple minutes to each irrigation
 - d. After approximately a week, repeat process until you are watering once a day.

2. Mowing:
 - a. Mow when turf is dry.
 - b. Mow with a "mulching rotary lawn mower".
 - c. Mow as required to maintain height of 3 to 4 inches.
 - d. Never remove more than 1/3 of leaf blade per mowing cycle.
3. Amendments and Fertilization During Growing Season:

2. Four to Six weeks after installation, fertilize with Bolero Lawn Food according to manufacturer's current printed instructions.
3. Allow for 10 pounds of gypsum per 1000 square feet for every 4 weeks after planting until Owner accepts maintenance. Apply gypsum by hand or tractor mounted broadcaster. Contingent upon season, application may not be necessary. Confirm with Landscape Architect prior to installation. If not used, submit credit to District.
4. Apply evenly over planting areas by spreading half in one direction and half in a direction 90 degrees to the first direction to assure even application.
5. Apply with either a broadcast centrifugal or gravity spreader.
6. Water thoroughly after application.

4. Resodding of Grass Areas: Resod without cost to District, and as soon as weather conditions permit, grass areas not in a vigorous, thriving condition, during and at the end of the maintenance period.

3.5 INSECTS, PESTS, AND DISEASE CONTROL

A. General:

1. Employ principles of IPM in the selection of preventative and control measures for plant pests and diseases.
2. Insignificant pests will be tolerated providing they do not seriously threaten planting health and appearance.
3. Monitor the site closely and take timely action to address problems identified.
4. Use personnel licensed and experienced using materials approved by the EPA and conform to applicable laws, codes and regulations, under the direction of a licensed certified pest control operator.
5. Spray with extreme care to avoid hazards to any person, pet, or automobile in the area or adjacent areas.
6. Meet requirements of chemical manufacturer's current printed instructions.
7. The Contractor shall be held liable for plant damage due to the use of chemicals.

B. Inspection:

1. Inspect plant material weekly for signs of stress and damage.
2. Submit a written and photographic inspection report of findings monthly to Owner and Owner's representative.
3. Spraying:
4. When necessary apply the least toxic chemical required for the existing problem.
5. Apply in strict accordance with manufacturer's current printed instructions.

- C. Apply sprays only if a pest or disease is a serious threat and cease application after problem is under control.

3.6 IRRIGATION SYSTEM

A. Damages:

1. Repair without charge to District damages to system caused by Contractor's operations.
2. Perform repairs within one watering period.

B. Cleaning and Monitoring the System:

1. Continually monitor the irrigation systems to verify that they are functioning properly as designed.
2. Clean filters and strainers at least once a month and as often as necessary to keep the irrigation systems free of sand and other debris.
3. Set and continuously adjust and program automatic controller for seasonal water requirement.
4. Make program adjustments as required by changing field conditions.
5. At least once a week, daily when required, use a soil sampling tube to check the rootball moisture of representative plants as well as the surrounding soil.
6. Prevent spraying on windows, building walls, and game courts, etc. by balancing the throttle control on the remote control valves and the adjustment screws on the sprinkler heads.
7. Do not allow water to atomize and drift.

3.7 FIELD QUALITY CONTROL

A. Maintenance Review:

1. At the end of the maintenance period, request a review by the District's representative to determine whether maintenance Work meets the requirements of the Contract Documents.
2. Submit a written request at least five working days prior to the anticipated date of review.
3. If it is found that the maintenance Work does not meet the requirements of the Contract Documents, the Contractor will receive written notification from the District's representative of corrective Work preventing District acceptance of the maintenance Work.
4. Perform corrective Work within ten calendar days after the review.
5. Upon completion of the corrective Work, request another review to determine whether the maintenance Work meets the requirements of the Contract Documents.
6. Corrective Work followed by review will be required until the corrective Work is found by the Owner's representative to meet the requirements of the Contract Documents.

A. Payment for Additional Maintenance Review Field Trips: If additional trips are required after the first review because of incomplete work, reimburse District for expenses and fee required to have District's representative make additional field trips.

B. District's Acceptance of Maintenance:

When the District's representative determines that the maintenance Work conforms to the requirements of the Contract Documents the Contractor will receive written notification designating the day which the District will accept maintenance responsibility.

1. Continue maintenance of landscape Work until the District accepts maintenance.

END OF SECTION

**SECTION 321123
AGGREGATE BASE**

PART 1 - GENERAL

1.1 SUMMARY

- A. Specifications for furnishing, spreading, and compacting aggregate base course for pavements as indicated.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 ASTM D2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 ASTM D3017 Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- B. State of California, Department of Transportation (Caltrans), Standard Specifications:
 Section 17 Watering
 Section 26 Aggregate Bases
- C. State of California, Department of Transportation (Caltrans), Standard Test Methods:
 Calif. Test 201 Method of Soil and Aggregate Sample Preparation Aggregates
 Calif. Test 202 Method of Tests for Sieve Analysis of Fine and Coarse Aggregates
 Calif. Test 205 Method of Determining Percentage of Crushed Particle
 Calif. Test 216 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates
 Calif. Test 217 Method of Test for Sand Equivalent
 Calif. Test 229 Method of Test for Durability Index
 Calif. Test 301 Method of Test for Resistance "R" Value of Treated and Untreated Bases, Subbases and Basement Soils by the Stabilometer

PART 2 - PRODUCTS

2.1 AGGREGATE BASE MATERIAL

- A. Class 2 aggregate base shall be free of vegetable matter and other deleterious substances. Coarse aggregate, material contained on the No. 4 sieve, shall consist of material of which 25 percent by weight shall be crushed particles as determined by California Test Method No. 205. Class 2 aggregate base shall conform to one of the following gradings, determined in accordance with California Test Method No. 202:

Sieve	Percentage Passing Sieves
	3/4 inch Maximum
2 inch	—
1 ½ inch	—
1 inch	100
¾ inch	90-100
No. 4	35 - 55
No. 30	10 - 30
No. 200	2 - 9

- B. Class 2 aggregate base shall conform to the following additional requirements:

Tests	Test Method No. Calif.	Requirements
Resistance (R-Value)	301	78 min.
Sand Equivalent	217	22 min.
Tests	Test Method No. Calif.	Requirements
Durability Index	229	35 min.

- C. Light Weight Backfill: Naturally-occurring volcanic rock with a maximum unit weight of 65 pounds per cubic foot, minimum Durability Index of 35 (California Test 229), minimum R-Value of 50 (California Test 301), wrapped in geotextile fabric, with the following gradation requirements:

Sieve Size	Percentage Passing
1-1/2 inch	100
1 inch	95 to 100
3/4 inch	90 to 100
3/8 inch	15 to 85
No. 4	0 to 9

- D. Geotextile Fabric: Mirafi FW300 or equivalent

2.2 SOURCE QUALITY CONTROL

- A. Submit certificate of compliance for approval prior to installation of material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Call for an inspection by the Engineer and obtain written acceptance of the prepared subgrade or subbase before proceeding with the placement of aggregate base course.
- B. The subgrade or subbase to receive aggregate base course, immediately prior to spreading, shall conform to the compaction and elevation tolerances indicated for the material involved and shall be free of standing water and loose or extraneous material.

3.2 INSTALLATION STANDARDS

- A. Aggregate base course shall be applied over the prepared subgrade or subbase and compacted in accordance with Section 26 of the Caltrans Standard Specifications.
- B. Aggregate base course shall be minimum uniform thickness after compaction of dimensions indicated. Where not indicated, compacted thickness shall be six inches for driveways/sidewalks and eight inches for roadways.
- C. All compaction expressed in percentages in this section refers to the maximum dry density as determined by California Test Method No. 216.

3.3 SPREADING OF MATERIAL

- A. Aggregate for base course shall be delivered as uniform mixture of fine and coarse aggregate and shall be spread in layers without segregation.
- B. Aggregate base course material shall be free from pockets of large and fine material.

- Segregated materials shall be remixed until uniform.
- C. Aggregate base material shall be moisture-conditioned to near optimum moisture content in accordance with the applicable requirements of geotechnical report or as approved by the Engineer.
 - D. Aggregate base course six inches and less in thickness may be spread and compacted in one layer. For thicknesses greater than six inches, the base course aggregate shall be spread and compacted in two or more layers of uniform thickness not greater than six inches each.

3.4 COMPACTING

- A. Relative compaction of each layer of compacted aggregate base material shall be not less than 95 percent as determined by California Test Method No. 216.
- B. Thickness of finished base course shall not vary more than 3/4 inch from the indicated thickness at any point. Base which does not conform to this requirement shall be reshaped or reworked, watered, and recompact to achieve compliance with specified requirements.
- C. The surface of the finished aggregate base course at any point shall not vary more than 3/4 inch above or below the indicated grade.

3.5 FIELD QUALITY CONTROL

- A. Perform field tests in accordance with ASTM D2922 to determine compliance with specified requirements for density and compaction of aggregate base material, and with ASTM D3017 to determine moisture-content compliance of the installed base course.

END OF SECTION

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SECTIONS 321216
ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Specifications for providing asphaltic concrete paving as indicated.
- B. Related Sections
 - 1. Section 321123, "Aggregate Base"

1.2 REFERENCES

- A. State of California, Department of Transportation (Caltrans), Standard Specifications

- Section 39 Asphalt Concrete
 - Section 92 Asphalt Binders
 - Section 94 Asphaltic Emulsions

- B. State of California, Department of Transportation (Caltrans), Standard Test Methods

- Calif. Test 202 Method of Tests for Sieve Analysis of Fine and Coarse Aggregates
 - Calif. Test 304 Method of Preparation of Bituminous Mixtures for Testing
 - Calif. Test 366 Method of Test for Stabilometer Value
 - Calif. Test 375 Determining the In Place Density and Relative Compaction of AC Pavement

1.3 PROTECTION

- A. Protect concrete pavements and walks, curbs and bases, and other improvements adjacent to the operations with suitable materials. The Contractor shall be responsible for any damage caused by the Contractor's employees or equipment and shall make necessary repairs. Building and other surfaces shall be covered with paper or other protection, where required. All damage caused by the Contractor's operations shall be prepared or replaced as required.

PART 2 - PRODUCTS

2.1 BASE COURSE MATERIAL

- A. Class 2 Aggregate Base. Percentage composition by weight of aggregate base material shall conform to the 3/4 inch maximum grading when determined by California Test 202.

2.2 TACK COAT

- A. Tack Coat: Diluted SS-1 or SS-1h emulsion or undiluted RS-1 emulsion in conformance with Section 94 or the Caltrans Standard Specifications.

2.3 ASPHALT PAVING MATERIALS

- A. Paving Asphalt: All purpose, aged residue, steam refined, PG 64-10 grade, in accordance with Section 92 of the Caltrans Standard Specifications.
- B. Aggregate: Type A, with the grading of the combined aggregate conforming to 1/2 inch maximum size, medium grading, as specified in Section 39 of the Caltrans Standard

Specifications.

- C. Mixing Facilities: Asphalt concrete surfacing material shall be furnished from an approved commercial asphalt central mixing plant.

2.4 SOURCE QUALITY CONTROL

- A. Contractor shall submit Certificate of Compliance from manufacturer for approval prior to installation.

PART 3 - EXECUTION

3.1 PLACING OF BASE COURSE

- A. The Contractor shall call for an inspection by the Engineer and obtain written approval of the subgrade before proceeding with the base course.
- B. Base course shall be minimum uniform thickness after compaction of dimensions indicated.
- C. Base course shall be placed over finished subgrade and compacted in accordance with Section 32 11 23 - Aggregate Base.
- D. After base course has been completed, the Contractor shall call for an inspection by the Engineer and obtain written approval before proceeding with application of the asphalt wearing surface.

3.2 PLACING OF TACK COAT

- A. The Contractor shall call for an inspection by the Engineer and obtain written approval of the subgrade before proceeding with the tack coat.
- B. The tack coat shall be applied using a calibrated distributor truck spray bar, hand spraying, squeegee and brush application in locations where required and per manufacturers requirements. Tack coat shall be applied in accordance with Section 39-4 of the Caltrans Standard Specifications at the rate of from 0.22 to 0.28 gallons per square yard.

3.3 PLACING ASPHALT CONCRETE

- A. Areas to be paved shall be covered with a layer of hot asphalt concrete surfacing not to exceed 3.0 inches after compaction.
- B. Paving asphaltic concrete shall be delivered, laid, rolled, and finished in accordance with Section 39 of the Caltrans Standard Specifications.
- C. Before placing asphalt concrete, a tack coat (paint binder) shall be applied to all vertical surfaces against which asphalt concrete surfacing will be placed. Tack coat shall be applied in accordance with Section 37-3.03B(6) of the Caltrans Standard Specifications at the rate of from 0.8 to 0.15 gallons per square yard.
- D. Finish surface of the wearing course shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, cold joints, or other irregularities.
- E. Finish paving shall conform to slopes, lines, and finish grades indicated, and shall drain properly. Where adjacent surfaces are intended to be flush (as at concrete gutters, walks, and paving), they shall conform smoothly at all joints.
- F. Ridges, indentations, and other objectionable marks left in the surface of the asphalt concrete by paving or rolling equipment shall be eliminated by rolling. The use of equipment that leaves ridges, indentations, or other objectionable marks in the asphalt concrete shall be discontinued, and other acceptable equipment shall be employed.
- G. Where cold joints are indicated or necessary, cut back the placed and compacted cold asphalt a minimum of three inches with a concrete or masonry power saw, so that a vertical face of compacted full thickness material is exposed. Treat this surface with a tack coat before proceeding with the placement of new asphaltic concrete surfacing.
- H. Finish paving shall conform to finish elevations within plus or minus 0.01 of a foot and shall be

level to within plus or minus 1/4 inch in 10 feet when measured with a 10 foot straightedge in any direction.

3.4 FIELD QUALITY CONTROL

- A. The Contractor shall control the quality of the work and shall provide adequate testing to assure compliance with these Specifications.
- B. After completion of paving work, all paving shall be flooded with water, and any resulting “ponds” shall be ringed with chalk. Such hollows shall be corrected with addition of asphalt paving materials and rerolling until all paving is completely level and free from hollows and high spots.
- C. The Engineer shall perform in-place density and compaction tests of the completed pavement in accordance with California Test 375 to determine compliance with specified requirements. Test shall be performed as often as necessary to verify compliance, but not less frequently than the following:
 - 1. One test required.

3.5 MAINTENANCE OF PAVEMENT

- A. Upon completion of final rolling, traffic shall not be permitted on the finished pavement for at least six hours, and until the asphalt concrete has cooled sufficiently to withstand traffic without being deformed. Finished pavement shall be maintained in finished clean condition until the work is accepted by the Engineer.

END OF SECTION

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SECTION 311316

SITE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork.
 - 2. Reinforcement.
 - 3. Expansion Joint Fill Material.
 - 4. Concrete Placement.
 - 5. Finishing.
 - 6. Curing.
 - 7. Downspout Nozzle
 - 8. Skate Deterrents.
 - 9. Cast Iron Detectable Warning Plate Type 1.
- B. For Earthwork, see Division 31.
- C. For Irrigation, see Section 32 84 00.
- D. For Site Concrete Water Repellents, see Section 07 09 21.
- E. For Site Concrete Sealants, see Section 32 13 73.
- F. For Site Furnishings, see Section 32 30 00.
- G. For Soil Preparation and Soil Mixes, see Section 32 91 13.
- H. For Planting Area Finish Grading, see Section 32 91 19.
- I. For Plant Material, see Section 32 93 00.
- J. For Landscape Drainage, see Section 33 41 01.
- K. For Sustainable Design Requirements, see Section 01 81 13.

1.2 DEFINITIONS

- A. Acceptance: Wherever the terms "acceptance" or "accepted" are used herein, they mean acceptance of Owner's representative in writing.
- B. Finishing Tolerances:
 - 1. "Class A": True plane within 1/8" in ten feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.
 - 2. "Class B": True plane within 1/4" in ten feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.

1.3 REFERENCES

- A. ASTM — American Society for Testing and Materials:
1. A82/A82M — Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement. Most current edition.
 2. A 497/A497M — Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement. Most current edition.
 3. A 615/A615M — Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. Most current edition.
 4. A 767/A767M — Specification for Zinc-Coated Bars for Concrete Reinforcement. Most current edition.
 5. A 775/A775M — Specification for Epoxy-Coated Reinforcing Steel Bars. Most current edition.
 6. C 33 — Specification for Concrete Aggregates. Most current edition.
 7. C 150 — Specification for Portland Cement. Most current edition.
 8. C 171 — Specification for Sheet Materials for Curing Concrete. Most current edition.
 9. C 260 — Specification for Air-Entraining Admixtures for Concrete. Most current edition.
 10. C 309 — Specification for Liquid Membrane-Forming Compounds for Curing Concrete. Most current edition.
 11. C 494/C494M — Specification for Chemical Admixtures for Concrete. Most current edition.
 12. C 881/C881M — Specification for Epoxy-Resin Base Bonding Systems for Concrete. Most current edition.
 13. C 979 — Specification for Pigments for Integrally Colored Concrete. Most current edition.
 14. C 1116 — Specification for Fiber-Reinforced Concrete and Shotcrete. Most Current Edition.
 15. D 1751 — Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). Most current edition.
 16. D 1752 — Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. Most current edition.
- B. ACI — American Concrete Institute, Manual of Concrete Practice:
1. ACI SP66— Manual of Standard Practices for Detailing Concrete Structures. Most current edition.
 2. ACI 303R — Guide to Cast-in-Place Architectural Concrete Practice. Most current edition.
 3. ACI 304R — Recommended Practice for Measuring, Mixing and Placing Concrete. Most current edition.
 4. ACI 305R — Recommended Practice for Hot Weather Concreting. Most current edition.
 5. ACI 306R — Recommended Practice for Winter Concreting. Most current edition.
 6. ACI 308 — Standard Practice for Curing Concrete. Most current edition.
 7. ACI 318 — Building Code Requirements for Reinforced Concrete. Most current edition.
 8. ACI 347R — Recommended Practice for Concrete Formwork. Most current edition.
- C. AWS — American Welding Society:
1. B3.0 — Standard Qualification Procedure. Most current edition.
 2. D12.1 — Reinforced Concrete Construction. Most current edition.
- D. CRSI — Concrete Reinforcing Steel Institute:
1. MSP-1-90 — Manual of Standard Practice. Most current edition.

1.4 SUBMITTALS

A. Product Data:

1. Expansion joint fill material
2. Color admixtures.
3. Micro-reinforcement.
4. Top Cast Surface Retarder
5. Skate Deterrent
6. Cast Iron Detectable Warning Plate Type 1

B. Samples:

1. Expansion Joint Fill Material: Submit one 12-inch length.
2. Skate Deterrent: Submit one unit.

C. Shop Drawings:

1. Detail installation of CIP Concrete Walls and CIP Concrete Biotreatment Planter Walls. Indicate wall locations, plans, elevations, cross sections, dimensions, limits of each finish, edge radii, skate deterrents and types of reinforcement, including special reinforcement and footings.
 - a. Detail loose and cast-in hardware, connections and joints, including accessories.
 - b. Detail form board and tie hole layout for concrete retaining wall. Refer to Architecture drawings for tie hole layout

D. Design Data:

1. Concrete mix.

E. Test Results:

1. Concrete Cylinder Tests.

1.5 QUALITY ASSURANCE

A. Contractor Qualifications: Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

B. Regulatory Requirements: Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.

C. Field Samples:

1. Provide one 6-feet by 6-feet sample of concrete paving. Include the specified color admixture, finish, control joints, expansion joint materials and sealant, and edge treatments.
2. Provide one 9-feet long segment of concrete planter wall. Include 9" wide weep depression, stepped offset walls with openings for planting. Include the specified color admixture, finish, control joints, expansion joint materials and sealant, and edge treatments.
3. Provide one 6-feet long segment of concrete retaining wall at tallest location per Grading Plan. Include the specified color admixture, control joints, expansion joint materials, tie holes, edge treatments, water repellent and anti-graffiti coating (See Site Concrete Water Repellents).

4. Construct as many samples as necessary to achieve an accepted finish over the entire surface of the sample.
5. Samples which are completely or partially finished incorrectly will be rejected.
6. Remove rejected samples immediately from the site.
7. Place the accepted sample in a location where the finishers can easily reference the sample finish.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Welded Wire Fabric: Leave tags designating size and spacing on each roll until installed.

1.7 SITE CONDITIONS

- A. General Environmental Requirements: Protect concrete against extreme cold and heat, frost, rapid drying and damage by rain.
- B. Environmental Requirements for Dowel Epoxy: Meet requirements of manufacturer's current printed instructions.

1.8 WARRANTY

- A. General Description: In addition to manufacturer's warranties, warrant Work for a period of one year from the Date of Final Completion against defects in materials and workmanship.
- B. Additional Items Covered: Warranty shall also cover repair of damage to other materials and workmanship resulting from defects in materials and workmanship.
- C. Exceptions: Contractor shall not be held responsible for failures due to ordinary wear, neglect by Owner, vandalism, or other causes beyond the Contractor's control.

1.9 LEED SUBMITTALS

- A. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
 - MRc3 - Sourcing of Raw Materials - **Recycled Content**: Provide product data for pre- and post- consumer recycled content.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

- A. Dowel Epoxy or Resin:
 1. The Rawlplug Company, Inc. – www.rawlplug.com
 2. Hilti, Inc. – www.us.hilti.com.
 3. Sika Corporation – usa.sika.com.
 4. Or accepted equal.

- B. Expansion Joint Material:
 1. Williams Products, Inc. – williamsproducts.net.
 2. Or accepted equal.
- C. Coloring Admixtures for Colored Concrete:
 1. Sika – www.usa.sika.com.
 2. Or accepted equal.
- D. Form Sealer:
 1. Nox-Crete – www.noxcrete.com.
 2. Or accepted equal.
- E. Form Release Agent:
 1. Nox-Crete – www.noxcrete.com.
 2. Or accepted equal.
- F. Skateboard Deterrent:
 1. Grinder Minders – www.grindtoahalt.com.
 2. Or accepted equal.
- G. Concrete Top Surface Retarder:
 1. GCP Applied Technologies – www.GCPAT.com
 2. Or accepted substitute.
- H. Cast Iron Detectable Warning Plate Type 1:
 1. Neenah Foundry – www.nfco.com.
 2. Or accepted substitute.

2.2 MATERIALS

- A. Cement for Grey Cement Concrete:
 1. ASTM C 150, Type I Portland Cement.
- B. Coarse Aggregate for Grey Cement Concrete:
 1. ASTM C 33, ACI 304R.
- C. Fine Aggregate for Grey Cement Concrete:
 1. ASTM C 33-03, ACI 304R, hard, durable and clean sand. Do not use sand coated with injurious amounts of silt, loam or clay or other deleterious matter. Fine aggregate and sand shall be from a single source and shall be like in visual appearance.
 2. Type: Orca Sand
- D. Reinforcing Bars:
 1. ASTM A 615, grade 60, deformed billet-steel bars, clean and free from rust, scale, or coating that will reduce bond.
- E. Welded Wire Fabric:
 1. ASTM A 185 plain wire, ASTM A 497 deformed wire.

- F. Tie Wire:
 - 1. 16 gauge or heavier, black annealed wire.
- G. Supports for Reinforcement:
 - 1. Meet requirements of CRSI-MSP-1.
 - 2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are stainless steel protected.
- H. Dowels:
 - 1. Quality: ASTM A 615, smooth, billet-steel bars.
 - 2. Size: As shown on Drawings.
- I. Water: Clean, potable, concrete mixing water free from injurious amounts of salts, oils, acids, alkalis, organic materials, iron, rust or other deleterious substances which would cause staining.
- J. Air Entrainment: ASTM C 260, non-staining.
- K. Coloring Admixtures for Colored Concrete: ASTM C 979, Chromix P Admixture, color as indicated on Drawings, as available from Sika.
- L. Expansion Joint Material: ASTM D 1752 Type II cork, or ASTM D 1752 Type I, sponge rubber with 30 to 40 pounds per cubic foot density, 95 percent minimum recovery and compatible with joint sealant to be used.
- M. Form Release Agent: Non-staining material.
- N. Chemical Admixtures: ASTM C 494, colored and water-reducing and/or retarding compatible, Type A or Type D, as required.
- O. Admixture Restrictions for Colored Concrete: Do not use calcium chloride or other accelerating admixtures containing calcium chloride, fly ash, or any admixtures that will stain colored and white concrete.
- P. Top Surface Retarder: Top Cast Acid Etch 01
- Q. Curing Paper: ASTM C 171.
- R. Dowel Epoxy: ASTM C 881, 2-part, chemical resistant, structural epoxy, designed for use in anchoring threaded rods, bolts, reinforcing bars, and smooth dowels to solid material.
- S. Curing Compounds for Non-Colored Concrete: ASTM C 309, non-staining.
- T. Dowel Sleeve: Plastic dowel cap, 4" length sized to fit dowels.
- U. Concrete Planter/Retaining Walls and Stairs Forming Material:
 - 1. MDO or HDO composite overlaid plywood for face forms.
 - 2. Synthetic Polyethylene or milled wood for reveals and corner forms.
- V. Form Sealer: Nox-Crete Clear Pre-Form transparent, penetrating polyurethane wood sealer.
- W. Aggregate Base for on-grade Installation: Per Geotechnical Investigation Report.
- X. Skateboard Deterrent:

1. Type: GrinderMinder - Cylinder
2. Finish: Solid Stainless Steel 316 with Brushed Finish Standard

Y. Expansion Joint Sealant:

1. Product: 890FTS-TXTR
2. Color: To be selected in field with final mock up

Z. Cast Iron Detectable Warning Plate Type 1:

1. Type: 24" x 36" Quick Connect Plates
2. Finish: Cast Iron
3. Quantity: See Drawings

2.3 MIXES

A. Concrete Paving (Vehicular and Pedestrian), Topping Slab, CIP Planter Walls, and CIP Biotreatment Planter Walls:

1. Mix design to match approved mock-up for architectural concrete wall design.
2. Meet applicable requirements of ACI 303R for mix proportioning and mixing.
3. Meet applicable requirements of ACI 304R for mix proportioning and mixing, except as modified by ACI 303R.
4. Employ commercial testing laboratory to design concrete mixes with 3,000 psi minimum strength at 28 days, maximum 4 inch slump and admixtures compatible with color admixture.
5. Submit mix design data to Owner's representative for review prior to mixing.
6. For colored concrete elements incorporate color admixture into mix by meeting the requirements of the color admixture manufacturer's current printed instructions and do not exceed 10 percent of mix content by weight.

B. Non-Architectural Concrete:

1. Mix design to match approved structural concrete mix design.
2. Meet requirements of ACI 304R for mix proportioning and mixing.
3. Employ commercial testing laboratory to design concrete mixes with 3,000-psi minimum strength at 28 days, maximum 4-inch slump and admixtures compatible with color admixture.
4. Submit mix design data to Owner's representative for review prior to mixing.

2.4 LEED REQUIREMENTS

- A. **PS EPD:** Products specified under this section must have a Type III Product Specific EPD.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.

- B. Subgrade Verification: Verify that subgrade is properly compacted and installed at correct elevations.
- C. Notification of Unsuitable Conditions: Before proceeding with Work, notify Owner and Owner's representative in writing of unsuitable conditions.

3.2 PREPARATION

- A. Protection:
 - 1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
 - 2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
 - 3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 - 4. Submit written notification of damaged plants and structures to Owner and Owner's representative.
- B. Surface Preparation: Remove water and other materials which could be absorbed by concrete from substrate or base.

3.3 EARTHWORK

- A. For Earthwork, see Division 31.

3.4 FORMWORK

- A. General:
 - 1. Meet applicable requirements of ACI 303R.
 - 2. Meet applicable requirements of ACI 304R, except as modified by ACI 303R.
 - 3. Construct forms accurately to dimensions, plumb and true to line and grade.
 - 4. Use forms that are strong, mortar tight, braced and tied so as to maintain position and shape during placing of reinforcing and concrete.
 - 5. Wavy surfaces and bulged walls or slab surfaces resulting from settlement or springing of formwork will be rejected.
 - 6. Carefully verify and check forms for alignment and level as the Work proceeds.
 - 7. Make needed adjustments or add additional bracing prior to pouring concrete.
- B. Form Materials at Exposed Surfaces:
 - 1. Smooth metal or MDO or HDO composite overlaid plywood for smooth finish, assembled with Class A formed finish for minimal surface deviation.
 - 2. Boards shall be sealed to avoid lignin-induced retardations of set of the surface fines, and resulting dusting.
- C. Reveals: Reveals shall be formed with sealed synthetic materials or milled wood.
- D. Tolerances:

1. Concrete Paving (Vehicular, Pedestrian and Topping Slab) to meet Class A tolerances. Slope of concrete to be constant with no depressions. True plane within 1/8" in ten feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.
 2. Concrete Planter Walls, Concrete Biotreatment Walls and Concrete Walls to meet Class B tolerances. Vertical and horizontal surfaces true plane within 1/4" in ten feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.
- E. Joints:
1. Construct forms and assemble them in such a manner so that joints occur at accepted locations.
 2. Provide a means to seal forms at joints such as foam tape, caulking or other gasket devices to avoid fines leaking out and rock pockets.
- F. Corners:
1. Form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed to face of concrete.
 2. Form exposed corners to produce square smooth, solid unbroken lines, unless indicated otherwise.
- G. Coordination of Trades: After forms have been placed notify other trades in sufficient time to complete installation of their Work.
- H. Other Trade Requirements:
1. Construct chases, slots and recesses as required.
 2. Consult other trades for definite locations, sizes and shapes.
 3. Locate inserts, anchor plates and other items to be embedded in concrete where required, properly place and securely anchor.
- I. Recesses and Openings: Provide as shown on the Drawings.
- J. Prior to Pouring Concrete:
1. Thoroughly clean out forms to be used.
 2. Thoroughly wet wood forms where form coatings are not used.
- K. Placement:
1. Allow zero drop to minimize entrapped air and eventual surface defects.
 2. Placement can use a tremie tube.
 3. Vibration shall be carefully done.
- L. Form Ties:
1. Ties shall be laid out in a regular pattern and per accepted Shop Drawings.
 2. Tie holes shall be partially patched per accepted Field Sample.
- M. Form Member Sealing:
1. After form boards have been placed in final form position, seal forming members and corner/reveal members.
 2. Apply in two coats, wet-on-wet, and according to manufacturer's current directions.
- N. Removal of Forms:
1. Do not remove supporting forms or shoring until concrete has sufficient strength to carry its own weight and other loads upon it.

2. Remove forms only after concrete has properly set and without damaging concrete.

O. Re-use of Forms:

1. Do not reuse if there is any evidence of surface wear or tear which would impair quality of finishes.
2. Store formwork and form materials in such a manner as to prevent damage or distortion.
3. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage to concrete finish.

3.5 REINFORCEMENT

- A. Fabrication and Placement: Meet applicable requirements of CRSI-MSP-1, ACI 318, ACI 303R and ACI 304R.
- B. Coordination with Other Trades: Coordinate other trades' schedules to avoid disturbing or moving Work already installed by one trade to admit the Work of another.
- C. Supports:
1. Accurately and securely fasten or support reinforcements to prevent displacement before or during pouring.
 2. Hang footing bars from forms.
 3. Support wire mesh with metal cradles.
- D. Reinforcement Splices:
1. Overlap welded wire fabric one mesh minimum.
 2. Overlap reinforcing bar 24 times the bar diameter minimum, except as otherwise noted.
- E. Dowel Epoxy: Meet requirements of manufacturer's current printed instructions.

3.6 CONCRETE PLACEMENT

- A. Other Requirements: Meet applicable requirements of ACI 303R and ACI 304R, except as modified below.
- B. Hot Weather Placement: Meet requirements of ACI 305R.
- C. Cold Weather Placement: Meet requirements of ACI 306R.

3.7 FINISHES

- A. Floated Finish:
1. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further until ready for floating.
 2. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.
 3. During or after the first floating, check the planeness of the surface with a ten foot straightedge applied at not less than two different angles.
 4. Cut down high spots and fill low spots, and produce a surface with a Class B tolerance throughout.

5. Re-float the slab immediately to a uniform sandy texture.

B. Steel Troweled Finish:

1. Prior to steel float troweling, provide a preliminary floated finish.
2. Trowel initial surface relatively free from defects, with some trowel marks visible.
3. Thoroughly consolidate surface by a second troweling with steel trowel.
4. Provide a finished surface essentially free from trowel marks, uniform in texture and appearance, and in a plane of Class A tolerance for horizontal surfaces and Class B for vertical surfaces.
5. See Top Cast finish for further finishing requirements.

C. Top Cast Finish:

1. Prior to top cast, provide a troweled finish on horizontal and vertical surfaces for all exposed Concrete Paving and Concrete Wall surfaces. For vertical surfaces construct formboards with seam 2" minimum below finish grade to allow for removal vertical formboards to allow for trowel face-finishing of vertical surfaces prior to application of Top Cast Finish, per timing requirements of manufacturer's printed instructions.
2. Apply Top Cast surface retarder per manufacturer's instructions, using same application rates, time of application post troweling, duration and crew as accepted field sample, using similar removal methods and same crew.
3. Remove Top Cast surface retarder per manufacturer's printed instructions, using the same duration, removal methods and crew as accepted field sample.
4. Perform Top Cast surface retarder in as continuous an operation as possible, utilizing the same work crew to provide a finish matching the accepted field sample.
5. Surface shall match the accepted field sample and be slip-resistant in compliance with ADA requirements.

3.8 SKATEBOARD DETERRENTS

- A. Install at locations shown on the Drawings, shall be level and installed per manufacturer's current printed instructions.

3.9 CONTROL JOINTS

- A. Type and Location: As detailed on the Drawings.
- B. Saw-cut joints: Saw-cut grooves so that a smooth uniform impression is obtained.
- C. Tooled joints: Form in fresh concrete using a jointer to cut the groove so that a smooth uniform impression is obtained.

3.10 EXPANSION JOINTS

- A. Locations and Widths: Provide joint material as shown on the Drawings, and where concrete paving abuts walls, curbs, or other structures.
- B. Installation:
1. Place joint materials with top edge below the paved surface as shown on the Drawings.
 2. Secure in place to prevent movement.

3. Install a rigid joint cap over the top of the fill material if required to keep top of fill material straight.
4. Apply Expansion Joint Sealant per manufacturer's instructions and to match accepted field sample.

3.11 CURING

- A. Other Requirements:
 1. Meet requirements of the ACI 303R except as modified by requirements below.
 2. Meet requirements of ACI 308, except as modified by ACI 303R and requirements below.
- B. Colored Concrete: Do not use curing compounds.
- C. Hot Weather Curing: Meet requirements of ACI 305R.
- D. Cold Weather Curing: Meet requirements of ACI 306R.

3.12 PATCHING

- A. Projections: Remove projecting fins, bolts, wire, nails, etc., not necessary for the Work, or cut them back 1 inch from the surface and patch in an inconspicuous manner.
- B. Voids:
 1. Fill holes with an accepted patching material the same color as the adjoining concrete.
 2. Mix and place patching material and finish flush with the adjacent surface.
- C. Corrective Patching:
 1. Correct defects in concrete Work.
 2. Chip voids to a depth of at least 1 inch with the edges perpendicular to the surface and parallel to form markings
 3. Fill voids, surface irregularities, or honey-combing by patching or rubbing.
 4. Insure that concrete surfaces so repaired duplicate the appearance of the unpatched Work.
- D. Defective Work: Remove in its entirety and replace defective concrete Work which after corrective patching fails to duplicate the appearance of un-patched Work as determined by the Owner's representative and fails to meet the requirements of these Specifications.

3.13 FIELD QUALITY CONTROL

- A. Test Cylinders:
 1. Provide minimum three 6-inch by 12-inch cylinders for each 150 cubic feet or 5,000 square feet of pour.
 2. Test 1 cylinder at 7 days, test second cylinder at 28 days, and test third cylinder only if needed for confirmation of compressive strength.
 3. Submit test results to Civil Engineer and Owner's representative.
- B. Field Observation Reviews by Owner's representative: Coordinate and schedule with Owner's representative.

3.14 CLEANING AND SEALING

A. Concrete Work:

1. The day prior to final review, remove stains, dirt and other materials using water and mild detergents.
2. Do not use other methods of cleaning unless accepted by the Owner's representative.
3. See Site Concrete Water Repellents 07 09 21.

3.15 PROTECTION

- A. Concrete Work: Protect Work against damage and defacement during subsequent construction operations until Final Completion by installing fencing, barriers and protective coverings.

END OF SECTION

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SECTION 321373
SITE CONCRETE SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Expansion Joint Sealant.
- B. For Site Concrete, see Section 321316.
- C. For Site Concrete Water Repellents, see Section 070921.
- D. For Precast Concrete Specialties, see Section 034800.

1.2 DEFINITIONS

- A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of District’s representative in writing.

1.3 REFERENCES

- A. ASTM — American Society for Testing and Materials:
 - 1. C 920 — Specification of Elastomeric Joint Sealants. Most current edition.
 - 2. C 1193 — Guide for Use of Joint Sealants. Most current edition.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Sealant.
 - 2. Bond Breaker.
 - 3. Joint Primers.
 - 4. Backup Material.
- B. Samples:
 - 1. Sealant Colors.
 - 2. Bond Breaker.
- C. Manufacturer’s Instructions:
 - 1. Sealant manufacturer’s current printed installation instructions.

1.5 QUALITY ASSURANCE

- A. Contractor Qualifications: Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

1.6 WARRANTY

- A. General Description: In addition to manufacturer's warranties, warrant Work for a period of one year from Date of Final Completion against defects in materials and workmanship.
- B. Additional Items Covered: Warranty shall also cover repair of damage to other materials and workmanship resulting from defects in materials and workmanship.
- C. Exceptions: Contractor shall not be held responsible for failures due to neglect by District, vandalism and other causes outside the Contractor's control.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Expansion Joint Sealant:
 - 1. Pecora Corporation – <http://www.pecora.com>.
 - 2. Or accepted equal.

2.2 MATERIALS

- B. Expansion Joint Sealant:
 - 1. 890FTS-TXTR
 - 2. Color: To be selected in Field with Field Sample
- C. Joint Primers: Use only those primers which have been tested for durability on the surfaces to be sealed and are specifically recommended for this installation by the manufacturer of the sealant used.
- D. Backup Materials: Use only those backup materials which are non-absorbent, non-staining, and specifically recommended for this installation by the manufacturer of the sealant used.
- E. Masking Tape: For masking around joints, provide an appropriate masking tape which will effectively prevent application of sealant on surfaces not scheduled to receive it, and which is removable without damage to substrate.
- F. Bond Breakers: Use only those bond breakers which are specifically recommended by the sealant manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
- B. Joint Size Verification: Verify that the required proportion of width of joint to depth of joint has been provided.
- C. Notification of Unsuitable Conditions: Before proceeding with Work, notify District and District's representative in writing of unsuitable conditions.

3.2 PREPARATION

- A. Protection:
 - 1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the work.
 - 2. Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.
 - 3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 - 4. Submit written notification of conditions damaged during construction to the District and District's representative immediately.

- B. Preparation of Concrete Surfaces:
 - 1. Clean surfaces to be dry, sound, and free from dust, concrete residue and other materials which could weaken bond or conflict with sealant width and depth.
 - 2. At open joints, remove dust by mechanically blown compressed air if required.
 - 3. Remove oil and grease, use sandblasting or wire brushing.
 - 4. Where surfaces have been treated, remove the surface treatment by sandblasting or wire brushing.

3.3 INSTALLATION

- A. Priming:
 - 1. Meet requirements of the manufacturer's current printed instructions.
 - 2. Meet requirements of ASTM C 1193, except where in conflict with manufacturer's instructions.

- B. Bond-Breaker Installation:
 - 1. Meet requirements of the manufacturer's current printed instructions.
 - 2. Provide bond-breaker where recommended by the manufacturer of the sealant, and where indicated by the Drawings.

- C. Backup Installation:
 - 1. Install back-up material where shown on the Drawings.
 - 2. Use a blunt-surfaced tool of wood or plastic, having shoulders designed to ride on the adjacent finished surface and a protrusion of the required dimensions to assure uniform depth of backup material below the sealant.
 - 3. Do not use a screwdriver or similar sharp-ended tool to install backup material.
 - 4. Using the blunt surfaced tool, smoothly and uniformly place the backup material to the depth required by the sealant manufacturer's current printed instructions, compressing the backup material no more than 25 percent and securing a positive fit.
 - 5. When using backup of tube or rod stock, avoid lengthwise stretching of the material.
 - 6. Do not twist or braid hose or rod backup stock.

- D. Masking: Thoroughly and completely mask joints on exposed surfaces.

- E. Equipment:
 - 1. Apply sealant under pressure with power-actuated hand gun or manually-operated hand gun, or by other appropriate means.

2. Use guns with nozzle of proper size, and providing sufficient pressure to completely fill the joints as designed.

F. Sealant Thickness: Meet requirements of the manufacturer's current printed instructions.

G. Tooling Sealant:

1. Tool sealant to insure complete filling of the joint to eliminate air pockets and voids and to insure positive adhesive of the sealant with the bonding surfaces.
2. Tool joints to the profile shown on the Drawings or if such profiles are not shown on the Drawings provide uniformly smooth joints with slightly concave surface.
3. Do not use tooling agent unless specifically recommended in writing by the manufacturer of the sealant.

3.4 FIELD QUALITY CONTROL

A. Field Observation Reviews by District's representative: Coordinate and schedule with District's representative.

3.5 CLEANING

A. Sealant Residue: Before it hardens, clean sealant from adjacent surfaces as the installation progresses, using solvent or cleaning agent recommended by the manufacturer of the sealant used.

END OF SECTION

SECTION 321413
INTERLOCKING CONCRETE PAVER

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Specifications and procedure for furnishing and installing interlocking concrete paver system,
- B. System shall consist of precast concrete Narrow Modular Paving Units, (NMP), with Portland cement mortar-set as indicated in plans.
- C. Related Sections:
 - 1. 321123 Aggregate Base
 - 2. 32 16 13 Concrete Curbs, Gutters, and Sidewalks

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - ASTM C33 Concrete Aggregates
 - ASTM C39 Concrete Compressive Strength
 - ASTM C144 Aggregate for Masonry Mortar
 - ASTM C150 Portland cement
 - ASTM C595 Standard Specification for Blended Hydraulic Cements
 - ASTM C642 Water Absorption, Density, Voids in Hardened Conc
 - ASTM C666 Rapid Freeze/Thaw Resistance of Conc
 - ASTM C979 Pigments for Integrally Colored Concrete
 - ASTM C1028 Coefficient of Friction

1.3 SUBMITTALS

- A. Samples: Submit two full-sized samples of each type of precast concrete paving units to show the full range of color and texture of unit for selection and approval. If sealer is to be applied to precast concrete paving slab, apply sealer on one sample.
- B. Warranty: Provide certified copies of manufacturer's product warranties.
- C. Shop drawings: Layout drawings showing pattern of pavers for each paved area, indicate pavers requiring cutting, indicate setting bed methods in each area and indicate details at vertical surfaces.

1.4 QUALITY ASSURANCE

- A. Compliance with Regulations: Comply with requirements of state and local building codes and with rules and regulations relating to building accessibility.
- B. Qualifications of Manufacturer: Company specializing in manufacture of precast concrete paving units with a minimum of 10 continuous years of documented experience.
- C. Qualifications of Subcontractor: Subcontractor shall submit evidence of skill and not less than 5 years of experience in this product type.
- D. Pre-installation Conference: As directed by the Architect
- E. Precast concrete paving units shall have a compressive strength of 5,000 psi minimum.

PART 2 - PRODUCTS

2.1 PAVER UNIT

Stepstone, Inc., 17025 South Main Street, Gardena, CA 90248, (310) 327-7474, (800) 572-9029, www.stepstoneinc.com or approved equivalent.

- A. Precast concrete paving units shall be Narrow Modular Pavers, (NMP), precast concrete, consisting of Portland cement, aggregate, and color admixtures.
 - 1. Portland Cement: ASTM C 150, Type III, high early strength.
 - 2. Aggregate: ASTM C 33.
 - 3. Color Admixture: By Davis Colors, or equal, as required to achieve color as selected.
 - 4. Aggregate for exposed aggregate surface: As selected.
 - 5. Portland Cement Mortar that meets or exceeds ANSI A118.4 requirements when mixed with water or a latex admixture, and is designed for installation of large format tile – Pedestrian and vehicular Installation.
 - 6. Grout that meets or exceeds ANSI A118.7 when mixed with water or a latex admixture.

- B. Precast concrete paving unit style:

Narrow Modular Pavers – 4" thick (5-7/8" x 11-7/8" x 4"). Compressive strength: Minimum 5,000 psi. Integrated spacer tabs allow Narrow modular pavers to be placed together and maintain even spacing throughout the installation. Minor adjustments may be necessary to maintain consistent joint lines. Narrow Modular Paver: 4 inches thick: 44 pounds per square foot. Water absorption: Not more than 6.0 % average, not more than 7.0 % for any individual unit for standard colors. Pavers shall have radius top edge to reduce chipping. All pavers have drafted sides

- C. Color and Finish

Colors: 1404 French Gray

All finishes shall be Light Sandblasted. Walking surfaces of precast concrete paving units shall have minimum coefficient of friction of 0.60, wet and dry.

2.2 FABRICATION

- A. Narrow Modular Pavers shall be hand-made, wet-cast of cement conforming to ASTM C 150, Type III, aggregates conforming to ASTM C 33, and pigments for integrally colored concrete conforming to ASTM C979.

2.3 SOURCE QUALITY CONTROL

- A. Concrete for Narrow Modular Pavers shall be tested frequently to assure that mixes provide units having not less than 5,000 psi compressive strength at 28 days (average test strength not less than 4,500 psi).
- B. Minor chips, hairline cracks, air voids and slight variations in color and finish are normal in precast concrete. When viewed in typical daylight illumination from a distance of 20 feet, minor chips, hairline cracks and air voids that cannot be seen with the naked eye are not grounds for rejection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine all surfaces.
- B. Verify all dimensions of in-place and subsequent construction.
- C. Notify the Contractor in writing of conditions detrimental to the proper and timely completion

- of the work.
- D. Do not proceed with the work until unsatisfactory conditions have been corrected.
 - E. Installation of precast concrete pavers and associated construction constitutes acceptance of the adjacent and underlying construction.

3.2 INSTALLATION - GENERAL

- A. Installation shall comply with requirements of applicable building codes and state and local jurisdictions.
- B. Install Narrow Modular Pavers in a mortar bed in accordance with the manufacturer's recommendations.
- C. Clean any mortar off the face of the pavers immediately. Never leave a 'cement haze' on the concrete paver's surface.
- D. Follow expansion and control joint materials manufacturer's instructions.
- E. Typical joints between the pavers at the top of paving surface shall be roughly 3/16" to 1/4" wide.
- F. Fill joints completely with polymeric joint sand designed for use over an impervious base, such as a concrete slab. Follow polymeric joint sand manufacturer recommendations for installation of joint sand. Note: do not allow polymeric sand residue to stain/discolor the surface of the paver.
- G. After sand is compacted seal sand with sealer appropriate for joint sand and concrete pavers. Follow sealer manufacturer recommendations for installation of sealer.

3.3 CLEANING:

- A. Clean exposed surfaces of precast concrete paving units. Use cleaners appropriate for precast concrete finishes and colors. Acid based cleaners will permanently alter finish and color.

3.4 COMPLETION

- A. Protect precast concrete paving units from damage due to subsequent building operations.
- B. After installation and before completion, inspect precast concrete paving units for construction damage and obtain new precast concrete paving units if required.
- C. Immediately prior to final acceptance of project, clean precast concrete paving units.

END OF SECTION

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SECTION 321613
CONCRETE CURB, GUTTERS, RAMPS AND WALKWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Coordination with the City of Oakland to obtain the necessary Encroachment Permit for all work within the City right-of-way and providing concrete curbs, gutters, and sidewalk per City of Oakland standard drawing S-1, as modified in the plans, and as specified herein.

Provide concrete driveway approach and curb ramp as indicated in the plans and as specified herein.

1.2 REFERENCE SPECIFICATIONS

- A. Wherever the words "Standard Specifications" are referred to, the reference is to the State of California, Department of Transportation, Standard Specifications, latest edition.

1.3 SUBMITTALS

- A. Submit certificate of compliance indicating that the concrete complies with the specifications as Product Information submittals.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Comply with the Standards Specifications, Paragraph 73-1.01.
 - 1. Cement: Type II Modified.
 - 2. Provide air-entrainment of three percent with admixture conforming to ASTM C260.
 - 3. Nominal size of large aggregate shall be 1".
 - 4. Minimum strength of concrete shall be 4000 psi.
 - 5. Lampblack shall be added to the concrete mix in the amount not less than one pound or more than two pounds of best quality lampblack to each cub yard of concrete.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with the Standard Specifications, Section 73, Paragraph 1.03 Construction, inclusive, except as modified in the plans and herein.
- B. Contractor shall coordinate with the City of Oakland to obtain the necessary Encroachment Permit for all work within the City right-of-way.
- C. Unless shown otherwise on the Drawings, replace existing curbs and sidewalks in kind within the City of Oakland right-of-way.
- D. Adjust structures such as valve boxes, manhole frames and covers, and electrical vaults to grade after the curb and gutter or sidewalk has been constructed for a reasonable distance on all sides of the structure. Complete the concrete work after the structure is adjusted.
- E. New concrete sidewalk within the City of Oakland right-of-way shall be colored with approximately 1-1/2 pounds of lamp black per cubic yard to match existing concrete sidewalk.
- F. When installing concrete curbs, gutters, and sidewalks within the City of Oakland right-of-way the Contractor shall provide continuous access and concrete protection by whatever

means necessary for the concrete until it dries. The Contractor shall replace any new concrete that is marked with graffiti before it dries at no additional cost to the Owner.

- G. Control and expansion/construction joints shall be located and installed as indicated in the plans.
- H. Concrete finish shall be as indicated in the landscape plans.

END OF SECTION

SECTION 323000
SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Combo Waste and Recycling Receptacle
 - 2. Bicycle Rack
 - 3. Removable Bollard
 - 4. Tree Grate
 - 5. Bike Locker
 - 6. Skate Deterrents
 - 7. Fabrication of Site Furnishings.
 - 8. Placement of Site Furnishings.

- B. For Precast Concrete Specialties, see Section 03 48 00.

- C. For Site Concrete, see 32 13 16.

1.2 DEFINITIONS

- A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of Owner’s representative in writing.

1.3 REFERENCES

- A. ASTM — American Society for Testing Materials:
 - 1. A 185/A185M — Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement. Most current edition.
 - 2. A 615/A615M — Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. Most current edition.
 - 3. C 33 — Specification for Concrete Aggregates. Most current edition.
 - 4. C 140 — Method of Sampling and Testing Concrete Masonry Units. Most current edition.
 - 5. C 150 — Specification for Portland Cement. Most current edition.
 - 6. C 330 / C 330M — Specification for Lightweight Aggregates for Structural Concrete. Most current edition.
 - 7. C 881/C881M — Specification for Epoxy-Resin-Base Bonding Systems for Concrete. Most current edition.
 - 8. C 979 — Specification for Pigments for Integrally Colored Concrete. Most current edition.
 - 9. C 1116 / C 1116M — Specification for Fiber-Reinforced Concrete. Most current edition.

- B. Uniform Building Code (UBC). Most current edition.

- C. Standard Grading and Dressing Rule No. 15, West Coast Lumber Inspection Bureau (SCLIB). Most current edition.
- D. American Lumber Standards Committee (ALSC).
- E. Product Standard 1 of the U.S. Dept. of Commerce (PS-1). Most current edition.
- F. Forest Stewardship Council (FSC).
- G. American Wood Preservers' Association (APE).

1.4 SUBMITTALS

- A. Product Data:
 - 1. Bike Rack: Manufacturer spec sheet, to include dimensions, finish and color, installation instructions
 - 2. Bike Locker: Manufacturer spec sheet, finish and color, installation instructions
 - 3. Trash Receptacle: Manufacturer spec sheet, finish and color, installation instructions
 - 4. Waste Receptacle: Manufacturer spec sheet, finish and color, installation instructions
 - 5. Bollard: Manufacturer spec sheet, finish and color, installation instructions
 - 6. Skate Deterrents: Manufacturer spec sheet, finish, installation instructions
 - 7. Tree Grate: Manufacturer spec sheet, finish, installation instructions
 - 8. Tree Grate Frame: Manufacturer spec sheet, finish, installation instructions
- B. Samples:
 - 1. Combo Trash and Recycling Receptacle: 4-inch segment of finish
 - 2. Bicycle Rack: 4-inch segment of finish
 - 3. Removable Bollard: 4-inch segment of finish
 - 4. Tree Grate: 12-inch segment of grate and attachment.
 - 5. Bike Locker: 4-inch sample of finish
- C. Shop Drawings:
 - 1. Provide shop drawings for Tree Grate and Tree Grate Frame. Show shop and erection details, to scale, including dimensions, sizes, thicknesses, gauges, finishes, joining, segments, joints, attachments, holes, welds, bolts, elevations and relationship of work to adjoining construction. Prepare details at not less than 3 inches = 1 foot.
 - 2. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from the Drawings.
 - 3. Indicate welded connections using AWS A2.0 welding symbols.
- D. Manufacturer's Current Printed Instructions:
 - 1. Furniture Manufacturer's Cleaning Instructions.

1.5 QUALITY ASSURANCE:

- A. Fabricator Qualifications:
 - 1. Established international reputation having work similar to that specified, in use for a minimum of 10 years.
 - 2. Shop shall have proper equipment for Work specified, including application of finish.

3. Fabricators and finishers shall be recognized experts in the Work they are engaged to perform.
- B. Regulatory Requirements:
1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over such Work.
 2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Loading and Shipment:
1. Carefully pack the units for shipment free from stains and other deleterious material.
 2. Exercise precautions against damage in transit.
- B. Storage:
1. Store units on non-staining wood skids or pallets at least four inches above grade.
 2. Place and stack skids and units to distribute weight evenly and to prevent breakage or cracking.
 3. Protect and store units from weather and soiling with waterproof non-staining covers or enclosure, but allow air to circulate around units.
- C. Handling:
1. Handle units to prevent chipping, breakage, soiling or other damage.
 2. Do not use pinch or wrecking bars without protecting edges of units with wood or other rigid materials.
 3. Lifts with wide-belt type slings wherever possible.
 4. Do not use wire rope or ropes containing tar or other substances which might cause staining.
 5. If required, use wood rollers and provide cushion at end of wood slides.

1.02 WARRANTY

- A. General Description: In addition to manufacturer's warranties, warrant Work for a period of one year from Date of Final Completion against defects in materials and workmanship.
- B. Additional Items Covered: Warranty shall also cover repair of damage to other materials and workmanship resulting from defects in materials and workmanship.
- C. Exceptions: Contractor shall not be held responsible for failures due to normal wear, neglect by Owner, vandalism and other causes outside the Contractor's control.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Combo Waste and Recycling Receptacle:
1. mmcite – www.mmcite.com.
 2. Or accepted equal.
- B. Bicycle Rack:

1. mmcite – www.mmcite.com.
2. Or accepted equal.

C. Bike Locker:

1. Dero – www.dero.com.
2. Or accepted equal.

D. Removable Bollard

1. mmcite – www.mmcite.com.
2. Or accepted equal.

E. Tree Grate

1. Urban Accessories – www.urbanaccessories.com
2. Or accepted equal.

2.2 MANUFACTURED UNITS

A. Combo Waste and Recycling Receptacle:

1. Type: Crystal CS210x – Custom adjoin (2) units
2. Finish: Powder-coated Steel
3. Color: Gray Aluminum RAL 9007
4. Capacity: 15 gallon (per unit)
5. Weight: 96 lb (per unit)
6. Inner Bin: Bent Zinc Coated
7. Label: Symbols for Waste and Recycling per manufacturer's standard graphics
8. Quantity: See Plans

B. Bicycle Rack:

1. Type: Elk110
2. Finish: Powder-coated Steel
3. Color: Gray Aluminum RAL 9007
4. Quantity: 4

C. Bike Locker:

1. Type: Single Locker
2. Finish: Powder-coated Steel
3. Color: Iron Gray
4. Quantity: 2

D. Removable Bollard:

1. Type: Elias SE150
2. Finish: Powder-coated Steel
3. Color: Gray Aluminum RAL 9007
4. Quantity: See plans

E. Tree Grate

1. Type: Jamison

2. Material: Ductile Iron
3. Finish: Rust conditioner
4. Quantity and Size: See Plans

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
- B. Notification of Unsuitable Conditions: Before proceeding with Work, notify Owner and Owner's representative in writing of unsuitable conditions.

3.2 PREPARATION

- A. Protection:
 1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
 2. Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.
 3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 4. Submit written notification of conditions damaged during construction to the Owner and Owner's representative within 2 working days of observed damage and before damage is covered.

3.3 INSTALLATION

- A. General: Install as indicated on Drawings.
 1. Contractor is responsible for all coordination with PG&E staff for stand by in the installation of all site furnishings within the PG&E easement.

3.4 FIELD QUALITY CONTROL

- A. Field Observation Reviews by Owner's representative: Coordinate and schedule with Owner's representative.

3.5 CLEANING

- A. General: Clean and keep clean until Owner accepts maintenance.
- B. Furniture Cleaning Method: Meet requirements of manufacturer's current printed instructions.

3.6 PROTECTION

- A. Furniture Storage: Protect furniture from damage due to construction Work operations and vandalism by storing in secure interior storage room until day of final review.

END OF SECTION

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SECTION 328400

IRRIGATION

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 DESCRIPTION OF WORK

- A. Provide all products and execute all labor to achieve installation of the irrigation system complete as indicated by the Drawings and Specifications.

1.2 RELATED WORK IN OTHER SECTIONS

- A. Related Landscape Work:

1. Section 329119, Planting Area Finish Grading
2. Section 329113, Soil Preparation and Soil Mixes
3. Section 329300, Plant Material
4. Section 320100, Landscape Maintenance Period

- B. Other Related Work: Consult all other relevant Specification Sections to determine the extent and character of work specified elsewhere, but related to that included herein.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

- A. Laws, Codes and Regulations: Perform work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work.
- B. Inspections and Permits: Provide for all inspections and permits required by federal, state and local authorities in furnishing, transporting and installing materials.
- C. Refer to Section 019100 General Commissioning. Irrigation systems are required to be commissioned by 2019 Calgreen code.

1.4 TRAFFIC CONTROL

- A. It is the responsibility of the contractor to ensure adequate protection and controls for pedestrian and vehicular traffic in the vicinity of the project areas. The contractor shall provide all signs, barricades, flagmen, etc., necessary to meet all traffic requirements for this project at his own expense.

1.5 APPLICABLE STANDARDS

- A. Comply with the current applicable specifications and guidelines of the following:

1. DIV — Division of Industrial Safety.
2. UPC — Uniform Plumbing Code published by the Association of Western Plumbing Officials.
3. ASTM — American Society for Testing and Materials.
4. NSF — National Sanitation Foundation.

1.6 SUBMITTALS

- A. Product data: Prior to delivery to site, submit 5 copies of current manufacturer's specifications and catalog cuts for the complete list of materials and assemblies to be installed.
- B. Final Record Documents: Submit Final Record Documents to the Landscape Architect at Preliminary Review.

1.7 RECORD DOCUMENTS

- A. Progress Record Documents:
 1. Maintain on the construction site at all times a record of all materials and equipment installed each day.
 2. Daily record information neatly to scale, on full-size prints of the irrigation construction documents.
 3. Record information neatly to scale, on full-size prints of the irrigation construction documents.
 4. Information shall include all changes, substitutions, and manufacturer's names and catalogue members for materials and equipment. Show actual locations of all valves and irrigation piping. Show dimensions from easily-identifiable permanent structures such as walls, curbs, fences, buildings or walks.
- B. Final Record Documents:
 1. Transfer all information noted on Progress Record Documents.
 2. After Work completion, transfer information noted on prints. Submit Progress Record Documents to the landscape architect for review of general information content (landscape architect will not be responsible for errors or omissions).
 3. Contractor shall be responsible for accuracy of information and errors or omissions.
 4. If first submittal is not accepted by landscape architect, resubmit until accepted.
 5. Once accepted, submit accepted final Record Documents to Owner

1.8 SERVICE MANUALS

- A. Submittal Procedure: At Preliminary Review, submit five individually bound Service Manuals to the Landscape Architect.
- B. Content:

1. Complete drawings, diagrams and spare parts lists of all equipment installed showing components and catalog numbers together with the manufacturer's name and address.
2. Index sheet indicating the Contractor's name, address and telephone number.
3. Copies of equipment, warranties and certificates.
4. Complete operating and maintenance instructions in sufficient detail to permit operating personnel to understand, operate, and maintain all equipment.

1.9 DEFINITION OF ACCEPTANCE

- A. Wherever the terms "acceptance" or "accepted" are used herein, they mean acceptance of Landscape Architect in writing.

1.10 INTENT OF DRAWING AND SPECIFICATIONS

- A. It is the intent of the Drawings and Specifications to provide a complete operable irrigation system. Any items not specifically shown in the Drawings or called for in the Specifications, but which are normally required to conform with such intent, are to be considered as part of the work.

1.11 SUBSTITUTIONS

- A. Written Acceptance: Specific reference to manufacturer's names and products specified in these sections are used as standards; this implies no right to substitute other materials or methods without written acceptance of the Landscape Architect.
- B. Contractor's Responsibility: Installations of accepted substitution(s) must be made to the satisfaction of Landscape Architect and without additional cost to Owner.

1.12 REVIEW OF SITE

- A. Visit project site and review conditions as they exist prior to submitting bid.

1.13 WORK SCHEDULE

- A. Submit a proposed work schedule to the Landscape Architect for acceptance at least fourteen days prior to start of irrigation work. Submit revised schedule(s) to the Landscape Architect immediately.

1.14 COORDINATION

- A. Coordinate and cooperate with other contractors to enable the work to proceed as rapidly and efficiently as possible in a workmanlike manner.

1.15 PROTECTION OF EXISTING CONDITIONS

- A. General: The Contractor shall use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the work.
- B. Barriers: Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.
- C. Operations: Do not store materials or equipment, permit burning, or operate or park equipment under the drip line of existing plants to remain.

- D. Notification of Damages: Submit written notification of all conditions damaged during construction to the Owner and Landscape Architect immediately.
- E. Determination of Damage: Landscape Architect will determine the extent of damage and value of damaged plant material.
- F. Replacement of existing plant material: Replace existing plants to remain which are damaged during construction with plants of the same species and size as those damaged at no cost to the Owner.
- G. Replacement of Existing Irrigation System: Immediately repair damage to existing systems. After making repairs remove all heads in repaired circuit(s) and flush lines clear of all dirt and foreign matter. After cleaning lines replace heads and return system to operating status.

1.16 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Labeling: Furnish standard products in unopened manufacturer's standard containers bearing original labels showing quantity, analysis and name of manufacturer.
- B. Storage: Store products with protection from weather or other conditions which would damage or impair the effectiveness of the product. Protect PVC pipes and fittings from direct sunlight. Beds on which pipe is stored must be full length of pipe.

1.17 ANALYSIS OF SAMPLES AND TESTS

- A. Analyses: Samples of materials may be taken and analyzed for conformity to specification at any time. The Contractor shall furnish samples as requested.
- B. Rejected Materials: Contractor shall remove rejected materials immediately from the site.
- C. Cost of Testing: The Contractor shall pay cost of testing of materials not meeting specifications.

1.18 HYDROSTATIC TESTING REVIEW

- A. Time of Review: The Landscape Architect will review the completed irrigation work during the hydrostatic testing prior to the backfilling of the trenches.
- B. Notification of Review: Notify the Landscape Architect and Owner's Representative at least 72 hours prior to the anticipated review.

1.19 PRELIMINARY ACCEPTANCE, FINAL ACCEPTANCE AND COMMENCEMENT OF THE MAINTENANCE PERIOD

- A. See Section 320100, Landscape Maintenance Period.

1.20 WARRANTY

- A. In addition to manufacturer's guarantees or warranties, work shall be warranted for 1 year from the date of Final Acceptance against defects in material, equipment and workmanship. Warranty shall also cover repair of damage to any part of the premises resulting from leaks or other defects in materials, equipment, and workmanship to the satisfaction of the Owner.

1.21 WARRANTY FOR SPRINKLER IRRIGATION SYSTEM

- A. Include the following warranty on contractor's letterhead with service manuals:

1. WE HEREBY WARRANT THAT THE SPRINKLER IRRIGATION SYSTEM WE HAVE FURNISHED AND INSTALLED IS FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP, AND THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS. WE AGREE TO REPAIR OR REPLACE ANY DEFECTS IN MATERIAL OR WORKMANSHIP, ANY SETTLING OF BACKFILLED TRENCHES, WHICH MAY DEVELOP DURING THE PERIOD OF ONE YEAR FROM DATE OF ACCEPTANCE AND ALSO TO REPAIR OR REPLACE ANY DAMAGE CAUSED BY ANY DEFECTS IN THE IRRIGATION SYSTEM OR RESULTING FROM THE REPAIRING OR REPLACING OF SUCH DEFECTS AT NO ADDITIONAL COST TO THE OWNER. ORDINARY WEAR AND TEAR, UNUSUAL ABUSE OR NEGLIGENCE ARE EXCEPTED. WE SHALL MAKE SUCH REPAIRS OR REPLACEMENTS, INCLUDING COMPLETE RESTORATION OF ALL DAMAGED PLANTING, PAVING, OR OTHER IMPROVEMENTS OF ANY KIND, WITHIN A REASONABLE TIME, AS DETERMINED BY THE OWNER, AFTER RECEIPT OF WRITTEN NOTICE. IN THE EVENT OF OUR FAILURE TO MAKE SUCH REPAIRS OR REPLACEMENTS WITHIN A REASONABLE TIME AFTER RECEIPT OF WRITTEN NOTICE FROM THE OWNER, WE AUTHORIZE THE OWNER TO PROCEED TO HAVE SAID REPAIRS OR REPLACEMENTS MADE AT OUR EXPENSE AND WE WILL PAY THE COSTS AND CHARGES THEREFORE UPON DEMAND.

PROJECT: _____

LOCATION: _____

CONTRACTOR: _____

LICENSE No.: _____

TELEPHONE: _____

GUARANTEE TO: _____

DATE OF ACCEPTANCE: _____

AUTHORIZED REPRESENTATIVE
: _____

PART 2 - PRODUCTS

2.1 PIPE

A. General: All pipe shall be NSF approved.

B. Piping on Pressure Side of Control Valves:

1. ASTM D 1785 polyvinyl chloride (PVC) 1120-1220, Class 315 for 2 inch and larger, Schedule 40 for 1.5 inch and smaller.

- C. Piping on Non-pressure Side of Control Valves:
 - 1. ASTM D 1785 polyvinyl chloride (PVC) 1120-1220, Schedule 40.
 - 2. Subsurface Dripline: As listed on Drawings.

2.2 FITTINGS

- A. Fittings for Pressurized Solvent-Welded Pipe:
 - 1. ASTM D 2466 Schedule 40 PVC as provided by the same manufacturer as the pipe.
 - 2. Connections of Mains to Remote Control and Quick-coupling Valves: ASTM D 2467 Schedule 80 PVC solvent-weld socket fittings.
- B. Fittings for Non-Pressurized Solvent-Welded Pipe:
 - 1. ASTM D 2466 and ASTM D 2467 Schedule 40 and Schedule 80, polyvinyl chloride, standard weight, as manufactured by "Sloane," "Lasco," or equal. Refer to installation details.
 - 2. Threaded PVC Nipples: Schedule 80 PVC.

2.3 NIPPLES

- A. Non-Ferrous: Schedule 40 red brass (85% copper, 15% zinc) with MIPT at both ends; ASTM B43.
- B. Plastic: Schedule 80, Type I, Grade 1 polyvinyl chloride (PVC); threaded both ends; ASTM D1784 and D1785; uniformly grey in color.
- C. Flexible: Factory made and assembled consisting of flexible polyvinyl chloride (PVC) hose fitted at each end with Schedule 40 PVC male adaptors; test rated at 200 psi static.

2.4 SLEEVE FOR CONTROL WIRE AND WATER LINE

- A. PVC 1120-1220, Schedule 40 pipe.

2.5 IRRIGATION CONTROLLER, MASTER CONTROL VALVE, AND FLOW METER

- A. As shown on the Drawings.

2.6 REMOTE CONTROL VALVES

- A. As shown on the Drawings.

2.7 CONTROL WIRE

- A. As shown on the Drawings.
- B. Splicing Materials: DBR/Y-6 as manufactured by 3M or equal.
- C. Sensor cable: As required by Controller Manufacturer.

2.8 VALVE BOXES FOR REMOTE CONTROL VALVES IN PLANTING AREAS

- A. Model No.: 1419B-12B.
- B. Color of Box and Lid: As shown on Drawings.

- C. Manufacturer: Oldcastle Precast, Inc., 1002 15th Street SW, Auburn, WA 98001, (800) 735-5566. Or equal.

2.9 VALVE BOXES FOR QUICK COUPLING VALVES IN PLANTING AREAS

- A. Model No.: 910-12B.
- B. Color of Box and Lid: As shown on Drawings.
- C. Manufacturer: Oldcastle Precast, Inc., 1002 15th Street SW, Auburn, WA 98001, (800) 735-5566. Or equal.

2.10 VALVE BOXES

- A. For Remote Control Valves:
 - 1. Planted Areas: Injection-moulded of Polyesters and fibrous inorganic temperature resistant components. Box shall provide adequate clearance to operate and service valve. Box and lid to be black, as manufactured by "Oldcastle Precast" or equal.

PART 3 - EXECUTION

3.1 LAYOUT

- A. General: During installation, conform as closely as possible to Drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown.
- B. Coverage: Make any necessary minor adjustments to layout required to achieve full coverage of irrigated areas at no additional cost to Owner.
- C. Stubouts: Where connections to existing stubouts are required, make necessary adjustments should stubouts be located differently than shown on the Drawings.
- D. Piping: Where piping is shown to be under paved areas but running parallel and adjacent to planted area, install piping in planted areas, unless specifically noted to be installed under paved areas. Do not install directly over another line in same trench.
- E. Existing Irrigation System: Adjust new head layout as necessary where it abuts existing irrigation systems.

3.2 TRENCHING

- A. Trench Depths:
 - 1. 18-inch deep over pipe on pressure side of irrigation control valve and control wires.
 - 2. 12-inch deep on non-pressure side of irrigation control valve.
- B. Trench Slopes:
 - 1. Mains: Slope to drain to control valves.
 - 2. Laterals: Slope to or from control valves.

3.3 CONDUITS AND SLEEVES

- A. Conduit: Furnish and install conduit where control wires pass under or through structures or

paving. Conduits to be of adequate size to accommodate retrieval for repair of wiring and shall extend 12 inches beyond edges of walls.

- B. Sleeving: Install sleeves for all pipes passing through or under structures or paving as shown on Drawings. Sleeving to be of adequate size to accommodate retrieval of wiring or piping for repair and shall extend 12 inches beyond edges of paving or other structures.

3.4 PIPE LINE ASSEMBLY

A. General:

1. Install pipes and fittings in accordance with manufacturer's latest printed instructions.
2. Clean all pipes and fitting of dirt, scales and moisture before assembly.
3. Install pipe fittings with at least 2 inches clearance from other pipes or fittings.

B. Solvent-Welded Joints for PVC Pipes:

1. Use solvents and methods specified by pipe manufacturer.
2. Let solvents cure a minimum of 1 hour before applying any external stress on the piping and at least 24 hours before placing the joint under water pressure.

C. Threaded Joints for Swing Joints:

1. Use Teflon tape on threaded PVC fittings for swing joints only.
2. Use strap-type friction wrench only. Do not use metal-jawed wrench.

D. Laying of Pipe:

1. Remove from trench all rocks or clods 1 inch diameter or larger. Bed pipes in at least 2 inches of soil excavated from trench. Backfill on all sides of piping to provide a uniform bearing.
2. Snake pipe from side to side of trench bottom to allow for expansion and contraction. One additional foot per 100 ft. of pipe is the minimum allowance for snaking.
3. Install pipeline warning tape for all supplyline pipes supplied with cistern well water. Install longitudinally on supplyline and secure with duct tape every 5 feet.
4. Do not lay PVC pipe when there is water in the trench.

3.5 IRRIGATION CONTROL VALVES

- A. Valve Locations: Install control valves where shown on Drawings and group together where practical.
- B. Valve Box Locations: Where two or more valves are installed adjacent to each other, provide at least 12 inches separation between valve boxes and align boxes parallel to each other in a row.
- C. Valve Boxes: Install valve boxes over valves to be flush with accepted finish grade.

3.6 AUTOMATIC CONTROLLER

- A. General: Install per local code and manufacturer's latest printed instructions.

- B. Connection to Valves: Connect remote valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.
- C. Labeling: Affix controller name (i.e., "CONTROLLER A") on inside of controller cabinet door with minimum of 1 inch high permanent letters.
- D. Irrigation Diagram: Affix a non-fading copy of irrigation diagram to cabinet door below controller name. Irrigation diagram to be sealed between two plastic sheets 20 mil. minimum thickness. Irrigation diagram shall be a reduced copy of the Record Drawing, clearly showing all valves operated by the controller, station number, valve size, and type of planting irrigated.
- E. Grounding and Certification: Per Manufacturers specifications and requirements.

3.7 IRRIGATION HEADS

- A. Bubbler Heads: Install all bubbler heads as detailed on the Drawings.

3.8 CONTROL WIRING

- A. Placement: Install control wires in common trenches with sprinkler mains and laterals wherever possible. Lay to the bottom side of pipe line. Provide a minimum of 2 feet of looped slack at valves.
- B. Detection Wire: Install a AWG size #12 or greater wire on top of the PVC supply line for the purpose of possible future mine detection search as the control wires are being installed on the bottom for the PVC supply line with electrical tape every 10 feet.
- C. Splicing: Crimp control wire splices at remote control valves. Seal with specified splicing materials. Line splices will be allowed only on runs of more than 2,500 feet.

3.9 CLOSING OF PIPE AND FLUSHING OF LINES

- A. Capping: Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
- B. Flushing: Thoroughly flush out all water lines before installing heads, valves and other hydrants.
- C. Testing: Test as specified below. Upon completion of testing, complete assembly and adjust sprinkler heads for proper water distribution.

3.10 HYDROSTATIC TESTING

- A. Procedure: Make hydrostatic tests with risers capped when welded PVC joints have cured at least 24 hours. Center load piping with backfill to prevent pipe from moving under pressure. All couplings and fitting shall be exposed. Apply continuous static water pressure of 125 psi as follows:
 1. All Piping on the Pressure Side of Control Valves: Four hour test.
 2. All Piping on the Non-pressure Side of Control Valves: Two hour test.
- B. Leaks and Retest: Repair leaks observed from tests and repeat testing until system passes tests.

3.11 BACKFILLING AND COMPACTING

- A. Backfill Material at Planting Areas:
 - 1. After system is operating and required tests and reviews have been made, backfill excavations and trenches with clean sand and soil, free of debris.
 - 2. Backfill in 6-inch lifts with compaction performed between each lift.
- B. Backfill Material at Unsleeved Pipe Under Paving: Provide all PVC pipe under paving with minimum of 4 inches of sand backfill on all sides and 30 inches cover to bottom of paving.
- C. Backfill Material at Existing Underground Pipes: Use only backfill material which has been screened to eliminate all material larger than 3/8 inches when backfilling adjacent to existing underground pipe lines.
- D. Backfill Compaction:
 - 1. Regardless of the type of pipe covered, compact to minimum 95% density under pavements, and 85% in planted areas.
 - 2. Compact trenches in areas to be planted by thoroughly flooding or jetting.
 - 3. Compact trenches in paved areas in 6-inch lifts.
- E. Finish Grading: Dress off all areas to accepted finish grades. Refer to Section 32 91 19, Planting Area Finish Grading.

3.12 CLEAN-UP

- A. Daily: Keep all areas of work clean, neat and orderly at all times.
- B. Final: Clean up and remove all deleterious materials and debris from the entire work area prior to Final Review.

END OF SECTION

SECTION 329113
SOIL PREPARATION AND SOIL MIXES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Subsoil Ripping of Planting Areas.
 - 2. Amendment of On-Grade Planting Area Soil.
 - 3. Mixing and Placement of Plant Pit Backfill Soil Mix.
 - 4. Mixing and Placement of Soil Mixes.
- B. For Earthwork, see Division 31.
- C. For Landscape Maintenance Period, see Section 320100.
- D. For Irrigation, see Section 328400.
- E. For Planting Area Finish Grading, see Section 329119.
- F. For Plant Material, see Section 329300.

1.2 DEFINITIONS

- A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of Owner’s representative in writing.

1.3 ALLOWANCE

- A. Allowance for Backfill Mixes and Soil Amendment Programs:
 - 1. Provide cash allowance based on materials specified assuming new materials are purchased and installed.
- B. Prior to purchase of materials, after final backfill mixes and amendment programs have been accepted by Owner’s representative, submit complete documentation of labor, materials and equipment comparing allowance with proposed installed costs of final mixes and amendment program.
- C. Credit unused monies to Owner.

1.4 REFERENCES

- A. ASTN – ASTM International

1. D 1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort. Most current edition.
 2. C 136 – Test Method for Sieve Analysis of Fine and Coarse Aggregates. Most current edition.
 3. D854 – Test Method for Specific Gravity Soils. Most current edition.
 4. D2974 – Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils. Most current edition.
 5. D3665 - Practice for Random Sampling of Construction Materials. Most current edition.
 6. D4427 – Classification of Peat Samples by Laboratory Testing. Most current edition.
- B. USDA – United States Department of Agriculture:
1. Soil Texture Triangle Classification. Most current edition.
 2. Handbook No. 60. Most current edition.
- C. ASA – American Society of America.
- D. SSSA - Soil Science of America.
- E. Geotechnical Investigation Report: Geotechnical Investigation and Geologic Hazards Evaluation, Laney College Library Learning Resource Center, Final Report, March 31, 2023 prepared by Fugro.

1.5 SUBMITTAL

- A. Product Data:
1. Chemical Additives.
 2. Sand.
 3. Organic Compost.
 4. Peat Moss.
 5. Perlite.
 6. Fertilizers.
 7. Water Storing Polymer.
 8. Planter Pot Soil.
 9. Aggregate for Structural Soil Mix.
- B. Test Reports:
1. Provide a “Complete Standard Analysis” of site soils, imported soils, and organic compost indicating the following:
 - a. pH measurement in the Saturation Extract, Electrical Conductivity of the saturation extract and Sodium Adsorption Ratio of the saturation extract. Utilize the following procedures utilizing the Methods of the United States Salinity Laboratory as published in the Agricultural Handbook Number 60 entitled “Diagnosis and Improvement of Saline and Alkali Soils”:
 - (a) pH Method 21
 - (b) Saturation Extract Method 2
 - (c) Sodium Adsorption Ratio Method 20b

- (d) As determined by ammonium bicarbonate-DTPA: Methods of Soil Analysis, Part 1, Physical and Mineralogical Methods, Soil Science Society of America, Inc., 1986, identify the following nutrients and elements:
 - (e) Boron, calcium, copper, iron, magnesium, manganese, molybdenum, phosphorous, potassium, sodium, sulfur, and zinc.
 - (f) Analyze the saturation extract for calcium, magnesium, sodium, boron, chloride, phosphorus, nitrate and sulfate.
- b. Measure the following trace metals by the ammonium bicarbonate-DTPA extract: Methods of Soil Analysis, Part 1, Physical and Mineralogical Methods, Soil Science Society of America, Inc., 1986.
 - (a) Aluminum, arsenic, cadmium, chromium, cobalt, lithium nickel, selenium, silver, strontium, tin and vanadium.
 - c. Determine the presence of calcium carbonate and/or magnesium carbonate.
 - d. As determined by Methods of Soil Analysis, Part 3 Chemical Methods, Soil Science Society of America, Inc., 1996, identify Soil Texture (gravel, sand, silt and clay) and percent gravel.
 - e. As determined by Methods of Soil Analysis, Part 3 Chemical Methods, Soil Science Society of America, Inc., 1996, identify organic matter content by the measurement of organic carbon. The quality of organic matter shall be determined by measuring organic carbon and total nitrogen.
 - f. As determined by Method 34b of Agricultural Handbook Number 60, identify Water Infiltration Rate.
 - g. Interpretation of nutritional deficiencies or excesses and potential toxicities shall be given.
 - h. Define import soil source and organic matter locations.
 - (a) Provide copy of the planting plan with each composite sample keyed by number to the area from which the composite samples were taken.
 - i. Soil Test for Parasitic Nematodes (if required).
 - j. Soil Test for Herbicide Contamination (if required).
 - k. Samples shall include location of source material, date of samples, and project name.
 - l. Bulk density and particle size analysis, including the following gradient of mineral content (USDA Designation is size in mm)
 - (a) Gravel – over 2mm
 - (b) Sand – 0.05 – 2mm
 - (c) Silt – 0.002-0.05mm
 - (d) Clay – minus 0.002mm
 - m. Sieve Analysis performed and compared with USDA Soil Classification System. Sieve analysis shall be by a combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in accord with particle size analysis, Chapter 15, Methods of Soil Analysis, Part 1, SSSA-ASA, Inc., 1986.
2. Structural Soil Mix Testing: Provide a two-gallon representative sample to Wallace Laboratories for an analysis of the structural soil mix indicating the following:
 - a. Particle size analysis, including the following gradient of mineral content (USDA Designation Size in mm):
 - (a) 3" (76mm)
 - (b) 2 ½" – 3" (63-76mm)
 - (c) 2" – 2 ½" (50-63mm)
 - (d) 1 ½" – 2" (37-50mm)
 - (e) 1" (25-37mm)
 - (f) ¾" (19-25mm)

- (g) Fine gravel – 1/8" – 3/4" (2-19mm)
 - (h) Sand – 0.05 -2mm
 - (i) Silt – 0.002-0.05mm
 - (j) Clay – minus 0.002mm
- b. Provide manufacturer's analysis of the following:
- (a) Loose and rodded unit weight.
 - (b) Bulk specific gravity and absorbance.
 - (c) Gravel dimension and surface texture description.
 - (d) Aggregate soundness and L.A. abrasion.
 - (e) Sample Collection Procedure:
 - (f) Collect a minimum of eight samples to make up the composite sample.
 - (g) Take samples from random locations in the stockpile varying from the top to the bottom and around the stockpile.
 - (h) Take at least half the samples from the lower third of the stockpile into a clean bucket
 - (i) Thoroughly mix material after samples are taken.
 - (j) Remove 2 gallon of material from bucket and fill a zip-lock plastic bag.
 - (k) Double bag the composite sample and label the bag with a permanent marker indicating the material name and date sample was taken.
3. Provide a percent pore space analysis as follows:
- a. $1 \text{ minus } [\text{rock specific gravity unit divided by the bulk specific gravity}] \text{ times}$

1.6 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
- 1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
 - 2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.
- B. Contractor Qualifications:
- 1. Have successfully installed structural soil mixes similar to the quality specified for a period of not less than 5 years.
 - 2. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

1.7 SITE CONDITIONS

- A. Environmental Requirements:
- 1. Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily.
 - 2. Apply water, if necessary, to bring soil to an optimum moisture content for tilling.
 - 3. Do not work soil when muddy or frozen.
 - 4. Do not apply chemicals if wind conditions will cause hazardous drift to people or property.

- B. Existing Conditions:
 - 1. Prior to Work commencement review locations of existing public underground utilities and structures with appropriate utility companies and clearly mark in field.
 - 2. Prior to Work commencement review location of existing private underground utilities and structures with Owner and clearly mark in field.
 - 3. Prior to Work commencement and after reviewing the Owner's record irrigation documents, review and clearly mark in field heads, valve boxes and other underground equipment, materials and structures.

1.1 PROJECT CONDITIONS

- A. Areas to receive structural soils shall be inspected by Owner's Representative before starting work.
- B. Verify extent of work requirements, including but not limited to potential need for temporary storage and staging of soils, including moving soil stockpiles at site to accommodate other work and the need to protect installed soils from compaction, erosion and contamination.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

- A. Pre-Plant Fertilizer for On-Grade Planting Areas:
 - 1. Gro-Power, Inc. – <http://www.gropower.com>.
 - 2. Or equal.
- B. Other Commercial Fertilizers:
 - 1. Or equal.
- C. Humate:
 - 1. Humate International, Inc. – <http://www.humateintl.com>.
 - 2. Or equal.
- D. Polymer:
 - 1. Complete Green Company – <http://www.bettertopsoils.com>.
 - 2. Or equal.
- E. Soil Testing Agency:
 - 1. Wallace Laboratories – <http://us.wlabs.com>.
 - 2. Or equal.
- F. Geotextile Fabric
 - 1. Carthage Mills – <http://carthagemills.com>.
 - 2. TenCate Nicolon Corporation – <http://www.tencate.com>.
 - 3. Or equal.
- G. Structural Soil Mix:
 - 1. TMT Enterprises – <http://www.tmtenterprises.net>.
 - 2. Or equal.

2.2 MATERIALS

- A. Soil for Backfill Mix: Soil excavated from on-site plant pits.
- B. Organic Compost:
 - 1. Fully composted aerobic compost without presence of decomposition products.
 - 2. Redwood and cedar products are not acceptable.
 - 3. Ash content of not less than 8 percent and no more than 50 percent.
 - 4. pH between 6 and 7.
 - 5. Salt content shall be less than 10 millimho / cm @ 25 degrees (ECe less than 10) in a saturated paste extract.
 - 6. Boron content of saturated extract <1.0 parts per million.
 - 7. Silicon content (acid-insoluble ash) shall be less than 20 percent.
 - 8. Calcium carbonate shall not be present
- C. Peat Moss:
 - 1. Canadian Sphagnum Peat.
 - 2. Or equal.
- D. Potential Chemical Amendments Required by Accepted Amendment Programs and Backfill Mixes:
 - 1. Ground Limestone: Agricultural limestone containing not less than 85 percent of total carbonate, ground to such fineness that 50 percent will pass No. 1 sieve and 90 percent will pass No. 20 sieve
 - 2. Dolomite Lime: Agricultural grade mineral soil conditioner containing 35-percent minimum magnesium carbonate and 49-percent minimum calcium carbonate, 100 percent passing #65 sieve.
 - 3. Gypsum: Agricultural grade product containing 80-percent minimum calcium sulfate.
 - 4. Iron Sulfate (Ferric or Ferrous): Supplied by a commercial fertilizer supplier, containing 20- to 30-percent iron and 35- to 40-percent sulfur.
 - 5. Potassium Sulfate: Agricultural grade (0-0-50).
 - 6. Single Superphosphate: Commercial product (0-20-0).
 - 7. Treble Superphosphate: Commercial product (0-48-0).
 - 8. Ammonium Nitrate: Commercial product (30-0-0).
 - 9. Calcium Nitrate: Agricultural grade containing 15.5-percent nitrogen.
 - 10. Urea Formaldehyde: Granular commercial product containing 38-percent nitrogen.
 - 11. IBDU (Iso Butyldiene Diurea): Commercial product containing 31-percent nitrogen.
 - 12. Soil Sulfur: Agricultural grade sulfur containing a minimum of 96-percent sulfur.
 - 13. Iron Sequestrene: Geigy Iron Sequestrene 330 Fe
 - 14. Silicic Acid Calcium: Commercial grade.
- E. Perlite:
 - 1. Horticultural Perlite, 6.5 to 7.5 pH.
 - 2. Or equal.
- F. Volcanic Rock:

1. Clean, free of materials toxic to plant growth, 60 pounds per cubic foot (961 kilograms per cubic meter) maximum damp weight, size as specified.
 2. Or equal.
- G. Preplant Fertilizer for Trees, Shrubs, Ground Cover and Turf Areas:
1. Gro-Power Plus 5-3-1.
 2. Or equal.
- H. Polymer:
1. Soil drain / PAM.
 2. Or equal.
- I. Imported Loamy Sand for Landscape Fill Soils:
1. General: Soil shall be of uniform quality and free of phytotoxic compounds.
 2. Particle Size Analysis: Less than 80-percent and more than 60-percent sand; less than 40-percent silt; less than 20-percent clay.
 3. pH: Range 5.5 – 7.5.
 4. EC: Less than 2.0 ds/m (USDA Circular No. 982).
 5. SAR: Less than 6.0.
 6. Contaminants: Free of phytotoxic compounds and debris, seeds or rhizomes of noxious weeds, herbicides, pesticides, heavy metals, biological toxins, excesses of fertilizer, component toxic to plants or humans, and less than 2-percent gravel.
 7. Salts: The electrical conductivity of the soil shall not exceed 2.0 decismens per meter as determined by the saturated-soil test method described in USDA Circular No. 982. The sodium absorption ratio shall not exceed 6.0. Boron levels shall not exceed 1.0 ppm.
 8. Boron: Less than 1.0 ppm.
 9. Sodium: Less than 5.0 meq/1.
 10. Chloride: Less than 5.0 meq/1.
- J. Succulent Planting Soil
1. Ultra Soil Cactus and Succulent Blend
 2. Or equal.

2.3 MIXES

- A. Composition of Plant Pit Backfill Mix for Plants at Existing Site Soils for Bidding Only:
1. Content:
 - a. 6 parts by volume existing soil removed from excavated plant pit.
 - b. 4 parts by volume organic compost.
 - c. 2 pounds gypsum per cubic yard of mix.
 - d. 1 pound ureaform (38-0-0) per cubic yard of mix.
 - e. 1 pound humate per cubic yard of mix.
 - f. 1/3 pound of potassium sulfate (0-0-50) per cubic yard of mix.
 - g. ½-pound dry polymer per cubic yard of mix.
 - h. 1/3 pound of single superphosphate (0-20-0) per cubic yard of mix.
 2. Mixing:

- a. Mix materials uniformly in bulk at one area.
 - b. Mix in clean area or machine, free of materials which will contaminate mix.
 - c. Do not mix materials at each pit.
- B. Plant Pit Backfill Mix for Actual Installation: The accepted backfill mix based on the soil fertility test report.
- C. Imported Sand/Peat Soil Mix:
- 1. Content:
 - a. 80% by volume #20 medium sized clean sand.
 - b. 20% by volume medium sized peat similar to sand size, pH 4.0 to 6.5, ECe less than 3 millimho/cm, carbon:nitrogen ratio less than 25, minus 10 mesh, minimum cation exchange capacity is 50 millimoles per 100 grams, minimum 60% organic matter.
 - c. Adjust the ratio of sand and peat to achieve the desired level of soil organic matter.
 - d. 1/3 pound ureaform (38-0-0) per cubic yard of mix.
 - e. 1/2 pound of potassium sulfate (0-0-50) per cubic yard of mix.
 - f. 1/3 pound of triple superphosphate (0-45-0) per cubic yard of mix.
 - g. 1/2 pound of agricultural gypsum
 - h. Ground agricultural limestone (calcium carbonate) – amount as needed to adjust the acidity to achieve a final pH between 6.5 and 7.2
 - 2. Properties: Properties of mix shall be as follows:
 - a. Organic carbon – 2.0 to 3.5% by dry weight
 - b. Ammonium bicarbonate available DTPA nutrients
 - c. Potassium – 125 to 250 parts per million
 - d. Phosphorus – 25 to 40 parts per million
 - e. If the level of micronutrients are low, incorporate compost at 5% by volume and provide 2.5% to 4.0% organic carbon on a dry weight basis.
 - 3. Contaminants: Free of phytotoxic compounds and debris, seeds or rhizomes of noxious weeds, herbicides, pesticides, heavy metals, biological toxins, excesses of fertilizer, component toxic to plants or humans, and less than 2-percent gravel.
 - 4. Mixing:
 - a. Mix materials uniformly in bulk at one area.
 - b. Mix in clean area or machine, free of materials which will contaminate mix.
- Structural Soil Mix**
- 5. Content:
 - a. 4 parts structural soil aggregate.
 - b. 1 part soil, treated with polymer.
 - 6. Mixing:
 - a. Mix polymer (PAM) with soil 48 hours ahead of blending with aggregate to allow for proper bonding.
 - b. Cure polymer treated soil by allowing the soil to partially dry.
 - c. Based upon accepted mix design, blend materials off-site in a clean area using an experienced blending operator.
 - d. Uniformly blend materials so that they are even distributed throughout mixtures.
 - e. Maintain adequate soil moisture content during mixing process.
 - f. Soils and mix components shall easily shred and break down without clumping.
 - g. Soil clods shall easily break down into a medium crumbly texture material.

- h. Do not blend materials that are saturated or contain excessive water.
- i. Measure and monitor amount of soils moisture at mixing site periodically during mixing process.
- j. Protect materials and mixtures from contamination prior to, during, and after mixing operations.
- k. Store mixes in stockpiles prior to shipment to site in clean areas protected from contamination from other materials.
- l. Reblend the mix if the components have separated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
- B. Underground Utilities and Structures: Verify that the locations of utilities, structures and other underground items have been clearly marked.
- C. Notification of Unsuitable Conditions: Before proceeding with Work, notify Owner and Owner's representative in writing of unsuitable conditions and conflicts.

3.2 PREPARATION

- A. Protection of Existing Conditions:
 - 1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
 - 2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction
 - 3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 - 4. Submit written notification of damaged plants and structures to Owner and Owner's representative immediately.
- B. Surface Preparation:
 - 1. Inspect soil surface for sticks, oils, chemicals, plaster, concrete, and other deleterious materials.
 - 2. Do Work required to remove and dispose of the deleterious materials.

3.3 SOIL TESTS TO DETERMINE AMENDMENT PROGRAM

- A. Take two 1-pound composite samples from 2 depths for each 2,500 square feet of planting area to be amended.
- B. Collect small portions of soil from a 4-inch depth and 24-inch depth at 5 evenly scattered locations within each 2,500 square feet of planting area to form the 2 composite samples.

- C. Keep the soil from each depth separate.
- D. For each 2,500 square feet area mix the soil from 4-inch depth to form the 1 composite sample and mix the soil from the 24-inch depth to form the other composite sample.
- E. Number samples and key numbers to a reproducible copy of the planting plan outlining each 2,500 square feet area that each pair of composite samples represent.
- F. Provide samples to Wallace Laboratories for "Complete Standard Analysis" report and amendment recommendations.
- G. At least 30 days prior to backfill mix or amendment Work, submit written "Complete Standard Analysis" report, including amendment recommendations, to Owner's representative for determination of the final backfill mixes and amendment program.

3.4 SOIL TESTS FOR NEMATODES AND HERBICIDE

- A. Parasitic Nematodes:
 - 1. Test soils which have been used for agricultural purposes within the prior 12 months for parasitic nematodes.
 - 2. Soil will be acceptable if the parasitic nematode population is less than 200 per 50 cubic centimeters of soil.
 - 3. Do not artificially dry soil prior to testing.
 - 4. Submit written test report to the Owner and Owner's representative.
- B. Herbicide Contamination:
 - 1. Perform a radish/rye grass growth trial on soils suspected of herbicide contamination.
 - 2. Submit written test report to the Owner's representative.

3.5 AMENDMENT OF TURF AND GROUND COVER SOIL

- A. Ripping of Compacted Areas Outside of Existing Tree Drip Lines: Where soil compaction has occurred, cross-rip to a depth of 12 inches prior to incorporating amendment
- B. Cultivation of Planting Areas Outside of Existing Tree Drip Lines: Rototill planting areas to a depth of 6 inches immediately prior to incorporating amendment.
- C. Cultivation Within Existing Tree Drip Lines:
 - 1. Carefully hand cultivate within the drip lines of existing trees to remain.
 - 2. Do not exceed 2 inches with depth of cultivation.
- D. Application Rates for bidding Purposes Only
 - 1. 6-cubic-yards nitrogen-treated pine bark per 1,000 square feet.
 - 2. 200 pounds pre-plant fertilizer per 1,000 square feet.
 - 3. 10 pounds iron sulfate per 1,000 square feet.

- E. Application Rates for actual Amendment Work: Apply appropriate amendments to the respective soil types at the rates recommended by the accepted amendment program based on the soil fertility test report.
- F. Incorporation of Amendments Outside Existing Tree Drip Lines: Incorporate uniformly within top 6 inches of soil layer with a rototiller, or other accepted method.
- G. Incorporation of Amendments Inside Existing Tree Drip Lines: Incorporate uniformly into upper 2 inches of soil with hand rake or manually operated garden cultivator, or other accepted method.

3.6 BACKFILL MIX INSTALLATION

- A. Scarification:
 - 1. Immediately prior to backfill mix placement, drill 2-inch diameter by 12-inch long holes at 18 inches on center in bottom and side soil surfaces of plant pits, no closer than 12 inches to finish grade.
 - 2. Do not drill through paving, curbs, or other structures or utilities.
- B. Placement: Place mix carefully into pits avoiding damage or contamination of other Work.
- C. Settlement Allowance: Place backfill mix to depth and elevation which allows for settlement.
- D. Mock-Up: Mock-up areas of backfill mix at the specified depths and apply irrigation to induce settlement, if required to help determine the amount of settlement which will be caused by irrigation and rain.

3.7 IMPORT PEAT/SAND SOIL MIX INSTALLATION

- A. Placement: Place mix carefully into pits or planters avoiding damage or contamination of other Work.
- B. Settlement Allowance: Place backfill mix to depth and elevation which allows for settlement.
- C. Mock-Up: Mock-up areas of backfill mix at the specified depths and apply irrigation to induce settlement, if required to help determine the amount of settlement which will be caused by irrigation and rain.

3.8 STRUCTURAL SOIL MIX INSTALLATION

- A. Place mix carefully to avoid damage or displacement of other materials such as paving, drain rock, geotextile fabric and irrigation piping.
- B. Do not mix subgrade soils on construction materials with mix.
- C. Remove soil mix contaminated with subgrade soil, construction materials or debris.
- D. Maintain mix in a moist, but not saturated, condition to prevent segregation of mix during placement.

- E. Install mix in 6 inch lifts in locations indicated on the Drawings.
- F. Compact lifts to 95 percent compaction in compliance with Geotechnical Investigation Report. Schedule the Geotechnical Engineer to perform nuclear density field tests after each lift of mix to confirm compaction.
- G. Install final lift of mix to elevations indicated on the Drawings.

3.9 FIELD QUALITY CONTROL

- A. Quality Control for Imported Loamy Sand Fill:
 - 1. Soil Test to Verify Soil Fertility and Texture:
 - a. Take representative samples from at least 5 locations at the source.
 - b. Provide samples to Wallace Laboratories for "Complete Standard Analysis" report and amendment recommendations.
 - c. At least 30 days prior to delivery, submit written "Complete Standard Analysis" report, including amendment recommendations to Owner's representative for verification of fertility and texture.
- B. Quality Control for Amended Soils and Soil Mixes:
 - 1. Have Wallace Laboratories take samples and perform soil tests to verify conformance of each soil mix composition with the Specifications.
 - 2. Have Wallace Laboratories determine the location(s) of samples to be taken.
 - 3. Have Wallace Laboratories take samples for testing of the first batch mixed and take samples at 25 cubic yard intervals thereafter.
 - 4. Submit for review and acceptance "Complete Standard Analysis" and corrective Work recommendations if required to meet requirements of the Specifications.
 - 5. If corrective Work is recommended by Wallace Laboratories perform the corrective Work before the commencement of backfill mix placement.
 - 6. After the corrective Work is complete, re-test soil mix(es) and submit the analysis and recommendations for acceptance.
 - 7. Perform the corrective Work followed by testing, and submittal of test analysis and recommendations until Wallace Laboratories indicates that the soil mix(es) meets the requirements of the Specifications.
 - 8. When the soil test indicates that the soil mix(es) meets the requirements of the Specifications the Contractor will receive written notification of acceptance from the Owner's representative.
 - 9. Upon receipt of written notification, the Contractor may commence with placement of backfill mix.
- C. Field Observation Reviews by Owner's representative: Coordinate and schedule with Owner's representative.

END OF SECTION

SECTION 329114
BIORETENTION SOILS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Specifications for furnishing, placing, and compacting bioretention soils as indicated.
- B. Related Sections:
 - 312000 Earthwork
 - 224000 Storm Drainage System

1.2 SUBMITTALS

The contractor shall submit to the Engineer for approval:

- A. A sample of mixed bioretention soil.
- B. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.
- C. Grain size analysis results of the fine sand component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
- D. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in Section 1.4.
- E. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".
- F. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.
- G. Provide the following information about the testing laboratory(ies) name of laboratory(ies) including:
 - 1. Contact person(s)
 - 2. Address(es)
 - 3. Phone contact(s)
 - 4. E-mail address(es)
 - 5. Qualifications of laboratory(ies), and personnel including date of current certification by STA, ASTM, or approved equal

PART 2 - PRODUCTS

2.1 SAND FOR BIORETENTION SOIL

- A. General
 - 1. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be non-plastic.
- B. Sand for Bioretention Soil Texture.
 - 1. Sand for Bioretention Soils shall be analyzed by an accredited lab using #200, #100, #40, #30, #16, #8, #4, and 3/8 inch sieves (ASTM D 422 or as approved by University), and meet the following gradation:

Sieve Size	Percentage Passing (by weight)	
	<i>Min</i>	<i>Max</i>
3/8 Inch	100	100
No. 4	90	100
No. 8	70	100
No. 16	40	95
No. 30	15	70
No. 40	5	55
No. 100	0	15
No. 200	0	5

Note all sands complying with ASTM C33 for fine aggregate comply with the above gradation requirements.

2.2 TOPSOIL FOR BIORETENTION SOIL

- A. General: Topsoil shall be free of wood, waste, or any other deleterious material.
- B. Topsoil for Bioretention Soil Texture: The overall topsoil texture shall be loamy sand as analyzed by an accredited laboratory. The overall dry weight percentages shall be 60-90% sand, with less than 20% passing than the #200 sieve and less than 5% clay of the total weight with no gravel.

2.3 COMPOSTED MATERIAL

Compost shall be a well decomposed, stable, weed free organic matter source meeting the standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).

- A. Compost Quality Analysis Before delivery of the soil, the Contractor shall submit a copy of lab analysis performed by a laboratory that is enrolled in the US Composting Council's Compost Analysis Proficiency (CAP) program and using approved Test Methods for the Evaluation of Composting and Compost (TMECC). The lab report shall verify:
 1. Feedstock Materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues.
 2. Organic Matter Content: 35% - 75% by dry wt.
 3. Carbon and Nitrogen Ratio: C:N < 25:1.
 4. Maturity/Stability: shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120F) upon delivery or rewetting is not acceptable. In addition, any one of the following is required to indicate stability:
 - a. Oxygen Test < 1.3 O₂ /unit TS /hr
 - b. Specific oxy. Test < 1.5 O₂ / unit BVS
 - c. Respiration test < 8 C / unit VS / day
 - d. Dewar test < 20 Temp. rise (°C)
 - e. Solvita® > 5 Index value
 5. Toxicity: any one of the following measures is sufficient to indicate non-toxicity.
 - a. NH₄- : NO₃-N < 3
 - b. Ammonium < 500 ppm, dry basis
 - c. Seed Germination > 80 % of control
 - d. Plant Trials > 80% of control
 - e. Solvita® > 5 Index value
 6. Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.
 - a. Total Nitrogen content 0.9% or above preferred.

- b. Boron: Total shall be <80 ppm; Soluble shall be <2.5 ppm
 - 7. Salinity: Must be reported; < 6.0 mmhos/cm
 - 8. pH shall be between 6.5 and 8. May vary with plant species.
-
- B. Particle size: 95% passing a 1/2" screen.
 - C. Bulk density: shall be between 500 and 1100 dry lbs/cubic yard
 - D. Moisture Content shall be between 30% - 55% of dry solids
 - E. Inerts: compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1 % by weight or volume
 - F. Weed seed/pathogen destruction: provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C for 15 days with at least 5 turnings during that period.
 - G. Select Pathogens: Salmonella <3 MPN/4grams of TS, or Coliform Bacteria <10000 MPN/gram
 - H. Trace Contaminants Metals (Lead, Mercury, Etc.) Product must meet US EPA, 40 CFR 503 regulations
 - I. Compost Testing. The Contractor will test all compost products within 120 calendar days prior to application. Samples will be taken using the STA sample collection protocol. (The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741 Phone: 631-737-4931, www.compostingcouncil.org). The sample shall be sent to an independent STA Program approved lab. The Contractor will pay for the test.

PART 3 - EXECUTION

3.1 PLACEMENT AND COMPACTION OF BIORETENTION SOILS

- A. Place the bioretention soil in 8" to 12" lifts. Lifts are not to be compacted but are placed to reduce the possibility of excessive settlement. Allow time for natural compaction and settlement prior to planting. Bioretention soil may be watered to encourage compaction.

END OF SECTION

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SECTION 329119
PLANTING AREA FINISH GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Finish grading of planting area surfaces.
- B. For Earthwork, see Division 31.
- C. For Landscape Maintenance Period, see Section 320100.
- D. For Irrigation, see Section 328400.
- E. For Soil Preparation and Soil Mixes, see Section 329113.
- F. For Plant Material, see Section 329300.

1.2 DEFINITIONS

- A. Soil Subgrade: The soil surface on which topsoil is placed.
- B. Finished Grades: The required final soil surface grade elevations indicated on the Drawings.
- C. Aesthetic Acceptance of Grades: Acceptance by the Owner's representative in writing of the aesthetic correctness of the contours. Aesthetic acceptance does not address whether an area drains properly, whether the areas are at the correct elevations, or whether it has been compacted properly.
- D. Acceptance: Wherever the terms "acceptance," "accepted," or "acceptable" are used herein, they mean acceptance of Owner's representative in writing.

1.3 REFERENCES

- A. ASTM — American Society for Testing Materials:
 - 1. D 1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort. Most current edition.
- B. Geotechnical Investigation Report: - Geotechnical Investigation and Geologic Hazards Evaluation, Laney College Library Learning Resource Center, Final Report, March 31, 2023 prepared by Fugro.

1.4 QUALITY ASSURANCE

- A. Finish Grade Smoothness Mockup:

1. Prepare a 20-foot by 20-foot area of finish graded soil representing the finished graded surface of the planting areas.
2. Locate mockup on site in a proposed planting area easily referenced by workers performing finish grading operations.
3. Protect accepted mockup from physical damage and erosion with fencing, canopies, sandbags or other accepted means until Final Completion.
4. The accepted mock-up shall be the standard by which finish grading is judged.

1.5 SITE CONDITIONS

A. Environmental Requirements:

1. Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily.
2. Apply water, if necessary, to bring soil to an optimum moisture content for grading.
3. Do not work soil when muddy or frozen.
4. Existing Conditions:
5. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing public underground utilities and structures with respective utility companies.
6. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing private underground utilities and structures with Owner.
7. Prior to Work commencement and after reviewing the Owner's record irrigation documents, review with Owner and clearly mark in field locations of field heads, valve boxes, and other underground equipment, materials and structures.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine site and verify that conditions are suitable for finish grading Work, and that no defects or errors are present which would interfere with or cause incorrect finish grading Work to occur.
- B. Excessive Compaction: Verify that the upper 18 inches of soil is compacted no more than 70 percent as determined by ASTM D 1557.
- C. Soil Preparation: Verify that subsoil ripping and soil preparation Work is complete.
- D. Notification of Unsuitable Conditions: Before proceeding with Work, notify Owner and Owner's representative in writing of unsuitable conditions and conflicts.

3.2 PREPARATION

- A. Protection of Existing Conditions:
 - 1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
 - 2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
 - 3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 - 4. Submit written notification of conditions damaged during construction to the Owner and Owner's representative immediately.

3.3 FIELD ENGINEERING

- A. General:
 - 1. Establish lines and levels, locate and lay out by instrumentation and similar appropriate means for planting area finish grades.
 - 2. Provide grade stakes and string lines to achieve smooth finish grades with positive surface drainage.
- B. Hand Graded and Screeded Areas:
 - 1. Install grade stakes at maximum 10 feet on center each way.
 - 2. Install additional grade stakes if required to achieve smooth, positive draining surface acceptable to the Owner's representative.
- C. Machine Graded Areas:
 - 1. Install grade stakes at maximum 25 feet on center each way.
 - 2. Install additional grade stakes if required to achieve smooth, positive draining surface acceptable to the Owner's representative.
- D. High Points and Low Points: Provide grade stakes at high points and low points including top of berms, catch basin rims and area drain rims.

3.4 FINISH GRADING OPERATIONS

- A. General:
 - 1. Grade soil surface with smooth uniform slope between points where elevations are given, and between points where elevations are given and existing grades.
 - 2. Slope finish grades to drain surface water away from buildings, walks, paving, and other structures unless indicated otherwise.
 - 3. Slope finish grades to drain surface water to catch basins, area drains or trench drains as shown on the Drawings.
 - 4. Grade soil surface smooth to be free of high and low areas which will inhibit surface drainage.
- B. Excessive Compaction:

1. Take precautions to prevent soil from becoming compacted more than 70 percent as determined by ASTM D 1557.
 2. Rip to an 18 inch depth and rototill areas compacted more than 70 percent.
- C. Screeding of Special Lawn Turf Areas:
1. After soil amendment Work has been completed, screed soil surface of planting areas smooth with straight edges.
 2. Apply a minimum 1-inch of irrigation water to induce settlement and melt clods.
 3. Prior to planting Work, screed soil surface smooth, adding amended soil to low areas.
- D. Equipment: Use equipment of appropriate size and type to achieve the sculptural forms, profiles and smooth soil surface free of high areas, depressions and equipment tracks.
- E. Depressions and Loose Material: Fill and compact any depressions, and remove loose material to finish surface true to line and grade, presenting a smooth, compacted, and unyielding surface.

3.5 TOLERANCES

- A. Hand Graded Areas:
1. Grade to within 0.03 foot of grades indicated on the Drawings, except bring soil edge surface grades, paving, curbs, and other structures to within 0.01 foot of grades shown on the Drawings.
 2. Transition soil edge surface grades along paving, curbs, and other structures to areas of less strict tolerance over 5 feet distance.
- B. Machine Graded Areas: Grade to within 0.05 foot of grades indicated on the Drawings.
- C. Allowances: Make proper allowances for settlement, spoils from plant pits, and addition of soil amendment.

3.6 FIELD QUALITY CONTROL

- A. Aesthetic Acceptance of Grades:
1. Upon completion of finish grading Work, schedule with Owner's representative a review to obtain aesthetic acceptance.
 2. Provide three-days advance written notification.
 3. Do not commence sodding, seeding or other planting Work until receiving aesthetic acceptance.
- A. Field Observation Reviews by Owner's representative: Coordinate and schedule with Owner's representative.

END OF SECTION

SECTION 329300
PLANT MATERIAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backfill Mixes.
 - 2. Drain Rock.
 - 3. Fertilizers.
 - 4. Plant Materials.
 - 5. Rock Mulch.
 - 6. Root Barriers.
 - 7. Root Ball Anchors.
 - 8. Steel Header and Stakes
 - 9. Angle Iron Header
 - 10. Wood Chip Mulch.
- B. For Earthwork, see Division 31.
- C. For Landscape Maintenance Period, see Section 320100.
- D. For Irrigation, see Section 328400.
- E. For Planting Soil Preparation, see Section 329113.
- F. For Planting Area Finish Grading, see Section 329119.
- G. For Landscape Drainage, see Section 334101.

1.2 DEFINITIONS

- A. Acceptance: Wherever the terms “acceptance”, “accepted”, or “acceptable” are used herein, they mean acceptance of Owner’s representative in writing, unless indicated otherwise.
- B. Tie Height: Lowest Height at which tree trunk will snap back to upright position when pulled to one side and released.
- C. Plant Height: Measurement of main body height, not measurement to top branch tip.
- D. Plant Spread: Measurement of main body diameter, not measurement from branch tip to tip.
- E. Caliper: Trunk diameter measured at a point 6 inches (150 mm) above natural ground surface for trees up to 4 inches (100 mm) in caliper, and measured at a point 12 inches (300 mm) above natural ground surface for trees over 4 inches (100 mm) in caliper.

1.3 REFERENCES

- A. ANSI — American National Standards Institute:
 - 1. Z60.1 — American Standard for Nursery Stock. Most current edition.
- B. ICBN — International Code of Botanical Nomenclature. Most current edition.
- C. ICNCP — International Code of Nomenclature of Cultivated Plant. Most current edition.
- D. NAAPS — National Arborist Association Pruning Standards. Most current edition.
- E. UC DAS — University of California Division of Agricultural Sciences.
 - 1. Leaflet 2576 — Staking Landscape Trees. Most current edition.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Fertilizer Tablets.
 - 2. Geotextile Fabric.
 - 3. Root Barriers.
 - 4. Steel Header and Stakes
 - 5. Angle Iron Header
 - 6. Tree Stakes.
 - 7. Tree Tie.
 - 8. Wetting Agent and Soil Penetrant.
 - 9. Root Ball Anchors
- B. Samples:
 - 1. Auxiliary Stake — 6-inch length.
 - 2. Cross-tie — 6-inch length.
 - 3. Rock Mulch — 1/2 pound bag.
 - 4. Wood Mulch — 1/2 pound bag.
 - 5. Angle Iron Header – 12" length
- C. Plant Material Photographs:
 - 1. At least 14 days prior to submittal of plant material location data, submit three color photographs each of representative plants of each type of plant material.
 - 2. Include a scale object in each photograph such as a tape measure or person.
- D. Plant Material Location Data:
 - 1. Quantities and sizes of each plant material type at each nursery or other place of growth.
 - 2. Address, phone number, and contact person for each nursery or other place of growth.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.

2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handling Plants:
 1. Do not lift or handle container plants by tops, stems or trunks.
 2. Do not bind or handle plants with wire or rope.
 3. Pad trunk and branches where hoisting cables or straps contact.
- B. AntiDesiccant:
 1. Spray plant material in full leaf immediately before transporting with antidesiccant.
 2. Meet requirements of anti-desiccant manufacturer's current printed application instructions.
- C. Digging Plants: Dig ball and burlap plants with firm, natural balls of earth of diameter meeting or exceeding requirements of ANSI Z60.1 and of sufficient depth as required to include the fibrous and feeding roots.
- D. Plant Storage Prior to Installation:
 1. Protect plant root balls from sun and drying winds.
 2. Keep root balls moist.
 3. Keep sun-sensitive plants shaded.
 4. Anchor plants to prevent damage from strong winds.

1.7 SITE CONDITIONS

- A. Environmental Requirements:
 1. Protect plant material being stored on site from sun and drying winds.
- B. Existing Conditions:
 1. Prior to Work commencement, review and clearly mark in field horizontal and vertical locations of public existing underground utilities and structures with respective utility companies.
 2. Prior to Work commencement, review and clearly mark in field horizontal and vertical locations of private underground utilities and structures with Owner.

1.8 WARRANTY

- A. Warranty Period: Warrant that plant material, except annuals, will be healthy and in vigorous, flourishing condition of active growth one year from date of Final Completion.
- B. Annuals: Warrant that annuals will be in a vigorous, flourishing condition of active growth until end of last annual change season.
- C. Delays: Delays in completion of planting operations which extend the planting into more than one planting season shall extend the Warranty Period correspondingly.
- D. Condition of Plants: Plants shall be free of dead or dying branches and branch tips, with foliage of a normal density, size and color.

- E. Incorrect Materials:
 - 1. During Warranty Period, replace at no cost to Owner, plants revealed as being untrue to name.
 - 2. Provide replacements of a size and quality to match the planted materials at the time the mistake is discovered.
- F. Replacements:
 - 1. As soon as weather conditions permit, replace, without cost to Owner, dead plants and plants not in a vigorous, thriving condition, as determined by the Owner's representative during and at the end of Warranty Period.
 - 2. Apply requirements of this Section to replacements.
- G. Exceptions: Contractor shall not be held responsible for failures due to neglect by Owner, vandalism and other causes outside the Contractor's control.

1.9 MAINTENANCE

- A. For Landscape Maintenance Period, see Section 32 01 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Fertilizer Tablets:
 - 1. Gro Power, Inc. – www.gropower.com.
 - 2. Grow Better – www.growbetter.com.
 - 3. Agri Tab Corporation – www.agritab.com.
 - 4. Or equal.
- B. Anti-Desiccant:
 - 1. Aquatrols Corporation – www.aquatrols.com.
 - 2. Or equal.
- C. Stress Reducing Agent: (DM – we need more manufacturers)
 - 1. EarthWorks – www.soilfirst.com.
 - 2. Or equal.
- D. Wetting Agent and Soil Penetrant:
 - 1. Aquatrols – www.aquatrols.com.
 - 2. Harell's – www.harrells.com.
 - 3. Or equal.
- E. Drain Rock
 - 1. American Soils Products, www.americansoil.com
 - 2. Or equal.
- F. Wood Chip Mulch:
 - 1. Lyngso – www.lyngsogarden.com
 - 2. American Soil Products – www.americansoil.com.

3. Or equal.
- G. Rock Mulch:
1. Lyngso – www.lyngsogarden.com
 2. American Soil Products – www.americansoil.com.
 3. Or equal.
- H. Deep Root / Aeration System:
1. Rootwell, Union Lake, MI., (888) 766-8935.
 2. Or equal.
- I. Geotextile Fabric:
1. mmCarthage Mills – www.carthagemills.com.
 2. Mirafi – www.tcmirafi.com.
 3. Or equal.
- J. Steel Header:
1. The J.D. Russell Company – www.jdrussellco.com
 2. Or equal.
- K. Root Barriers:
1. Deep Root – www.deeproot.com.
 2. Century Products – www.centuryrootbarrier.com.
 3. Or equal.
- L. Root Ball Anchors
1. Platipus Earth Anchoring Systems – www.platipus-anchors.com.
 2. Or equal.

2.2 SUBSTITUTIONS

- A. Plant Material: Accepted substitute plants shall be true to species and variety and shall meet requirements of this Section except that plants larger than specified may be used if accepted.

2.3 MATERIALS

- A. Plants:
1. Growing Practices: Nursery grown in accordance with best horticultural industry practices.
 2. Nomenclature: Plant nomenclature shall meet requirements of ICBN and ICNCP.
 3. Climatic Growing Conditions: Grown under climatic conditions similar to those of project for at least two years unless otherwise accepted.
 4. Container Growth Limitations: Container stock excluding annuals shall have been grown in the containers in which delivered for at least six months, but not over two years.
 5. Root Ball Size: Meet or exceed requirements of ANSI Z60.1.
 6. Branching: Structurally strong, able to stand upright without stakes or guys on a windless day; exceptionally heavy, symmetrical, tightly knit, so trained or favored in development and appearance as to be superior in form, number of branches, compactness and symmetry.
 7. Vigor: Sound, healthy and vigorous, well branched and densely foliated when in leaf.
 8. Disease and Pests: Free of disease, insect pests, eggs, or larvae.

9. Root System: Healthy well-developed root systems, free of kinked, circling, girdling and center roots, rootbound condition and cracked or broken root balls.
10. Measurements: Measure plants when branches are in their normal upright position.
11. Pruning: Do not prune, thin or shape plants before delivery without acceptance.
12. Unacceptable Conditions: Multiple leaders, unless specified, damaged or crooked leaders, bark abrasions, sun-scalds, disfiguring knots, or fresh cuts of limbs over 3/4-inch diameter which have not completely callused.

B. Fertilizer Tablets:

1. Grow-Power 21 gram tablets, 20-10-5 (NPK) formula.
2. Grow-Power 7 gram ADS tablets, 12-8-8 (N-P-K) formula.
3. Agri Tab Aquatic fertilizer, 12-20-8 in compressed spike form.
4. Agri Tab Aquatic fertilizer, 20-5-10 5 gram tablets.
5. Or equal.

C. Water: Clean, fresh and potable.

D. Drain Rock: ¾ inch round.

E. Wood Chip Mulch:

1. Match existing
2. Or equal.

F. Rock Mulch:

1. 3/8" crushed black basalt.

G. Anti-Desiccant: Commercially available spray protective coating, designed to reduce plant transpiration loss, which produces a moisture retarding barrier not removable by rain or snow.

H. Stress Reducing Agent:

1. Roots Concentrate.
2. Or equal.

I. Wetting Agent and Soil Penetrant:

1. AquaGro 2000M.
2. AquaGro 2000G.
3. Or equal.

J. Geotextile Fabric:

1. Mirafi Filterweave 140 NC non-woven geotextile composed of polypropylene fibers.
2. Carthage FX-300MF
3. Or equal.

K. Steel Header:

1. Flexible carbon steel, ¼ inch by 5 inches by minimum 16 feet minimum length pieces, black factory paint finish, double staked overlap joints and designed to receive tapered steel stakes.

L. Steel Header Stakes:

1. Steel, tapered, 16-inch minimum length, with black paint finish, designed specifically to anchor steel header in place, manufactured by manufacturer of the steel header for which they will be used.

M. Angle Iron Header

1. Material: A36 Steel Angle
2. Finish: Galvanized
3. Size: 4" x 4"

N. Root Barrier

1. UB 24-2
2. Deep Root, www.deeproot.com
3. Or equal.

O. Root Ball Anchoring

1. Platipus Earth Anchoring Systems, www.platipus-anchors.com.
2. Duckbill Model 68-RBK for trees up to 1 inches caliper.
3. Deadman System – Plati-Mat RF2RDMP for trees 1.5 to 6 inches caliper.
4. Or equal.

2.4 MIXES

- A. For Plant Pit Backfill, see Section 02920.

2.5 SOURCE QUALITY CONTROL

A. Plant Material Review and Tagging:

1. Trees will be reviewed, photographed and tagged by the Owner's representative at the nursery, or other place of growth prior to delivery of trees to site.
2. At Owner's representative's discretion, shrubs may or may not be reviewed, photographed, and tagged by the Owner's representative at the nursery or other place of growth.
3. Tagging of plant material at the nursery or place of growth does not cancel the right of the Owner's representative to reject plant material at the site, if damage or unacceptable conditions are found that were not detected at the nursery, place of growth or in the submitted photographs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
- B. Fine Grading and Soil Preparation: Verify that fine grading and soil preparation Work is complete.
- C. Verification Surface Drainage: Verify positive surface drainage of planted areas.

- D. Notification: Before proceeding with Work, notify Owner and Owner's representative in writing of unsuitable conditions.

3.2 PREPARATION

- A. Protection of Existing Conditions:
 - 1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
 - 2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
 - 3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 - 4. Submit written notification of damaged plants and structures to Owner and Owner's representative immediately.

3.3 SUBSURFACE OBSTRUCTIONS

- A. Plant Pit Excavation: If rock, underground utilities, structures, tree roots or other obstructions are encountered in the excavation of plant pits, alternate locations may be accepted by the Owner's representative.
- B. Cost for Removal of Obstructions: Where locations cannot be changed, submit cost estimate for Work to remove the obstructions to a depth of not less than 6 inches below the required pit depth, and proceed with Work after Owner's approval.
- C. Irrigation Piping: Reroute around the plant root ball.

3.4 PLANT LAYOUT

- A. Trees:
 - 1. Stake location of trees where indicated on Drawings.
 - 2. Scale tree locations where no dimensions are given.
 - 3. Drive a 3-foot long wood lath stake at each tree location and mark each tree type with different color survey tape.
 - 4. Contact Owner's representative to review locations in field prior to excavating plant pits.
 - 5. Do not excavate plant pits until Owner's representative has accepted locations.
- B. Shrubs and Groundcover.
 - 1. Layout according to Drawings.
 - 2. Contact Owner's representative if there are any conflicts that would prevent plants from being laid out according to Drawings.
 - 3. Contact Owner's representative to determine if a review of locations in field, prior to excavating plant pits, is required.

3.5 EXCAVATION OF PLANT PITS

- A. Equipment:
 - 1. Excavate pits with a backhoe or hand digging.

2. Do not use an auger.
- B. Dimensions:
1. Excavate plant pits to a depth equal to the root ball height minus the amount needed to account for settlement and to install the root balls at the specified elevation relative to adjacent finished grade.
 2. Install top of plant root balls 1-inch above adjacent finished grade except where indicated otherwise.
 3. Excavate pits to a diameter which is 3 times the root ball diameter, except where indicated otherwise on the Drawings.
 4. Center plant pits on plant locations where possible.
 5. Where plant pits cannot be excavated to specified dimensions nor centered on plants due to obstructions such as paving, walls, curbs, or other structures excavate pits in directions without obstructions until pit volume equals the specified plant pit volume, except where indicated otherwise.
 6. Do not undercut adjacent obstructions unless accepted by the Owner's representative.
 7. Excavate plant pit sides along adjacent elements such as paving, walls, curbs, and other structures at a 45 degree angle sloping away from the bottom surfaces of the adjacent elements, except where indicated otherwise.

3.6 ROOT BARRIERS INSTALLATION

- A. Locations: Install root barriers where shown on Drawings and according to manufacturer's current printed instructions.

3.7 STEEL HEADER INSTALLATION

- A. Locations: Install where indicated on Drawings.
- B. Horizontal Alignment:
1. Install straight sections free of "wiggles" using string lines as guides.
 2. Install curved sections as smooth curves free of small "wiggles" following alignment marked with paint by Owner's representative in field.
- C. Vertical Alignment: Install parallel with finished grade.
- D. Stakes:
1. Install stakes in solid undisturbed soil.
 2. Recompact loose disturbed soil to at least 85 percent relative compaction before installing stakes.
 3. Install stakes at every location in header sections designed to attach stakes to headers.
- E. Damaged headers: Replace header sections damaged by construction operations.

3.8 PLANTING AND BACKFILL OPERATIONS

- A. Protection of Plants Prior to Installation:
1. Protect plant root balls from sun or drying winds.

2. Keep root balls of plants that cannot be planted immediately upon delivery in the shade, well protected and well watered.

B. Removal of Containers:

1. Remove canned stock carefully after cans have been cut on two sides with accepted cutter.
2. Do not use spade to cut containers.

C. Root Ball Scarification:

1. After removing plant from container, scarify side of root ball to prevent root-bound condition.
2. Loosen root ball soil surface to depth of 1/8 to 1/4 inch without damaging roots or breaking root ball.

D. Cutting Circling Roots:

1. If circling roots are encountered at root ball sides, notify Owner's representative for field review.
2. Upon Owner's representative's acceptance, cut roots on 4 sides of root ball 90 degrees apart at no extra cost to Owner.
3. Use a 4-inch wide sharp straight blade.
4. Cut roots by pushing spade or knife down sides of root ball 90 degrees to root ball surface and 2 inches into root ball.
5. Keep spade or knife sharp to cut roots cleanly.

E. Plant Placement:

1. Handling plant carefully, set plant root ball on pit bottom centered on accepted horizontal location.
2. Install plant root ball vertically so that top of root ball is 1 inch above adjacent finished grade after settlement except where indicated otherwise.

F. Removal of Root ball Wrapping Materials: Remove and dispose of burlap, nylon cord, wire baskets, twine and other materials prior to backfilling.

G. Backfill Mix Placement:

1. Place mix carefully as not to damage the plant root ball, trunk, branches, or foliage.
2. Fill pit until top of backfill mix is even with top of root ball.
3. Settle mix by watering evenly.
4. Fill settled backfill mix with additional soil mix as required to bring it even with top of root ball.
5. Continue filling and watering settled areas until settlement stops.

H. Settled Plant Adjustment: Raise plant root balls which settle so that top of root balls are at the specified elevation relative to adjacent finished grade.

I. Final Compaction: Compact soil mix by saturating with water.

J. Fertilizer Tablets:

1. Place maximum quantities recommended by the manufacturer's current printed instructions.
2. Place tablets between bottom of root ball and 1/3 way up root ball, 2 inches away from root ball.

3. Do not place tablets higher than 1/3 way up root ball.
4. Space tablets equally around root ball.
5. Install tablets at trees, shrubs, ground cover, ornamental grasses, and ferns.

K. Stress Reducing Agent:

1. After backfilling plant pits, drench backfill at rates recommended by manufacturer.
2. Drench backfill same day backfill is placed.

L. Wetting Agent and Soil Penetrant:

1. After backfilling plant pits, drench backfill at rates recommended by manufacturer.
2. Drench backfill same day backfill is placed.

3.9 ROOT BALL ANCHOR INSTALLATION

A. Manufacturer's Requirements: Meet requirements of manufacturer's current printed instructions.

B. Root Ball Characteristics:

1. Install anchors only on firm root balls.
2. Do not install anchors on trees grown in sand, sawdust or other loose growing mixes.

3.10 WOOD CHIP MULCH INSTALLATION

A. Depth: Install geotextile fabric and rock mulch at depths and locations shown on the Drawings.

B. Surface: Rake mulch surface smooth.

C. Woody Plant Stems: Slope mulch away from woody plant stems so that mulch does not touch stems.

3.11 ROCK MULCH INSTALLATION

A. Depth: Install geotextile fabric and rock mulch at depths and locations shown on the Drawings.

B. Surface: Rake mulch surface smooth.

C. Woody Plant Stems: Slope mulch away from woody plant stems so that mulch does not touch stems.

3.12 FIELD QUALITY CONTROL

A. Field Observation Reviews by Owner's representative: Coordinate and schedule with Owner's representative.

3.13 SCHEDULES

A. Root Ball Anchor Schedule:

<i>Tree Caliper at 12 Inches Above Grade</i>	<i>No. of Guys</i>	<i>Cable Size</i>	<i>Turn-buckle Size</i>	<i>Ground Anchors</i>
3 - 6 inches	3	1/8 inch 7 × 7	1/4 × 4 inches	4 × 4 × 24 × 18 inches deep deadmen (or) Laconia LA-4-40 SM (or) Duckbill 68
6 - 8 inches	3	3/16 inch 7 × 7	5/16 × 4-1/2 inches	6 × 6 × 30 × 30 inches deep deadmen (or) Laconia LA-6-60 (or) Duckbill 88

END OF SECTION

SECTION 331000
WATER UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Specifications for providing water service and distribution and modification to existing water mains and services as indicated. The extent of water distribution is indicated on the Contract Drawings and includes furnishing, installing, testing, and disinfecting permanent water supply piping and services as indicated.
- B. The jurisdictional water utility district shall provide water services to the water meter as indicated on the Contract Drawings. The Contractor shall be responsible for making all such arrangements. All work on the jurisdictional agency's facilities shall be in accordance with the agency's adopted standards and performed by the agency or their representative.

1.2 RELATED SECTIONS

- A. Section 312324 – Trench Excavation and Backfill

1.3 REFERENCES

- A. Codes and Standards: The design and installation of underground water piping shall conform to the following codes and standards except as specifically noted in these standards.
 - 1. Latest edition of the California Plumbing Code (CPC)
 - 2. Latest edition of the California Fire Code
 - 3. Latest edition of the California Building Code
 - 4. Latest adopted edition of the National Fire Protection Association (NFPA) 24: Standard for the Installation of Private Fire Service Mains and Their Appurtenances
 - 5. American Water Works Association (AWWA) standards and manuals as appropriate for installation and materials including, but not limited to:
 - a. C-104 (2013): Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - b. C-105 (2010): Polyethylene Encasement for Ductile-Iron Pipe Systems
 - c. C-150 (2008): Thickness Design of Ductile-Iron Pipe
 - d. C-151 (2009): Ductile-Iron Pipe, Centrifugally Cast for Water
 - e. C-504 (2010): Rubber-Seated Butterfly Valves
 - f. C-600 (2010): Installation of Ductile-Iron Water Mains and Their Appurtenances
 - g. C-605 (2013): Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for water
 - h. C-651 (2014): Disinfecting Water Mains
 - i. C-900 (2007): Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 12 in. (100 mm Through 300 mm), for Water Transmission and Distribution
 - j. M-11 (2004): A Guide for Steel Pipe Design and Installation, 4th Ed.
 - k. M-14 (2014): Recommended Practice for Backflow Prevention & Cross-Connection Control, 4th Ed.
 - l. M-23 (2002): PVC Pipe - Design and Installation, 2nd Ed.
 - m. M-27 (2013): External Corrosion: Introduction to Chemistry and Control, 2nd Ed.
 - n. M-41 (2009): Ductile-Iron Pipe and Fittings, 3rd Ed.
 - o. M-55 (2006): PE Pipe—Design and Installation, 2nd Ed.

1.4 SUBMITTALS

- A. Shop Drawings, Product Data, and Samples
- B. Shop drawings showing all piping layout and pipe sizes, valves, backflow prevention device, and locations of tie-ins, buttresses, and thrust blocks.
- C. Manufacturer's product data for manufactured materials and equipment, including all valves and backflow prevention device.

1.5 SITE CONDITIONS

- A. Excavations in which products will be buried shall be dry.
- B. Coordinate the installation of water supply system with the jurisdictional water utility owner. Contractor shall coordinate with jurisdictional water utility owner for installation of the new domestic water meter and water lateral within the City right-of-way. The jurisdictional water utility owner shall install the new domestic water lateral from the existing water main to the new water meter. Contractor shall coordinate depth and location of new domestic water lateral with the jurisdictional water utility owner.
- C. Existing Underground Piping: Existing utilities and piping, where known, are shown on the Drawings. Exact locations and depths of existing lines must be determined in the field by the Contractor by exploration using methods which will not damage any existing improvements.
- D. Location and Alignment of New Work: Pipe alignments may be varied from those shown on the Drawings when field conditions indicate that the change would be advantageous. Any such proposed changes shall be brought to the attention of the Engineer. Changes shall not be made until written approval from Engineer has been obtained. Provide traffic cover plates over trenches at streets, parking areas and pedestrian pathways to maintain access, unless closure is permitted by the Engineer.
- E. Interference with Normal Operations at the Site: All pipe work shall be coordinated with the required excavation and backfill so that there will be a minimum of interruption in the normal use of roads, parking areas, pathways and other existing facilities.
- F. Shutdowns of Existing Systems: To the extent required for the installation of the new work, shutdowns of the existing facilities will be permitted. Perform Work that involves tie-in to existing systems at such times as will cause the least inconvenience to University activities. This may be at night and/or on weekends. Prior to any shutdown, Contractor shall notify Engineer in writing at least 10 days prior to the planned tie-in. The Engineer will then schedule the shutdown with campus facilities Service staff who will determine the actual time of the tie-in as close as possible to the Contractor's request. Include in Contractor's bid the cost of overtime necessary to perform the Work. No extra payment will be allowed for overtime to meet this requirement.
- G. At least one week prior to the shutdown the Contractor shall submit to the Engineer a schedule and plan showing the following: a) how connections to existing facilities are to be made; b) length of time required to accomplish the work and to get the systems into service, and c) a list of all equipment and materials required to make the tie-in. The shutdown will not be permitted to commence until the Contractor has received written permission from the Engineer and the Contractor has provided assurance to the Engineer that all necessary material, equipment and manpower will be available at the proper time so that the shutdown will proceed on schedule.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS, SIZES AND OTHER REQUIREMENTS

- A. Water Distribution Main (pipe size 4 inches and larger)
 - 1. PVC AWWA C-900 DR-18 (Class 235); or
 - 2. Polyethylene Pipe (PE): PE 4710, ASTM F714, Pressure Class 200, DR9 , conforming to AWWA C906, if specifically approved by Facilities Services and the Designated Campus Fire Marshal; or

3. Ductile Iron Pipe (DIP): Pressure Class 350 pipe conforming to AWWA/ANSI C151/A21.5, cement-mortar lining conforming to AWWA/ANSI C104/A21.4, with standard thickness per AWWA/ANSI C150/A21.50. U.S. Pipe, American Cast Iron Pipe Company (ACIPCO), or approved equivalent.
 - a. Flanged ends shall conform to AWWA/ANSI C115/A21.15.
 - b. Rubber-gasket joints shall conform to AWWA/ANSI C111/A21.11.
- B. Water Service Line (pipe size 3 inches and smaller)
 1. Water lateral shall be ASTM B88 type "K" copper pipe with brazed joints using minimum 15 % silver brazing alloy.
 2. High Density Polyethylene Pipe (HDPE): PE4710, Pressure Class 200, DR 9 conforming to AWWA C901. J-M Manufacturing PIPE or approved equivalent.
- C. Underground conduit for fire alarm system shall be polyvinyl chloride pipe: Less than 6 inches nominal size: ASTM D3034, SDR 26. Joints: Elastomeric gasket joints, ASTM D3212. Gaskets: Submit two sample gaskets with an explanation of the markings. Above ground conduit for fire alarm system shall be flex steel-galvanized electrical conduit.
- D. Couplings and pipe thread adapters for copper tubing shall be Mueller 110 compression connection series or equal. Soldered joints are not allowed.
- E. All ferrous materials, restrainers, T-Head bolts, clamps, joint restraint clams, washers, tie rods, bolts and nuts shall have at least one coat of protective coating (bituminous mastic) of an approved type before backfilling.
- F. Mechanical joint ductile-iron fittings shall conform to ANSI A 21.53 (AWWA C153) – "Ductile-Iron Compact Fittings, 3-in. through 24-in. and 54-in. through 64-in. for Water Service". All mechanical joints shall be fully restrained with Mega Lug or an Engineer approved equal.
- G. Flanged fittings shall conform to ANSI A 21.10 (AWWA C110) – "Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in. for Water and Other Liquids".
- H. Push-on joint fittings are not allowed except for special circumstances approved in advance, in writing by Owner's Representative.
- I. All restrainers and ductile-iron fittings shall be wrapped with at least one layer of 10-mil plastic.
- J. All ductile-iron pipe shall be wrapped with at least one layer of 10-mil plastic.
- K. Hot tapping and use of saddles are not permitted unless approved in advance by the Engineer.

2.2 Valves

- A. Valves shall conform to AWWA C-504. Valves shall be Pratt Butterfly Valves (or equivalent)
- B. Indicating posts used for underground valves or wall indicating valves shall be of the type that use the words "OPEN" when the valve is open and "SHUT" when the valve is closed. Mueller gate valves with a resilient seal (or equivalent) shall be used.
- C. Valves shall open when turned counter-clockwise.
- D. A concrete pad shall be placed under all valves.

2.3 Water Supply Backflow Preventer Assemblies

- A. Backflow Prevention Devices
 1. Backflow preventers shall be as indicated in the plans.
 2. A three inch (3") outlet with bolted flange shall be provided downstream of the backflow preventer for testing purposes.
 3. All test openings in the backflow preventer shall be plugged.
 4. Select appropriate backflow prevention devices for the intended service. The following devices are listed in approximate decreasing order of effectiveness and reliability.
 5. Air-Gap Separations (a physical break between the supply pipe and a receiving vessel): The air gap shall be at least twice the diameter of the supply pipe, measured vertically above the overflow rim of the vessel with a minimum clearance of one inch (1"). This provides the maximum degree of protection and should be used wherever a non-pressurized supply is acceptable. It shall be used where sewage or toxic substances are involved.

6. Reduced-Pressure Backflow Preventers: Use for protection of all direct or indirect connections where the device may be subject to back pressure and for isolating industrial water systems from the domestic water system. Locate in an accessible location. Where spillage is unacceptable, discharge with an air gap into a floor drain. Install backflow preventer at least 12" above floor or ground. Test cocks must be accessible.
7. Pressure-Type Vacuum Breaker: Use only as protection for direct or indirect water connections to all types of polluted or contaminated liquids where the vacuum breakers are not subject to back pressures. These units may be installed under continuous line pressure. Install in an accessible location. Where spilling into room is objectionable, it shall be specified as modified with drain connection and waste.
8. Anti-Siphon Ballcocks: Use for tank-type water closets and urinals. The outlet of the backflow preventer shall be at least one inch (1") above the opening of the overflow pipe.
9. Vacuum Breakers for Flush Valves: Occurs at toilets or urinals. Specify installation at least four inches (4") above the overflow rim.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall coordinate with domestic water service connection and meter installation with EBMUD. As indicated in plans, EBMUD will tap existing water main and install the domestic water meter. Contractor shall assume 6 – 9 months for installation of domestic water meter and service line following submittal of the new water meter application to EBMUD.
- B. Show valves at all services from mains and at other points to minimize disruption of building operations. Valves should be located at the building exterior and where mains enter the building.
- C. Use separate cold water services for domestic and fire where it is from the University system.
- D. Thrust blocks shall be as indicated in the plans

3.2 MAINTAINING WATER SERVICES

- A. Maintain water service and conduct operations at times selected to minimize duration and inconvenience of service interruption.
- B. Water valves in service owned by the jurisdictional water utility Owner shall be operated only by personnel of that jurisdictional water utility district.
- C. Except as specified otherwise herein, and where applicable, materials and construction methods shall be in accordance with the provisions of the jurisdictional water utility district standard drawings and specifications.

3.3 INSTALLATION

- B. Installation Requirements
 1. Excavating and backfilling, including bedding and compacting requirements, to the backflow preventer assemblies shall be in accordance with the provisions of the jurisdictional water utility district standard drawings and specifications. Excavating and backfilling, including bedding and compacting requirements, beyond the backflow preventer assemblies shall conform to Section 312324 – Trench Excavation and Backfill.
 2. Provide concrete thrust blocks for elbows, tees, valves, and appurtenances of buried piping. Thrust blocks shall be constructed as indicated.
 3. Install piping true to line and grade, supported and guided to assure alignment under all conditions.
 4. Install unions at each connection to valves.
 5. Make change in line with fittings. Do not spring joints to effect change of direction.
 6. Do not field cut pipe unless necessary. Make such necessary cuts by means of equipment designed for the purpose, ensuring a smooth square end.

7. For connection to existing pipe, provide pipe with suitable ends or adapters, after verification of size and type of existing pipe.
- C. Valves
1. Install valves in accordance with the valve manufacturer's installation instructions.
 2. Where valves are provided by the jurisdictional water utility, provide suitable access for operation of valves.
 3. Unless approved by the Engineer, campus personnel shall operate, open, or close any valve in the existing system.
 4. Valves shall conform to AWWA C-504. Valves shall be Pratt Butterfly Valves (or equivalent) except as required by section (5) (below).
 5. As applicable, indicating posts used for underground valves or wall indicating valves shall be of the type that use the words "OPEN" when the valve is open and "SHUT" when the valve is closed. Mueller gate valves with a resilient seal (or equivalent) shall be used.
 6. Valves shall open when turned counter-clockwise.
 7. A concrete pad shall be placed under all valves.
- D. Thrust Blocks and Harnessing
1. Provide for counteracting thrust caused by static and dynamic forces, including water hammer at bends, tees, reducers, valves, and dead-ends by installing harnessing as indicated or required. For other methods, submit details for approval of the Engineer prior to use.
 2. Provide concrete thrust blocks as indicated where harnessing is not practicable.
- E. Water Service Connectors
1. Make water service connections, as indicated, in accordance with California Plumbing Code and the installation instructions of the service pipe and fittings manufacturer.
- F. Acceptance Requirements
1. After installation of pipes, ends of pipes shall be either capped or plugged. No piping shall be buried before being inspected and tested.
- G. Corrosion Protection
- All buried ferrous metal fittings and appurtenances shall be provided with bituminous coating corrosion protection and as indicated in the design plans.
1. Ferrous metal fittings and appurtenance as herein referred to are: valves, tees, elbows, reducers, crosses, plug assemblies, pumping tees, services, blowoff installations, flexible couplings, leak clamps, tie rods, etc.
 2. Joints, fittings, and appurtenances that are required to be coated by the Contractor may be coated before or after installation in the trench.
 3. Cast-iron pipe or bare metal pipe extending into the soil from a concrete structure shall be insulated from the concrete and leak-proofed. The insulation shall extend through the concrete a minimum of three (3) inches on each side. The insulation shall consist of one layer of Scotchrap Tape No. 50 and two coats of bituminous paint. The pipe shall be clean, dry, and free from loose scale before applying the adhesive and tape. The edges of the tape shall be lapped not less than one-half (1/2) inch.
 4. Bituminous coating shall be applied in two coats with a minimum 20-mil dry thickness per coat. Applications shall be in accordance with manufacturer's instructions. Allow first coat to dry as recommended by the manufacturer before application of second coat. Allow second coat to dry before encasing in polyethylene tubing or wrap. Inspector must inspect coating prior to covering with polyethylene. Joints must be not be covered with polyethylene during the pressure test witnessed by the Owner's Representative.

3.4 TESTS

- A. Protection from Flooding
Provide positive measures to protect exposed, installed pipe and compacted pipe bedding from flooding during testing.
- B. Notice of Testing
 - 1. Give three (3) days notice of intention of testing to the Engineer and jurisdictional agency. The Contractor will furnish, install, and operate pumps, gages, meters, and individual pipe connections to test openings.
 - 2. Designate largest sections feasible for testing and sterilizing.
- C. Testing Requirements
 - 1. Prior to backfilling, isolate system by use of approved valves, caps and plugs, or other means.
 - 2. Maintain such isolation throughout the performance of leakage and pressure testing.
 - 3. Where valves are used for isolation, eliminate leakage through such valves if it occurs. Maintain new work isolated from existing water mains, except for test connections, until testing and sterilization have been completed.
 - 4. For hydrostatic tests, provide approved caps and plugs in sections to be tested and remove them after testing.
 - 5. Prevent leakage in pipes and fittings at openings. Temporarily block plugged and capped ends to prevent displacement.
 - 6. Install water source connection for testing, as directed.
 - 7. Provide labor and materials required for leakage testing, including excavation for installation and removal of pumps, gages, meters, and water source connections.
 - 8. Where leakage exceeds the Owner's standards, perform necessary corrective measures.
 - 9. Remove and replace defective pipes, joints, fittings, valves and appurtenances. Reset such items if displaced.
- D. Hydrostatic Tests
 - 1. Perform hydrostatic tests in accordance with the Owner's requirements. All such tests shall be witnessed by the representative. The Contractor shall be responsible for making all such arrangements.
 - 2. Test the fire water system hydrostatically in sections to a pressure of at least 200 psi or 50 psi + maximum static pressure, whichever is greater for not less than 120 minutes.
 - 3. Test the domestic water system for building service lateral(s) at 100 psi for 120 minutes. Pressure test pipe before backfilling. Repair leaks and retest the system until the system is leak free. Use instruments calibrated by a quality laboratory.
 - 4. The test pressure shall not drop during the test period.
 - 5. Leakage is permitted in accordance with NFPA 24 Section 10.10.2.2.4.
 - 6. Gauges shall be either:
 - A digital gauge having a 0.1-psi resolution and a 1% full scale accuracy or An analog gauge having a 3½ inch diameter face and a 1% full scale accuracy. The test pressure shall not exceed 75% of the analog gauge full scale. Gradations shall be in 1-psi increments

Test sequence shall be as follows:

 - a. Lines shall be fully flushed.
 - b. Lines shall be hydrostatically tested.
 - c. Lines shall be fully flushed.
 - d. Lines shall be fully disinfected.

3.5 SYSTEM DISINFECTION

- A. Standard Disinfection Procedure For Domestic Water System
 - 1. Supervision and Testing: Perform entire disinfection procedure under the supervision of Environment, Health and Safety (EH&S). Provide five (5) days' notice to schedule

- procedure.
2. Contractor's Responsibility: Furnish a copy of the California Department of Pesticide Regulation (DPR) Qualified Applicator License, equipment, materials and transportation to disinfect domestic hot and cold water systems and fire lines directly connected thereto, in conformity with procedures and standards described herein.
 3. Disinfecting Agent: An aqueous solution of sodium hypochlorite (minimum 5.25% available chlorine). The use of powdered hypochlorite and chlorine gas are prohibited unless specifically approved by Environment, Health and Safety (EH&S).
 4. Preliminary Preparations:
 - a. Service Cock: Provide within three feet (3'-0") of the entrance of the supply main to the building, a three-quarter inch (3/4") service cock, or valve, for the purpose of introducing the disinfecting agent.
 - b. Flushing: After final pressure tests and before draining for disinfection, open each fixture or outlet until the water flow is clear.
 5. Disinfection Procedure:
 - a. Drain entire domestic water system including fire line.
 - b. Post suitable warning signs at each outlet: Warning - Do Not Use - Water System Being Chlorinated.
 - c. Inject disinfectant solution into the system through the service cock by means of a pump, or other pressure device, at a slow continuous rate, simultaneous with a reduced flow from the water main, until the Ortho-Tolidin test for residual chlorine at each outlet shows a concentration of at least 50 ppm, but note more than 100 ppm.
 - d. Close all outlets and valves, including the service valve at the main and the injection cock. Retain the chlorinated water in the system for 24 hours.
 - e. After the 24 hour holding period, the residual chlorine concentration shall be not less than 50 ppm as shown by the Ortho-Tolidin test.
 - f. Drain and flush entire domestic water system until Ortho-Tolidin tests show background residual chlorine concentration at any and all outlets.
 - g. Environment, Health and Safety (EH&S) shall determine whether samples of water must be collected and analyzed for the determination of bacteriological quality.
 6. Standards Necessary for Approval:
 - a. The water system shall have been uniformly chlorinated under the supervision of Environment, Health and Safety (EH&S) as outlined above.
 - b. The results of water sample analysis shall be negative for the Coliform organisms.
 - c. If the test for the bacteriological quality of the water in the system does not meet the standards, repeat the disinfection procedure until the specified standards are met.
 - d. Final Approval: Environment, Health and Safety (EH&S) shall give written approval to the University for acceptance and use of the water system after the above procedures have been successfully completed and the standards met.

END OF SECTION

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SECTION 333000
SITE SANITARY SEWERAGE SYSTEM

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all solid wall pipe as indicated in the Drawings; and all appurtenant work, complete and operable, including all manholes, cleanouts, fittings and connections as shown on the Drawings and as specified herein.
- B. Piping under existing pavement and retaining walls may be installed by jacking, boring or by hydraulic driving except as otherwise indicated in Drawings or directed. Use existing sleeves where applicable. At location where cutting is required make all cuts clean using power saws. Replace and restore all surfaces to original conditions, including grades and landscaping. Match restoration work with original work in every respect, including type, strength, texture and finish.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312324 Trench Excavation and Backfill

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards:
 - ASTM A 48 Specification for Gray Iron Castings.
 - ASTM C 150 Specification for Portland Cement.
 - ASTM C 478 Specification for Precast Reinforced Concrete Manhole Sections.
 - ASTM D 1784 Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
 - ASTM D 2241 Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR-Series).
 - ASTM D 3034 Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
 - ASTM D 3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 - ASTM F 477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.4 CONTRACTOR SUBMITTALS

- A. Certificates of Compliance: Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.
- B. Submit plan and profile drawings for sewer connection showing pipe sizes, location, alignment of sewer service and elevations along with the details associated with the improvements, location of boring pits.

1.5 QUALITY ASSURANCE

- A. Tests: All materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.
- B. All costs of such inspection and tests shall be borne by the CONTRACTOR.

- C. The pipe shall be subjected to the specified hydrostatic strength tests, flexure tests, and crushing tests. The crushing tests shall be made on samples taken from the center of full-length sections of pipe.

1.6 PROJECT CONTROLS

- A. Interruption of Existing Sanitary Sewerage: Do not interrupt service to facilities occupied by District or others unless permitted under the following conditions and then only after arranging to provide temporary service according to the requirements indicated:
 - 1. Notify the ENGINEER no fewer than eleven (11) working days in advance of the proposed interruption of service.
 - 2. Do not proceed with interruption of service without ENGINEER'S written permission.
 - 3. Submit plans to the ENGINEER showing rerouting of the temporary sanitary sewer service and obtain written approval from ENGINEER prior to proceeding with the work.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All solid wall pipes shall be continuously and permanently marked in conformance with the appropriate ASTM.
- B. The CONTRACTOR shall also require the manufacturer to mark the date of extrusion on the pipe.
- C. Pipe shall be of the pipe pressure class as shown on the Drawings.

2.2 PIPE

- A. All PVC pipe shall conform to the following requirements, unless otherwise specified, or as shown on the Drawings:
 - 1. Gravity sewer laterals shall be High-Density Polyethylene (HDPE) SDR-17 pipe; with a minimum standard diameter ratio (SDR) of 21. Other materials may be used based on site conditions as approved by the Engineer.
 - 2. Sanitary sewer pipes shall be green colored. If not manufactured green, sanitary sewer pipes shall be wrapped with Christy™ TA-33-PW21, 2" x thick green 10mil polywrap, or approved equal.

2.3 FITTINGS

- A. All fittings including wyes and sanitary sewer lateral cleanouts for PVC pipe shall conform to the requirements of ASTM D 2241. The ring groove and gasket ring shall be compatible with PVC pipe ends.
- B. The strength class of the fittings shall be not less than the strength class of any adjoining pipe.

2.4 BEDDING MATERIAL

- A. Unless otherwise specified or shown, all material used for pipe bedding shall conform to the requirements for bedding in Section 312324 "Trench Excavation and Backfill".

2.5 FLEXIBLE COUPLINGS

- A. Flexible couplings used for repairs shall be rubber, full-circle, clamp-on type conforming with ASTM C 425 and provided with 2 stainless steel band screw-clamps to secure the coupling tightly to entering and exiting pipes. All screw-clamp hardware shall be Type 304 or Type 316 stainless steel. Rubber material shall be suitable for use on sewage systems.

Sanitary sewer connection at the building point of connections shall be made by using Calder Couplings or approved equal.

2.6 SANITARY SEWER CLEANOUTS

- A. At grade, cleanouts shall have adjustable sleeve-type housing, threaded brass plug with countersunk slot, and cast iron frame and cover.

2.7 LATERAL CONNECTIONS TO SANITARY SEWER

- A. Service lateral connections to new sewers shall be made with Wye fittings, installed as the sewer pipe is laid.
- B. Service lateral connections to existing sewers shall be made by "Tap-Tite" method, or with approved "Sealtite" type saddle fittings which utilize neoprene gasket seals and stainless steel bands, or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the ENGINEER, and shall be subject to its approval before acceptance. All material found during the progress to have defects will be rejected and the CONTRACTOR shall promptly remove such defective materials from the site of the WORK.

3.2 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Section 312324 "Trench Excavation and Backfill" and as specified herein.

3.3 PIPE LAYING

- A. The pipe shall be installed in conformance with the requirements of ASTM D 2321, as specified herein and as shown on the Drawings. The pipe sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for connecting joints, the bedding for the pipe shall be checked for firmness and uniformity of surface.
- B. Proper implements, tools, and facilities as recommended by the pipe manufacturer's printed instructions shall be provided and used by the CONTRACTOR for safe and efficient execution of the work. All pipe, fittings, and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
- C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or will produce ragged, uneven edges.
- D. Installation of pipes in prepared trenches shall start at the lowest point, with the spigot ends pointing in the direction of flow.
- E. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.

- F. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the CONTRACTOR at its own expense.
- G. Installation of Warning Tape shall be THOR ENTERPRISES, CALPICO, or equal. Tape to hold the wire in place shall be pipe wrap tape, 2 inches wide, 10 mil.

3.4 PIPE HANDLING

- A. Handling of all pipe shall be done with care to insure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.
- B. Pipe shall be inspected both prior to and after installation in the trench and all defective lengths shall be rejected and immediately removed from the working area.

3.5 PVC FIELD JOINTING

- A. Each pipe elastomeric-gasket joint shall be installed in conformance with the manufacturer's printed recommendations. Elastomeric Gaskets shall conform to ASTM D3212.
- B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be then forced into the ring to complete the joint.
- C. The pipe shall not be deflected either vertically or horizontally in excess of the printed recommendations of the manufacturer.
- D. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe which has floated shall be removed from the trench, cleaned, and re-laid in an acceptable manner. No pipe shall be laid when, in the opinion of the ENGINEER, the trench conditions or weather are unsuitable for such work.

3.6 FITTINGS

- A. All fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into trench by acceptable means without damage to the fittings. Fittings shall be carefully connected to pipe or other facility, and joint shall be checked to insure a sound and proper joint.

3.7 SANITARY SEWER CLEANOUTS

- A. Where indicated in plans, install two-way Sanitary Sewer Clean outs on 4 inch sanitary sewer laterals. Clean outs shall be cast iron ANACO, Two-Way Combination Clean-out; American Brass and Iron; or equal. Sanitary sewer cleanouts on 6 inch and larger pipe shall be a combination Wye and 1/8th bend, ANACO; American Brass and Iron; or equal.

3.8 TESTING

- A. Testing Requirements
 1. Conduct a mandrel test to ensure that the line is free of obstructions subsequent to the placing of intermediate backfill material over the line.
 2. Upon completion of the test and determination that the line is free of obstructions, plug, cap or otherwise close the open end or ends of the installed piping to prevent the entrance of debris into the lines.
 3. Supply all tools, equipment, and water necessary to make all tests.
 4. Flush all sewer lines prior to testing and accumulated materials shall be removed at each manhole and no materials shall be allowed to enter the existing sewer system.
 5. The Contractor shall be responsible for making all necessary arrangements with the jurisdictional sanitary utility owner for performing and witnessing the required tests.

- B. Sanitary Sewer Pipeline Tests
1. Perform air test on all installed sanitary sewer pipes upon completion of backfill.
 2. Test all sewers 24" or less in diameter with low pressure.
 3. Sewers with a diameter greater than 24 inches may be tested by visual inspection.
- C. Low Pressure Air Test (Gravity Pipe)
1. Clean set sections of pipe to be tested before starting air test.
 2. Plug pipe outlets with pneumatic plugs capable of resisting internal testing pressures without requiring external bracing.
 3. Immediately following pipe cleaning and wetting, slowly supply air to plugged pipe until internal air pressure reaches 5 psi. Allow at least two minutes for temperature to stabilize before proceeding, except slowly add air to maintain a minimum of 4.5 psig but less than 5 psig pressure. While temperature is stabilizing, spray plugs, pipes, and hoses with soap solution and eliminate air leaks.
 4. After temperature has stabilized, measure time required (10 minute min.) for pressure to drop of 1 psig so that the pressure at the end of the test is at least 3.5 psig. If measured time exceeds allowable time, pipe will not be accepted.
 5. Time, in seconds, for pressure to drop from 4.5 to 3.5 psig shall be not less than the following; time for intermediate lengths shall be interpolated:

Length	Pipe Diameter, Inches						
	8	10	12	15	18	21	24
Pipe (Ft)	8	10	12	15	18	21	24
25	18	28	40	62	89	121	158
50	35	55	79	126	178	243	317
75	53	83	119	186	267	364	475
100	70	110	158	248	356	485	634
125	83	138	198	309	444	595	680
150	110	165	238	375	510	595	680
175	123	193	277	425	510	595	680
200	141	220	317	425	510	595	680
225	158	248	340	425	510	595	680
250	176	275	340	425	510	595	680
275	194	283	340	425	510	595	680
300	211	283	340	425	510	595	680
350	227	283	340	425	510	595	680
400	227	283	340	425	510	595	680

END OF SECTION

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SECTION 334000
STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Furnish and install all structures, piping, fittings, and accessories, and perform all earthwork, grading, adjustments of inlets and flushing of all existing systems as shown on the Drawings, described in these specifications, and as required to construct a complete and operable storm water runoff drainage system.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
- B. State of California, Department of Transportation, Standard Specifications (Standard Specifications) Current Edition.
- C. Standard Specifications for Public Works Construction written by the Southern California Chapter, American Public Works Association

1.3 SUBMITTALS

- A. Submit the following in the Product Information category.
 - 1. Shop Drawings: Submit detailed drawings and specifications on all precast drop inlets, junction boxes and accessories, including gratings, covers and frames.

1.4 QUALITY ASSURANCE

- A. All products and materials furnished under this Section shall be of a manufacturer who has been regularly engaged in the design and manufacture of said products and materials for a period of at least 5 years. If the product of an alternate supplier is proposed, it shall be demonstrated to the satisfaction of the Owner's Representative to be of a quality and serviceability equal to the product made by the manufacturer specifically named herein.
- B. The Owner will inspect and verify percent of slope.

PART 2 - PRODUCTS

2.1 PRECAST DRAIN INLETS, GRATES AND FRAMES

- A. Drain Inlets and Junction Boxes: Precast concrete structures, sizes appropriate designed to withstand an AASHTO H-20 loading. Provide interlocking joints where depth requires more than one unit. Minor variations from the drawings may be accepted to permit the use of manufacturer's standard methods of fabrication. Manufacturers: Santa Rosa Cast Products Company; Christy; or equal. Contractor shall be responsible for field verifications for sizing of all storm drain elements.

2.2 STORM DRAINAGE SYSTEM PIPES

- A. Polyvinyl Chloride Pipe (PVC):
 - 1. Pipe and Fittings: Polyvinyl chloride sewer pipe: Less than 12 inches nominal size: ASTM D3034, SDR 26.
 - 2. Joints: Elastomeric gasket joints, ASTM D3212.
 - 3. Gaskets: Submit two sample gaskets with an explanation of the markings.
- B. High Density Polyethylene Pipe (HDPE): PE 4710, Pressure Class 160, DR 13.5, conforming to AWWA C906. Driscoplex 4000/4100, or approved equivalent.

- C. Perforated Pipe: PVC conforming to ASTM D2729 or HDPE SDR 17 conforming to AWWA C906. Perforations shall be 2 rows of ½” holes on 5” centers, 120° apart, or as approved by the Engineer.
- D. Inlets
 - 1. Grates and frames shall be ADA compliant, bicycle-proof and supplied by the manufacturer of the catch basin and be matched to the Drain Inlet.
- E. Pop-up Emitters
 - 1. NDS (size per plan), green, or as approved by the Engineer

PART 3 - EXECUTION

3.1 CLEANING

- A. Thoroughly clean the inside of each existing piping system of all dirt, loose scale, sand, and other foreign material. Cleaning shall be by sweeping, flushing with water, or blowing with compressed air, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 3 feet per second. Contractor shall be responsible for collection and disposal of all debris gathered from cleaning operations.

3.2 FIELD TESTING

- A. Perform leakage tests on all pipe installed in this project. Water exfiltration test or air pressure test in accordance with Section 306-1.4 of the Standard Specifications for Public Works Construction written by the Southern California Chapter, American Public Works Association, et al.

3.3 INSTALLATION OF PRECAST DRAIN INLETS

- A. Install drain inlets, level and set to grade, on a 6-inch sand or gravel leveling course, compacted to 95% relative density. Grout firmly in place to form a tight seal.
- B. Install trench drain level and set to grade as indicated in plans. Grout firmly in place to form a tight seal.

END OF SECTION

SECTION 334101
LANDSCAPE DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Drain Rock.
 - 2. Geotextile Fabric.
 - 3. Pipe and Fittings.
 - 4. Trench Drain and Frame.
 - 5. Paving Area Drain Cover.
 - 6. Planting Area Drain Cover.

- B. For Trenching and Backfilling, see Section 312333.

- C. For Landscape Maintenance Period, see Section 320100.

- D. For Site Concrete, see Section 321316.

- E. For Irrigation, see Section 328400.

- F. For Soil Preparation and Soil Mixes, see Section 329113.

- G. For Planting Area Finish Grading, see Section 329119.

- H. For Plant Material, see Section 329300.

- I. For Site Storm Drainage Utilities, see Section 334000.

1.2 DEFINITIONS

- A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of Owner’s representative in writing.

- B. PVC: Polyvinyl Chloride.

- C. SDR: Standard Dimensional Ratio.

1.3 REFERENCES

- A. ASTM — American Society for Testing and Materials:
 - 1. D 698 — Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. Most current edition.
 - 2. D 1557 — Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort. Most current edition.
 - 3. D 2729 — Specification for PVC Sewer Pipe and Fittings. Most current edition.
 - 4. D 3034 — Specification for Type PSM PVC Sewer Pipe and Fittings. Most current edition.

5. F 679 — Specification for PVC Large-diameter Plastic Gravity Sewer Pipe and Fittings. Most current edition.
- B. Caltrans Standard Specifications – Most current edition.

1.4 SUBMITTALS

- A. Product Data:
1. Pipe and Fittings.
 2. Geotextile Fabric.
 3. Paving Area Drain.
 4. Planting Area Drain.
 5. Trench Drain and Frame.
 6. Drain Rock.
- B. Shop Drawings:
1. Provide shop drawings for Trench Drain, Trench Drain Grates and Paving Area Drain. Show shop and erection details, to scale, including dimensions, sizes, thicknesses, gauges, finishes, joining, segments, joints, attachments, holes, welds, bolts, elevations and relationship of work to adjoining construction. Prepare details at not less than 3 inches = 1 foot.
 2. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from the Drawings.
 3. Indicate welded connections using AWS A2.0 welding symbols.
- C. Samples:
1. Trench Drain Frame and Grates, 12 inches in length.
- D. Record Documents:
1. Maintain on the construction site a record of materials and equipment installed each day.
 2. Daily record information neatly to scale, on full-size prints of the irrigation construction documents.
 3. Include changes, substitutions, and manufacturer's names and catalog numbers for materials and equipment.
 4. Show actual locations of drains, grates, clean-outs and piping.
 5. Show dimensions from easily-identifiable permanent structures such as walls, curbs, buildings or walks.
 6. Procure reproducible sepia mylars of the current construction documents from the Owner's representative.
 7. After Work completion, transfer information noted on prints to the reproducible mylars and submit to the Owner's representative for review of general information content (Owner's representative will not be responsible for errors or omissions).
 8. Contractor shall be responsible for accuracy of information and errors or omissions.
 9. If first submittal is not accepted by Owner's representative, resubmit until accepted.
 10. Submit accepted final record documents to Owner.

1.5 QUALITY ASSURANCE

- A. Contractor Qualifications:

1. Have successfully installed landscape drainage similar to the quality specified for a period of not less than 5 years.
 2. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.
- B. Regulatory Requirements: Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Storage:
1. Store products with protection from weather or other conditions which would damage or impair the effectiveness of the product.
 2. Protect PVC pipes and fittings from direct sunlight.
 3. Store pipe on beds equal to or longer than pipe.

1.7 SITE CONDITIONS

- A. Environmental Requirements:
1. Lay and join pipe in dry trenches.
- B. Existing Conditions:
1. Prior to Work commencement review locations of existing public underground utilities and structures with appropriate utility companies and clearly mark in field.
 2. Prior to Work commencement review location of existing private underground utilities and structures with Owner and clearly mark in field.
 3. Prior to Work commencement and after reviewing the Owner's record irrigation documents, review and clearly mark in field heads, valve boxes and other underground equipment, materials and structures.

1.8 WARRANTY

- A. General Description: In addition to manufacturer's warranties, warrant Work for a period of one year from date of Final Completion against defects in materials and workmanship.
- B. Additional Items Covered: Warranty shall also cover repair of damage to other materials and workmanship resulting from defects in materials and workmanship and trench backfill settlement.
- C. Exceptions: Contractor shall not be held responsible for failures due to ordinary wear, neglect by Owner, vandalism, and other causes outside the Contractor's control.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

- A. Plastic catch basins, planting area drains and grates:
1. National Diversified Sales (NDS) – <http://www.ndspro.com>.

2. Or accepted equal.
- B. Geotextile fabric:
1. Mirafi – www.tcmirafi.com.
 2. Carthage Mills – www.carthagemills.com.
 3. Or accepted equal.
- C. Worm drive hose clamps:
1. McMaster-Carr Supply Company – <http://www.mcmaster.com>.
 2. Or accepted equal.
- D. Vehicular Rated Trench Drains:
1. Urban Accessories – www.urbanaccessories.com.
 2. Or accepted equal.
- E. Vehicular Rated Paving Area Drain:
1. Urban Accessories – www.urbanaccessories.com.
 2. Or accepted equal.
- F. Flexible Couplings:
1. Fernco Inc., Sparks – <http://www.fernco.com>.
 2. Or accepted equal.

2.2 MATERIALS

- A. Perforated and Solid Non-perforated Pipe:
1. ASTM D 3350 Cell, Classification 324420C
 2. ASTM D 1248 Type III, Class C, Category 4, Grade P33
 3. AASHTO M252 double-wall, corrugated, HDPE, smooth-interior wall.
 4. Or equal.
- B. Perforated and Solid Corrugated Pipe Fittings:
1. ASTM F 405, HDPE.
 2. Or equal.
- C. Saddle Fitting for Connections to HDPE Pipe:
1. Fittings recommended by HDPE pipe manufacturer.
 2. Or equal.
- D. Couplings for Cast-iron Area Drain Pipe to Solid Pipe:
1. Fernco flexible coupling as recommended by pipe manufacturer.
 2. Or equal.
- E. Plastic Planting Area Drains:
1. Type: Round flat grates
 2. Color: Black
 3. Quantity: See Drawings
- F. Vehicular Rated Trench Drain and frame:
1. Type: Jamison (7" x 36")

2. Metal: Cast Ductile Iron
3. Finish: Rust Conditioner
4. Or accepted equal

G. Vehicular Rated Area Drain:

1. Type: Slot T-24 (5 1/4" DIA, 8" DIA, See Plans)
2. Metal: Cast Ductile Iron
3. Finish: Rust Conditioner
4. Quantity: See Drawings
5. Or accepted equal.

H. Geotextile Fabric:

1. Mirafi 140 NC (for California Clay Soils – for tree subdrainage and french drains)
2. Or accepted equal.

I. Drain Rock:

1. Crushed clean pea gravel, 1/4-inch diameter.

J. Cleanout for Planting Areas:

1. Schedule 80 female adaptor with brass male pipe thread plug.

K. Sand Backfill: Durable particles, free of thin or elongated pieces, lumps of clay, soil, loam or vegetable matter, with the following particle size gradation:

Sieve Size (Square)	Percent Passing
4	100
16	80-100
50	20-60
100	10-40
200	0-10

L. Granular Embedment:

1. Free flowing sandy material which contains no clay, reasonably free of organic material.

M. Planting Area Backfill for Upper 12 Inches:

1. Upper 12 inches of soil excavated from trenches stockpiled separately on site.

N. Water for Sprinkling Backfill:

1. Clean, potable.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection:

1. Use every possible precaution to prevent damage to existing conditions to remain.
2. Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.
3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
4. Submit written notification of conditions damaged during construction to the Owner and Owner's representative within 2 working days of observed damage and before damage is covered.

3.2 TRENCH EXCAVATION

A. Excavation:

1. In planting areas excavate and stockpile separately upper 12 inches of soil to be used later for backfilling upper 12 inches of trenches in planting areas.
2. Pile materials suitable for back-filling a sufficient distance from banks of trenches to prevent slides or caveins.
3. Coordinate trench excavation with pipe installation to avoid open trenches for prolonged periods.
4. Excavate width of the trench to provide adequate space for workers to place and joint the pipe or culvert properly, but hold the clear space between the barrel of the pipe and trench wall to the minimum required for a satisfactory installation.
5. Excavate trench to width necessary for sheeting and bracing and proper performance of the Work.
6. Accurately grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil or the required thickness of bedding material at every point along its entire length, except for portions of pipe sections where it is necessary to excavate for bell holes and for proper making of pipe joints.
7. Dig depressions for joints after trench bottom has been graded and only 1/2 inch greater length, depth and width than the bell, as required for properly making the particular type of joint, and to insure that the bell does not bear on the bottom of the hole.
8. Over-cut with sand cushion may also be employed for pipe at Contractor's option.
9. Pile excavated material on one side only of trenches to permit ready access to and use of existing fire hydrants, valves, manholes and other utilities system appurtenances.
10. Remove and dispose of excavated materials not required or satisfactory for backfill.
11. Keep surface drainage of adjoining areas unobstructed.
12. Remove water by pumping or other accepted method and discharge at a safe distance from the excavation.

B. Unsatisfactory Fill:

1. When unsatisfactory fill incapable of properly supporting pipe is encountered in bottom of trench, notify Owner and soils engineer in writing.
2. Upon Owner approval, remove unsatisfactory fill to depth accepted by the soils engineer.
3. Backfill over-depths with material accepted by the soils engineer.
4. Compact over-depth fill material to 95 percent as determined by ASTM D 1557.
5. Back-filling of unauthorized overdepths shall be at the expense of the Contractor.

3.3 PIPE INSTALLATION

- A. Manufacturer's Requirements: Meet requirements of the manufacturer's current printed instructions.
- B. Pipe Laying:
 - 1. Furnish and place in position necessary batter boards, string lines, plummets, graduated poles, etc., required in establishing and maintaining the lines and grades.
 - 2. Protect batter boards and location stakes from possible damage or change of location.
 - 3. Begin laying of the pipe on the prepared foundation at the outlet or downstream end with the spigot or tongue end of the pipe joint pointing downstream and proceed toward the inlet or upstream end with each abutting section of pipe properly matched, true to the established lines and grades.
 - 4. Provide acceptable equipment for hoisting and lowering the sections of pipe into the trench without disturbing the prepared bedding foundation or the sides of the trench.
 - 5. Clean ends of the pipe carefully before the pipe is placed in the trench.
 - 6. As each length of pipe is laid, protect openings to prevent the entrance of earth or bedding material.
 - 7. Fit and match pipe so that when laid in the prepared bedding it will form a smooth, uniform conduit.
- C. Jointing: Meet requirements of pipe manufacturer's current printed instructions.

3.4 GEOTEXTILE FABRIC, DRAIN ROCK AND PERFORATED PIPE INSTALLATION

- A. Wrapped Drain Rock Around Perforated Pipe:
 - 1. Center fabric strip over trench.
 - 2. Overlap uphill fabric edges over downhill fabric edges a minimum of 12 inches.
 - 3. Install drain rock and pipe as shown on Drawings.
 - 4. After drain rock is installed, fold fabric over top of drain rock with minimum 12 inch overlap.
 - 5. Attach fabric ends to pipe as shown on the Drawings.
 - 6. Immediately backfill 2 inches depth sand layer on lapped fabric.

3.5 TRENCH BACK-FILLING OVER SOLID PIPE

- A. General Backfill:
 - 1. Coordinate backfilling with testing of utilities.
 - 2. Where damage is likely to result from withdrawing, leave sheeting in place and cut off a minimum of 24 inches below finished grade.
 - 3. Carefully backfill trenches with granular backfill and deposit in 9 inch maximum layers, loose depth.
 - 4. Bring up granular backfill material evenly on both sides of pipe for its full length and thoroughly and carefully compact until pipe has a cover of not less than 1 foot.
 - 5. Reopen trenches and excavation pits improperly backfilled, or where settlement occurs, to the depth required to obtain the specified compaction, then refill and compact, and restore the surface to the specified grade and compaction.
- B. Backfill Under Paving:
 - 1. Backfill as specified above for general backfill, except that remainder of trench above the granular backfill material shall be backfilled with field sand in 6 inch maximum layers, and

each layer moistened and compacted to 95 percent of the maximum density obtained at optimum moisture as determined by ASTM D 1557.

2. Backfill to permit the rolling and compaction of the filled trench with the adjoining material to provide the required bearing value so that paving of the area can proceed immediately after backfilling is complete.

C. Backfill in Planting Areas:

1. Backfill as specified above for general backfill except bring granular fill up to 12 inches below finish grade.
2. Compact granular fill to a maximum 75 percent as determined by ASTM D 1557.
3. Backfill upper 12 inches with stockpiled soil from upper 12 inches of trench excavation.
4. Settle upper 12 inches of soil by sprinkling with minimum 2 inches of water.

3.6 FIELD QUALITY CONTROL

- A. Field Observation Reviews by Owner's representative: Coordinate and schedule with Owner's representative.

3.7 CLEANING

- A. General: Clean and keep clean until Owner accepts maintenance.

END OF SECTION

APPENDIX A

Laney Library & Learning Resource Center

Commissioning Plan

October 2020



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1. Executive Summary

The Red Car Analytics Commissioning Team has developed this Commissioning Plan to provide direction on the commissioning process and scope of commissioning, defining related activities and team responsibilities. The Plan includes definitions of commissioning terms, descriptions of commissioning processes, a comprehensive team directory, detailed information on roles and responsibilities, project and system descriptions, lists of documents related to commissioning, commissioning schedule milestones, coordination and communication protocols, and resolution pathways and procedures. It describes the scope, approach, time frame, responsibilities, and technical requirements for the commissioning activities.

The Commissioning Authority (CxA) is Red Car Analytics.

1.1. Abbreviations

A/E	Architect & Design Engineers	IC	Irrigation Contractor
BAS	Building Automation System	IOM	Installation and Operations Manuals
BOD	Basis of Design	IOR	Inspector of Record
CC	Controls Contractor	MC	Mechanical Contractor
CM	Construction Manager	MEP	Mechanical Electrical Plumbing
Cx	Commissioning	O&M	Operations and Maintenance
CxA	Commissioning Authority (Red Car)	OPR	Owner’s Project Requirements
CxC	Commissioning/MEP Coordinator (GC)	OR	Owner’s Representative
EC	Electrical Contractor	PC	Project Coordinator
EOR	Engineer of Record	PM	Project Manager
FM	Fire Marshal	SOO	Sequence of Operation
FPT	Functional Performance Test	TAB	Test-Adjust-Balance
GC	General Contractor		

1.2. General Project Information

Project:	Laney Library and Learning Resource Center
Location:	Oakland, CA
Building Certification:	targeting LEED NC v4 Certification
Total Square Footage:	73,746 gsf
Construction Period:	Nov 2021 to Nov 2023

2. Commissioning Team Roles and Responsibilities

The Commissioning Authority (CxA) reports results, findings, and recommendations directly to the Owner. In general, the CxA shall coordinate the commissioning activities directly with the design team and the MEP coordinator (CxC), and shall distribute reports to the General Contractor, Project Manager, Architect/Engineers, and Commissioning Coordinator. The design team roles and responsibilities are identified in this Cx Plan. The contractors’ commissioning responsibilities are detailed in the project specifications and this Cx Plan.

Where items in this plan differ from the specifications, the CxC shall bring these issues to the attention of the Owner’s Representative and the Commissioning Authority for resolution.

2.1. Commissioning Team Directory

Name	Company	Role	Phone	email
Greg Cheifetz	Peralta Community College	Owner		
Eric Skiba	Noll & Tam	Architect	510.542.2200	eric.skiba@nollandtam.com
Gavin Ross	Noll & Tam	Architect	510.542.2260	gavin.ross@nollandtam.com
Anna de Anguera	Cavagnero	Architect	510.499.6427	annad@cavagnero.com
Angela Wisely	Brightworks	Sustainability Consultant	415.230.2136	angela.wisely@brightworks.net
Glenn Friedman	Taylor Engineering	Mechanical & Plumbing Engineering	510.220.5895	gfriedman@taylor-engineering.com
Joe Arnstein	Taylor Engineering	Mechanical & Plumbing Engineering	704.582.2081	jarnstein@taylor-engineering.com
Stefan Gracik	Alter Engineering	Energy Modeling	724.968.6938	stefan@alterengineers.com
Paul Carey	O’Mahony & Myer	Electrical Engineering	415.218.0629	pcarey@ommconsulting.com
Sean Henderson	Mantlela	Landscape/Irrigation Engineering	513.532.4685	sean@mantlela.com
Michele Sagehorn	Red Car Analytics	Commissioning Authority	707.591.4555	michele@redcaranalytics.com

2.2. General Descriptions and Responsibilities

General descriptions of the commissioning roles are as follows:

Owner or Owner's Representative (OR)

- Oversees the work of the CxA
- Assists the CxA with directing the project team
- Provides final approval and sign-off of Cx Plan
- Responsible for the development of the Owner's Project Requirements document
- Arbitrate disagreements between the CxA and others

Commissioning Authority (CxA)

- Defines the project specific scope and requirements of commissioning
- Develops and oversees the Commissioning Plan and related activities
- Assists the team with implementation of the Commissioning Plan
- Advises the Owner on acceptance of design, construction and commissioning

Architect

- Assists Owner in development of the Owner's Project Requirements document
- Coordinates/Manages submittal documents
- Provides resolution to design-related issues
- Participates as needed in commissioning process

Engineers

- Provides Basis of Design document
- Completes and signs T24 Commissioning Design Checklist Compliance forms
- Reviews submittals and provides comments
- Provides clarifications to design intent
- Provides resolution to design-related issues
- Participates as needed in commissioning process

General Contractor (GC)

- Provides a competent person in the role of MEP Coordinator (CxC)
- Provides coordination with subcontractors for all commissioning related activities
- Incorporates commissioning activities into the master construction schedule
- Directs subcontractors to provide resolution to construction issues
- Notify the commissioning agent of any change orders that may affect commissioned systems
- Coordinates owner training with subcontractors and commissioning agent
- Assists in resolving any warranty issues raised during the End-of-Warranty Review

MEP Coordinator of the GC (CxC)

- Acts as the representative of the construction team and main point of contact for the CxA
- Delegates commissioning tasks to the subcontractors
- Coordinates and manages subcontractors and commissioning schedule
- Collects, assembles and manages commissioning documentation from subcontractors
- Works with subcontractors to correct installation/commissioning deficiencies as quickly as possible
- Provides support for functional testing as needed

MEP Subcontractors (Subs)

- Reviews and comments on multiple releases of the Cx Plan
- Provides competent personnel to execute commissioning tasks
- Coordinates with GC on scheduling of commissioning tasks and potential conflicts
- Demonstrates and documents approved installation and operation of equipment
- Assists the team to provide resolution to construction issues
- Coordinates with equipment vendors for proper documentations and procedures

TAB Subcontractor

- Coordinates with the commissioning team in the weeks prior to balancing
- Completes air and water balancing, per AABC or NEBB requirements and project specifications
- Provides a field copy to CxA prior to functional testing
- Identifies and reports on issues discovered in the field while balancing
- Demonstrates TAB results to CxA during Functional Performance Tests
- Coordinates with MEP Coordinator and CxA for resolution to issues

Controls Subcontractor (CC)

- Performs all the tasks of MEP Subcontractors as listed above
- Provide Point-to-Point checks and calibration of all sensors prior to FPTs
- Provide point trends and assistance with remote access to building automation system
- Provide a person capable of demonstrating Functional Performance Test scripts and proper system operation
- Provide list of all schedules, set points, and alarms

Equipment Vendors

- Provides documentation on furnished equipment, including complete submittals, equipment data, installation manuals, O&M manuals, start-up procedures, and warranties

2.3. Project Management Protocols

The following protocols will be used on this project:

- The CxA will communicate directly to the appropriate party and inform both the OR and CxC
- Deficiencies found during testing shall be corrected by the contractor within 7 days of receiving an Issues Log from the CxA
- Resolution of minor deficits during Functional Performance testing may be permissible, as determined by the CxA at the point when the deficient are found
- Problem solving: The CxA may recommend solutions to problems, however the burden of responsibility to solve, correct and retest problems is with the contractor
- The OR shall arbitrate disagreements between the CxA and others.

Issue	Protocol
Requests for information or formal documentation requests:	The CxA goes through the architect, engineer, or CxC.
Minor or verbal information and clarifications:	The CxA communicates directly to the informed party and informs the CxC.
Notifying contractors of significant deficiencies:	The CxA documents and communicates deficiencies through the CxC and OR. The CxA may discuss deficiency issues with contractors on an informal basis and will immediately notify the CxC or GC.
Scheduling commissioning meetings:	The CxA coordinates with the CxC. The CxC will coordinate meeting attendance for all required parties and will provide advance notification to the CxA.
Making a request for significant changes:	The CxA has no authority to issue change orders or construction directives. Any actions or observations of the CxA that might result in changes to the contract documents shall be approved by the PM and the design team will issue the changes.
Making small changes in specified Sequences of Operation (SOO)	The CxA notifies A/E of suggested change, which, if approved, is then implemented via RFI. Implemented changes in the SOO shall be documented by the CC in the as-built records, will become part of the O&M/ Systems Manuals, and the CC will notify the CxC and OR of the change in writing.
Making small changes to correct deficiencies	The CxA may request small changes to correct deficiencies from the responsible contractor. The CxA will immediately inform the GC's CxC of any such request. The respective contractor will be required to notify the CxC of the deficiency and correction.
Subcontractors disagreeing with requests or interpretations by the CxA	The OR will arbitrate disagreements between the CxA and others.

2.4. Project Management Protocols

The CxA will use a platform to store and share the commissioning documents, so that they can be viewed/downloaded at any time by all commissioning team members. The platform used will be either **Microsoft sharepoint or box**, where specific folders will be organized to make it easy to find the essential documents (e.g. – current version cx plan, etc.).

Red Car Analytics uses a cloud based program to document and maintain the commissioning issue logs (design/construction). The use of this program is simple and requires no password or special software, only the participants' email. The issue log(s) are essentially an excel spreadsheets, but allows parties to collaborate and to always have access to the latest update. The software also allows attachments to be stored and tracked with the associated issue. The use of this software allows for more detail and history that may prove useful to the owner or operator of the building.

3. Systems to be Commissioned

The following systems and equipment will be commissioned in this project. All general references to equipment in this document refer only to systems and equipment that will be commissioned.

Mechanical

- HVAC System & Controls
- Air Handling Unit(s)
- Hydronic Pump(s)
- VAV Terminal Unit(s)
- Building fan(s)
- Building Management System/Controls

Plumbing

- Domestic HW System

Electrical/Lighting

- Lighting and Controls

Miscellaneous

- Irrigation/Irrigation Controls

4. Commissioning Process – Design Phase

The general sequence of Cx tasks and timing within the design schedule is shown below. The Architect and/or General Contractor are responsible to include commissioning tasks into the design and construction schedules and organize the participants.

Commissioning Schedule	Schematic Design	Design Development	Construction Documents	Bidding and Contract Award
Cx Review/Kickoff Meeting	[Red bar spanning Schematic Design, Design Development, and Construction Documents]			
Verify Owner Project	[Red bar spanning Schematic Design, Design Development, Construction Documents, and Bidding and Contract Award]			
Basis of Design	[Red bar spanning Schematic Design, Design Development, Construction Documents, and Bidding and Contract Award]			
Develop Cx Plan		[Red bar spanning Design Development, Construction Documents, and Bidding and Contract Award]		
LEED Design Review	[Red bar spanning Schematic Design, Design Development, Construction Documents, and Bidding and Contract Award]			
Title 24 CXR-E Design Review		[Red bar spanning Design Development, Construction Documents, and Bidding and Contract Award]		
Cx Specifications		[Red bar spanning Design Development, Construction Documents, and Bidding and Contract Award]		
Controls Integration Meeting		[Red bar spanning Design Development, Construction Documents, and Bidding and Contract Award]		
Development of Training Requirements		[Red bar spanning Design Development, Construction Documents, and Bidding and Contract Award]		
Development of System Manual Content		[Red bar spanning Design Development, Construction Documents, and Bidding and Contract Award]		

[Red bar] MEP Cx

4.1. Title 24 Cx Schematic Design Kickoff Meeting

Title 24-2013 requires a meeting in early Schematic Design between the owner, Cx Design Reviewer, and the design team. The intent of the meeting is to lay out the process and timing for the design review(s) and provide the team with the Title 24 forms. It is recommended that the facility manager and/or facility mechanics participate in the design phase.

4.2. Owner's Project Requirement

Identifying and documenting the project's design intent, or Owners Project Requirements, provides the design and construction teams with an understanding of the design goals for the project. The OPR is used to evaluate the design and construction efforts, assuring the goals are met, as well as helping to develop Functional Performance Tests. The OPR is developed by the CxA with guidance from the owner/owner representative at the beginning of the project. It is a living document and should be updated throughout the project. The CxA reviews the OPR for clarity and completeness.

The OPR should be documented during programming or schematic design, including:

- Energy efficiency goals
- Ventilation requirements
- Project program, including facility functions and hours of operation, and need for afterhours operations
- Equipment and systems expectations

4.3. Basis of Design

The Basis of Design documents the thought processes and assumptions behind design decisions and is meant to show compliance with the OPR. The Basis of Design includes general information about the project, as well as specific technical design information about the proposed equipment and systems. This includes HVAC load calculations, overview of the sequence of operations, assumptions about temperature, light, hours of occupancy, etc. Plumbing and electrical BOD are developed to indicate how the domestic hot water and lighting controls are integrated into the building as well. This document may also be used during functional testing to confirm the design strategy and to help troubleshoot issues that may arise.

4.4. Commissioning Plan

The Commissioning Plan (Cx Plan) is the roadmap for all activities related to Title 24 2013 and LEED commissioning. Commissioning begins during early design and continues through construction and into the post-occupancy period; therefore this document is intended to provide requirements for both design and construction teams. A preliminary Cx Plan is developed during the early design phase and updated by the CxA as needed throughout the project.

4.5. Commissioning Design Review

A review of the project's design drawings and specifications is performed as a part of the commissioning requirements prior to the completion of Construction Documents. An initial review is initiated at mid-construction documents, with a back-check in subsequent issues. These reviews are conducted by the CxA, as a consultant to the owner, but not as the Engineer of Record. Issues related to the design must ultimately be resolved by the Engineer of Record.

The review focuses on the functionality of the systems, completeness and coordination of the drawings and specifications, maintainability of the systems, and overall compliance with the OPR and BOD. A Design Issue Log is maintained by the CxA to track all issues, responses, and actions related to commissioning. A/E members shall provide a written response to items found in the Design Issues Log.

4.6. Title 24 Code Design Review

There is a compliance form that are required by code to be submitted to the building department when filing for a building permit. The initial in-person design review meeting is to be held during the schematic phase of design. The owner, design team representatives (including the project architect and mechanical and electrical design engineers), and Design Reviewer meet to discuss the following:

- Project coordination, including involvement with the Design Reviewer
- Project scheduling, including design review
- Project scope
- Owner's Project Requirements
- Basis of Design
- Design elements and assumptions
- HVAC system selection
- Construction Documents Design Review checklists
- Energy efficiency measures

At the 90% CD phase, drawings and specifications are provided to the Design Reviewer, who reviews the construction documents using form NRCC-CXR-E. The Design Reviewer reviews the construction documents for clarity, completeness, and adherence to the owner's goals.

The NRCC-CXR-E acknowledges the design review has been executed, with signatures from the responsible engineer(s), and Design Reviewer. The form is provided to the Architect and placed on drawings to be submitted with the application for the building permit.

4.7. Commissioning Specifications

Commissioning specification language is incorporated into the construction documents. Section 019113 in Division 1 is dedicated to the General Commissioning Requirements. This language communicates commissioning roles and responsibilities to the construction team including the following:

- Components and systems that are commissioned
- Parties involved and their respective responsibilities for the commissioning process
- Commissioning schedule management
- Issue and non-compliance management
- Submittal review requirements and approval
- Definition of terms
- Scope and rigor of the start-up process, including responsibility for developing and executing startup checklists, and for the approval of these documents
- Scope and rigor of Functional Performance Testing, including responsibility for writing, executing, witnessing, and signing-off the tests
- Operations and Maintenance documentation requirements
- Training requirements for facility staff and building users (or Owner's representatives?)
- System manual requirements

4.8. Development of the System Manual

The CxA shall develop and outline the requirements of the Systems Manual with input from the Owner. The Systems Manual provides future operating staff with the information needed to understand and optimally operate the commissioned systems. It provides Facilities staff with the information necessary to monitor, maintain, and optimize system operations on an ongoing basis, and aids in the long-term success of building operations' energy efficiency strategies according to the design intent. The Systems Manual will be updated after Functional Performance Tests are complete, and within ten (10) working days of receiving as-built BAS drawings, Sequences of Operation, and other documentation from the CxC.

The Systems Manual will include the following documentation submitted by the CxC:

- 1) System Single Line Diagrams
- 2) As-built Sequences of Operations, control drawings, and as-built setpoints
- 3) Operating instructions for integrated building systems
- 4) Recommended schedule of maintenance requirements and frequency, if not included in the project O&M manuals
- 5) Recommended schedule for calibrating sensors and actuators
- 6) Basic Operation:
- 7) Written narrative of equipment operation
- 8) Interfaces, interlocks and interaction with other equipment and systems

4.9. Development of Training Requirements

The CxA shall review the training requirements and confirm that they meet the scope of the owner's requirements for the operator training. The training requirements must be completed before the bid documents are finalized, and be incorporated into the commissioning specifications as part of the bid package.

The training requirements shall include the following:

- List of those who should receive operational training, by position and name
- List of systems that require operator training
- Level of instruction required for each system
- Determination of whether the training provided by the equipment manufacturer is acceptable
- Tracking method to ensure that all required positions or persons receive training

4.10. Controls Integration

They are essentially a series of meetings that go over the project's control issues to enhance an understanding of the full sequences of control and interactions. When conducted during design, the meeting will reduce change orders and Requests for Information (RFIs). When conducted during design and again during submittal review in construction, the meetings will shorten the time required to program and reprogram the controls, perform testing and troubleshooting, and will enhance building operation and control for facility staff.

In design phase the meeting(s) include at minimum; the MEP engineers, controls contractor (if available), CxA, and owner representative. Discussion will include integration and interoperability issues between equipment, systems and disciplines to ensure that integration issues and responsibilities are clearly described in the specifications. The controls design as well as the sequence of operations for each system will be reviewed and clarified for all parties.

5. Commissioning Process – Construction Phase

The general sequence of Cx tasks and timing within the construction schedule is shown below.

Commissioning Schedule	Early Construction Phase	Installation	Start-up	Project Close-out	Post-Occupancy
Construction Team Kickoff Meeting	██████████	██████████	██████████		
Submittal Review	██████████	██████████	██████████	██████████	██████████
Controls Integration meeting	██████████				
Installation Verification Checklists or Mockup Performance Test Witness	██████████	██████████			
Equipment Start-up (Verification) or Witness Installation		██████████	██████████	██████████	██████████
Test and Balancing (Verification)		██████████	██████████		
Functional Testing		██████████	██████████	██████████	██████████
Owner Training / Verification		██████████	██████████	██████████	
Cx Report					██████████
Systems Manual					██████████
Post-Occupancy / Warranty Review			██████████	██████████	██████████

MEP Cx

5.1. Commissioning Kick-Off Meeting

A commissioning kick-off meeting shall be conducted by the CxA. In attendance shall be the respective representatives of the OR, GC, CC, PC, MC, EC, IC, TAB, and all subs installing equipment to be commissioned. At the meeting, the commissioning process will be reviewed, and management and reporting lines will be determined. The flow of documents will be reviewed, and process questions will be addressed. The general list of each party's responsibilities, including the development of the Installation Verification and Startup Checklists and Functional Performance Tests for each piece of equipment, deliverables, proposed commissioning schedule, training and close-out will be presented and finalized.

The intent of the meeting is to provide an understanding with all parties as to the project's commissioning process and their respective responsibilities. The CxA will develop meeting minutes and a list of action items to be distributed to all key participants.

5.2. Commissioning Schedule

The CxA shall develop an initial commissioning schedule. The CxC shall incorporate the Cx schedule into the overall construction schedule. The Cx schedule shall be updated and refined by the CxA as construction progresses.

The following sequential priorities will be followed in the development of the commissioning schedule:

1. Equipment is not temporarily started (for heating or cooling), until Installation Verification Checklist and Start-up checklist items and all manufacturers' pre-start procedures are completed, and moisture, dust and other environmental and building integrity issues have been addressed.
2. TAB is not performed until the envelope is completely enclosed and ceiling complete, unless the air is ducted.
3. The controls system and equipment it controls are not functionally tested until all points have been calibrated and Installation Verification Checklists have been completed.
4. Functional testing does not begin until Installation Verification Checklists, Start-up and TAB have been completed for a given system. This does not preclude a phased approach.

5.3. Submittals and Documentation

5.3.1. Submittals and Sequence of Approvals

Description	Responsible Party	Delivery
HVAC, DHW, Lighting Controls, Electrical, Renewable Energy Systems, Irrigation Systems		
Equipment Submittal	Subcontractors	Prior to ordering equipment
Manufacturer’s Installation and Operations Manuals	Subcontractors	8 weeks prior to startup
Single Line Diagram - showing equipment configuration	A/E or Subcontractor	8 weeks prior to startup
Sequence of Operations	A/E	Prior to construction (100% CD)
Startup & Installation verification Checklist - Draft Submittal	Subcontractors	8 weeks prior to startup
Procedure for piping, flushing and ductwork testing	MEP Sub	8 weeks prior to startup
Completed Startup & Installation Verification Checklists	Subcontractors	After Startup Checklist approval
Draft Functional Test Scripts for Team review	CxA	4 weeks prior to FPTs
Completed Controls Point-to-Point Checklist	BAS Sub	After Start-ups
Vibration/Sound Control Devices	MEP/TAB Sub	Provide report to CxA
Completed Piping, Flushing, Ductwork documentation	MEP Sub	After approval of procedures
Test and Balance Report-including vibration/sound requirements	TAB Sub	After approval of Completed Startup Checklists
Title 24 Acceptance Tests	Subcontractors	Prior to Functional Performance Tests
Functional Performance Tests (FPT)	Team	After approval of TAB Report
Response to Issues Logs	Team	As Issues are remedied
Training Agenda Submittal	Subcontractors	2 weeks prior to training
Training of Staff & Maintenance	Subcontractors	After Training Agenda approval
Training Log	GC	After Training is complete

5.4. Equipment Submittals

Equipment submittals are provided to the CxA at the same time as the EOR is reviewing the documents. The CxA will send all comments to the EOR several days prior to the architect's deadline. The EOR will review and merge the comments as necessary. It is the responsibility of the architect to incorporate all party's comments prior to returning the equipment submittal to the subcontractor. CxA review is based on adherence to contract documents, though may also have a focus on maintainability, access, and other functional aspects of the equipment.

5.5. Contractor Documentation

Once the equipment submittals are approved, each MEP subcontractor shall submit additional Contractor Documentation that is used in the commissioning process. These documents are to be provided as a package within 4 weeks of the approved submittals. Included in this package are the following:

5.5.1. Manufacturer's Installation and Operations Manual (IOM)

This manual generally can be downloaded from the manufacturer's website. The document may or may not be the same as the Operations and Maintenance Manual. It includes the recommended steps and procedures for proper installation, calibration, and configuration of the equipment. Include project Tag Numbers on all documents. Identify options that are being provided and/or cross out sections that are not appropriate to this project's installation.

5.5.2. Single Line Diagrams (SLDs)

Single line diagrams show equipment connections to integrated systems.

5.5.3. Sequence of Operations (SOO)

The contract documents generally contain the SOO, developed by the EOR. If this is not included in the drawing or specifications, the controls contractor (or subcontractor) submits the SOO to the EOR for review and approval.

Additionally, if there is a piece of equipment that is stand-alone or using its own internal controls; a sequence of operation is required from the manufacturer for that specific piece of equipment.

Other systems may finalize their sequence of operation during the submittal process. Such systems might include; Emergency Electrical/Security Protocols, Lighting systems, Automatic Shades, etc.

The SOO is a narrative describing the equipment and systems' startup, shutdown, capacity modulation, emergency and failure modes, alarms, and interlocks to other equipment. The CxA shall review and comment on the approved SOO and request clarifications and/or suggestions for all commissioned systems.

5.5.4. Installation Verification Checklists

These are the checklists that incorporate steps to install, configure, and calibrate the components of the equipment. Included are steps found in the manufacturer's recommendations, contract document requirements, and the contractor's standard procedures. These are sometimes references as Pre-Start, pre-checks, or pre-functional checks and are generally performed prior to the equipment being operated. They may be combined with the Start-up Checklists as long as all the procedures are incorporated.

5.5.5. Startup Checklists

Startup Checklists are designed to verify the equipment is configured and adjusted to comply with the manufacturer requirements and contract specifications. These steps include procedures involving the equipment's operational functions. Typically, pressure and temperature adjustments and verifications, modification of settings and schedules, and confirmation of functional operations are all part of the Startup Checklist. The contractor's standard Startup Checklist can be incorporated into these other requirements. If vendors are providing the startup, a copy of their checklist is required for review and acceptance. Ultimately, the subcontractor is responsible for the Startup procedures to be complete.

5.5.6. TAB Outline Plan

The CxC shall submit the outline of the TAB plan and approach prepared by the TAB contractor to the CxA and the BAS contractor at the same time when other submittals and contractor documentation is being processed. A full description of the procedures and the equipment to be verified, along with the design values, shall be provided.

A written explanation of the intended use and specific requirements of the BAS for the successful and timely completion of the TAB should be included in the plan. The EOR shall review and approve the plan. The CxA shall review the proposed plan for understanding and coordination issues and may provide comment, but is not responsible for approving the TAB plan.

5.6. CxA Reviews

The CxC shall submit equipment and contractor documentation provided by the manufacturer and developed by the installing contractor for review by the CxA. The CxA shall suggest additional startup procedures to be incorporated, based on contract documents and manufacturers recommendations.

5.7. Special Submittals and Notifications

5.7.1. Changes to Previous Submittals

The Subs, GC or A/E shall notify the CxA of any new design intent or operating parameter changes, modified control strategies or sequence of operation, or other change orders that may affect commissioned systems.

5.7.2. Controls Points List

The MEP EOR shall provide the CxA with a project specific full points list, at least thirty (30) days prior to performing the functional tests.

5.8. Controls Integration Meetings

The CxA, CxC, EOR, CC and OR (or Owner’s designated Facility Representative) will conduct controls integration meeting(s) in coordination with team members as appropriate, including the controls programmer for the project. The meetings shall occur after the software and database drawings are issued for initial review, but prior to the development of the database and code for any piece of equipment. The meetings shall discuss and clarify the following issues:

- Points database
- Sequence of Operation, setpoints, and schedules
- Functional interlocks
- Operator workstation graphics
- Field sensor and panel location
- Integration with other systems

5.9. Miscellaneous Meetings

The CxA may attend selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in commissioning. The CxC shall provide the CxA with information regarding substitutions, RFIs, change orders and any Architect’s Supplemental Instructions (ASI) that may affect commissioning of equipment, systems or the commissioning schedule.

During construction, meetings between various commissioning team parties will be scheduled by the CxA through the CxC.

5.9.1. Site Observations

The CxA shall make periodic visits to the site to observe equipment and system installations. Additional visits may be made to observe the contractor’s pre-functional testing and verification of installations. The CxA shall be given adequate notice (no less than seven working days) by the CxC.

5.10. Startup

Installing Subs are responsible for each part of Installation Verification Checklists and Startup Checklists for commissioned equipment and systems. The parties responsible for each part of these checklists are identified on the checklists. The startup procedures are directed and executed by the Sub or equipment vendor.

The Subs shall provide to the CxC the manufacturer checklists, Installation Verification, and Startup Checklists, including actual field checkout sheets used by the field technicians. The CxC shall forward the documents to the CxA. These documents shall become part of the Commissioning Final Report.

5.10.1. Execution of Startup Checklists and Startup

The Installation and Startup Checklists are directed and executed by the Sub or vendor. To document the process of startup, the site technician performing the tasks shall check off items on the checklists as they are completed. Only individuals having direct knowledge of a line item being completed shall check or initial the forms.

The Subs and/or vendors execute the checklists and submit a signed and dated copy of the completed Installation and Startup Checklists to the CxC, who shall forward it to the CxA. The CxA may review Startup Checklists in progress.

5.10.2. Deficiencies and Non-Conformance

The Subs shall clearly list any outstanding items from the startup procedures that were not successfully completed. The procedures form and deficiencies shall be provided to the CxA within two (2) days of test completion. The Subs and vendors shall correct and retest any deficiencies or uncompleted items, involving the CxC as necessary, prior to the start of functional performance testing. The CxC shall notify the CxA when all deficiencies and uncompleted items have been resolved.

5.10.3. Electrical Systems Checkout Plan

The Electrical contractor shall use the approved Electrical Checkout plan; which will include MOPs (Methods of Procedure) and required testing forms as their start-up verification. The Electrical contractor shall review the FPTs in advance when provided by the CxA and provide written comments and detailed amendments no less than fourteen (14) days prior to the start of functional testing. The CxA shall consider the written comments in finalizing the FPTs within seven (7) days of receipt.

5.10.4. Controls and Checkout Plan

The BAS contractor shall utilize the BAS Point-to-Point and calibration checks as their startup verification.

All controls-related Startup Checklists and verifications must be completed and accepted by the CxA prior to TAB. The BAS contractor shall execute the assigned tests and trend logs and be available for assistance for mechanical system Functional Performance Tests.

5.10.5. Startup Document Review

The Subs shall provide the CxC with copies of the completed Installation Verification Checklists, Startup Checklists, and manufacturer's startup forms for all commissioned equipment and systems. The CxC shall forward the completed Cx documentation to the CxA as it is submitted, and in all cases, a minimum of five (5) working days prior to the start of Test Adjust Balance.

5.11. Test and Balance (TAB)

The final TAB plan (as refined from the TAB outline plan) shall be provided to the CxA for review at least thirty (30) days prior to the commencement of TAB work. The TAB report shall be provided to the CxA upon completion, no later than five (5) days following completion of TAB work and 10 days prior to functional testing.

The TAB contractor shall submit weekly written lists of completed tests and reports of discrepancies to the CxC. The CxC shall forward to the CxA.

In general, TAB work does not begin until the BAS control system has been verified by Point-to-Point and calibration checks and these documents are accepted by the CxA.

The BAS contractor shall also meet with the TAB contractor prior to the start of TAB and review the TAB plan to determine the capabilities of the control system for use in TAB. The BAS contractor shall provide the TAB contractor with any necessary instruments for configuring terminal unit boxes and instruct the TAB contractor in their use. The BAS contractor shall also provide a technician qualified to operate the controls to assist the TAB contractor in performing TAB activities, as needed.

5.12. Functional Performance Test (FPT) and Verification Procedures

Functional testing is the dynamic testing of systems (rather than just components) under full operation. Systems are tested under all modes of operation as defined in the sequences of operations, such as during cooling and heating loads, low and high loads, component failures, occupied and unoccupied modes, varying outside air temperatures, emergency and power failure, alarms, interlocks, and other operating conditions. Testing proceeds from components- to subsystems- to systems- and finally to interlocks and connections between systems.

Functional testing and verification shall be achieved by manual testing, by monitoring the performance and analyzing the results using the BAS trend log capabilities, or by stand-alone data-loggers, depending on the equipment and sequence as referenced in the FPTs. The systems shall be run through all of the control system's sequences of operation and verified to be responding as stated.

5.12.1. Development of FPTs

The CxA shall develop the Functional Performance Test procedures in a sequential written form. The CxA reviews all equipment submittals, manufacturer's recommended tests, and any change orders affecting equipment or systems, updated points list, control sequences and setpoints. The CxA may require clarification from the CxC, Subs and the A/E regarding sequences and operation for this purpose. The CxA shall utilize this data in preparing test forms and sequential test procedures to verify proper operation of each piece of equipment and system. Tests are prepared to yield results that are predictable and repeatable.

FPT procedures shall be distributed for review by all parties in advance of the scheduled tests. FPTs shall be submitted to the A/E for approval and finalized by the Commissioning Authority prior to the start of testing.

The BAS contractor shall review the FPTs in advance when provided by the CxA and provide written comments and detailed amendments no less than fourteen (14) days prior to the start of functional testing. The CxA shall consider the written comments in finalizing the FPTs within seven (7) days of receipt.

5.12.2. Contractor Review and Approval of FPTs

Thirty (30) days prior to performing any functional tests, proposed FPTs will be provided to the subcontractors. The Subs shall review and provide the CxA with their review of any procedures that are inconsistent with their understanding of the equipment operations, or conditions that may be unsafe or incompatible with maintaining the warranty.

5.12.3. Functional Test Prerequisites

Prior to the initiation of Functional Performance Tests, the CxA shall verify that Startup Checklists have been completed. BAS installation must be substantially completed (automatic operation) and their conformance to test requirements must be documented and accepted by

the CxA before commencing functional testing of systems. TAB for air and hydronic systems must be completed and at a minimum, the preliminary reports from the field submitted to the CxA.

5.12.4. Title 24 Acceptance Tests

Contractors are to submit a copy of all Title 24 Acceptance Tests to CxC, who will forward to CxA prior to the start of Functional Performance Tests. These tests are a further verification, beyond the other startup procedures, that the equipment is properly configured and ready for testing.

5.12.5. Execution of Functional Testing Procedures

5.12.5.1. Process

The CxA shall schedule Functional Performance Tests through the CxC. A meeting shall be held by the CxC at the start of the FPTs to review the planned tests and assure the required parties are prepared.

The CxA shall oversee, witness, and document the Sub's demonstration of the Functional Performance Test procedures for all equipment and systems according to the Specifications and the Cx Plan. The Subs or manufacturer's representatives shall execute and demonstrate the tests following the procedures developed by the CxA.

5.12.5.2. Preliminary Testing

The controls contractor, subcontractor, or vendor shall run through all functional testing prior to demonstrating the functional tests to the CxA. This is done to ensure that all readily observable deficiencies are corrected prior to witness testing. If, during functional performance testing, it becomes clear that preliminary testing by the Sub was not performed or not completed effectively, testing may be postponed at the discretion of the CxA. Testing shall recommence or resume after completion of preliminary testing.

5.12.5.3. Deficiencies and Re-Testing

In the process of witnessing Functional Performance Tests, the CxA will document non-compliant tests and significant system deficiencies on the procedure or test form. The CxA will notify the PC and CxC of deficiencies or non-conformance issues by documenting them on the Commissioning Issues Log in a timely fashion. Corrections of minor deficiencies may be made during the test demonstrations at the discretion of the CxC and CxA.

Decisions regarding minor deficiencies and corrections will be made at as low a level as possible; e.g., from the CxA, CxC and the Sub. The CxC and Subs will schedule re-testing as required, providing written notification to the CxA. For disputed items, the Owner will be the final authority.

Any additional retesting and site visits necessitated by equipment or systems not being fully functional when otherwise stated by the responsible contractor shall be at the expense of the responsible contractor.

Any additional verification or back-checks of issues due to equipment or systems not being functional when otherwise signed off by the responsible contractor shall be at the expense of the responsible contractor.

5.12.5.4. Issues Log

The CxA shall document all deficits found throughout commissioning in an Issues Log that is updated, distributed, and sent to the commissioning team. This document represents the observations by the CxA, as a third party representative of the owner. Subs shall correct deficiencies, sign them off, and notify the CxA in writing when ready for re-testing. It is the responsibility of each responsible party to address each issue by responding in writing as to what remedy or response the contractor has to the identified item. The CxA shall schedule re-testing through the GC.

5.12.5.5. Facilities Staff Participation

Facilities Operations staff is encouraged to attend and participate in the testing process. This process neither constitutes nor replaces formal training.

5.12.6. Execution of Functional Testing Procedures

Prior to functional testing, the GC's Controls Contractor (CC) shall set up trends on the BAS as specified in the FPTs and/or contract documents. The CC shall download and submit trend data to the GC, who shall forward it to the CxA for review. The data must be electronic and in spreadsheet or database format.

Trending Requirements:

- Trend logs must be established before functional testing; Commissioning Agent to review 24 hours of trend data prior to functional testing
- Remote access must be established prior to functional testing and the CxA shall be given access
- Submit trends for all points listed in specifications. Equipment should be trended during a period similar to design conditions
- Trend data must be saved in CSV (Comma delimited) (*.csv) format or database format
- All data is to be within the 14 day trend period for any particular submittal period
- Status or Change of Value (COV) data may be saved with other COV data in a single file, but not with Time Series data
- Provide 14 continuous days of data, 24 hours a day, with time intervals as specified in Functional Performance Tests

5.13. O&M Manuals and Warranty Documentation

The CxC shall assemble all the turn-over documents required by the contract documents; this may include O&M manuals, equipment warranties, contractor guarantees, and as-builts. Typically these documents are reviewed and accepted by the A/E team. Additionally, the CxC should furnish these documents to the Operations Staff for internal review and input, and as a precursor to training. The CxC shall also review the turn-over package for completeness, approve each equipment warranty and will verify that all requirements for maintaining the warranty are valid and clearly stated. The CxA shall be provided the final turn-over package and will verify that it complies with the contract requirements.

5.14. Final Commissioning Report

A final summary report by the CxA will be provided to the OR. The report shall include an executive summary, list of participants and roles, overview of commissioning and testing scope, and a general description of testing and verification methods and results. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment, system interactions or operations, future actions, commissioning process changes, etc. may also be listed.

5.15. Systems Manual

The CxA shall develop the Systems Manual with input from the CxC, Subs, OR, CC, TAB, and Operations staff. The Systems Manual provides future operating staff with the information needed to understand and optimally operate the commissioned systems. It provides Facilities staff with the information necessary to monitor, maintain, and optimize system operations on an ongoing basis, and aids in the long-term success of building operations' energy efficiency strategies according to the design intent. The Systems Manual will be developed after Functional Performance Tests are complete, and within ten (10) working days of receiving as-built BAS drawings, Sequences of Operation, and other documentation from the CxC.

The Systems Manual will include the following documentation submitted by the CxC:

1. System Single Line Diagrams
2. As-built Sequences of Operations, control drawings, and as-built setpoints
3. Operating instructions for integrated building systems
4. Recommended schedule of maintenance requirements and frequency, if not included in the project O&M manuals
5. Recommended schedule for calibrating sensors and actuators if not included in O&M manuals.
6. Basic Operation:
 - a. Written narrative of equipment operation
 - b. Interfaces, interlocks and interaction with other equipment and systems

5.16. Training and Orientation of Personnel

Owner training and orientation on equipment and systems shall be provided by the GC and Subs in accordance with the contract documents. The GC and Subs shall submit training plans to the CxA at least 30 days prior to scheduling training. Training plans shall include the name and qualifications of the trainer, the targeted audience, and a list of topics to be covered. The CxA shall review the training for system overview, design intent, and design criteria.

The operations personnel should be trained on the safe and proper operation, maintenance, diagnosis and repair of each piece of equipment. Submitted O&M information should be used during these training activities.

5.16.1. Training Sessions / Agenda

For each piece of equipment or system, a written training agenda will be developed and submitted for review and approval. OR and CxA will review and comment on each agenda in accordance with the training plan and project specifications. Recommended topics include:

1. Systems and equipment conceptual overview – what is the equipment, what is its function, and with what other systems or equipment does it interface
2. Sequences of operation in all modes of operation
3. Review of information in the System Manual
4. Review of the pertinent record drawings
5. Warranty details
6. Relevant health and safety practices and concerns
7. Common problems and their diagnosis and/or repair
8. Review and demonstration of servicing and preventive maintenance
9. Hands-on training for Facility staff
10. Proper maintenance schedules, tasks and procedures with demonstrations
11. Emergency response and recovery procedures in accordance with 2012 NFPA 3, Section A.1.3.2(5)
12. Emergency response and recovery procedures in accordance with 2012 NFPA 3, Section A.1.3.2(5)

5.16.2. Training Record

Following the training, the CxC and the Contractor will prepare a Training Record which will include, for each piece of equipment, a check-off of training covering each topic per the Project Training Plan. A log with the trainer and attendees signatures and date shall be included. PM, CxA, and the A/E will review the final Training Report.

5.17. Current Facility Requirements

New to LEED version 4 is the requirement for the CxA to assemble and maintain a current facility requirements (CFR) and operations and maintenance (O&M) plan that contains the necessary information to operate the building efficiently. The minimum documentation for the plan are listed below:

- Sequences of operation for the building
- Building occupancy schedule
- Equipment run-time schedule
- Setpoints for all HVAC equipment
- Lighting levels throughout the building
- Minimum outside air requirements
- Changes in schedules or setpoints for different seasons, days of the week, and times of day
- Systems narrative describing the mechanical and electrical systems and equipment
- Preventive maintenance plan for building equipment described in the systems narrative
- Cx program that includes periodic Cx requirements, ongoing Cx tasks, and continuous tasks for critical facilities.

5.18. Warranty Period Commissioning

The CxA will conduct a Post-Occupancy and Warranty Period Commissioning Review. Post-Occupancy Commissioning will include a site visit approximately 8 – 10 months after occupancy, but before the warranty period has expired. During this site visit the CxA will interview the owner’s representative and/or facility staff to identify any problems with commissioned equipment, or concerns they have with operating the building as originally intended. Any unresolved items on the Issues Log will be reviewed. The CxA will participate in forming a plan with the owner to have these items resolved. The CxA may witness deferred testing. The CxA will document their findings in a site visit report.

5.18.1. Post-Occupancy Trend Analysis

The CxA may analyze the trend data for systems integration issues and to review operation over variable conditions and times. Trend reviews provide a record of actual operating conditions and may reveal anomalies in settings, schedules, or responses that are inconsistent with the prescribed sequence of operations, where energy efficiencies or equipment operations may be compromised. This method of assessment is also an example of the recommended long term continuous commissioning to assure building operations are optimally maintained.

5.19. Ongoing Commissioning Plan

The CxA shall issue an ongoing Commissioning Plan (Cx Plan) before or as part of the 10-month review of the building operation. The Ongoing Commissioning Plan is effectively a recurrence of the functional performance testing, monitoring based commissioning, and reporting procedures to ensure the building continues to perform according to the OPR, BOD and approved design and construction documentation throughout the lifetime of the building. The CxA shall provide blank functional performance tests for all commissioned systems, the issues log and direction for testing new and retrofitted equipment over time.

Ongoing Cx activities can be performed by in-house operating personnel or by a third party CxA and is required to occur at least twice a year to account for the seasonal variation.



Geotechnical Investigation and Geologic Hazards Evaluation Laney College Library Learning Resource Center

Oakland, California

04.72190021-PR-001 04 | March 31, 2023

Final

Peralta Community College District



Document Control

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March 31, 2023

Dear Ms. Smith,

Fugro is pleased to submit this final geotechnical investigation and geologic hazards evaluation report for the proposed new Library Learning Resource Center project at Laney College in Oakland, California. Our work was authorized by the District professional service agreement (Requisition No. 2-129461, PO No. 3-118689) dated February 19, 2019, Amendment No. 1 (Requisition No. 2-135365, PO No. 3-122826) dated December 11, 2019, Amendment No. 2 (Requisition No. 2-145003, PO No. 3-131458) dated September 1, 2021, and the Amendment No. 3 (PO No. PCCD1-3000135642) dated August 3, 2022 and was executed in general accordance with the scopes listed in our Proposals No. 04.72189129-P-001(Rev.02), No. 04.72190021-P-001(Rev.00), No. 04.72160021-P-002(02), and No. 04.72190021-P-003 (01), dated February 19, 2019, July 19, 2019, July 12, 2021, and April 27, 2022, respectively.

This report was prepared to identify the key geologic and geotechnical aspects of the site and provide geotechnical recommendations for design and construction of the project. This report also summarizes the results of our geotechnical and geologic site data review, field exploration, laboratory testing, and geologic and seismic hazard evaluations for the project site. We appreciate this opportunity to be of service to the District. Should you have any questions or require additional information, please contact us.

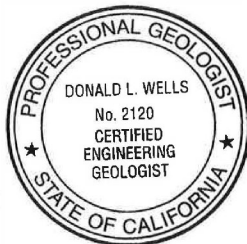
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Supplements

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Supplement B **Laboratory Testing Program**

Supplement C **Previous Field Exploration Logs and Laboratory Test Results**

C.1 Exploration Boring Logs and CPTs by Fugro, February 2002, Fugro No. 1430.001

C.2 Exploratory Boring Logs and Lab Results by WCS, November 1965, WCS No. S10312

Supplement D **Liquefaction Triggering and Post-Liquefaction Deformation Analyses**

Supplement E **Dynamic Densification Analyses**

Supplement F **Slope Stability Analyses**

Supplement G **Site-Specific Ground Motion Analyses**

Supplement H **LPILE Analyses**

Supplement I **DMM Design and Recommendations Report**

I.1 Introduction

I.2 Proposed Structure

I.3 Subsurface Conditions

I.4 DMM Ground Improvement

I.5 Seismic Design Parameters

I.6 Foundation System

I.7 Conclusions and Recommendations

I.8 References

1. Introduction

This report presents the results of the geotechnical investigation and geologic hazards evaluation conducted by Fugro USA Land, Inc. (Fugro) for the new Library Learning Resource Center on the Laney College campus. The campus is located at 900 Fallon Street in the City of Oakland and County of Alameda, California, as shown on the Vicinity Map (**Plate 1**). A topographic map of the area, along with coordinates for the site (Lat. 37.794899°N and Long. 122.262363°W) are presented on the Topographic Site Map (**Plate 2**). Previously, Fugro performed a geotechnical study of the same site in 2002 and the results were presented in a report dated March 27, 2002.

This report was prepared in accordance with guidance from the California Geological Survey (CGS) – Note 48, *Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings*, (CGS, 2019), the American Society of Civil Engineers (ASCE) ASCE/SEI 7-16 Standard, *Minimum Design Loads for Buildings and Other Structures* (ASCE, 2016), and following the regulations of the 2019 California Building Code (2019 CBC; California Building Standards Commission, 2019).

Because the course of the design changed during the review process by California Geology Survey (CGS) and the Department of the State Architects (DSA), relevant information throughout the body of the previous report dated February 28, 2022, is updated in this report.

In addition, the design team decided to use Deep Mixing Method (DMM) ground improvement and shallow foundation system in lieu of proposed deep foundation and retaining wall system in our 2020 report. The detailed design assumptions, discussions, recommendations, and specifications are presented in DMM Design and Recommendations, **Supplement I**. Updated information and discussions shown in **Appendices I** and **J** supersede the similar subject in this report.

1.1 Project Description

According to the preliminary building layout plan provided by Noll & Tam Architects and Planners and as shown on the Site Plan (**Plate 3**), we understand that the proposed Library Learning Resource Center site is in the southeast corner of the Laney College main campus and is bounded by 7th Street on the southwest, Lake Merritt Channel on the east, a cooling tower structure and Building E on the northeast, and a handicap parking lot on the northwest. The site is located about 100 feet southwest of the Bay Area Rapid Transit (BART) underground tube easement. According to site survey information provided by CSW/Stuber-Stroeh Engineering Group, Inc. (April 2019), the existing surface elevations at the proposed building area varies from Elevations of +18 feet to +21 feet (NAVD 88).

The new building is planned to be an at grade, 3-story high building with an estimated footprint area of about 24,197 square feet and project size of 75,622 square feet. The proposed building location is about 130 to 160 feet away from the edge of the Lake Merritt Channel west bank. No significant raising of the existing site grade is anticipated for the project according to the project drawings provide by Noll & Tam Architects dated October 14, 2022.

At the time of our study, the site was occupied by several portable classroom buildings, a small bathroom structure, a small storage shed, and associated concrete walkways and landscaping. Short retaining walls up to about 3 feet high were located to the northeast of the classroom buildings, which retained the existing generally level pad of the existing improvements. Based on available aerial photographs of the site, these existing improvements appeared to be installed between August 2007 and September 2008. These improvements will be removed prior to the new construction.

1.2 Scope of Services

The purpose of our geotechnical investigation and geologic hazards evaluation was to identify key geotechnical, geologic hazards, and seismology aspects of the site in accordance with CGS Note 48 that could impact the project and provide geotechnical recommendations for design and construction of the project. The scope of our services performed included the following:

- Compile and review available geotechnical and geologic data that is contained in our files and provided by others, including existing geologic and seismic hazard maps and other generally available related literature.
- Review previous geotechnical investigation reports for the site and vicinity by Fugro and others, including results of previous exploratory borings, Cone Penetration Tests (CPT), and laboratory testing.
- Conduct a field exploration program including one (1) exploratory boring to a depth of about 76-1/2 feet and eight (8) CPTs to a maximum depth of about 75-1/2 feet;
- Perform geotechnical laboratory testing on selected soil samples for classification, index, strength, consolidation, and corrosivity testing.
- Identify the site geotechnical and geologic conditions (e.g., stratigraphy, subsurface soil characteristic and engineering properties, depths to groundwater, and geologic hazards) that could impact the project, as mandated by CGS Note 48.
- Perform engineering analyses using the field and laboratory data, including detailed liquefaction triggering, post-liquefaction deformation, dynamic densification, lateral spreading, and slope stability evaluations.
- Develop site-specific seismic design criteria per 2019 California Building Code (CBC), including a site-specific ground motion response analysis and a Probabilistic Seismic Hazard Analysis (PSHA).
- Respond the CGS and DSA review comments.

- Provide ground improvement design, drawings, and specifications.
- Communicate with the structural engineer and assist in finalizing the foundation design.
- Prepare this report to summarize the results of our geotechnical and geologic data review, field exploration, laboratory testing, geologic hazards evaluations, and engineering analyses, and to provide geotechnical conclusions and recommendations for design and construction of the project.

Chemical analytical assessment of onsite materials or groundwater for contaminants was beyond our scope of work.

2. Data Review, Exploration and Laboratory Testing

2.1 Review of Existing Data

As part of our study, Fugro reviewed relevant geotechnical, geologic, and seismic data, as well as results of previous explorations and laboratory testing performed in the vicinity of the project site, including the following reports, literature, and maps. The conclusions from our review of the existing data are presented in subsequent sections of this report.

2.1.1 Previous Geotechnical Data and Reports

- Woodward-Clyde-Sherard and Associates, March 9, 1966. *Soil Investigation for the Proposed Peralta Junior College Civic Center Site, Phase 1 – Preliminary Studies*, WCS No. S10312.
- Woodward-Clyde-Sherard and Associates, May 1, 1967. *Peralta College – Chinatown General Neighborhood Renewal Area (GNRA)*, WCS No. 11032.
- Kaldveer Associates, September 9, 1991. *Feasibility Foundation Investigation, Proposed Pool Improvements, Laney College*, Kaldveer No. K1329-1-863.
- Harza Kaldveer, October 22, 1993. *Geotechnical Investigation for Proposed Pool Replacement, Laney College*, Harza No. K1329.
- Fugro, March 27, 2002. *Geotechnical Investigation, New Art Building at Laney College*, Fugro No. 1430.001.
- Fugro, March 29, 2005. *Geotechnical Study and Geologic Hazard Evaluation, Laney College Art Building*, Fugro No. 1430.005.
- Geotechnical Engineering Inc., March 20, 2006. *Additions to Building A & Chiller Room Adjacent to Building B, Laney College*, GEI No. 41357.
- Fugro, August 25, 2006. *Geologic Hazards Evaluation, Laney College Building A Renovation*, Fugro No. 1430.008.
- Fugro, June 10, 2008. *Geotechnical Review, Proposed New Laney College Library Site Study*, Fugro No. 1813.002.
- Terraphase Engineering, May 31, 2012. *Geotechnical Design Report, Proposed Laney College Building Efficiency for a Sustainable Tomorrow (BEST)*, Terraphase No. 0034-001-003.

2.1.2 Geologic Maps, Literature, and Hazard Zonation Maps

- Witter, Knudsen, Sowers, Wentworth, Koehler, and Randolph, 2006. *Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California*, USGS Open File Report 2006-06-1037.
- Helley and Graymer, 1997. *Quaternary Geology of Alameda County, and Parts of Contra Costa, Santa Clara, San Mateo, San Francisco, Stanislaus, and San Joaquin Counties, California: A Digital Database*, USGS Open File Report 97-97.

- Rogers and Figuers, December 30, 1991. *Engineering Geologic Site Characterization of the Greater Oakland-Alameda Area, Alameda and San Francisco Counties, California*, NSF Grant No. BCS-9003785.
- California Geological Survey, *Earthquake Fault Zones, Oakland West Quadrangle*, Revised Official Map, Released: January 1, 1982.
- California Geological Survey, *Seismic Hazard Zones, Oakland West Quadrangle*, Official Map, Released: February 14, 2003.
- California Geological Survey, 2003. *Seismic Hazard Zone Report for the Oakland West 7.5-Minute Quadrangle, Alameda County, California*, Seismic Hazard Zone Report 081.
- Holzer, Bennett, Noce, Padovani, and Tinsley, 2002, revised 2010. *Liquefaction Hazard and Shaking Amplification Maps of Alameda, Berkeley, Emeryville, Oakland, and Piedmont, California: A Digital Database*, USGS Open File Report 2002-02-296.
- Holzer, 1998. *The Loma Prieta, California, Earthquake of October 17, 1989 - Liquefaction*, USGS Professional Paper 1551-B.
- Youd and Hoose, 1978. *Historical Ground Failures in Northern California Triggered by Earthquakes*, USGS Professional Paper 993.
- California Geological Survey, July 31, 2009. *Tsunami Inundation Map for Emergency Planning, Oakland West Quadrangle*.
- Federal Emergency Management Agency, *Flood Insurance Rate Map (FIRM), Panel 06001C0067H (12/21/18)*.
- City of Oakland Community and Economic Development Agency, November 2004, *Safety Element, City of Oakland Safety Plan*.

2.2 Field Exploration

Fugro performed a geotechnical field exploration program that consisted of one (1) exploratory boring to a depth of about 76-1/2 feet and eight (8) CPTs (Cone Penetration Tests) to a maximum depth of about 75-1/2 feet on March 29, 2019, and January 2, 3, and 7, 2020. In addition, three (3) shallow hand auger borings to a maximum depth of about 6 feet were also performed at three (3) CPT locations (2019-CPT-1 through 2019-CPT-3). During the design of the Deep Mixing Method (DMM) ground improvement and to better define the bottom of Young Bay Mud (YBM) layer, we performed 10 additional CPTs to a maximum depth of about 100 feet on November 17, 18, and 22, 2022. The new CPTs are used to develop cross sections for the DMM Design and Recommendations, **Supplement I**. The approximate locations of the borings and CPTs are shown on the Site Plan (**Plate 3**). The locations were determined by pacing or tape measurement from field landmark references; and should be considered accurate only to the degree implied by the method used.

Drilling permits were attained from Alameda County Public Work Agency (ACPWA) for the subsurface explorations. Underground Service Alert (USA) was notified, and a private utility

locating company, Bess Testlab, Inc. (BTL) of Hayward, California, was retained to clear the boring and CPT locations prior to explorations. In addition, a hand auger was also used to clear the top 5 to 6 feet of soils for utilities below existing ground surface at some of the boring and CPT locations.

The boring was performed by a State of California C-57 licensed driller, Geo-Ex Subsurface Exploration (GeoEx) of Dixon, California, using a track-mounted CME 75 drill rig equipped with a mud rotary wash system and a 140-lb automatic trip hammer. According to a hammer calibration report provided by Geo-Ex, the 140-pound automatic trip hammer used at the site for soil sampling had been rated as having an average energy transfer ratio of about 91 percent (calibrated on December 18, 2018).

CPTs were performed by both Fugro and Gregg Drilling, LLC (Gregg) of Martinez, California, in general accordance with ASTM D5778. Fugro used a 25-ton truck-mounted rig with an electronic piezocone penetrometer that has a tip area of 15 cm², a friction sleeve area of 225 cm², and a tip end area ratio of 0.59. Gregg used a 20 and 25-ton truck-mounted rig and a self-anchoring mini track-mounted rig with an electronic piezocone penetrometer that has a tip area of 15 cm², a friction sleeve area of 225 cm², and a tip end area ratio of 0.8. The cones were advanced at a standard rate of 2 cm/sec into the ground to measure tip resistance, sleeve friction, and excess pore pressure. Pore water pressure dissipation tests were also performed at selected depths. In addition, in-situ soil shear wave velocity measurements were performed at an approximate 5-foot interval at the 2020-CPT-07 location. The CPT logs and interpretations are presented in **Supplement A**.

Our field engineer continuously logged soils encountered in the borings in the field. The soils are classified in general accordance with the Unified Soil Classification System (ASTM D2487 and D2488). The logs of the borings as well as a key for the classification of the soils are included in **Supplement A**. Upon completion of our field explorations, the borehole and CPT holes were backfilled with neat cement grout in accordance with ACPWA requirements. All drilling derived soil cuttings and fluids from mud rotary wash drilling were containerized in 55-gallon metal drums and transported to appropriate facilities for disposal by Geo-Ex.

Representative soil samples were obtained during drilling using a Modified California split-barrel drive sampler (outside diameter of 3.0 inches, inside diameter of 2.5 inches) and a Standard Penetration Test (SPT) split-barrel drive sampler (outside diameter of 2.0 inches, inside diameter of 1.375 inches). Soil samples were transmitted to laboratories for evaluation and appropriate testing. The sampler types are indicated in the "Sampler" column of the boring log as designated in **Plate A-1**.

Resistance blow counts were obtained with the drive samplers by dropping a 140-pound automatic trip hammer through a 30-inch free fall in general accordance with ASTM D1586. The

samplers were driven 18 inches, or a shorter distance where hard resistance was encountered, and the number of blows were recorded for each 6 inches of penetration. The blows per foot recorded on the boring logs represent the accumulated number of blows that were required to drive the last 12 inches. When the SPT split spoon sampler was used, these blow counts are the standard penetration resistance values (N values). However, due to the large diameter of the Modified California sampler, the blow counts recorded for this sampler are not standard penetration resistance values. These values were multiplied by a conversion factor of 0.63 for the Modified California Sampler and the calculated approximate equivalent N values are presented on our logs within parenthesis. No hammer energy correction had been applied on the N values presented on the logs.

Previously, several exploratory borings and CPTs were performed in 2002 by Fugro and in 1965 by Woodward-Clyde-Sherard and Associates (WCS) at the site and vicinity. The approximate locations of these previous explorations are also shown on the Site Plan (**Plate 3**). Logs of these previous explorations and laboratory testing results are included in **Supplement C** for reference. The results of these previous explorations and laboratory testing are also incorporated into this report.

2.3 Laboratory Testing

Our geotechnical laboratory testing program was directed toward a quantitative and qualitative evaluation of the physical and mechanical properties of the soils underlying the site. This program included:

- Fifteen (15) moisture content and dry unit weight determinations per ASTM D2937,
- Eight (8) hydrometer, sieve, and percent passing #200 sieve analyses per ASTM D422 and D1140,
- One (1) plastic and liquid limits per ASTM D4318,
- Two (2) unconsolidated undrained triaxial shear strength tests (TXUU) per ASTM D2850,
- One (1) incremental consolidation test per ASTM D2435, and
- Three (3) organic content determinations per ASTM D2974.

All tests were performed by Fugro's geotechnical laboratory in Ventura, California and Cooper Testing Laboratory in Palo Alto, California. Our laboratory testing results are included in **Supplement B**. Some of the test results are also presented on the boring logs (**Supplement A**) at the corresponding sample depths.

Corrosivity tests that include redox, pH, chlorides, sulfates, and resistivity were performed by CERCO Analytical, Inc. in Concord, California, on two representative onsite near-surface soil samples (from 2019-CPT-01 at about 2-1/2 feet and 2019-CPT-03 at about 4 feet). The test results and a brief evaluation report prepared by CERCO regarding the onsite near-surface soil corrosivity are also included in **Supplement B**.

3. Geologic and Seismic Setting

This section summarizes the regional geologic and tectonic setting, the local geologic setting, the site geology, and regional active faults and seismicity.

3.1 Regional Geologic and Tectonic Setting

The project site is located near the east shore of the San Francisco Bay in the Coast Ranges geomorphic province (CGS, 2002). The Coast Ranges are northwest-trending mountain ranges, typically rising to 2,000 to 4,000 ft. in elevation, with intervening elongated valleys. The oldest rocks in the range were formed from the subduction of the Farallon Plate beneath the North American Plate during the Jurassic and Cretaceous periods. The Franciscan Formation in the San Francisco Bay area is a complex of graywacke sandstone, shale, and other lithologies that accumulated in the offshore trench in the subduction zone, then were pushed up onto the continent. Later, Tertiary continental sediments and volcanic rocks were deposited over the Franciscan Formation.

Subduction was followed by strike-slip faulting along the San Andreas fault system starting in southern California about 28 million years ago as subduction gradually consumed the Farallon Plate, and the Pacific Plate and the North American Plate boundary migrated northward. The strike-slip motion along faults in the San Francisco Bay Area developed over the past 5 to 10 million years (Atwater, 1970; Wallace, 1990; Atwater & Stock, 1998). At the present time, the San Andreas fault and sub-parallel faults such as the Hayward fault form the boundary zone between the Pacific and North American plates in the San Francisco Bay area. Deformation over the past few million years along various faults of the San Andreas fault system has produced a series of northwest-trending valleys and mountain ranges, including the East Bay Hills, the San Francisco Peninsula, and the intervening San Francisco Bay.

The Hayward fault extends along the western front of the East Bay Hills along the east side of San Francisco Bay and forms an approximate boundary between two distinctly different geologic and physiographic provinces. Based on work by Radbruch (1969), basement rocks underlying the area west of the Hayward fault are primarily those of the Jurassic to Cretaceous Franciscan Complex (about 200 to 80 million years old). East of the Hayward fault, the basement rocks are Jurassic to Cretaceous sedimentary rocks of the Great Valley Sequence (about 140 to 65 million years old). These Mesozoic rocks are overlain by Tertiary volcanic and sedimentary rocks (65 to 2.5 million years old) in the East Bay hills. The San Francisco Bay Area experienced several episodes of uplift and faulting during late Tertiary time (about 25 to 2 million years ago).

The surficial deposits of the flatlands that lie between the hills and the bay are derived from erosion of the Mesozoic and Tertiary rocks in the hills. They are Quaternary in age, or less than

about 2 million years old, and consist primarily of alluvial deposits laid down by streams draining the hills. These deposits form and underlie the wide, gently sloping East Bay Plain and provide the relatively level building sites for most of the development in the East Bay. Sediments that reach the bay are deposited as estuarine deposits in the tidal marshes, mud flats, and the floor of the bay.

The position of the Bay shoreline varied throughout the Quaternary as sea level rose and fell in response to glacial cycles. During peak of the last major glaciation, around 15,000 years ago, sea level was about 330 feet lower than it is today and the San Francisco Bay was a wide valley with streams flowing across the valley floor, joining together to flow out the Golden Gate and finally meeting the sea near the Farallon Islands. As the ice from the great continental glaciers melted, sea level began to rise, with the sea entering the Bay about 10,000 years ago. The present sea level was reached within the Bay about 6,000 years ago (Atwater et al., 1977).

As a result of these sea level fluctuations, the thick sequence of sediments in and adjacent to the bay includes layers of estuarine silts and clays deposited during interglacial periods, alternating with layers of sandy alluvial deposits laid down during glacial periods (Atwater et al., 1977; Sloan, 2006). Borehole data to depths of 300 feet in the central part bay show strata from as many as four glacial-interglacial cycles.

3.2 Local Geologic Setting

In the area of the site, thick Quaternary deposits overlie the basement rocks. The Quaternary deposits represent several stages of deposition, which have taken place over the last 2 million years or so. The combined thickness of the sediments above the Franciscan bedrock is estimated to be on the order of 500 feet based on deep boreholes drilled in downtown Oakland (Rogers & Figuers, 1991).

Structurally, the project site is in an area dominated by the active San Andreas Fault system that includes from west to east, the San Gregorio, San Andreas, Hayward-Rodgers Creek, Calaveras, Concord-Green Valley, and Greenville faults, as well as many other minor faults. The Hayward fault borders the western margin of the East Bay Hills in the eastern San Francisco Bay Area. The site lies about 2-1/2 miles southwest of the toe of Oakland Hills, which are part of the Diablo Range that separates the San Francisco Bay from the San Joaquin Valley. The nearest bodies of surface water are the Oakland Inner Harbor, located about 1/2 mile to the south, and Lake Merritt, located 1/4 mile to the north.

3.3 Site Geology

According to Witter et al. (2006), and as shown on the Quaternary Geologic Map (**Plate 4**), the site is located bayward of the historical shoreline, on former tidal flats adjacent to the Lake Merritt Channel that were filled to make land. The site is roughly in the middle of the estimated

500- to 1,400-foot-wide natural outlet channel of Lake Merritt, which had been dramatically reduced in width with development of the region after the 1860s. Filling of this area occurred between 1894 and 1915 based on the study by Rogers and Figuers (1991).

The historical artificial fill overlies Holocene estuarine mud (afem), which is known locally as Young Bay Mud. According to Helley and Graymer (1997), most of the fill placed before 1965 in San Francisco Bay Area was not compacted and consists of dumped or hydraulically emplaced materials. Based on the results of subsurface geotechnical explorations, the site is generally underlain by about 8 to 25 feet thick of heterogenous man-made fills that locally contain various amounts of concrete, brick, and wood debris.

The Young Bay Mud is a water-saturated estuarine deposit, predominantly gray, green and blue clay and silty clay deposited in tidal marshlands and mud flats of San Francisco Bay. The mud generally contains a few lenses of well-sorted, fine sand and silt, a few shelly layers, and peat. The Young Bay Mud was deposited during the post-Wisconsin rise in sea-level, about 12,000 years to present, and interfingers with and grades into fine-grained alluvial deposits at the distal edge of Holocene alluvial fans.

3.4 Regional Faulting and Seismicity

The San Francisco Bay Area is recognized by geologists and seismologists as one of the most seismically active regions in the United States. As described in Section 3.1 and as shown on the Regional Fault and Seismicity Map (**Plate 5**), numerous major fault zones cross through the San Francisco Bay Area, generally trending northwest-southeast. These faults and other local faults have produced many strong earthquakes, magnitude 6.0 and greater, over the last two centuries within about 60 miles (100 km) of the site, as detailed in Section 3.5.

As shown on **Plate 5**, the site is located about 3.5 miles southwest of the Hayward fault zone. The Alquist-Priolo (AP) Earthquake Fault Zone Map of the Oakland West Quadrangle (**Plate 6**) shows that the site is not located within an earthquake fault zone, as designated by the State of California (California Geological Survey (CGS), 1982).

The Hayward fault exhibits typically geomorphic evidence of Holocene (less than 11,000 years) displacement such as shutter ridges, offset drainages, and aligned topographic sags and scarps. The Hayward fault zone varies in width, from relatively narrow traces of 5 to 10 meters in width, to a zone of subparallel strands several hundred meters wide, or more in fault stepovers. Fault creep occurs at the ground surface along most of the Hayward fault, with average measured creep rates of about 4 to 5 mm/year in the Oakland-Berkeley area (WGCEP, 2003).

Active faults located within about 60 miles (100 km) of the project site, and their generalized fault rupture parameters from the U.S. Geological Survey (USGS) are summarized in Table 3.1.

Table 3.1: Regional Active Faults and Generalized Rupture Parameters

Fault	Approximate Closest Distance from Site to Fault (miles)	Direction from Site to Fault	Estimated Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Hayward-Rodgers Creek	3.4	NE	7.3	150	9
Mount Diablo	13.4	N	6.7	25	2
Calaveras	13.9	NE	7.0	123	15
San Andreas	14.6	SW	8.0	472	17
Green Valley	16.5	NE	6.8	56	4.7
San Gregorio	18.9	SW	7.5	176	5.5
Greenville	24.2	E	7.0	50	2
Monte Vista-Shannon	24.6	S	6.5	45	4
West Napa	25.5	N	6.7	30	1
Great Valley 5 Pittsburg Kirby Hills (Closest Section)	27.4	NE	6.7	32	1
Point Reyes	32.9	NW	6.9	47	0.3
Hunting Creek-Berryessa	45.5	N	7.1	60	6
Zayante-Vergeles	51.2	SE	7.0	58	0.1
Maacama-Garberville	58.7	NW	7.4	221	9

Sources: USGS, 2008. *National Seismic Hazard Maps – Source Parameters* website

Earthquakes on the faults in Table 3.1 or on smaller, mapped or unmapped faults could cause strong ground shaking at the site. A USGS Fact Sheet (Aagaard et al., 2016) indicates there is a 72 percent chance of at least one magnitude 6.7 or greater earthquake striking the San Francisco Bay region between 2014 and 2043. Earthquake intensities will vary throughout the San Francisco Bay Area depending upon the magnitude of the earthquake, the distance of the site from the causative fault, the type of materials underlying the site, and other factors.

According to 2019 CBC and ASCE 7-16, and based on an average soft clay soil site condition (Site Class E), the site geometric mean peak ground acceleration (PGA_M) from the Maximum Considered Earthquake (MCE) is estimated to be about 0.80g. The MCE peak ground acceleration has a 2 percent probability of being exceeded in 50 years (a mean return period of 2,475 years), except where deterministically capped along highly active faults.

3.5 Historical Seismicity

Major earthquakes have been recorded along the San Andreas Fault system and across California since the late 1700s. Table 3.2 presents large magnitude ($M \geq 6.0$) regional earthquakes within about 60 miles (100 kilometers) of the site from 1800 to 2018, arranged in chronological order. The Northern California Earthquake Data Center (NCEDC) and National Atlas of United States database was accessed to obtain the historical seismicity information presented in Table 3.2. The epicenter locations are shown on the Regional Fault and Seismicity Map (**Plate 5**).

Table 3.2: Large Magnitude ($M \geq 6.0$) Earthquakes Within About 60 Miles (100 km) of the Site

Epicenter Location	Date	Magnitude	Distance (mi)	Direction from Site to Epicenter
Near San Francisco	6/21/1808	6.0	13.1	W
In the San Francisco Bay Area	6/10/1836	6.8	3.4	E
In the San Francisco Area	6/1838	7.0	15.5	SW
North of San Jose	11/26/1858	6.1	28.4	SE
In the Santa Cruz Mountains	10/8/1865	6.3	45.6	SSE
Near Hayward	10/21/1868	6.8	11.0	SE
West of Antioch	5/19/1889	6.0	24.3	NE
Near Vacaville	4/19/1892	6.4	44.4	NNE
Near Winters	4/21/1892	6.2	52.5	NNE
Near Mare Island	3/31/1898	6.2	28.9	NNW
Near San Francisco	4/18/1906	7.8	14.8	SW
Near Coyote Hills	7/1/1911	6.6	46.9	SE
Near Morgan Hill	4/24/1984	6.2	45.1	SE
Loma Prieta	10/17/1989	6.9	56.3	SSE
Napa	8/24/2014	6.0	29.1	N

Several of these events were strong enough to cause structural damage to buildings in Oakland. The estimated $M_{6.8}$ 1868 Hayward earthquake ruptured the Southern Hayward fault from Hayward northward to Oakland and damaged or destroyed numerous buildings in Hayward, San Leandro, Oakland, and San Francisco (Lawson, 1908). The 1868 Hayward earthquake apparently resulted in damage in Oakland corresponding to Modified Mercalli Intensity (MMI) VIII (partial damage to buildings, walls); however, there is little reported information on ground shaking and damage in Oakland, largely because the area was sparsely populated at the time of these earthquakes (Topozada & Park, 1982; Topozada, 2000).

During the moment magnitude (M_w) 7.8 1906 San Francisco earthquake, the San Andreas fault ruptured over a distance of about 296 miles (474 km) from Shelter Cove near Cape Mendocino

southward to near San Juan Bautista. Maximum lateral displacements of 15 to 20 feet (4.6 to 6.1 meters) occurred north of the Golden Gate at Olema in Marin County (Lawson, 1908). Landslides, liquefaction, and ground settlement occurred throughout the Bay Area and in the vicinity of the surface rupture as a result of this earthquake. The ground shaking in Oakland during the 1906 earthquake is characterized as MMI VII to IX (minor to major damage to and collapse of structures; Lawson, 1908; Boatwright & Bundock, 2005). Significant damage occurred to masonry buildings across the city (Lawson, 1908). Ground failure effects, including liquefaction, lateral spreading, and settlement occurred in several areas along the Oakland-Alameda Estuary and at the southern end of Lake Merritt, (Youd & Hoose, 1978; Knudsen et al., 2000).

The most significant recent seismic event to occur in the San Francisco Bay Area was the October 17, 1989, Loma Prieta earthquake. The epicenter of this earthquake was located approximately 56 miles southeast of the site. This moment magnitude 6.9 earthquake ruptured a 22-mile (35-km) section of a splay of the San Andreas fault. The 1989 Loma Prieta earthquake produced MMI VII to VIII effects in the vicinity of the site (McNutt & Topozada, 1990). Specific ground failure effects near the project site at Lake Merritt and the estuary channel resulting from the 1989 Loma Prieta and 1906 San Francisco earthquakes are described in the Section 5.2.1.

In addition to the damage from liquefaction near the site, the 1989 Loma Prieta Earthquake caused minor to significant damage to structures in the vicinity of the project site, including collapse of the elevated Cypress Structure on the west side of Oakland, and damage to buildings in downtown Oakland. The recorded peak ground acceleration from strong ground motion stations near the site is listed in Table 3.3; the nearest sites (within one mile of the project site) had PGAs of 0.18 to 0.26g.

Table 3.3: Strong Ground Motion Recordings from the 1989 Loma Prieta Earthquake

Station Number and Name	Site Conditions	Peak Ground acceleration (g)	Station Distance from Site (Miles)
58483 – Oakland – 24 story residential building	Alluvium	0.18 (ground)	0.35 NE
58224 – Oakland Title Ins. & Trust – 2 story building	Alluvium	0.26 (ground) 0.21 (revised NGA)	0.8 NNW
58334 – Piedmont – 3 story school office building	Serpentinite	0.08 (ground) 0.18 (structure)	2.4 NE
58338 – Piedmont Junior High School grounds	Weathered serpentinite	0.08 (ground)	2.5 NE
58472 – Oakland-Outer Harbor Warf	Fill/Bay Mud	0.29 (ground)	3.4 WNW
1662 – Emeryville – 6363 Christie	Alluvium	0.25 (ground, revised NGA)	3.8 NW

Station Number and Name	Site Conditions	Peak Ground acceleration (g)	Station Distance from Site (Miles)
Data from U.S. National Center for Engineering Strong Motion Data (URL: http://www.strongmotioncenter.org/), and the Pacific Earthquake Engineering Research (PEER) Center Next Generation Attenuation (NGA) Database (http://peer.berkeley.edu/nga/earthquakes.html)			

4. Site Conditions

This section describes historical and present land use and topography at the project site, subsurface soils and geologic strata, and groundwater conditions based on project geotechnical data.

4.1 Surface Conditions

At the time of our study and as shown on the attached Site Plan (**Plate 3**), the proposed Library Learning Resource Center site is in the southeast corner of the Laney College main campus and is bounded by 7th Street on the southwest, Lake Merritt Channel on the east, a cooling tower structure and Building E on the northeast, and a handicap parking lot on the northwest.

The site is occupied by several portable classroom buildings, a small bathroom structure, a small storage shed, and associated concrete walkways and landscaping. Several large and small diameter trees were located around the perimeter of the site. Short retaining walls up to about 3 feet high are located to the northeast of the classroom buildings, which retained the existing generally level building pad. Based on available aerial photographs of the site, these existing improvements appeared to be installed between August 2007 and September 2008.

According to site survey information provided by CSW/Stuber-Stroeh Engineering Group, Inc. (April 2019), the existing surface elevations at the proposed building location varies from Elevations of +18 feet to +21 feet (NAVD 88). The areas to the east of the proposed building location sloped gently downward toward the Lake Merritt Channel with inclinations of about 6:1 (horizontal to vertical) to 10:1. The top of the adjacent channel bank is at about Elevation of 7 feet.

Comparing the topographic information contained on the site plan Figure 1 of the 2002 Fugro report, the current site grade appears to have been modified to create the generally level pad for the portable classroom buildings. We estimated minor cut and fill grading of up to about 2 to 3 feet had been performed at the site during the portable classroom development in 2007 or 2008. The actual details of the previous grading are unknown. We recommend any available previous grading and construction records be forwarded to us for further review.

In addition, based on our review of historical USGS topographic maps from 1915 to 1980 and aerial photographs of the site vicinity from 1993 to 2018, it is our understanding that the Lake Merritt Channel had been re-aligned and widened in 1970s to the current alignment. In the site area, the old channel west bank was located about 140 feet east of the current west bank.

4.2 Subsurface Conditions

The subsurface soil conditions encountered by our borings and CPTs at the proposed Library Learning Resource Center site are consistent with Quaternary geologic mapping of the project site vicinity that shows artificial fill overlying estuarine mud. Similar subsurface soil conditions were also reportedly encountered by previous borings and CPTs by Fugro and others in 1965 and 2002 at the site and vicinity. Our interpretations of the site subsurface soil conditions are presented on the Cross-Sections A-A' through E-E' (**Plates 7** through **11**, respectively).

The subsurface soils below the site generally consisted of predominately medium dense sandy fills that extended to depths of about 8 to 25 feet (Elevation of about +8 feet to -5 feet). Clayey fills of about 2 to 4 feet thick were also encountered in some areas. These fills are heterogenous and locally contain various amounts of concrete, brick, and wood debris. An unknown obstruction was also previously encountered at about 5 feet deep at the 2002-CPT-1 location. Most of these fills appear to be derived from the historical filling of the natural Lake Merritt outlet channel between 1860s and 1940s, and the later development of the Laney College campus in 1960s. Most likely these fills were not compacted to current acceptable geotechnical engineering standards.

Below the surficial fill layer, very soft to soft, high moisture content, and low shear strength Young Bay Mud was encountered to a depth of about 30 feet (Elevation of about -10 feet) at the northwest side of the proposed building location and about 50 feet (Elevation of about -30 feet) at the southeast side of the proposed building location. Some thin loose to medium dense sand lenses about 2 to 6 feet thick were also encountered within the Young Bay Mud layer. About 15-feet of loose to medium dense sands were also encountered between the surficial fill and the Young Bay Mud layers in 2019-CPT-3. These sands could be either historical fills placed in the natural Lake Merritt outlet channel or natural sand deposits that existed within the channel.

Underlying the Young Bay Mud layer, medium dense to very dense sands and stiff to hard clays were encountered to the maximum depth explored of about 76-1/2 feet (or elevation of about -60 feet).

The thin surficial layers of clayey fills are considered to have a low to medium plasticity and low to moderate expansion potential; the sandy fills are non-expansive. Our logs and interpretations of borings and CPTs are presented in **Supplement A**. Our laboratory testing results of the onsite soil samples are included in **Supplement B**. Logs of historic explorations and results of lab testing are included in **Supplement C** for reference.

4.3 Groundwater

Based on CPT pore pressure dissipation tests at selected depths, the site groundwater table is estimated to be at depths of about 5 to 18 feet (Elevations of about 0 to +9 feet). In addition,

groundwater was reportedly encountered at 2002-CPT-2 location at a depth of about 11 feet (Elevation about +8 feet). The previous borings (2002-EB-1 through 2002-EB-3) also reportedly encountered groundwater at depths of about 15 to 45 feet (Elevations of about +5 to -27 feet). It should be noted that these borings might not have been left open for a sufficient period of time to establish equilibrium groundwater conditions. Fluctuations in the groundwater level could occur due to change in seasons, variations in rainfall, tidal effects, and other factors. According to CGS Seismic Hazard Zone report for the Oakland West Quadrangle (CGS, 2003), as shown on **Plate 13**, historically high groundwater in the site region had been reported at a depth of about 10 feet.

We recommend a design groundwater Elevation of +8 feet be used for the project designs, which generally corresponds to both the top elevation of Young Bay Mud layer within the project area and the top elevation of the adjacent Lake Merritt Channel bank.

5. Geologic Hazards Evaluation

Site geologic hazard evaluations were performed in accordance with guidance from the CGS Note 48 (CGS, 2019). The opinions, conclusion, and recommendations in the following sections were based on the results of our review of available information relating to geotechnical, geologic, and seismic data within the vicinity of the site, project field exploration and laboratory programs, and site-specific engineering analyses.

Hazard evaluations are grouped into five sections, addressing: 1) fault rupture, 2) seismic ground shaking effects (liquefaction, dynamic densification, and lateral spreading, 3) slope stability, 4) compressible soils (settlement of non-engineered fills and young sediments), and 5) other hazards (expansive soils, corrosive soils, volcanic eruptions, flooding and dam inundation, tsunami and seiche, naturally occurring asbestos, and hydrocompaction).

5.1 Fault Rupture Hazard Evaluation

Surface fault rupture occurs when an earthquake results in displacement of the ground surface along the trace of an active fault. Based on existing geologic maps and literature, there are no known active fault traces within, adjacent to, or trending towards the project site. The closest known active fault is the Hayward Fault, located approximately 3.6 miles (5.8 kilometers) to the northeast. The site is not located within a Fault-Rupture Hazard Zone, as shown on the Earthquake Fault Zone Map for the Oakland West Quadrangle (CGS, 1982). No other faults are mapped or known to occur near the project site. Based on this information, the potential for surface fault rupture at the site is very low.

5.2 Seismic Ground Shaking Effects

Strong ground shaking at the project site is anticipated during a moderate to severe earthquake occurring anywhere in the Bay Area. Strong ground shaking can cause direct damage to structures; and has the potential of inducing other phenomena that can cause indirect damage to structures. These phenomena include soil liquefaction, dynamic densification of dry soils, lateral spreading, and ground cracking, seismically induced waves, such as tsunamis and seiches, inundation due to dam or embankment failure, and landsliding.

Detailed discussions of liquefaction, dynamic densification and lateral spreading with respect to the site are presented in the subsequent paragraphs of this section. Discussions of landsliding, both static and seismically induced, are presented in Section 5.3, and discussions of tsunami, seiche, and flooding due to dam or embankment failure are presented in Section 5.5.

5.2.1 Liquefaction and Dynamic Densification

Soil liquefaction is a phenomenon primarily associated with saturated cohesionless soil layers. These soils can dramatically lose strength due to increased pore water pressure during cyclic loading, such as imposed by earthquakes. During the loss of strength, the soils acquire mobility sufficient to permit both horizontal and vertical movements. Soils that are most susceptible to liquefaction are clean, loose, uniformly graded, saturated sands that lie close to the ground surface; although, liquefaction can also occur in fine-grained soils, such as low-plasticity silts. In addition, dynamic densification may occur within loose to medium dense, dry sand layers located above groundwater level.

According to Witter et al. (2006) and the Association of Bay Area Governments (ABAG) Resilience Program Liquefaction Susceptibility Map, the site (as shown on **Plate 12**) is located in an area that has been characterized as having a very high liquefaction susceptibility. The Seismic Hazard Zones Map of the Oakland West Quadrangle (CGS, 2003) indicates the site is located within a liquefaction seismic hazard zone (as shown on **Plate 6**), as designated by the State of California.

Our site liquefaction evaluations, which included liquefaction history review and liquefaction triggering and post-liquefaction deformation analyses, are presented in the following sections. In addition, potential for dry sand dynamic densification was also evaluated.

5.2.1.1 Historical Liquefaction in Site Region

According to the seismic hazard zone report of Oakland West Quadrangle (CGS, 2003), several historical liquefaction events had been documented from past earthquakes. Youd and Hoose (1978) compiled observed ground failures caused by earthquake shaking in northern California, including the 1906 San Francisco and 1868 Hayward earthquakes. Following the 1906 earthquake, a 24-inch steel pipe crossing 12th Street at Lake Merritt dam (Site 175 as indicated on **Plate 13**) was reportedly snapped from the settling of the flood gate. The foundation of Lake Merritt dam was also reported as "cracked and broken". Along the west shore of Lake Merritt, the bank had been cracked and broken, and caved off into the lake.

In addition, liquefaction related ground failures caused by earthquake shaking occurred during the 1989 Loma Prieta earthquake throughout the San Francisco Bay Area and are summarized by Tinsley et al. (1998). Ground settlement and several sand boils (Site 43) were observed along Lake Merritt Channel Park and Peralta Park, adjacent to the Laney College campus. The ground settlement resulted in the rupture of 6-, 12-, and 36-inch diameter main pipelines. Lateral spreading apparently occurred on the western bank of Lake Merritt during the 1906 event, but this bank was not distressed during the 1989 earthquake.

It is also our understanding damage to the original Laney College swimming pool, located to the north of Building E, was reported after the 1989 earthquake (Kaldveer, 1991), probably as the result of soil liquefaction. A replacement swimming pool was constructed in mid-1990s.

5.2.1.2 Liquefaction Evaluation Methodology

We performed both CPT- and SPT-based liquefaction triggering and post-liquefaction deformation analyses for the site generally in accordance with the guidelines listed in the CGS Special Publication 117A (2008) and the recommended procedures by Southern California Earthquake Center (SCEC, 1999).

Our analyses were based on a peak ground acceleration from a Maximum Considered Earthquake (MCE) event. A geometric mean MCE peak ground acceleration (PGA_M) of 0.81g (adjusted for a Site Class E soil condition) with a mean earthquake magnitude of Mw 7.0 and a modal magnitude of Mw 7.5 were determined for the site per ASCE 7-16 and seismic hazard deaggregation (USGS 2014 model). Our recommended project design groundwater level, at Elevation of +8 feet, was used in the analyses to assess its impacts on liquefaction and liquefaction induced ground surface damage potential.

For comparison and sensitivity evaluation purposes, both methodologies described by NCEER (2001) and by Boulanger and Idriss (BI, 2014) were used for CPT-based analyses. Post-liquefaction deformations were calculated for all layers by using Ishihara and Yoshimine procedures (1992) for NCEER method and EERI Monograph 12 procedures (Idriss & Boulanger, 2008) for BI 2014 Method. Sensitivity analysis was performed with changing earthquake Magnitude to Mw 7.6. Sensitivity analyses show the estimated settlements are not sensitive to earthquake Magnitude as the volumetric strain models saturate at the already low Factors of Safety estimated in this study.

The SPT-based analyses generally followed the methodology described in the EERI Monograph 12 (MNO-12, Idriss & Boulanger, 2008). Per CGS Note 48 requirements, post-liquefaction deformations were calculated for soil layers that have a factor of safety against liquefaction less than 1.3.

5.2.1.3 Liquefaction Evaluation Results and Conclusions

Our results from both CPT- and SPT-based analyses generally indicate that the saturated, loose to medium dense sand layers of various thicknesses located both above and within the Young Bay Mud layer have a high potential for liquefying when they are subjected to an MCE earthquake event. The majority of these sand layers were encountered in borings and CPTs at the site within depths of about 30 to 40 feet (above Elevation of about -15 feet). The extent of the potentially liquefiable soils, factors of safety against liquefaction triggering, and calculated

liquefaction-induced cumulative ground settlements at each boring and CPT location are presented in **Supplement D**.

We calculated that the MCE earthquake-induced liquefaction in these sand layers would result in residual volumetric strains varying from about 1 to 4 percent and total ground surface settlements (without reduction associated with the depth of occurrence) ranging from as little as 1 inch to up to about 6-1/2 inches. The table below summarizes the calculated liquefaction-induced settlement using the three different methods referenced above for the site boring and CPT locations. It should be noted the actual ground settlements may differ from our estimates due to uncertainties in the current liquefaction triggering and settlement analysis methodology. In addition, it is a generally accepted idea that the contribution of liquefiable soil layers to surface settlement diminishes as the depths of the layers increase.

Table 5.1: CPT- and SPT-Based Liquefaction Analysis Results

Location	Liquefiable Soil Elevation (ft)	Calculated Cumulative Ground Settlement (inches)		
		MNO-12 SPT Method	NCEER 2001 CPT Method	BI 2014 CPT Method
2019-CPT-01	+8 to +1.5 -5 to -7.5	-	3-1/4	3-1/2
2019-CPT-02	+7 to -2.5 -26.5 to -31	-	2-1/2	3
2019-CPT-03	+7 to +3.5 +2 to -14 -37.5 to -39	-	5	6-1/2
2020-CPT-04	+8 to +6 -9 to -13	-	1-1/2	1-3/4
2020-CPT-05	+7 to +5 -12.5 to -14.5 -17 to -19 -24 to -29	-	2-1/4	2-3/4
2020-CPT-06	+8 to +4.5 -0.5 to -3 -38 to -40 -43 to -45.5	-	2	2-3/4
2020-CPT-07	+8 to +7 -33 to -35 -38 to -40.5	-	1	1
2020-CPT-08	+3.5 to 2 -12.5 to -16 -27 to -31	-	2	2-1/4
2002-CPT-2	+7 to +6 -9.5 to -12	-	1	1-1/2
2020-B-01	+7 to +0.5 -13 to -18.5 -31 to -34	3-1/2	-	-
2002-EB-1	-12 to -17 -22 to -27	3-1/4	-	-
2002-EB-2	-	0	-	-
2002-EB-3	-10 to -16 -28 to -33	2-1/2	-	-

Based on our review of available maps and literature, and the results of our site evaluations, it is our opinion, when the site is subjected to a Maximum Considered Earthquake (MCE) event, the likelihood of liquefaction occurring at the site is high.

5.2.2 Dynamic Densification Evaluations

We performed both CPT-based and SPT-based dynamic densification evaluations based on procedures developed by Tokimatsu and Seed (1987) and Robertson and Shao (2010). A geometric mean MCE peak ground acceleration (PGA_M) of 0.81g, a mean earthquake magnitude of 7.0, and the project design groundwater level at Elevation of +8 feet were used in our analyses. The potential dynamic densification settlements of the near-surface unsaturated sandy fills of about 8 to 13 feet in thickness at the site are estimated to be on the order of 1/4 to 1/2 inch after the MCE event. The detailed results of each boring and CPT location are presented in **Supplement E**. It is our opinion that the potential for soil dynamic densification to impact the site is low.

5.2.3 Lateral Spreading

Lateral spreading occurs when soils liquefy during an earthquake event and the liquefied soils, along with the overlying soils, move laterally toward a free face or unconfined space, such as the west bank of the Lake Merritt Channel. Lateral spreading can result in significant horizontal ground displacements.

Our site lateral spreading evaluations generally followed methodology described in the EERI Monograph 12 (MNO-12, Idriss and Boulanger, 2008) to estimate the maximum shear strain of each liquefiable soil layer and calculate the Lateral Displacement Index (LDI) (Zhang et al., 2004) at each CPT and boring location. The detailed results are included in **Supplement D**.

In addition, empirical correlations developed by Youd et al. (2002) were also used to identify the potential soil layers that are prone to trigger ground lateral spreading and to provide estimates for possible ground lateral displacement. According to Youd et al. (2002), saturated cohesionless soil sediments with SPT $N_{1,60}$ -value equal or more than 15 are considered as not likely to have significant displacement during earthquakes smaller than magnitude 8. Our calculated LDIs and order of ground lateral displacements (from soil layers having $N_{1,60}$ -value less than 15) at the site CPT and boring locations are summarized in the table below. It should be noted these values should be considered as an index due to the limitations of the current engineering knowledge and analysis methodology. The Table 5.2 lateral displacement values are for Mw 7.0 earthquake.

Table 5.2: CPT- and SPT-Based LDI and Lateral Displacement Analysis Results

Location	Liquefiable Soil Elevation (ft)	Calculated Lateral Displacement Index - LDI (inches)	Potential Lateral Spreading Triggering Soil Elevation (ft)	Estimated Ground Lateral Displacement (inches)
2019-CPT-01	+8 to +1.5 -5 to -7.5	42	-	0
2019-CPT-02	+7 to -2.5 -26.5 to -31	30 to 33	+7 to -2.5	12 to 24
2019-CPT-03	+7 to +3.5 +2 to -14 -37.5 to -39	56 to 59	+7 to -8	18 to 36
2020-CPT-04	+8 to +6 -9 to -13	18	-	0
2020-CPT-05	+7 to +5 -12.5 to -14.5 -17 to -19 -24 to -29	22 to 24	+7 to -2	12 to 24
2020-CPT-06	+8 to +4.5 -0.5 to -3 -38 to -40 -43 to -45.5	25 to 27	+8 to -5	12 to 30
2020-CPT-07	+8 to +7 -33 to -35 -38 to -40.5	10	+8 to -5	12 to 24
2020-CPT-08	+3.5 to 2 -12.5 to -16 -27 to -31	22	-	0
2002-CPT-2	+7 to +6 -9.5 to -12	12	-	0
2020-B-01	+7 to +0.5 -13 to -18.5 -31 to -34	23	+7 to +3.5	6 to 18
2002-EB-1	-12 to -17 -22 to -27	30	-	0
2002-EB-2	-	0	-	0
2002-EB-3	-10 to -16 -28 to -33	23	-	0

Our results generally indicate the loose to medium dense sand layers encountered by CPTs and borings in the area adjacent to the Lake Merritt Channel at Elevations between +8 and -5 feet have a high potential to trigger ground surface lateral spreading during soil liquefaction from an

MCE event. The other onsite liquefiable sand layers are considered as having low potential to trigger ground lateral spreading due to their presence in isolated thin pockets and/or being located at deeper depths in relation to the bottom of the Lake Merritt Channel. Our estimated lateral extent of potential ground lateral spreading/slope instability is shown on **Plate 3**.

5.3 Slope Stability Analysis

The project proposed building is located about 130 to 160 feet away from the edge of the west bank of the channel. Our evaluations are only meant to assess the global stability of the proposed development and the potential lateral extents of ground failures caused by the possible lateral spreading of the channel bank during an MCE event (if it occurs). Detailed stability evaluation of the existing channel west bank is beyond our scope of work, since soil stratigraphy below the bank and channel were extrapolated from data developed for the project area.

The global site slope stability was evaluated using a two-dimensional, limit equilibrium computer program, SLOPE/W (GeoStudio 2016, Ver. 8.16.1.13452), and Spencer analysis method. The recommended analysis procedures by South California Earthquake Center (SCEC, 2002) were generally followed. The representative Cross-Sections A-A', D-D' and E-E' (**Plates 7, 10 and 11**) were used in our analyses to evaluate the following four (4) design loading cases:

- Case 1: Long Term (Static)
- Case 2: Seismic Event Yield Acceleration (Pseudo-static)
- Case 3: Seismic Event $k = 0.15g$ (Pseudo-static); Fixed Slip Surface at Edge of Building
- Case 4: Post-Liquefaction (Static)

Factors of safety against slope stability failures were calculated for the Cases 1, 3, and 4. Pseudo-static yield acceleration (k_y to achieve a factor of safety equals 1.0) was calculated for Case 2.

5.3.1 Subsurface Soil Engineering Properties

Soil engineering properties were developed based on the field exploration and laboratory testing results by Fugro and others, and typical engineering correlations. The table below summarizes the soil properties used in our analyses.

Table 5.3: Soil Engineering Properties Used in Site Slope Stability Analyses

Material	Unit Weight (pcf)	Material Shear Strength	
		Cohesion c' (psf)	Friction Angle ϕ' (degree)
Sandy Fill	120	0	35
Young Bay Mud with Sand Lenses	90	0.35 x Effective Overburden Stress (psf)	0
Interbedded Clays and Sands	130	0	40
Highly Liquefiable Sands	110	0	33
Post-Liquefaction Sands (Residual Strength)	110	100 + 20 x Depth (ft)	-

5.3.2 Slope Stability Analysis Results and Conclusions

The results of our slope stability analyses are presented in the table below. Our interpreted cross-section stratigraphic profiles, soil engineering properties used in the analyses, and the detailed results of the analyses are presented on the computer program printouts in the attached **Supplement F**.

Table 5.4: Slope Stability Analysis Results

Cross-Section	Case 1 Long Term	Case 2 Seismic Event Yield Acceleration	Case 3 Seismic Event $k = 0.15g$; Fixed Slip Surface at Edge of Building	Case 4 Post-Liquefaction
	Factor of Safety	k_y	Factor of Safety	Factor of Safety
A-A'	2.8	0.12	0.9	2.6
D-D'	2.2	0.12	0.9	2.0
E-E'	1.7	0.11	0.9	1.5

The results of our slope stability analyses generally indicate that the factors of safety against slope failures for the Case 1 (Long Term, Static) are 2.8, 2.2, and 1.7, respectively, for Sections A-A', D-D' and E-E', which exceed the generally accepted minimum allowable value of 1.5 for long term conditions.

For the Case 2 (Seismic Event Yield Acceleration, Pseudo-static), the yield accelerations (k_y) are determined to be 0.12g, 0.12g, and 0.11g, respectively, for Sections A-A', D-D', and E-E'. Using the Bray (1998) procedure as recommended by the SCEC publication (2002), we calculated slope displacements on the order of about 15 to 24 inches (38 to 61 centimeters) may occur during an MCE event (with a maximum horizontal acceleration of 0.81g from a mode magnitude 7.5

causative earthquake located at 6.8 kilometers from the site). These calculated displacements exceed the threshold of 6 inches (15 cm) defined by the SCEC publication (2002), which likely distinguishes conditions in which small to moderate displacements are likely from conditions in which large displacements are likely. However, as indicated on the result printouts in **Supplement F**, the most critical slip surfaces along these cross-sections do not daylight within the proposed building location.

In addition, by fixing the slip surface daylight location at the edge of the proposed building location, factors of safety against slope failures for the Case 3 (Seismic Event $k = 0.15g$, Pseudo-Static) are all 0.9 for Sections A-A', D-D' and E-E', which also fail to meet the commonly accepted minimum value of 1.15 for seismic performance (Seed, 1979)³⁴. It should also be noted, due to the low undrained shear strength of Young Bay Mud used in the Case 2 and Case 3 analyses (pseudo-static), the calculated low factors of safety and the estimated large and deep slip surfaces (35 to 45 feet deep below the top of channel bank) may not fully represent the seismic global slope stability at the proposed building location (which is about 130 to 160 feet away from the edge of the channel bank). Seismic slope stability of site is most likely governed by the extent of possible ground lateral spreading during major liquefaction events.

In Case 4 (Post-Liquefaction, Static), post-liquefaction residual shear strength was used for the highly liquefiable sands. The factors of safety against slope failures are 2.6, 2.0, and 1.5, respectively, for Sections A-A', D-D' and E-E', which exceed the generally accepted minimum value of 1.3 for short term conditions after major liquefaction events.

Due to the high degree of uncertainties on site subsurface conditions, seismic characteristics of the triggering earthquake, and analysis methodology, the results of our seismic slope stability and lateral spreading analyses should be considered as an index of site performance during major earthquake events. It is our opinion that the potential for slope instability during an MCE event and/or after major liquefaction event to impact the proposed building location is low to moderate. However, extensive slope failures may occur for the areas immediately adjacent to the Lake Merritt Channel if soil liquefaction and ground lateral spreading do occur at the site region during major earthquake events. Our estimated lateral extent of potential ground lateral spreading/slope instability is shown on **Plate 3**.

5.4 Compressible Soils

The site is blanketed by historical sandy or clayey fills that extend to depths of about 8 to 25 feet (Elevation of about +8 feet to -5 feet). Most of these fills appear to be derived from the historical filling of the natural Lake Merritt outlet channel between 1860s and 1940s, and the later development of the Laney College campus in 1960s. These fills are heterogenous and locally

³⁴ Seed, 1979. *Considerations in the Earthquake-Resistant Design of Earth and Rockfill Dams*, Geotechnique, V. 29 (3), p. 215-263.

contain various amounts of concrete, brick, and wood debris. These historical fills were most likely not compacted to the current acceptable geotechnical engineering standards and are potentially compressible. In addition, we estimated minor cut and fill grading of up to about 2 to 3 feet had been performed at the site during the portable classroom development in 2007 or 2008. The actual details of the previous grading are unknown.

Below the surficial fill layer, Young Bay Mud was encountered to about 30 feet deep (Elevation of about -10 feet) at the northwest side of the proposed building location and about 50 feet deep (Elevation of about -30 feet) at the southeast side of the proposed building location. This 15- to 35-foot-thick layer of slightly over-consolidated to normally consolidated Young Bay Mud is very soft to soft, has a high moisture content and a low shear strength, and is highly compressible. Under additional new loads, such as weights of the new fills and structures, the Young Bay Mud will consolidate while the induced excess pore water pressures are dissipating, which may cause detrimental total and differential settlements to the imposing structures and improvements.

We estimate the primary consolidation settlement due to the historical fills placed prior to 1960s at the site should have been completed. Additional settlements from the recent fill placement during the portable classroom development in 2007 or 2008 may be still ongoing. We recommend any available previous grading and construction records be forwarded to us for further review.

No significant raising of the existing site grade is anticipated for the project. If new fills will be placed to raise the existing grade, we anticipate that additional settlement will occur in the future. Our analyses indicate that for every foot of new fills that will be placed, it would induce an additional ultimate settlement of about 2 to 3 inches over the next 10 to 30 years. This additional settlement will also likely affect the integrity of the existing and/or new utility lines. In addition, this settlement will also cause downdrag forces to the pile-supported structure.

5.5 Other Geologic Hazards

Below we briefly review other geologic hazards identified by the CGS (2019) Note 48 as exceptional geologic hazards or adverse site conditions that do not occur statewide. This section addresses expansive soils, corrosive soils, volcanic eruptions, flooding and dam inundation, tsunamis and seiche, naturally occurring asbestos, and hydrocompaction.

5.5.1 Expansive Soils

The near-surface soils encountered at the site were predominately man-made fills that consist of silty sands and lean clays. The expansion potential of the near-surface soils at this site is considered low to moderate. The potential expansive soil hazard can be further reduced provided our recommendations in the report are followed.

5.5.2 Corrosive Soils

Corrosivity tests, that include redox, pH, chlorides, sulfates, and resistivity were performed by CERCO Analytical, Inc. on two representative onsite near-surface soil samples (from Boring 2019-CPT-01 at about 2-1/2 feet and 2019-CPT-03 at about 4 feet). The test results and a brief evaluation report prepared by CERCO regarding the onsite soil corrosivity are also included in **Supplement B**. According to the evaluation report, the onsite near-surface soils should be considered as “moderately” and “slightly” corrosive based on resistivity and redox potentials measurements, respectively.

5.5.3 Volcanic Eruption

The hazards of volcanic eruption include impact and inundation by lava flows, volcanic mudflows, or pyroclastic flows, and the effects of airborne volcanic ash and gases. No active volcanoes occur in the San Francisco Bay area. The nearest active volcano is the Clear Lake Volcanic Field, located about 90 miles north of the site. Volcanic flows would not extend far enough to affect the site. Airfall ash, which is known to travel great distances, would likely travel eastward based on prevailing winds. Potential hazards associated with volcanic activity in the site region are estimated to be very low (Miller, 1989).

5.5.4 Flooding and Dam Inundation

In this section we provide a brief discussion of flooding and dam inundation hazard based on a review of readily available information. A detailed risk evaluation of flooding and inundation at the site was not performed because the initial screening evaluation did not identify any significant flooding or inundation hazards.

According to the FEMA (2018) flood insurance rate map for Oakland, the project building area is located outside a 100-year flood zone. The site is adjacent to the Lake Merritt Channel, which serves as the outlet for Lake Merritt and whose level is controlled by tide level in the Oakland Inner Harbor and the level of Lake Merritt, which is partially tidal. Tide gates at the 7th Street bridge regulate the water flows into and out of Lake Merritt. The elevation of the site is 18 to 21 ft (NAVD88) and the highest astronomical tide (HAT) in the Oakland Inner Harbor is about 8 feet (NAVD88) (<https://tidesandcurrents.noaa.gov/datums.html?id=9414764>), at least 10 feet lower than the site. Runoff into Lake Merritt from heavy storms could raise the water level in the tidal channel if lake waters were released through the tide gates, but this is not likely to exceed the HAT.

The City of Oakland notes that there are 13 active dams, reservoirs, and clearwells that, in case of failure, would cause flooding in Oakland. These facilities include:

- Central, Claremont, Dingee, Dunsmuir, Estates and 39th Avenue reservoirs, the dams at Lake Chabot and at Upper San Leandro reservoir, and the Upper San Leandro filtration plant no. 1 and no. 2 clearwells (owned by the East Bay Municipal Utility District, EBMUD);
- Lake Temescal dam (owned by the East Bay Regional Park District);
- Lower Edwards and Upper Edwards reservoirs (owned by the Mountain View Cemetery Association); and
- Lower and Upper Edwards reservoirs, owned by the Mountain View Cemetery Association.

However, according to Figure 6.1 of the City of Oakland General Plan Safety Element (2004), the site is not located within any of the dam failure inundation areas of any of these above facilities. Based on this information, the potential for flooding or inundation of the project site by dam failure is judged to be very low.

5.5.5 Tsunami and Seiche

During a major earthquake, strong waves such as tsunamis or seiches may be generated in large bodies of water and may cause damage to structures at or near the shoreline. Tsunamis are large waves generated by displacement of the seafloor by earthquakes, coastal or submarine landslides, or volcanoes. Damaging tsunamis are a potential hazard along the California coast. Most historical California tsunamis were associated with distant earthquakes (such as those in Alaska or Pacific Ocean), not with local earthquakes. However, they may occur, especially along the far northern coast of California where seafloor displacement is associated with major subduction zone earthquakes. Devastating tsunamis have not occurred in historic times in the San Francisco Bay Area.

The existing surface elevations at the project building area are about +18 feet to +21 feet (NAVD 88) and the site is located about 1/4 mile from the Oakland Inner Harbor, bounded by the Alameda Island and the Oakland bay shore. According to the Tsunami Inundation Map for Emergency Planning of the Oakland West Quadrangle (CGS, 2009), the project building area is located adjacent to but outside the mapped boundary of an identified potential tsunami inundation area. It appears the mapped boundary lies approximately at Elevation of +15 feet. In our opinion, the potential inundation hazard by a tsunami at the project building area is low.

A seiche is a wave that occurs in an enclosed basin as a result of displacement in the basin bottom, large landslides into the basin, or periodic oscillation or sloshing of the water in the basin. According to City of Oakland General Plan Safety Element (2004), the nearby by Lake Merritt, with depths greater than 2 to 3 feet only near its center, is likely too shallow to be able to generate devastating seiches. In our opinion the potential for damage due to a seiche is negligible.

5.5.6 Supplement Naturally Occurring Asbestos (NOA)

Inhalation of asbestos fibers may cause cancer. Most commonly, asbestos occurrences are associated with serpentinite and partially serpentinized ultramafic rocks.

Asbestos occurs naturally in certain geologic settings in California. Exposure and disturbance of rock and soil that contains asbestos can result in the release of fibers to the air and consequent exposure to the public. Asbestos most commonly occurs in ultramafic rock that has undergone partial or complete alteration to serpentine rock (proper rock name serpentinite) and often contains chrysotile asbestos. In addition, tremolite, another form of asbestos, can be found associated with ultramafic rock, particularly near faults. Sources of asbestos emissions include:

- Unpaved roads or driveways surfaced with ultramafic rock,
- Construction activities in ultramafic rock deposits or soils, or
- Rock quarrying activities where ultramafic rock is present.

The bedrock underlying the site is estimated to be on the order of 500 feet below the surface. In addition, no serpentinite gravels were reportedly encountered in the previous borings at the site, and no serpentinite outcrops or serpentine derived soils are identified in the hills that drain into Lake Merritt. Therefore, we consider the possibility of NOA at the site to be very low.

5.5.7 Hydrocompaction

Hydrocompaction; also referred to as hydro-collapse, is a process of settlement and resulting volume change that occurs in, low density, fine sand with minor amounts of silt and clay. Near-surface soils above groundwater encountered at the site predominately consist of medium dense silty sands and gravels or medium stiff clays; therefore, the potential for hydrocompaction or hydrocollapse is very low.

6. Discussion and Conclusions

It is our opinion that the project is feasible from a geotechnical and engineering geologic standpoint, provided that the conclusions and recommendations presented in this report are incorporated into the project design and specifications. The principal geotechnical considerations are discussed in the following sections.

6.1 Seismic and Geologic Hazards

The site is in a seismically active region of California. Significant earthquakes in the San Francisco Bay Area have been associated with movements within the fault zones. Earthquakes occurring along faults in the area have the potential to produce strong ground shaking at the site. Structures within the San Francisco Bay Area will experience similar shaking effects during a moderate to strong earthquake. Details discussions regarding the site geologic hazards are presented in **Section 5.0**.

Based on the results of our review and evaluation, geologic hazards at the project site consist of the potential for strong ground shaking, liquefaction, lateral spreading, landsliding, compressible fills and soils, corrosive soils, and expansive soils. Detailed measures to mitigate these geologic hazards are incorporated in our recommendations presented in **Section 7.0**.

However, the potential for surface fault offset, dynamic densification, seismically induced waves, flooding, dam inundation, hydrocompaction, NOA, and volcanic eruption at the project building area appear to be low to negligible.

6.2 Liquefaction, Lateral Spreading, and Slope Instability

As described previously, the results of our site liquefaction evaluations generally indicate the saturated, loose to medium dense sand layers of various thicknesses located both above and within the Young Bay Mud layer have a high potential for liquefying when they are subjected to an MCE earthquake event. The majority of these sand layers were encountered by borings and CPTs at the site within depths of about 30 to 40 feet (above Elevation of about -15 feet). We calculated that the MCE induced liquefaction in these sand layers would result in residual volumetric strains varying from about 1 to 4 percent and total ground surface settlements (without reduction associated with the depth of occurrence) ranging from as little as 1 inch to up to about 6-1/2 inches.

Our lateral spreading analysis results generally indicate the loose to medium dense sand layers encountered by CPTs and borings in the area adjacent to the Lake Merritt Channel at Elevations between +8 and -5 feet have a high potential to trigger ground surface lateral spreading during soil liquefaction from an MCE event. The other onsite liquefiable sand layers are considered as

having low potential to trigger ground lateral spreading due to their presence in isolated thin pockets and/or being located in deeper depths in relation to the bottom of the Lake Merritt Channel.

In addition, it is our opinion the potential for slope instability during an MCE event and/or after major liquefaction event to impact the proposed building location is low to moderate. However, extensive slope failures may occur for the areas immediately adjacent to the Lake Merritt Channel if soil liquefaction and lateral spreading do occur at the site region during major earthquakes.

We recommend the proposed new building be supported on a deep foundation system that provides proper bearing support during the potential soil liquefaction events. The deep foundation should be designed to resist downdrag loads that would be imposed upon the foundations due to soil liquefaction.

In addition, the southeast side of the proposed new building foundation should also include a permanent shoring system, or a ground improvement technique should be used to mitigate the detrimental impacts from the potential lateral spreading and slope instability from the areas immediately adjacent to the Lake Merritt Channel. Our estimated lateral extent of potential ground lateral spreading/slope instability is shown on **Plate 3**.

Based on the proposed building layout, we recommend the permanent shoring system along the southeast side of the proposed building (estimated lateral spreading/slope instability lateral extent) be designed to retain a 12-foot-high column of soils, assuming the loss of adjacent ground support due to slope failure. The small portion of the shoring system located further east of the area of estimated lateral spreading/slope instability should be designed to retain an 18-foot high column of soils. Our recommended lateral pressures for the shoring system designs are shown on **Plates 14** and **15**. Recommendations and specifications for ground improvement technique are presented in **Supplement I and J**.

The site and any new improvements not supported on deep foundations may experience total areal ground surface settlements on the order of about 1 to 4 inches with locally up to about 6-1/2 inches of settlement. In the area immediately adjacent to the channel bank, the ground settlements may be larger than the above estimates if lateral spreading occurs. Underground pipelines (gas lines, sanitary sewers, water services, etc.) should be properly designed to accommodate for the settlement caused by the liquefaction of the underlying supporting soils. Consideration should be given to using flexible pipe connections to mitigate potential damage from the estimated potential liquefaction-induced settlement of 4 inches at locations where the pipes are connected to pile-supported structures.

It should be noted that after a major liquefaction event, phenomena such as sand boils, ground cracking, and differential movement of overlying improvements such as roadways and utilities may be observed and may require repair.

Alternatively, soil liquefaction ground improvement options that involve densification, drainage, reinforcement, mixing, or replacement of the liquefiable soils can be used to mitigate the site liquefaction, lateral spreading, and slope instability potentials. If needed, we can provide additional recommendations during project design, once the building and development layouts are finalized.

6.3 Compressible Soils

As described previously, the site is blanketed by sandy or clayey fills that extended to depths of about 8 to 25 feet (Elevation of about +8 feet to -5 feet). Below the surficial fill layer, Young Bay Mud was encountered to about 30 feet deep (Elevation of about -10 feet) at the northwest side of the proposed building location and about 50 feet deep (Elevation of about -30 feet) at the southeast side of the proposed building location. This 15- to 35-foot layer of slightly over-consolidated to normally consolidated Young Bay Mud is very soft to soft, has high moisture content and low shear strength, and is highly compressible under new additional loads. Besides the areas of the recent fills placed during the portable classroom development in 2007 or 2008, we estimated the site primary consolidation settlement due to the historical fills placed prior to 1960s should have been completed.

In our 2020 report, we recommend the proposed new building be supported on a deep foundation system that extends to a depth of at least 70 feet (or to a pile tip Elevation of -50 feet) to transfer bearing loads to the sand and clay layers below the Young Bay Mud layer. Either precast pre-stressed concrete driven piles or drilled piles, such as Case-in-Drilled-Hole (CIDH) piers and auger cast piles, can be used at the site. We note that 70- to 110-foot long, 14-inch square, precast, pre-stressed concrete driven piles were used to support the existing Art Building (built in 2005) that is also located adjacent to the Lake Merritt Channel and is about 500 feet northeast of the proposed Library Learning Resource Center site. Furthermore, the new Building Efficiency for a Sustainable Tomorrow (BEST) Center built in 2016 also is reportedly supported by 95- to 105-foot long, 14-inch square, precast, pre-stressed concrete driven piles.

The design team has decided to use a DMM ground improvement technique in combination with a shallow foundation for the LLRC building. The details of the design and specifications are presented in **Supplement I and J**.

In addition, to reduce the soil consolidation-induced downdrag forces on the pile foundations, we recommend the proposed project site grading activities, construction of the new surface improvements (such as exterior flatwork), and backfill for deeply buried pipelines (if any) be designed so “zero net load” will be imposed on the underlying Young Bay Mud. A “zero net

load” condition can be achieved by over-excavating the fills (and possibly a portion of the Young Bay Mud if necessary) and backfilling the excavation with lightweight fill materials. Lightweight fills or concrete materials should also be used to backfill deep pipe trenches. The weight combination of new fills, at-grade new improvements, and new lightweight fills and/or concrete materials should not exceed the weight of the soils removed.

Our recommended unit weights of the fills and Young Bay Mud to be used in the “zero net load” analyses are shown in the table below. The site grade prior to the portable classroom development in 2007 or 2008 should be used in the analyses as the base line. We also recommend a groundwater level at Elevation of +8 feet be used in the analysis.

Table 6.1: Recommend Fill and Young Bay Mud Unit Weight

Soil Unit	Elevation	Unit Weight (pcf)
Existing Fill and Soil Above Groundwater	Above +8 Feet	110
Young Bay Mud Below Groundwater	Below +8 Feet	30

Alternatively, lightweight concrete materials such as Elastizell and Geofom can be used as lightweight fills. We note that with the use of these lightweight materials below the ground water level would likely require dewatering of the excavation until sufficient weight from fills and/or structure loads are imposed to prevent potential uplift water pressures from lifting the lightweight fill materials.

6.4 Deep Mixing Method (DMM)

The design team decided to use shallow foundation and ground improvement technique in lieu of deep foundation and retaining wall system to create a more competent bearing layer for the shallow foundation and reduce the ground displacements due to lateral spreading. DMM ground improvement is one of the many techniques that is an in-situ soil treatment in which native soils or fills are mixed and blended with cement or other binders and water. The final mixed soil-binder product has enhanced engineering properties such as increased strength, lower permeability, and reduced compressibility. Two types of DMMs are used in the United States: wet mixing and dry mixing. Wet mixing involves injecting binders in slurry (wet) form to blend with the soil. Primarily single-auger, multi-auger, or cutter-based mixing processes are used with cement-based slurries to create isolated elements, continuous walls or blocks for large-scale foundation improvement, earth retaining systems, hydraulic barriers, and contaminant/fixation systems. Dry mixing uses binders in powder (dry) form that react with the water already present in the soil. Primarily single-auger dry mixing processes are used with lime and lime-cement mixtures to create isolated columns, panels, or blocks for soil stabilization as well as reinforcement of cohesive soils.

Soils best suited to DMM include cohesive soils with high moisture contents and loose, saturated, fine granular soils. DMM has also been used successfully in a wide range of less cohesive soils and fills, but it is typically not feasible in very dense or stiff materials or in ground with obstructions such as cobbles or boulders. The treated soil properties obtained by DMM reflect the characteristics of the native soil, binder characteristics, construction variables, operational parameters, curing time, and loading conditions. The generic term DMM is inclusive of other terms such as deep soil mixing (DSM) and cement deep soil mixing (CDSM). A detailed design and recommendations are presented in DMM Design Recommendations, **Supplement I and J**.

6.5 Preliminary Corrosion Evaluation

Corrosivity tests that include redox, pH, chlorides, sulfates, and resistivity were performed by CERCO Analytical, Inc. in Concord, California, on two representative onsite near-surface soil samples (from Boring 2019-CPT-01 at about 2-1/2 feet and 2019-CPT-03 at about 4 feet). The test results and a brief evaluation report prepared by CERCO regarding the onsite soil corrosivity are also included in **Supplement B**. We recommend these test results and the report be forwarded to the project underground contractors, pipeline designers, and foundation designers and contractors, so that they can design and install corrosion protection measures for buried concrete structures and ferrous metal. We also recommend additional testing be performed if the test results in **Supplement B** are deemed insufficient by the designers of the corrosion protection.

6.6 Construction Considerations

Excavations will be required to construct building foundations and elevator pit (if any), install utilities, and to remove locally weak or unsuitable soils. All excavations that will be deeper than 5 feet and will be entered by workers should be shored or sloped for safety in accordance with Occupational Safety and Health Administration (OSHA) standards.

If earthwork is performed during the dry season, moisture conditioning will be required to raise the onsite soil moisture contents to the engineered fill placement and compaction recommendation presented in this report. If earthwork is performed during or shortly after wet weather conditions, the moisture content of the soils could be appreciably above optimum. Consequently, subgrade preparation and fill placement may be difficult. Additional recommendations for wet weather construction can be provided at the time of construction, if required.

7. Recommendations

7.1 Seismic Design

The proposed new building should be designed to resist the lateral forces generated by earthquake shaking in accordance with Chapter 16 of the 2019 California Building Code (CBC). This section presents seismic design criteria according to 2019 CBC, which has adopted the seismic hazard assessment procedures provided by ASCE 7-16, Minimum Design Loads for Buildings and Other Structures. Per Section 11.6 of ASCE 7-16, structures of Risk Category I, II, and III (defined in ASCE 7-16 Table 1.5-1) should be designed according to Seismic Design Category "D".

Our liquefaction triggering hazard assessment indicated that the soils at the site are potentially liquefiable. Therefore, according to ASCE 7-16, the site is classified as Site Class F, and site response analyses, as defined in Section 21.1 of ASCE7-16, are required to calculate the design ground motions at the ground surface. Additionally, due to the large ground motion amplitudes expected at the site, ASCE 7-16 also requires the performance of a site-specific seismic hazard assessment according to Section 21.2 of ASCE 7-16. Detailed discussions of these site-specific ground motion analyses are included in **Supplement G**.

Table 7.1 tabulates the spectral ordinates of the recommended site-specific MCE_R and design response spectra per ASCE 7-16 for the ground surface. The corresponding design acceleration parameters S_{MS} , S_{M1} , S_{DS} , S_{D1} , S_S , and S_1 are tabulated in **Table 7.2**. The MCE_R and design response spectra per ASCE 7-16 at the base of the Young Bay Mud layer is provided in **Supplement G**.

Table 7.1: MCE_R and Design Response Spectra per ASCE 7-16 at the Ground Surface, 5% Damping

Period (sec)	Horizontal Spectral Acceleration (g)	
	Site-Specific MCE _R	Design Response Spectrum
0.01 (PGA)	0.584	0.389
0.03	0.639	0.426
0.05	0.694	0.463
0.075	0.763	0.508
0.1	0.831	0.554
0.15	0.969	0.646
0.2	1.11	0.738
0.25	1.24	0.829
0.3	1.38	0.921
0.304	1.39	0.927
0.4	1.39	0.927
0.5	1.39	0.927
0.75	1.39	0.927
1	1.39	0.927
1.5	1.39	0.927
1.52	1.39	0.927
2	1.06	0.704
3	0.827	0.551
4	0.733	0.489
5	0.561	0.374
7.5	0.282	0.188
8	0.264	0.176
10	0.169	0.113

Table 7.2: Design Acceleration Parameters per ASCE 7-16 at the Ground Surface, 5% Damping

Parameter	Value
S _{MS}	1.39 g
S _{M1}	2.93 g
S _{DS}	0.927 g
S _{D1}	1.96 g
S _s	1.74 g
S ₁	0.66 g

7.2 Earthwork

7.2.1 Site Clearing and Preparation

The site should be cleared of all obstructions, including any existing structures and their entire foundation systems, concrete slabs-on grade, existing utilities and pipelines and their associated backfill, designated trees and their associated entire root systems, landscaping, and debris. Concrete/asphalt concrete, baserock, and trench backfill materials can be reused as new fills provided debris is removed and concrete/asphalt concrete are broken up to meet the engineered fill size requirements presented in this report.

Holes resulting from the removal of underground obstructions extending below the proposed finish grade should be cleared and backfilled with engineered fills and compacted to the requirements presented in this report. We recommend backfilling operations for any excavations to remove underground obstructions be performed under observations and testing of the project Geotechnical Engineer. After clearing, areas containing heavy surface vegetation should be stripped to an appropriate depth to remove these materials. We estimate the stripping depth to be about 6 inches. The amount of actual stripping should be determined in the field at the time of construction. Stripped materials should be removed from the site or stockpiled for later use in landscaping, if desired.

7.2.2 Subgrade Preparation

Following the site clearing and preparation, soil subgrades in areas to receive engineered fill, slabs-on-grade, or pavements be scarified to a depth of at least 12 inches, moisture conditioned to approximately 3 percent above optimum water content and compacted to the requirements for engineered fills. Locally weak fills and soils, if encountered, should also be excavated and replaced, or otherwise stabilized as recommended by the project Geotechnical Engineer at the time of earthwork operations.

The prepared subgrade surface should be firm, unyielding, and kept moist during construction. The subgrades should be protected from damage caused by weather and construction traffic. If the subgrades are left exposed to weather for extended periods of time or are disturbed by construction traffic, the project Geotechnical Engineer should be consulted on the need for subgrade moisture reconditioning and/or scarifying and recompacting to eliminate shrinkage cracks and disturbances.

7.2.3 Engineered Fill Materials

Any new fills placed at the site should consist of engineered fills that meet the requirements presented in this report, except for landscaping materials which are placed on level ground. All engineered fills should have an organic content of less than 3 percent by volume and should not

contain rocks or lumps larger than 4 inches in greatest dimension with not more than 15 percent larger than 2.5 inches.

Onsite soils (except for Young Bay Mud) and fills can be used as new fills. Imported fills not used as non-expansive fills should be predominantly granular, have a liquid limit less than 40 percent, and have a plasticity index not exceeding 20. Imported, non-expansive fills should consist of sub-angular to angular particles, have a plasticity index not exceeding 12, and have a significant fine content. All imported fills should not contain environmental contaminants or debris and should be non-corrosive.

7.2.4 Fill Placement and Compaction

Within the upper 5 feet of the finished ground surface, we recommend engineered fills be compacted to at least 90 percent relative compaction, as determined by ASTM D1557. Engineered fills below a depth of 5 feet should be compacted to at least 95 percent relative compaction. The upper 6 inches of subgrade soils beneath pavements should be compacted to at least 95 percent relative compaction. Fill material should be spread and compacted in lifts not exceeding approximately 8 inches in uncompacted thickness.

We recommend engineered fills be moisture conditioned to approximately 3 percent above optimum water content. To achieve satisfactory compaction of fill materials, it may be necessary to adjust the water content at the time of earthwork operations. This may require that water be added to soils that are too dry, or that aeration be performed in any soils that are too wet. To achieve satisfactory compaction of onsite excavated soils from near or below the existing groundwater level will require drying at the time of construction.

7.2.5 Trench Backfill and Pipe Bedding

To prevent imposing additional load to the underlying soils and to reduce potential settlement along deeply buried pipelines, trench backfill materials should be properly selected so that the unit weight of backfill materials is less or equivalent to the unit weight of the removed onsite soil materials (zero net load). Considerations should be given to increasing the hydraulic gradient of gravity flow pipes to account for potential soil differential consolidation settlements below the pipes and also using flexible connections for all pipes.

Pipeline trenches should be backfilled with engineered fills placed in lifts of approximately 8 inches or less in uncompacted thickness. Thicker lifts can be used provided the method of compaction is approved by the project Geotechnical Engineer and the required minimum degree of compaction is achieved. Backfill should be placed by mechanical means only; jetting is not permitted. Onsite soils, and onsite and imported fills when used for trench backfill should be compacted to at least 90 percent relative compaction. Imported sands and aggregate bases when used for trench backfill should be compacted to at least 95 percent relative compaction and sufficient water is added during backfilling operations to prevent the soil from "bulking"

during compaction. The upper 3 feet of trench backfill in foundation, slab, and pavement areas should be entirely compacted to at least 95 percent relative compaction.

Sand or gravel backfilled trench laterals that extend from irrigated landscaped areas, such as lawns or planting strips, toward pavements, exterior slabs, and building foundations, should be plugged with onsite or imported clayey soils, low strength concrete, or sand-cement slurry mixture below the edges of pavements and exterior slabs, and under perimeters of the foundations. The plugs for the trench laterals should be at least 24 inches thick, extend at least 24 inches beyond the trench walls, and extend from the bottom of the trench to the top of the sand or gravel backfills.

Bedding material should consist of Caltrans Class 2 Aggregate Base or Aggregate Base Course (ABC) meeting the requirements of Section 26 of Caltrans Standard Specifications. All bedding material shall have 3/4-inch maximum aggregate size and be free from organic or vegetable matter, lumps, or balls of silt/clay, or any other deleterious matter. ABC material shall conform to the following gradations when tested in accordance with ASTM C136 or California Test 202.

Table 7.3: Aggregate Base Course Gradation Requirements

Sieve Size (Square Openings)	Percentage by Weight Passing Sieves
1 inch Screen	100
3/4 inch Screen	90 to 100
No. 4 Sieve	35 to 60
No. 30 Sieve	10 to 30
No. 200 Sieve	2 to 9

In addition to the above requirements, all material used shall conform to the following quality requirements:

- Resistance (R-Value) with the minimum test results of 78;
- Sand Equivalent with the minimum test result of 22; and
- Durability Index with the minimum test result of 35.

7.2.6 Exterior Flatwork

We recommend exterior slabs, such as sidewalks and patios, be placed directly on the properly prepared subgrades in accordance with the recommendations presented in this report.

Eliminating aggregate base, gravel, or crushed rock base beneath exterior slabs will reduce the potential for landscape irrigation water to seep through the granular materials and cause the underlying soil subgrades to saturate or pipe. Prior to placing concrete, subgrade soils should be

moisture conditioned to increase their moisture content to approximately 3 percent above laboratory optimum moisture (ASTM D-1557).

The expansive clayey soils and fills at the site could be subjected to volume changes during fluctuations in moisture content. As a result of these volume changes, some vertical movement of exterior slabs should be anticipated. This movement could result in damage to the exterior slabs and might require periodic maintenance or replacement. Adequate clearance should be provided between the exterior slabs and building elements that overhang these slabs, such as doors that open outward. We recommend reinforcing exterior slabs with steel bars in lieu of wire mesh. To reduce potential crack formation, considerations should be given to installing of #4 bars spaced at approximately 18 inches on center in both directions. Both score joints and expansion joints can be used to control cracking and allow for expansion and contraction of the concrete slabs.

We recommend appropriate flexible, relatively impermeable fillers be used at all expansion and cold joints. The installation of dowels at all expansion and cold joints will reduce differential slab movements; if used, the dowels should be at least 30 inches long and should be spaced at a maximum lateral spacing of 18 inches. Although exterior slabs that are adequately reinforced will still crack, trip hazards requiring replacement of the slabs will be reduced.

It should be noted, movements or failures of the exterior slabs should be anticipated after major liquefaction events. Repair of the exterior slabs, as well as site regrading, may be needed after the events.

7.2.7 Surface Drainage and Landscaping

We recommend exaggerated positive surface gradients that take into account potential differential ground settlements be provided adjacent to structures and for pavements to direct surface water toward suitable discharge facilities. Roof downspouts and landscaping drainage inlets should be connected to solid pipes that discharge into appropriate facilities. Ponding of surface water must not be allowed adjacent to structure foundations and exterior slabs, adjacent to pavements, at the top or adjacent to retaining walls.

To reduce moisture changes in the soils below and adjacent to structure foundations and exterior slabs, landscaping and irrigation systems should be designed and installed in a uniform and systematic manner as equally as possible on all sides of the foundations and adjacent to exterior slabs. If landscaping plans include trees, they should be planted a minimum distance of one-half the anticipated mature height of the trees from improvements to reduce the adverse effects from the tree roots. We recommend that drought resistant plants and low flow/drip irrigation watering systems be used. All irrigation systems should be regularly maintained and inspected for leakage. Over-watering must be avoided.

For bio-retention swales and basins (if planned), where they are located within 10 feet of infrastructure improvements (such as structure foundations, exterior flatwork, and pavements), we recommend they be lined with a relatively impermeable membrane to reduce water seepage and the potential for damage to other infrastructure improvements (such as foundations, exterior slabs, and pavements). The membrane can consist of a layer of STEGO Wrap 15-mil or equivalent installing below and along the sides of these facilities to direct the collected water into subdrain pipes. The membrane should be lapped and sealed in accordance with the manufacturer's requirements, including sealing joints where pipes penetrate the membrane.

The bio-treatment soil mix materials within swales and basins should be considered as having no lateral load resistant. We recommend the sidewall slopes of the swales and basins not to exceed 2:1 (horizontal to vertical) to reduce potential vertical and lateral movements of surrounding ground surface. In addition, we recommend either improvements (foundations, exterior slabs, and pavements) be setback beyond an imaginary 1:1 (horizontal to vertical) plane projected upward from the bottom edges of the swales and basins or the affected areas of the improvements be supported by deepening foundations or edges. Alternatively, properly designed below-grade enclosure structures can be used to build the swales and basins and to retain surrounding ground and improvements.

7.2.8 Construction During Wet Weather Conditions

If construction proceeds during or shortly after wet weather conditions, the moisture content of the onsite soils could be appreciably above optimum. Consequently, subgrade preparation, placement of onsite soil as structural fill might not be possible. A geotechnical engineer can provide alternative wet weather construction recommendations in the field at the time of construction, if appropriate.

7.3 Building Foundation System

The proposed new building foundation should be designed to provide proper bearing supports during the potential soil liquefaction events. Two foundation system are proposed: 1) deep foundation in combination with a permanent shoring system on the southeast side of the proposed new building foundation and 2) shallow foundation in combination with DMM ground improvement technique to mitigate the detrimental impacts from the potential lateral spreading and slope instability from the areas immediately adjacent to the Lake Merritt Channel. Our estimated lateral extent of potential ground lateral spreading/slope instability is shown on **Plate 3**.

Based on the proposed building layout, we recommend the permanent shoring system along the southeast side of the proposed building (estimated lateral spreading/slope instability lateral extent) be designed to retain a 12-foot-high column of soils, assuming the loss of adjacent ground support due to slope failure. The small portion of the shoring system located to further

east of the estimated lateral spreading/slope instability lateral extent should be designed to retain an 18-foot high column of soils. Our recommended lateral pressures for the shoring system designs are shown on **Plates 14** and **15**.

We recommend the proposed new building be supported on a deep foundation system that extends to a depth of at least 70 feet (or to a pile tip Elevation of -50 feet) to transfer bearing loads to the sand and clay layers below the Young Bay Mud layer. Either precast pre-stressed concrete driven piles or drilled piles, such as Case-in-Drilled-Hole (CIDH) piers and auger cast piles, can be used at the site. The deep foundation should also be used to support any exterior elements that are considered essential parts of the building. Structural slabs should be designed to span between pile foundations. Detailed descriptions of the ground improvement technique are presented in DMM Design and Recommendations, **Supplement I and J**.

The deep foundation should be designed to resist downdrag loads that would be imposed upon the foundations due to soil liquefaction. Consideration should also be given to using flexible pipe connections to mitigate potential damage from the estimated potential liquefaction-induced settlement of 4 inches at locations where the pipes are connected to pile-supported structures.

Structures not supported on deep foundations may experience total areal ground surface settlements on the order of about 1 to 4 inches with locally up to about 6-1/2 inches of settlement. In the area immediately adjacent to the channel bank, the ground settlements may be larger than the above estimates if lateral spreading occurs.

7.3.1 Pile Axial Load Capacity

The new building can be supported by a deep foundation system that develops its load carrying capacity from soil friction/adhesion within the competent sand and clay layers below the Young Bay Mud. Either precast pre-stressed concrete driven piles or drilled piles, such as Case-in-Drilled-Hole (CIDH) piers and auger cast piles, can be used at the site

Piles should be at least 14 inches in square or diameter, extend to a depth of at least 70 feet (or to a pile tip Elevation of -50 feet), and have a center-to-center spacing of at least 3 times the pile dimension. The actual design lengths of the piles should also be determined using an ultimate skin friction of 1,500 psf (pounds per square feet) for the pile section located below the bottom of the Young Bay Mud layer. As indicated on **Plates 7** through **11**, the bottom of the Young Bay Mud layer is located at about 30 feet deep (Elevation of about -10 feet) at the northwest side of the proposed building location and about 50 feet deep (Elevation of about -30 feet) at the southeast side of the proposed building location. The pile section within and above the Young Bay Mud layer should be neglected in design for axial loading. The allowable axial capacity should be calculated by dividing the ultimate axial capacity by the factors of safety provided in

the table below or the project structural design over strength factor (if applicable). Eighty percent (80 percent) of the skin friction value can be used to resist uplift.

Table 7.4: Recommended Factors of Safety for Axial Loading of Pile Foundation

Load Condition	Factor of Safety
Dead Load	3
Dead plus Live Loads	2
Total Loads (including wind or seismic)	1.5

The piles should also be designed to resist downdrag loads that would be imposed upon the foundations due to potential liquefaction of the isolated sand layers above Elevation of about - 15 feet. We recommend an average negative skin friction of 650 psf be included along the upper 35 feet of the pile shaft to account for the potential liquefaction-induced downdrag forces from about 15 feet of fills, and 20 feet of Young Bay Mud with liquefied sand lenses. This value should be subtracted from the ultimate pile axial capacity.

A viscous bituminous coating can be applied on the upper 35 feet of pile shaft to reduce the downdrag loads. A fifty percent (50 percent) reduction is applicable to the above downdrag value when bituminous coating is used.

Static total and differential settlements of the pile supported structure are estimated to be insignificant (i.e., less than 0.5 inch) and within tolerable limits for the proposed structure. Seismic settlement of the pile is estimated to be less than 1 inch assuming the pile is designed to resist the downdrag force only using pile skin friction.

Regardless of the calculated pile lengths to meet axial capacity demands, a minimum of 35 feet of pile embedment is also needed to provide pile "fixity" to resist lateral loading based on the LPILE analysis results.

7.3.2 Pile Lateral Load Capacity

We evaluated pile lateral load capacities using the computer program LPILE (Ensoft, Ver. 2017.11.01) to model subsurface soils as a series of discrete springs with nonlinear behavior. Our analyses assumed a 70-foot long, 14-inch square elastic pile with a design concrete strength of 5,000 pounds per square inch (psi). The estimated flexural rigidity (EI) of the pile was reduced by fifty percent (50 percent) to account for an assumed twenty percent (20 percent) of pile section concrete crack in the direction of lateral loading. Pile axial loads were not included in our analyses.

Four (4) different soil profiles (1, 2, 3A & 3B) along the Cross-Section A-A' (**Plate 7**) were established in our analysis models based on the idealized subsurface soil conditions at the site. The locations of these profiles are shown on **Plate G-1** for reference, included in **Supplement G**.

Both Profiles 1 and 2 have the same soil stratigraphy, besides the thickness of the Young Bay Mud layer. An additional saturated highly liquefiable sand layer was also included in Profiles 3A and 3B between the surficial fill layer and the underlying Young Bay Mud layer. In Profile 3B, this sand layer was assumed to be liquefied during earthquake events. A design groundwater table at an elevation of +8 feet were used for all profiles. The detailed soil stratigraphy and engineering properties used in our analyses are in the tables below.

Table 7.5: Soil Engineering Properties for Profile 1

Depth Below Ground Surface	Soil Layer	Model Used	Effective Unit Weight (pcf)	Material Properties					
				Undrained Cohesion c (psf)		Strain at 50% Stress		Friction Angle ϕ' (degrees)	p-y Modulus, k (pci)
				Top	Bottom	Top	Bottom		
0 to 12 feet	Sandy Fill	Reese (Sand)	120	-	-	-	-	32	90
12 to 30 feet	Young Bay Mud with Sand Lenses	Soft Clay (Matlock)	26	504	668	0.02	0.01	-	-
Below 30 feet	Sand and Clays	Reese (Sand)	66	-	-	-	-	40	125

Table 7.6: Soil Engineering Properties for Profile 2

Depth Below Ground Surface	Soil Layer	Model Used	Effective Unit Weight (pcf)	Material Properties					
				Undrained Cohesion c (psf)		Strain at 50% Stress		Friction Angle ϕ' (degrees)	p-y Modulus, k (pci)
				Top	Bottom	Top	Bottom		
0 to 12 feet	Sandy Fill	Reese (Sand)	120	-	-	-	-	32	90
12 to 43 feet	Young Bay Mud with Sand Lenses	Soft Clay (Matlock)	26	504	786	0.02	0.01	-	-
Below 43 feet	Sand and Clays	Reese (Sand)	66	-	-	-	-	40	125

Table 7.7: Soil Engineering Properties for Profile 3A

Depth Below Ground Surface	Soil Layer	Model Used	Effective Unit Weight (pcf)	Material Properties					
				Undrained Cohesion c (psi)		Strain at 50% Stress		Friction Angle ϕ' (degrees)	p-y Modulus, k (pci)
				Top	Bottom	Top	Bottom		
0 to 7 feet	Sandy Fill	Reese (Sand)	120	-	-	-	-	32	90
7 to 18 feet	Highly Liquefiable Sands	Reese (Sand)	46	-	-	-	-	33	60
18 to 41 feet	Young Bay Mud with Sand Lenses	Soft Clay (Matlock)	26	504	668	0.02	0.01	-	-
Below 41 feet	Sand and Clays	Reese (Sand)	66	-	-	-	-	40	125

Table 7.8: Soil Engineering Properties for Profile 3B

Depth Below Ground Surface	Soil Layer	Model Used	Effective Unit Weight (pcf)	Material Properties					
				Undrained Cohesion c (psi)		Strain at 50% Stress		Friction Angle ϕ' (degrees)	p-y Modulus, k (pci)
				Top	Bottom	Top	Bottom		
0 to 7 feet	Sandy Fill	Reese (Sand)	120	-	-	-	-	32	90
7 to 18 feet	Highly Liquefiable Sands	Liquefied Sand (Rollins)	46	-	-	-	-	-	-
18 to 41 feet	Young Bay Mud with Sand Lenses	Soft Clay (Matlock)	26	504	668	0.02	0.01	-	-
Below 41 feet	Sand and Clays	Reese (Sand)	66	-	-	-	-	40	125

Both free and fixed pile head conditions were examined in our analyses. Our estimated lateral loads for 1/4-inch, 1/2-inch, and 1 inch of lateral displacements at pile heads for each pile head condition and loading case (1 through 6) are presented in the tables for each soil profile. The calculated pile head deflection, bending moment, and shear force versus embedment depth are

presented in **Supplement H**. It should be noted that no factor of safety was applied to the estimated loads or deflections.

Table 7.9: Estimated 70' Long 14" Square Pile Lateral Load Capacities – Profile 1

Loading Case	Pile Head Condition	Pile Head Displacement (in)	Lateral Load at Pile Head (kips)	Maximum Moment in Pile (kip-ft)
1	Free	0.25	9	25
2	Free	0.5	13	44
3	Free	1.0	21	77
4	Fixed	0.25	20	71
5	Fixed	0.5	33	125
6	Fixed	1.0	53	221

Table 7.10: Estimated 70' Long 14" Square Pile Lateral Load Capacities – Profile 2

Loading Case	Pile Head Condition	Pile Head Displacement (in)	Lateral Load at Pile Head (kips)	Maximum Moment in Pile (kip-ft)
1	Free	0.25	9	25
2	Free	0.5	13	44
3	Free	1.0	21	77
4	Fixed	0.25	20	71
5	Fixed	0.5	33	125
6	Fixed	1.0	53	221

Table 7.11: Estimated 70' Long 14" Square Pile Lateral Load Capacities – Profile 3A

Loading Case	Pile Head Condition	Pile Head Displacement (in)	Lateral Load at Pile Head (kips)	Maximum Moment in Pile (kip-ft)
1	Free	0.25	8	25
2	Free	0.5	13	43
3	Free	1.0	21	78
4	Fixed	0.25	20	70
5	Fixed	0.5	33	124
6	Fixed	1.0	53	220

Table 7.12: Estimated 70' Long 14" Square Pile Lateral Load Capacities – Profile 3B

Loading Case	Pile Head Condition	Pile Head Displacement (in)	Lateral Load at Pile Head (kips)	Maximum Moment in Pile (kip-ft)
1	Free	0.25	8	23
2	Free	0.5	12	39
3	Free	1.0	19	67
4	Fixed	0.25	17	58
5	Fixed	0.5	26	94
6	Fixed	1.0	37	146

Where competent subgrade soils exist, a soil passive resistance equal to an equivalent fluid weighing 350 pcf (pounds per cubic foot), which acts against the vertical face of the pile cap and grade beam (assumes a deflection of approximately 1/2 inch), can also be used in conjunction with the above estimated pile shaft lateral load capacities. A higher soil passive resistance equal to an equivalent fluid weighing 450 pcf can be used for the portion of the surficial fills that is properly over-excavated and re-compacted as engineered fills. The upper 12 inches of soils should be neglected in passive resistance design unless they are confined by a pavement or slab. This value can be used without reduction if the pile shaft lateral load capacity is also based on a compatible 1/2 inch pile head displacement. Any portion of the pile cap, grade beam and shaft located above an imaginary 1.5:1 (horizontal to vertical) plane projected upward from the bottom edge of the adjacent utility trenches should be ignored in the passive resistance design.

For closely spaced piles, the shear planes in the soil overlap and the lateral resistance for a pile within the group is less than that of a single pile. We note that the leading piles are generally less impacted by group effects and tend to draw higher loads. To account for the reduction of soil resistance because of group effects, we recommend multiplying the lateral loads by the reduction factors provided in the table below. Reduction factors, or p-multipliers, are a function of center-to-center spacing where D is the pile diameter. P-multipliers should be applied to trailing piles in the direction of loading.

As an example, a 1 by 6 pile row with a center-to-center spacing of 6 diameters and loaded in the direction parallel to the pile row would use a p-multiplier of 1.0 for the lead pile and 0.7 for all trailing piles. The same group loaded perpendicular to the pile row would use a p-multiplier of 1.0 for all piles. Linear interpolation may be used for other pile spacing.

Table 7.13: Reduction Factors for Pier Lateral Load Capacity

Center-to-Center Spacing	p-Multiplier
8D	1.0
6D	0.7
4D	0.4
3D	0.3

7.3.3 Pile Construction

We recommend that the installation or excavation of all piles be performed under the direct observation of the project Geotechnical Engineer to confirm that the piles are founded in suitable materials and constructed in accordance with the recommendations presented herein. All piles should be installed or constructed vertically to their design tip elevations at the specified locations to develop adequate vertical pile capacities.

The pile driving hammer and the methods of handling, picking, and setting the piles should be properly selected by the contractor and reviewed by both the project Structural Engineer and Geotechnical Engineer. It is possible for a very large or very small hammer to cause damage to the pile it is driving. The pile driving criteria should be established by the Contractor in conjunction with the project Geotechnical Engineer by performing a wave equation analysis (WEAP) after selections of type and size of pile and pile hammer have been finalized, and prior to pile installation.

In addition, we recommend an indicator pile program be performed for the project, which consists at least 5 indicator piles and Pile Dynamic Analyzer (PDA) tests. The indicator piles should be performed in close proximity to the exploratory borings and CPTs to determine the lengths for production piles and driving resistance of the piles, as well as to verify the pile

capacities and the anticipated soil profile across the site. The indicator piles should be at least 10 feet longer than the anticipated design length of the production piles. The indicator pile program should be conducted using the same equipment and same installation methods that will be used for installing the production piles. Due to the potential for encountering hard driving within dense sands below the Young Bay Mud layer, we recommend that the moment resisting reinforcement in the indicator piles be deepened 10 to 20 feet in anticipation of possible pile cutoffs.

The project Geotechnical Engineer should observe the driving of all indicator and production piles and in no case should driving be terminated without the approval of the project Geotechnical Engineer. The project Geotechnical Engineer should evaluate the allowable capacity of any piles driven shorter than their anticipated lengths.

We recommend predrilling through the existing fill layer be performed at driven pile locations to avoid obstructions and potential damage to the piles. The pre-drilled holes should have a diameter less than the 3/4 the diagonal width of the piles.

7.3.4 Deep Mixing Method (DMM) Ground Improvement

Several alternatives were considered for mitigating the lateral spread hazard at the planned building site, including installation of a retaining wall and the deep mixing method (DMM) beneath the building footprint. Considering the high seismic demand, presence of shallow liquefiable soils and soft Young Bay Mud, proximity to the Lake Merritt Channel, and constraints from the PG&E easement on the north side of the planned building, it is our experience and opinion that continuous grids of deep mixed shear walls are the most suitable, robust, and cost-effective technique to mitigate the lateral spread hazard at the planned building site. The grids of deep mixed shear walls will provide support for shallow foundation systems for seismic loading and transfer bearing loads deeper to the medium dense to very dense sands and stiff to hard clays, reducing total and differential building settlements. In addition, we recommend using structural slabs to span between DMM deep mixed shear walls, assuming that the untreated soils within the grid walls may still develop post-liquefaction reconsolidation settlements below slabs. The deep mixed shear walls will also affect the composite ground response to horizontal ground motions. This section presents a brief overview of the deep mixing method (DMM), our design approach, DMM design properties, and results of our evaluation process, including results of seismic stability analyses. Seismic design parameters incorporating the composite response of the deep mixed zone are presented in **Supplement I and J**, herein.

7.3.5 Building Ground Interior Slab

The interior ground slab should consist structural slabs that are designed to span between pile foundations. The slab should be underlain by an at least 12 inches of properly compacted engineered fills that extend at least 3 feet beyond the foundation footprints.

If migration of water vapor through interior slab is undesirable, we recommend a vapor retarder and an underlying 4-inch layer of $\frac{3}{4}$ -inch, clean, crushed, uniformly graded gravel/drain rock be placed between the bottom of the slab and the recommended engineered fill layer. The gravel/drain rock layer can be considered as part of the non-expansive engineered fill layer. We recommend the vapor retarder consist of a single layer of Stego Wrap Vapor Barrier 15 mil or equivalent provided the equivalent satisfies the following criteria: a permeance less than 0.01 perms as guided by ACI 302.2R, Class A strength as determined by ASTM E1745, and a thickness of at least 15 mils. Installation of the vapor retarder, including protrusions where pipes or conduit penetrate the membrane, should conform to ASTM E1643 and the manufacturer's requirements. Care must be taken to protect the membrane from tears and punctures during construction. We do not recommend placing sand or gravel over the membrane. The subgrade below the slab should be properly prepared, firm, and non-yielding. All foundation excavations should be kept moist and free of loose soils and standing water prior to concrete placement.

Concrete slabs retain moisture and often take many months to dry; construction water added during the concrete pour further increases the curing time. If the slabs are not allowed to completely cure prior to constructing the super-structure, the concrete slabs will expel water vapor and the vapor will be trapped under impermeable flooring. A proper water/cement ratio should be determined by the foundation designers for the slabs to reduce vapor transmitting if need. We recommend the foundation designer determine if corrosion protection is needed for the foundation concrete and reinforcing steel. The corrosivity test results of onsite soil samples and a brief evaluation report by others are included in **Supplement B**; the foundation designer should determine if additional testing is needed. In addition, the foundation designers should provide recommendations to reduce the potential for differential concrete curing if necessary.

7.4 Retaining Walls

Retaining walls can be supported on spread footing or pile foundations. Fill placed behind walls should conform to the engineered fill materials, and fill placement and compaction recommendations. If heavy compaction equipment is used behind the walls, the walls should be appropriately designed to withstand loads exerted by the heavy equipment and/or temporarily braced.

For retaining walls not to be supported on piles, a "zero net load" approach should be used for the wall design and construction to reduce the soil consolidation settlement below the walls. Detailed descriptions of the approach are provided in **Section 6.3**. It should be noted that walls located within the area of potential ground lateral spreading/slope instability (east of the dashed line) may potentially experience large vertical and lateral movements during major earthquake events.

7.4.1 Lateral Loads

Any walls that retain soils should be designed to resist both lateral earth pressures and any additional lateral loads caused by roadway surcharging, earthquake loading, and hydrostatic pressure if the walls are located below groundwater table. Considerations should be given to applying waterproofing to backside of the wall to reduce water/vapor transmission and efflorescence forming on the front wall face.

We recommend that any undrained unrestrained walls are free to deflect or rotate be designed to resist an equivalent fluid pressure of 85 pounds per cubic foot (pcf). Undrained restrained walls should be designed to resist an equivalent fluid pressure of 100 pcf. This assumes walls with level backfills. Walls with inclined backfill should be designed for an additional equivalent fluid pressure of 1 pound per cubic foot for every 2 degrees of slope inclination. Walls subjected to surcharge loads should be designed for an additional uniform lateral pressure equal to $1/3$ the anticipated surcharge load for unrestrained walls, and $1/2$ the anticipated surcharge load for restrained walls.

If back-drainage is provided behind the walls, we recommend that drained unrestrained walls be designed to resist an equivalent fluid pressure of 50 pounds per cubic foot (pcf). Drained restrained walls should be designed to resist an equivalent fluid pressure of 75 pcf. These recommended drained lateral pressures assume walls are fully-back drained to prevent the build-up of hydrostatic pressures. This can be accomplished by using $1/2$ to $3/4$ inch crushed, uniformly graded gravel entirely wrapped in filter fabric, such as Mirafi 140N or equal (an overlap of at least 12 inches should be provided at all fabric joints). The gravel and fabric should be at least 8 inches wide and extend from the base of the wall to within 12 inches of the finished grade at the top (Caltrans Class 2 permeable material (Section 68) may be used in lieu of gravel and filter fabric). A 4-inch diameter, perforated pipe should be installed at the base and centered within the gravel. The perforated pipe should be connected to a solid collector pipe that transmits the water directly to suitable discharge facilities. If weep holes are used in the wall, the perforated pipe within the gravel is not necessary provided the weep holes are kept free of animals and debris, are located no higher than approximately 6 inches from the lowest adjacent grade and are able to function properly. As an alternative to using gravel, pre-fabricated drainage panels (such as AWD SITEDRAIN Sheet 94 for walls or equal) may be used behind the walls in conjunction with perforated pipe (connected to solid collector pipe), weep holes, or strip drains (such as SITEDRAIN Strip 6000 or equal).

For walls that are higher than 6 feet, we recommend the walls also be designed to resist a uniform lateral pressure of $38H$ pcf for both unrestrained and restrained wall conditions based on the ground acceleration from a design basis earthquake (Seed and Whitman, 1970; Atik and Sitar, 2007), where H is the height of the retaining portion of the walls. This seismic induced earth pressure is in addition to the pressures noted above. Due to the transient nature of the

seismic loading, a factor of safety of at least 1.1 can be used in the design of the walls when they resist seismic lateral loads.

7.4.2 Wall Footing Foundation

Retaining walls can be supported by conventional spreading footings that are designed for “zero net load” and bear on competent onsite fills. Over-excavation and re-compaction of any weak fills below the footings may be required due to the heterogenous nature of the onsite existing fills. The bottom of the footings should be at least 12 inches wide and founded at least 24 inches below lowest adjacent finished grade. Deeper embedment will be required for footings that are located adjacent to or near top of slopes. Portion of the footings located within 10 feet (as measured laterally) of the slope face should be ignored in both vertical and passive resistance design.

Footings located adjacent to other footings or utility trenches should also bear below an imaginary 1.5:1 (horizontal to vertical) plane projected upward from the bottom edge of the adjacent footings or utility trenches. Alternatively, the foundation reinforcing could be increased to span the area defined above assuming no soil support is provided. Our recommended allowable spread footing bearing pressures are provided below. These allowable bearing pressures are net values; therefore, the weight of the footing can be neglected for design purposes.

Table 7.14: Allowable Wall Spread Footing Bearing Pressures

Load Condition	Allowable Bearing Pressure (psf)	Factor of Safety
Dead Load	“Zero Net Load”	-
Dead plus Live Loads	“Zero Net Load”	-
Total Loads (including Wind or Seismic)	3,000	1.5

Resistance to lateral loads can be provided by friction along the base of footings and by passive pressures acting on the sides of footings. An allowable friction coefficient of 0.3 times the dead load (a factor of safety of 1.5) may be used to evaluate the allowable frictional resistance along the bottom of footings. Where the footing is poured neat against competent subgrade soils, a passive pressure equal to an equivalent fluid pressure of 350 pounds per cubic foot (pcf) can be used for lateral load resistance against the sides of footings perpendicular to the direction of loading. The upper 12 inches of soils should be ignored, unless they are confined by pavement or slab. This passive resistance should be considered as an ultimate value (a factor of safety of 1.0) and assumes a deflection of approximately 0.5 inch to fully mobilize the passive resistance.

7.5 Additional Geotechnical Services

Fugro should review geotechnical aspects of the plans and specifications to check for conformance with the intent of our recommendations. We recommend that Fugro be also retained to provide geotechnical services during earthwork operation and foundation installation to observe compliance with the design concepts, specifications, and recommendations presented in this report. Our presence will also allow us to modify design if unanticipated subsurface conditions are encountered.

8. Limitations

The opinions, conclusions, and recommendations presented in this report are based on our reviews of available geologic and geotechnical data, maps, reports, our site subsurface exploration and laboratory testing results, our engineering analysis results, and information provided by others. Our opinions, conclusions, and recommendations are solely professional opinions and were made in accordance with generally accepted local and current geotechnical engineering principles and practices. We make no warranty, either express or implied.

Site exploration and testing characterizes subsurface conditions only at the locations where the explorations or tests are performed and at the time when services were conducted; actual subsurface conditions between explorations or tests may be different than those described in this report. Variations of subsurface conditions from those analyzed or characterized in this report are not uncommon and may become evident during construction. In addition, changes in the condition of the site can occur over time as a result of either natural processes (such as earthquakes, flooding, or changes in ground water levels) or human activity (such as construction adjacent to the site, dumping of fill, or excavating). If changes to the site's surface or subsurface conditions occur since the performance of the field work described in this report, or if differing subsurface conditions are encountered, we should be contacted immediately to evaluate the differing conditions to assess if the opinions, conclusions, and recommendations provided in this report are still applicable or should be amended.

This report has been prepared for the exclusive use of Peralta Community College District and their consultants for specific application to the proposed Laney College Library Learning Resource Center in Oakland, California as described herein. If there are any changes in the nature, design or location of the project, as described in this report, or if any future additions are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the project changes are reviewed by us, and the conclusions and recommendations presented in this report are modified or verified in writing.

Reliance on this report by others must be at their risk unless we are consulted on the use or limitations. We cannot be responsible for the impacts of any changes in geotechnical standards, practices, or regulations subsequent to performance of services without our further consultation. We can neither vouch for the accuracy of information supplied by others, nor accept consequences for use of segregated portions of this report without our prior consultation.

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Base map from ESRI, 2023

Legend



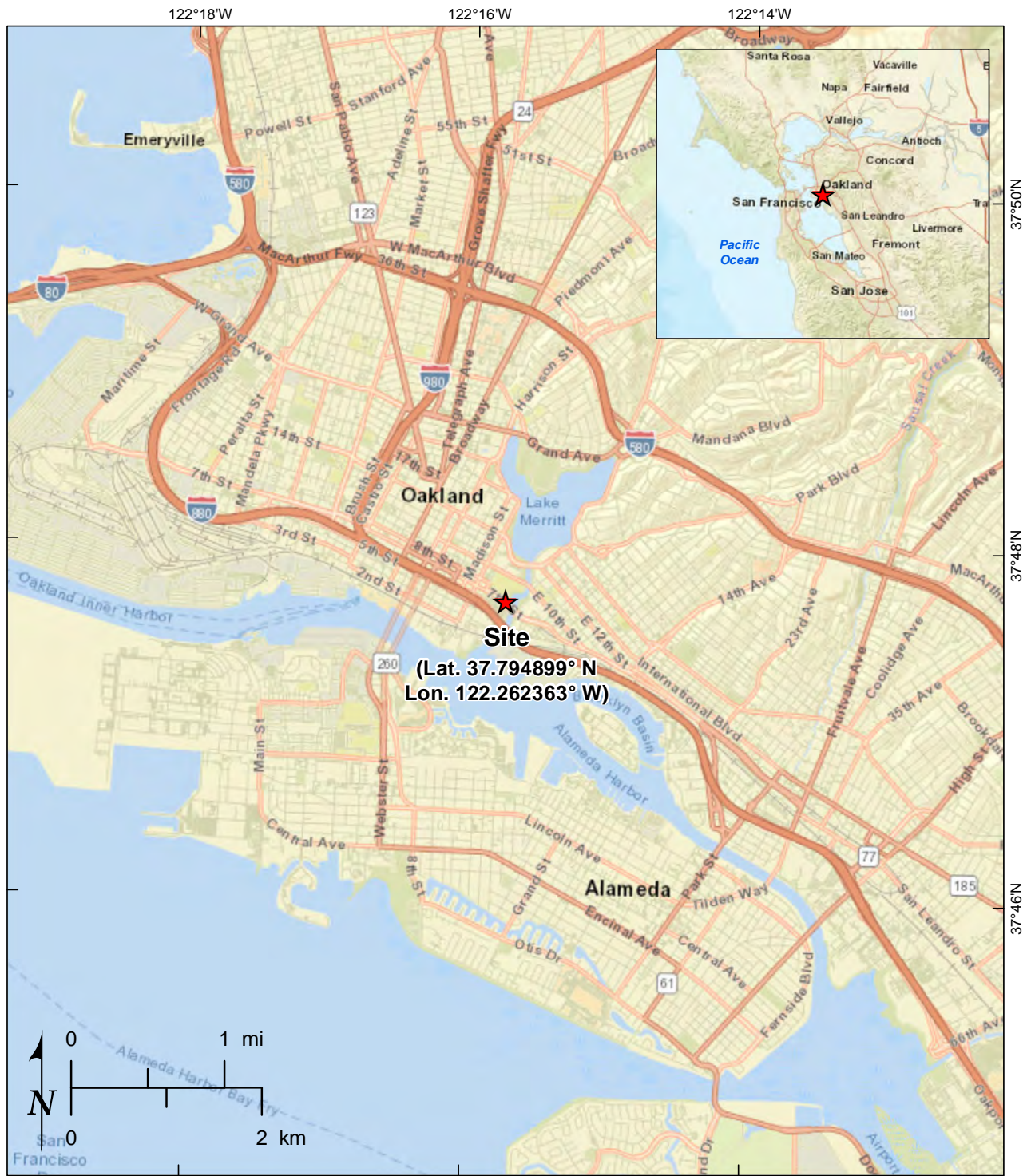
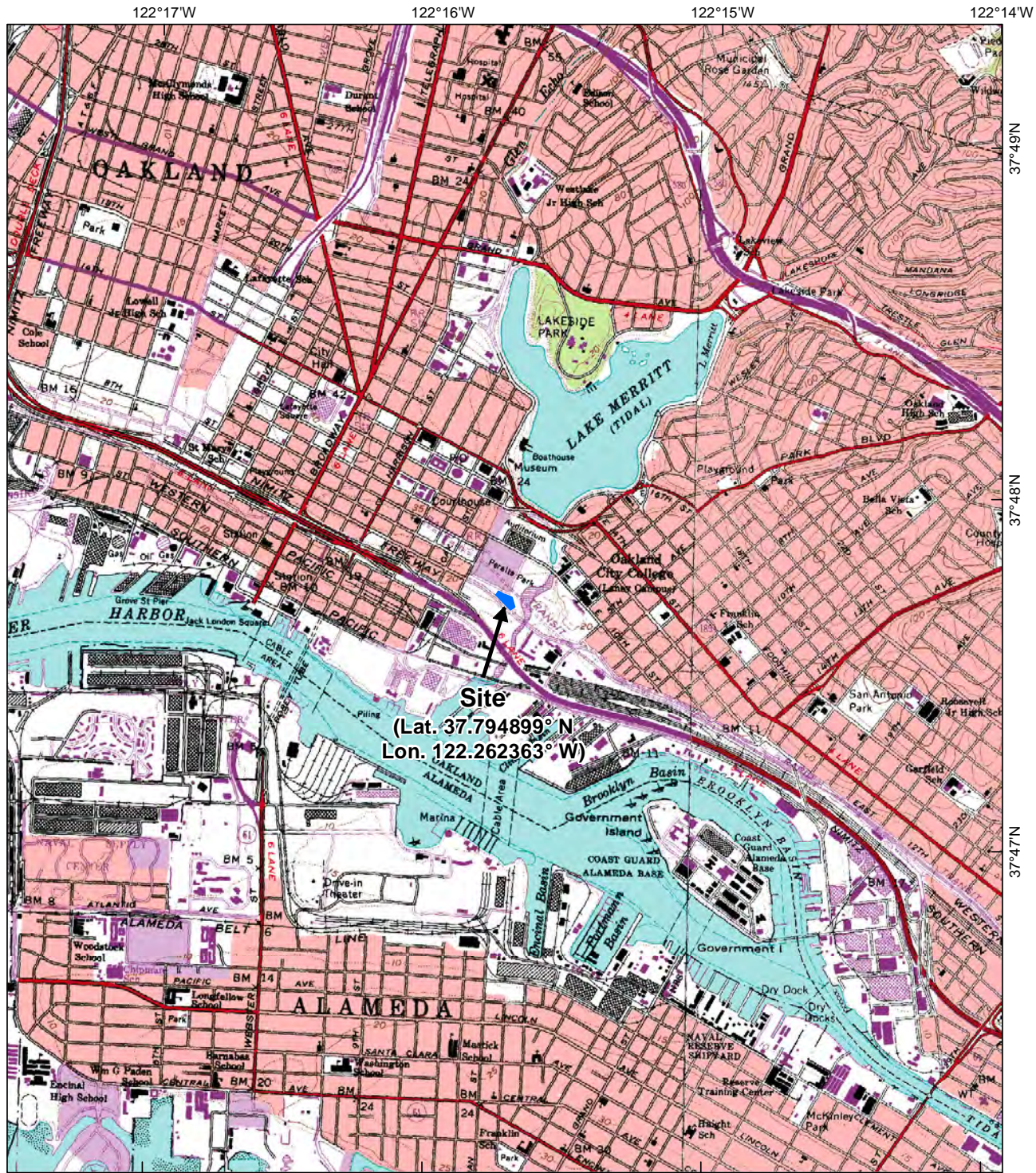
-  Earthquake-induced landslide zone (CGS, 2003)
-  Liquefaction zone (CGS, 2003)

Plate-6: CGS Seismic Hazard Zone Map



Base map from Esri, 2023.

Plate-1: Vicinity Map



Base map USGS Oakland West and Oakland East 1:24,000-scale topographic quadrangles, 1980.

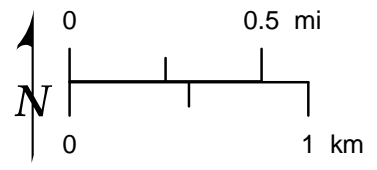
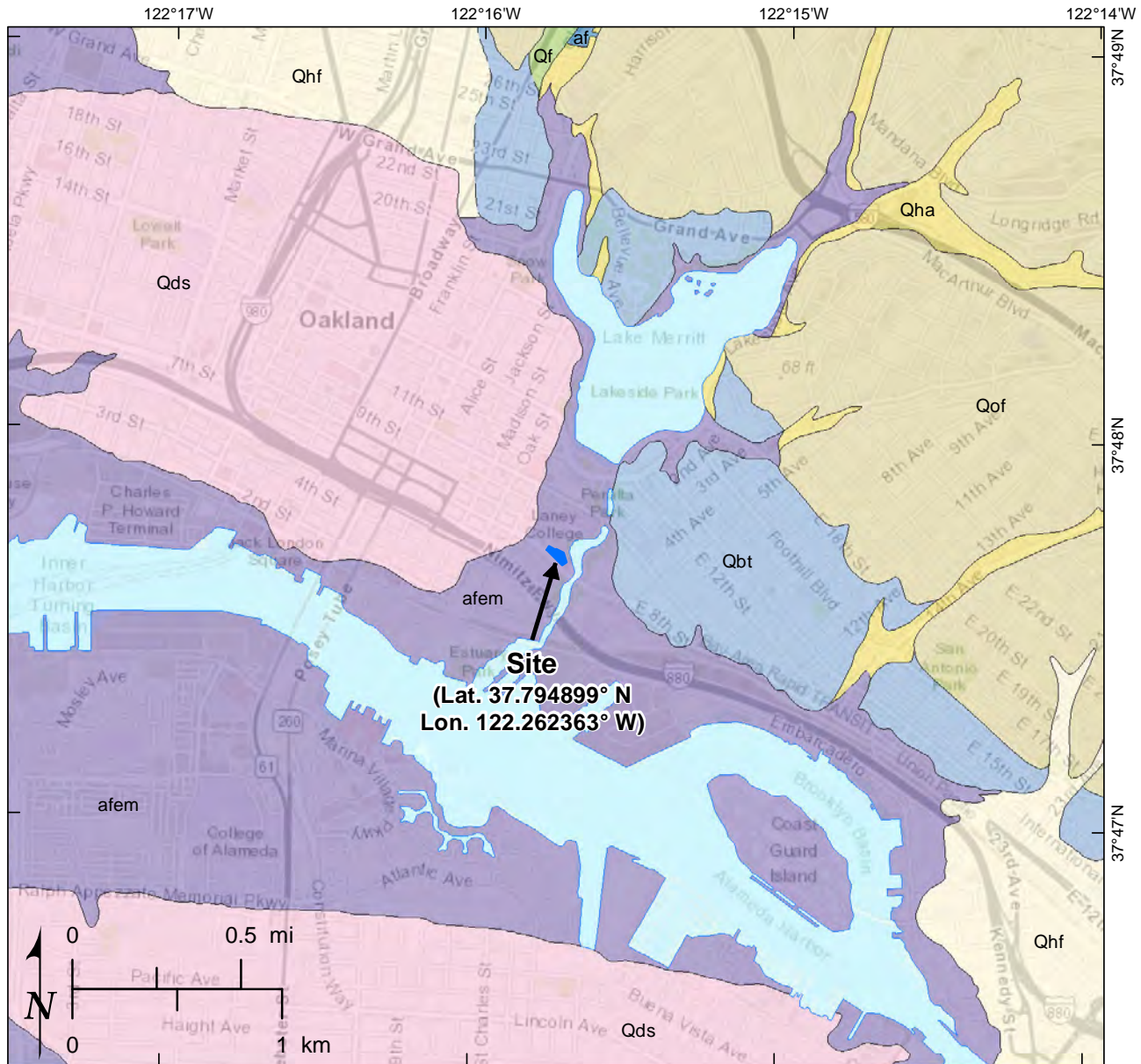


Plate-2: Topographic Site Map



Aerial imagery from Bing Maps. Topo contours provided by CSW/Stuber-Stroeh, April 2019. Proposed building location provided by Noll and Tam Architects, January 2020.

Figure 3: Site Plan



Base map USGS Oakland West and Oakland East 1:24,000-scale topographic quadrangles. Geologic map: Witter et al, 2006.

Legend

HISTORICAL

- af Artificial fill
- afem Artificial fill over estuarine mud

HOLOCENE TO LATEST PLEISTOCENE

- Qds Dune sand
- Qf Alluvial fan deposits

EARLY TO LATE PLEISTOCENE

- Qof Alluvial fan deposits

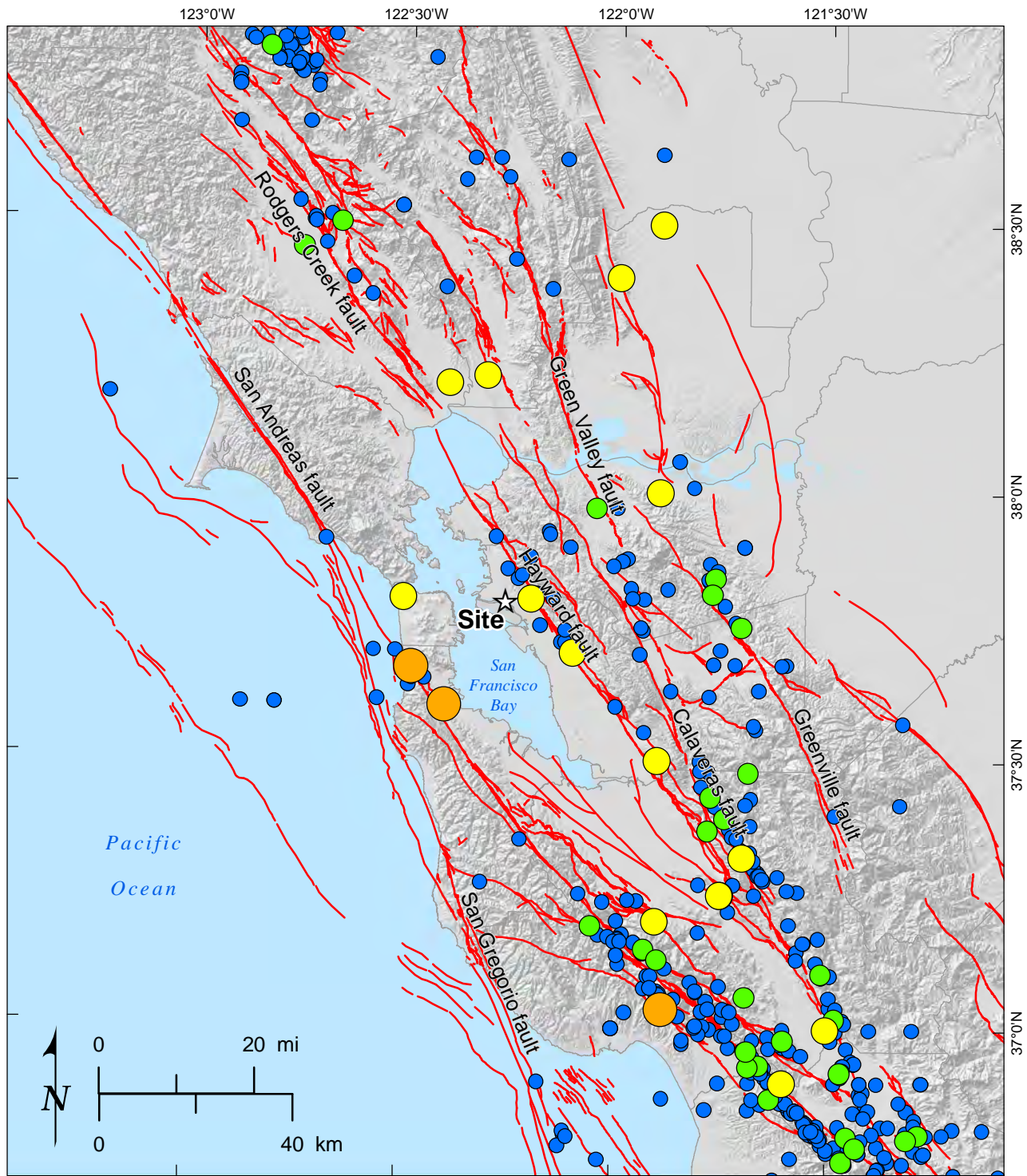
HOLOCENE

- Qhf Alluvial fan deposits
- Qha Alluvial deposits, undifferentiated

PLEISTOCENE

- Qbt Bay terrace deposits

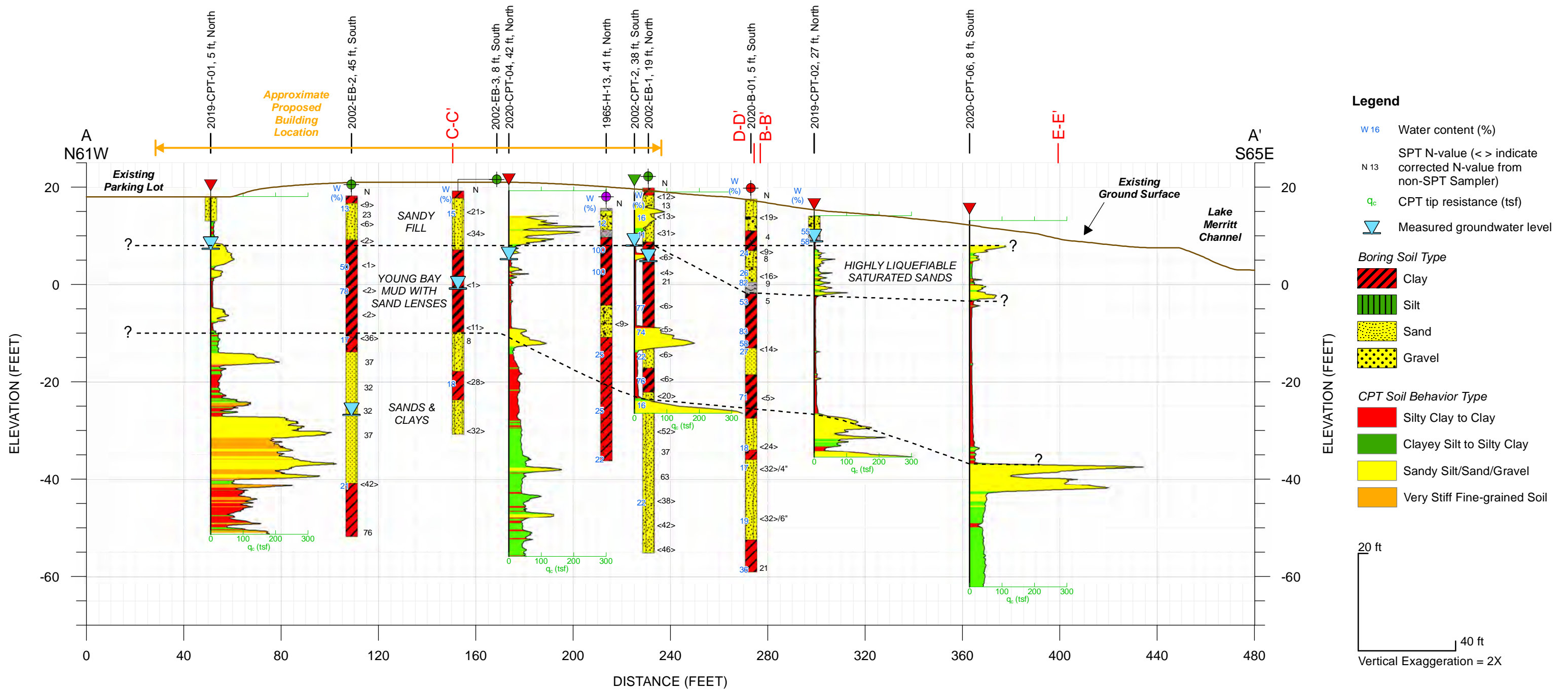
Plate-4: Quaternary Geologic Map



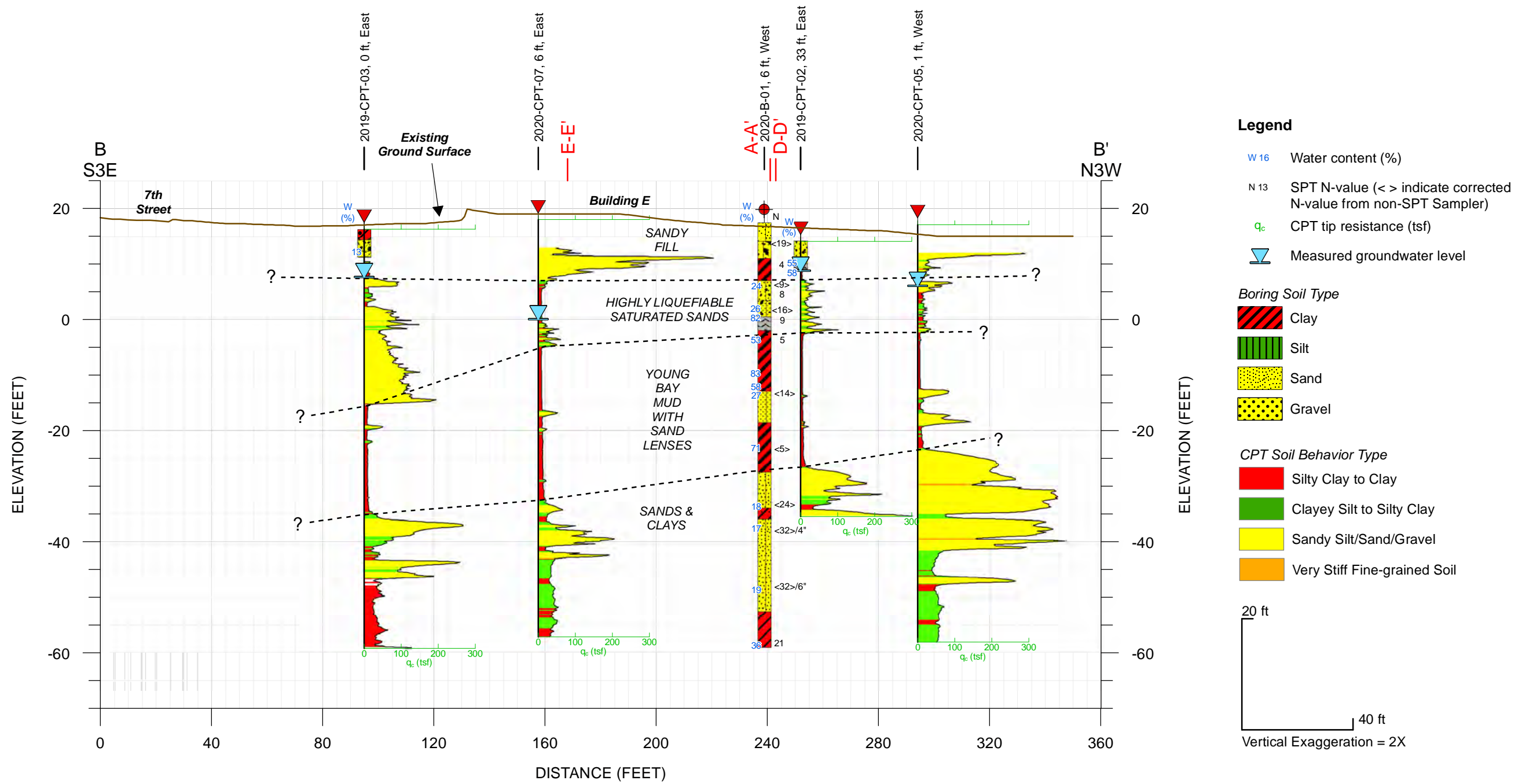
Legend

- | | | |
|---|---|--|
| <ul style="list-style-type: none"> ● 4.0 - 4.9 ● 5.0 - 5.9 ● 6.0 - 6.9 ● ≥ 7.0 | <p><i>Seismicity by Magnitude (1910-2018 Earthquake Catalog from NCEDC and 1568-2009 Significant Earthquake data from USGS)</i></p> | <p>— <i>Faults (USGS, Quaternary Fault and Fold Database, 2017)</i></p> |
|---|---|--|

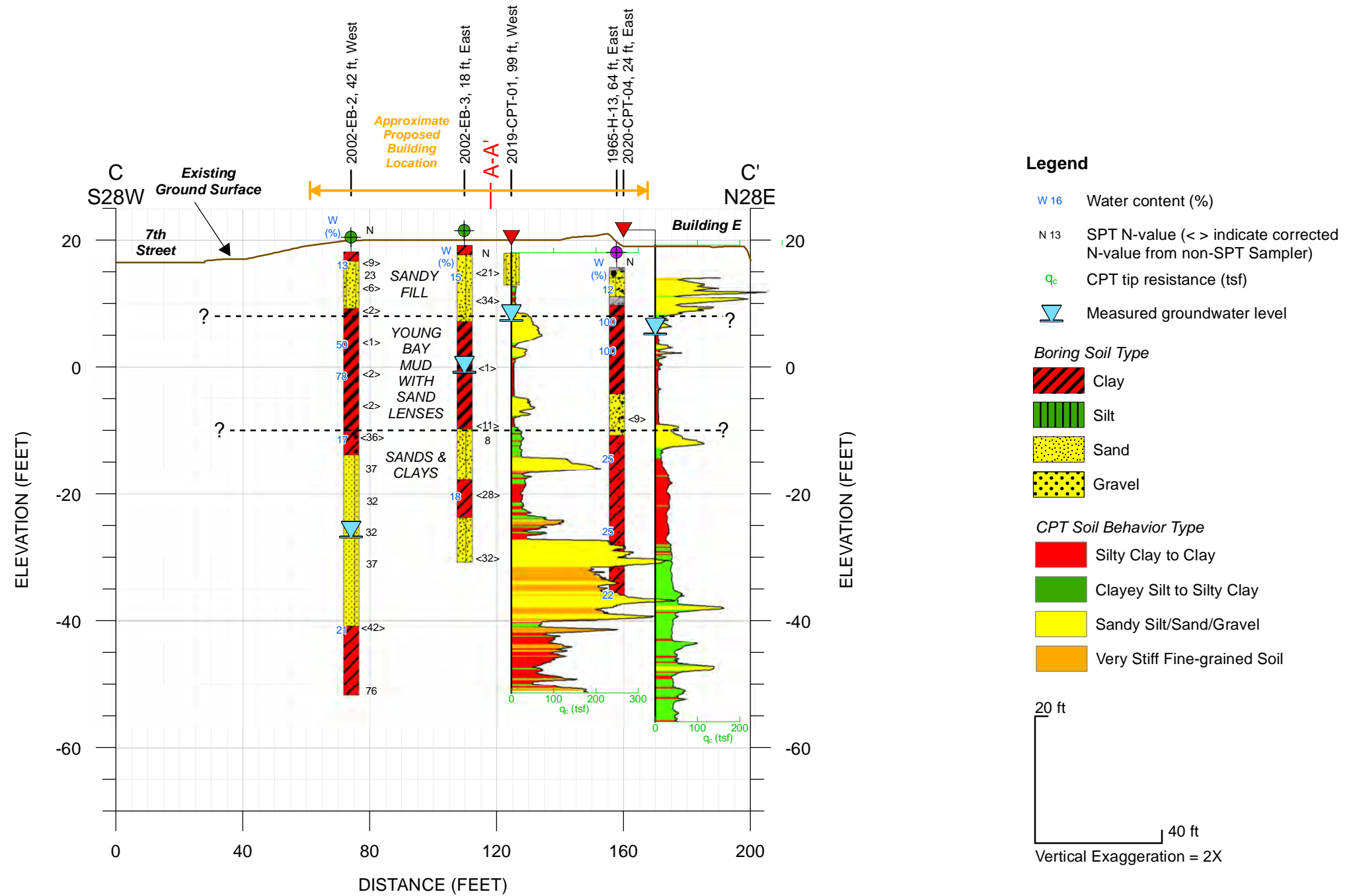
REGIONAL FAULT AND SEISMICITY MAP



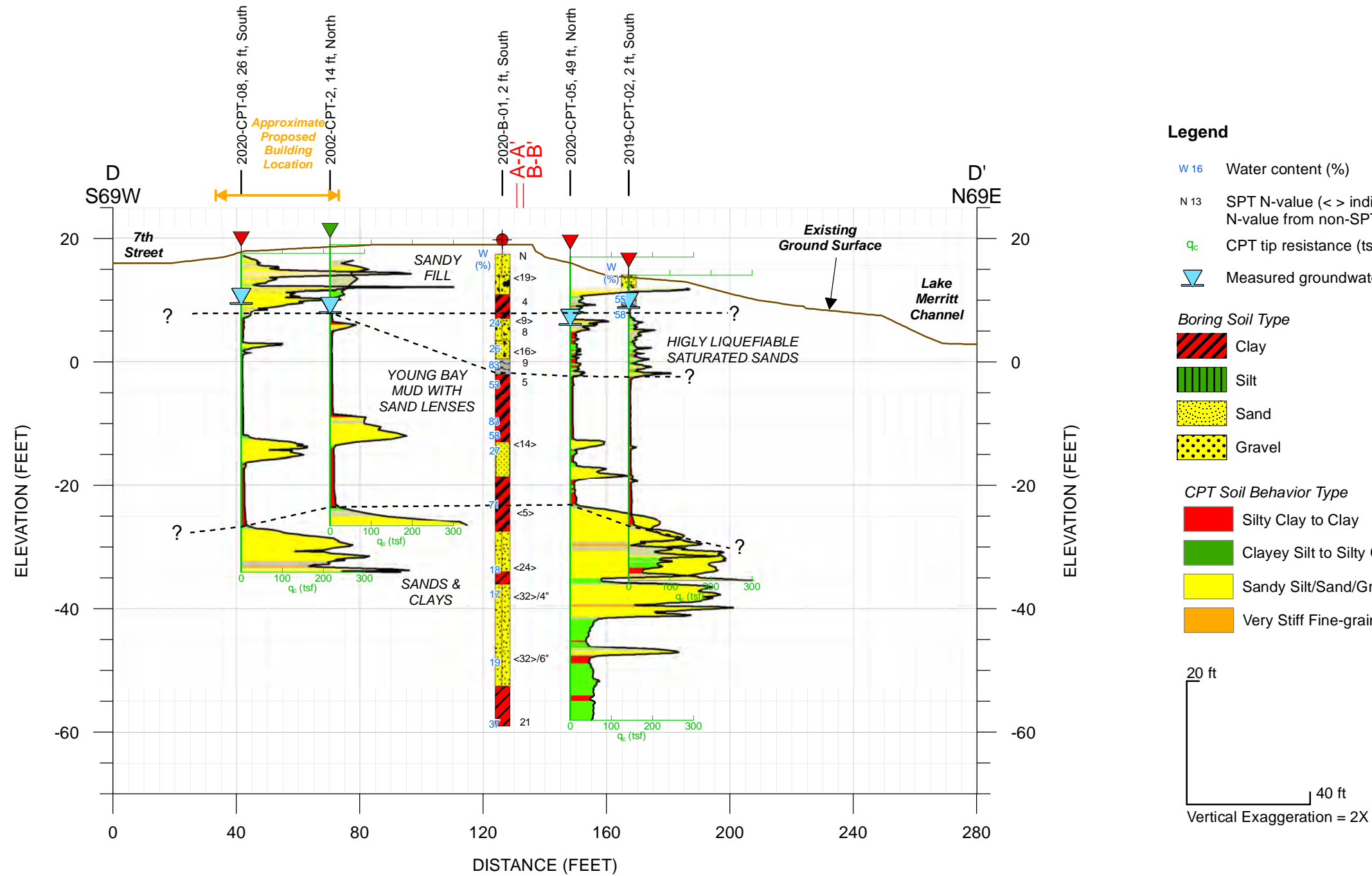
CROSS SECTION A-A'



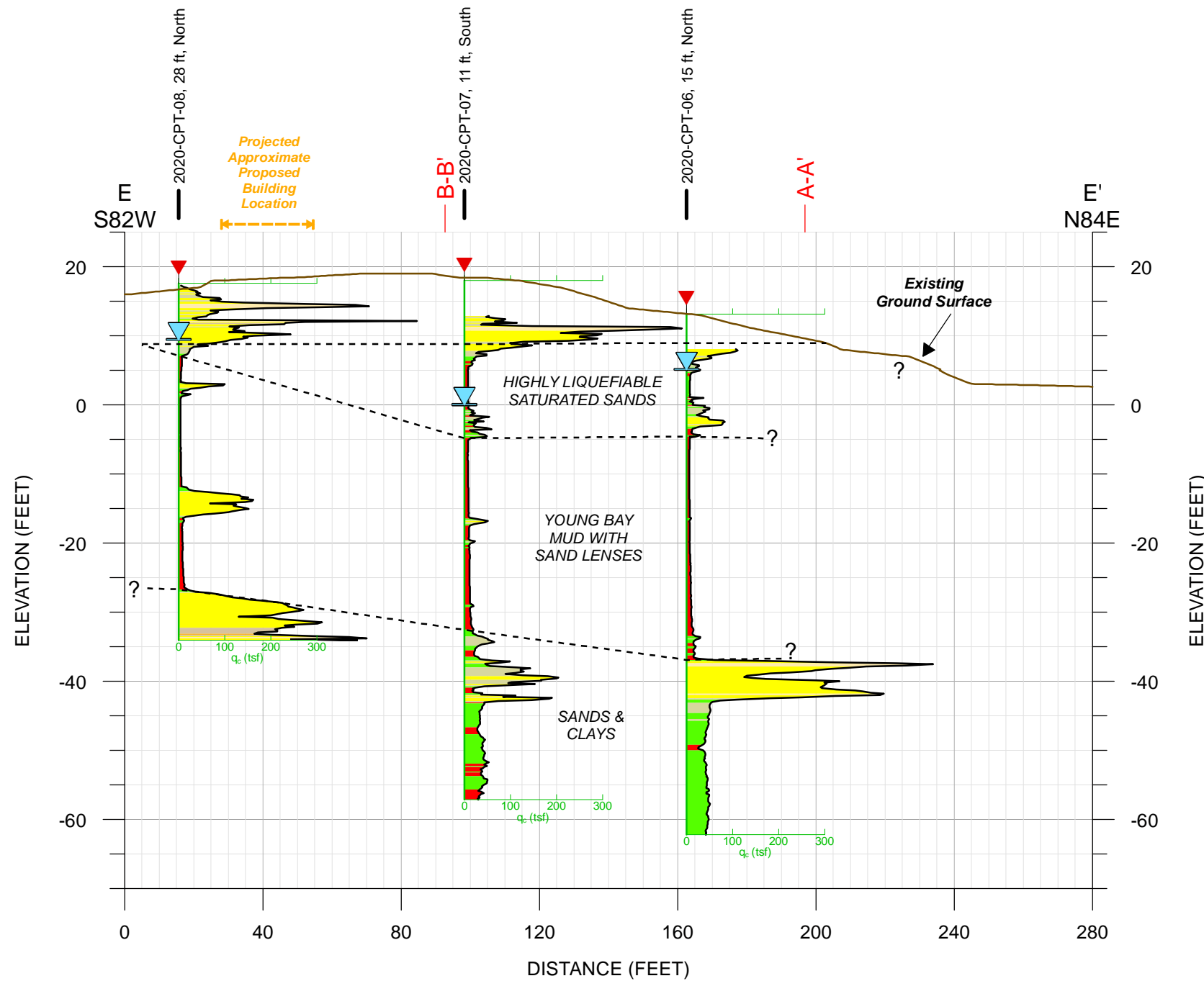
CROSS SECTION B-B'



CROSS SECTION C-C'



CROSS SECTION D-D'



Legend

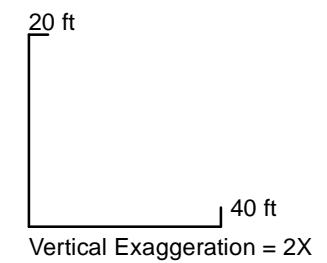
- W_{16} Water content (%)
- N_{13} SPT N-value (< > indicate corrected N-value from non-SPT Sampler)
- q_c CPT tip resistance (tsf)
- Measured groundwater level

Boring Soil Type

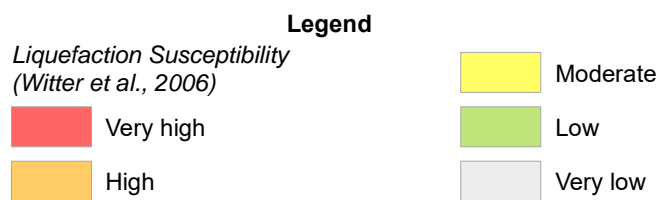
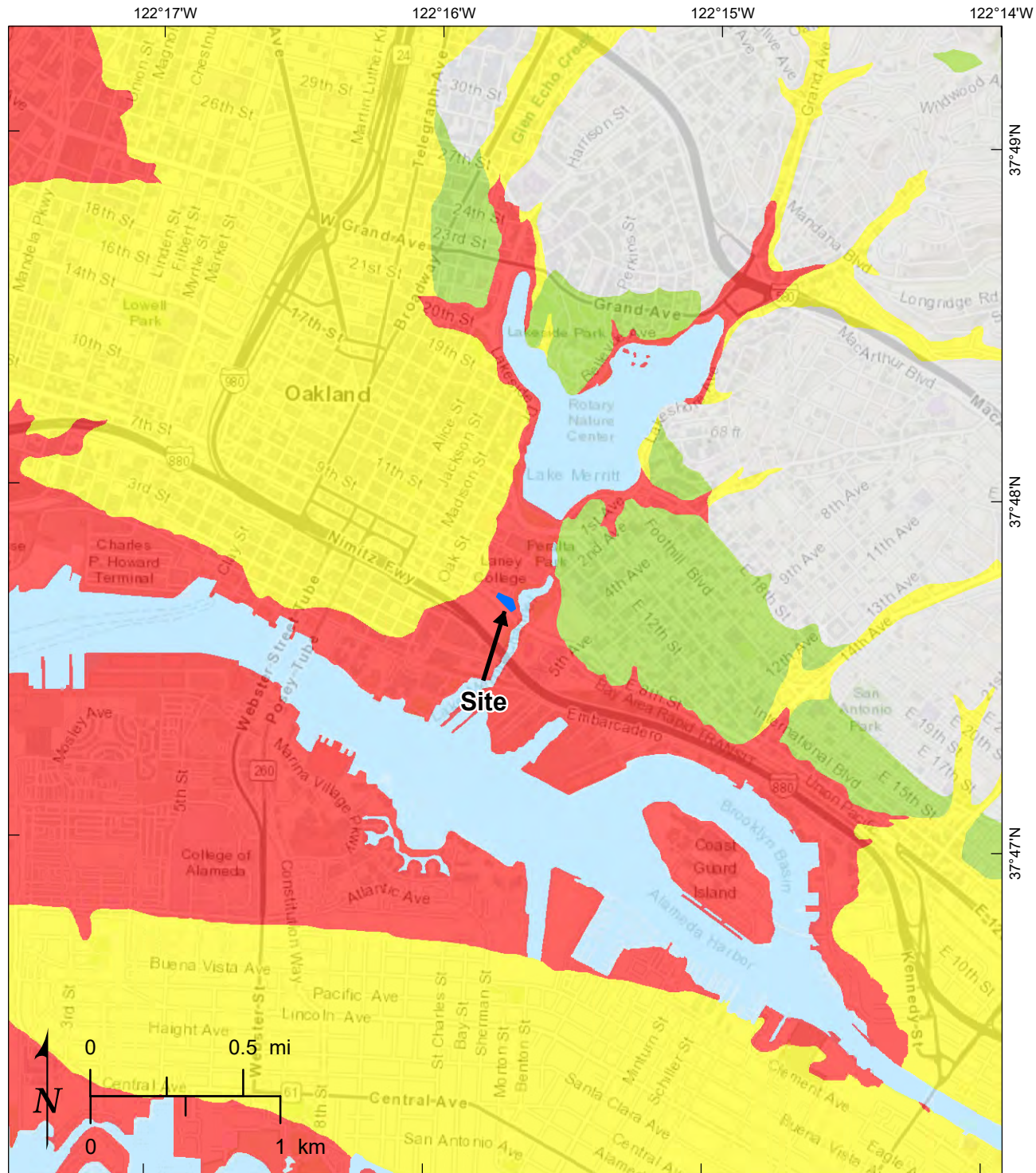
- Clay
- Silt
- Sand
- Gravel

CPT Soil Behavior Type

- Silty Clay to Clay
- Clayey Silt to Silty Clay
- Sandy Silt/Sand/Gravel
- Very Stiff Fine-grained Soil



**PERALTA COMMUNITY COLLEGE DISTRICT
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER
OAKLAND, CALIFORNIA**



LIQUEFACTION SUSCEPTIBILITY

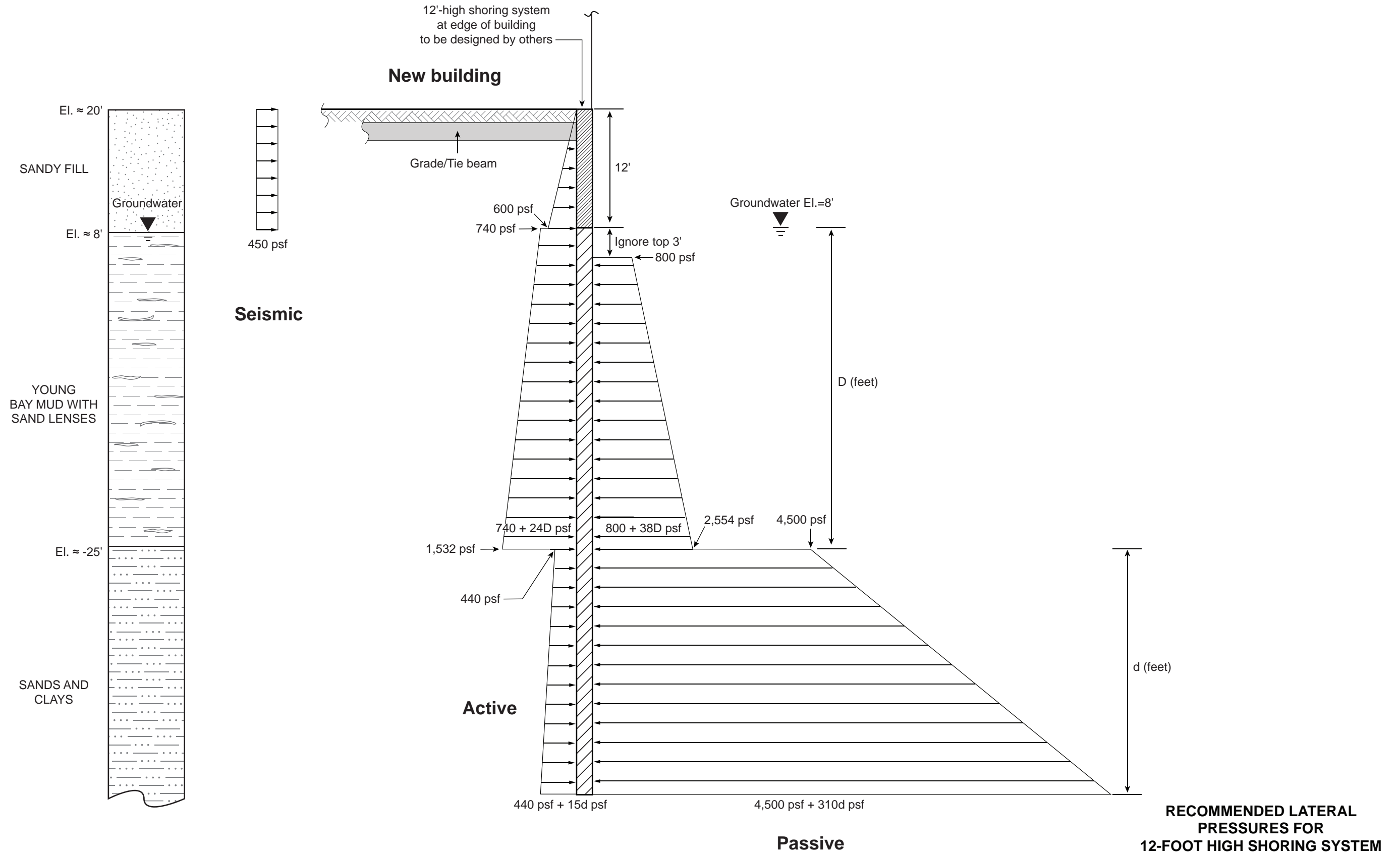


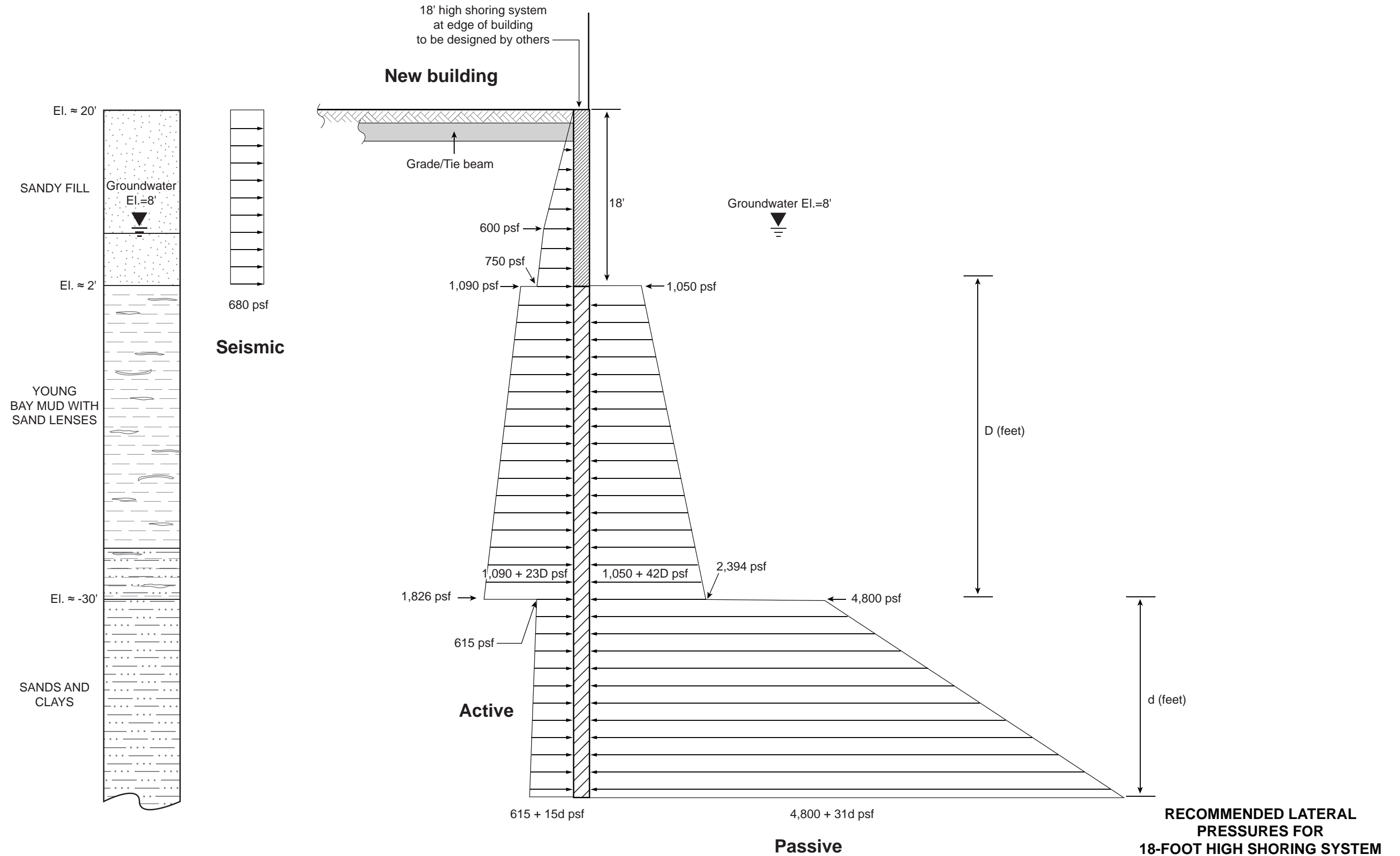
Legend

Historical Ground Failures (Knudsen et al., 2000)

- | | | |
|---|--|--|
| <ul style="list-style-type: none"> ⊠ Miscellaneous effects ✖ Ground settlement ◁ Lateral Spread ○ Sand boil + Pipeline break | <ul style="list-style-type: none"> × Cracks in streets or ground x Location of multiple ground effects (See corresponding symbols) ● Geotechnical borings used in liquefaction evaluation ○ Groundwater level data | <ul style="list-style-type: none"> 174 Number assigned to ground failure site - adapted from Youd and Hoose (1978), Tinsley and others (1998), and by Knudsen and others (2000) —10— Depth to historically high groundwater, in feet |
|---|--|--|

**HISTORICAL LIQUEFACTION SITES
 AND HISTORICALLY HIGH GROUNDWATER TABLE**





Supplement A

Field Explorations

CLASSIFICATION AND MATERIAL SYMBOLS

MAJOR DIVISIONS PER ASTM D2488-06		MAJOR GROUP NAMES AND MATERIAL SYMBOLS	
COARSE-GRAINED SOILS More than 50% retained on the No. 200 sieve	GRAVELS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	Clean gravels less than 5% fines	GW Well-Graded GRAVEL
			GP Poorly Graded GRAVEL
		Gravels with more than 12% fines	GM SILTY GRAVEL
			GC CLAYEY GRAVEL
	SANDS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	Clean sand less than 5% fines	SW Well-Graded SAND
			SP Poorly Graded SAND
		Sands with more than 12% fines	SM SILTY SAND
			SC CLAYEY SAND
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid Limit Less than 50%	ML SILT	
		CL Lean CLAY	
		OL ORGANIC SILT	
	SILTS AND CLAYS Liquid Limit Greater than 50%	MH Elastic SILT	
		CH Fat CLAY	
		OH ORGANIC CLAY	
HIGHLY ORGANIC SOILS	PT Peat or Highly Organic Soils		
Notes: Classification of soils on the boring logs is in general accordance with ASTM D2488, or D2487 if appropriate laboratory data are available. The geologic formation is noted in bold font at the top of interpreted interval on the boring logs.		OTHER MATERIAL SYMBOLS	
		Debris or Mixed Fill	
		Pavement with Aggregate Base	

SAMPLER TYPE

SPT (Driven) 1-3/8" ID 2" OD	Modified California (Driven) 2-3/8" ID 3" OD	Modified California (Driven) 1-7/8" ID 2-1/2" OD
Shelby Tube (Pushed) 2-7/8" ID 3" OD	Pitcher Barrel (Rotary-cut) 2-7/8" ID	Osterberg (Piston) 2-7/8" ID
101 Geobarrel (Rotary-cut) 2-7/8" ID	Rock Core (Rotary-cut) See log for size	Vibracore (Vibrated) See log for size
Push-core (Pushed) See log for size	Collected from Auger	Other See log for details

Note: Refer to text of report for additional details or other sampler types.

BLOW COUNT

Number of blows required to drive sampler each of three 6-in. intervals, as measured in the field (uncorrected). An SPT hammer (140 lb., falling 30-in.) was used unless otherwise noted on the boring log. For example:

Blow Count	Description
5 7 8	5, 7, and 8 blows for first, second, and third interval, respectively.
35 50/3"	35 blows for the first interval. 50 blows for the first 3 inches of the second interval. Lack of third value implies that driving was stopped 3 inches into the second interval.
WOH WOH 5	"WOH" indicates that the weight of the hammer was sufficient to advance the sampler over the first two intervals. 5 blows were required to advance the sampler over the third interval.

N-VALUE

The N-Value represents the blowcount for the last 12 inches of the sample drive if three 6-inch intervals were driven. N-value presented is independent of impact energy. If 50 hammer blows were insufficient to drive through either the second or the third interval, the total number of blows and total length driven are reported (excluding the first interval). "ref" (refusal) indicates that 50 blows were insufficient to drive through the first 6-inch interval.

Parenthesis indicate that an approximate correction has been applied for non-SPT drive samplers. For example, a factor of 0.63 is commonly used to adjust blow counts obtained using a 3-inch outside diameter modified California sampler to correspond to Standard Penetration Test.

UNDRAINED SHEAR STRENGTH

A value of undrained shear strength is reported. The value is followed by a letter code indicating the type of test that was performed, as follows:

- U - Unconfined Compression
- Q - Unconsolidated Undrained Triaxial
- T - Torvane
- P - Pocket Penetrometer
- M - Miniature Vane
- F - Field Vane
- R - R-value

OTHER TESTS

Field or laboratory tests without a dedicated column on the boring log are reported in the Other Tests column. A letter code is used to indicate the type of test. For certain tests, a value representing the test result is also provided. Typical letter codes are as follows. Additional codes may be used. Refer to the report text and the laboratory testing results for additional information.

- k - Permeability (cm/s)
- Consol - Consolidation
- Gs - Specific Gravity
- MA - Particle Size Analysis
- EI - Expansion Index
- OMV - Organic Vapor Meter

WATER LEVEL SYMBOLS

- Initial water level
- Final water level
- Seepage encountered

INCREASING MOISTURE CONTENT



CONSISTENCY OF COHESIVE SOIL

CONSISTENCY	UNDRAINED SHEAR STRENGTH (KIPS PER SQUARE FOOT)
Very Soft	< 0.25
Soft	0.25 to 0.50
Medium Stiff	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	> 4.0

Note: In absence of test data, consistency has been estimated based on manual observation.

APPARENT DENSITY OF COHESIONLESS SOIL

APPARENT DENSITY	N-VALUE
Very Loose	0 to 4
Loose	5 to 9
Medium Dense	10 to 29
Dense	30 to 49
Very Dense	> 49

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	LOCATION:	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S _u ksf	OTHER TESTS
						N 37.795163+/- E 122.262754+/- WGS84 SURFACE EL: 18.0 ft +/- (rel. NAVD88 datum)							
						FILL: 0 TO 6 FEET SILTY SAND (SM): loose to medium dense, light brown, dry, fine-grained, silty							
5						Change color to mottled gray brown , trace coarse-grained, few gravel (fine, subangular to subrounded), few brick fragments and organics NOTES: 1. Terms and symbols defined on Plate A-1.							

BORING DEPTH: 6.0 ft
 BACKFILL: Cement Grout
 DEPTH TO WATER: Not Encountered
 FIELDWORK DATE: March 29, 2019
 DRILLING METHOD: 3-in dia Hand Auger

HAMMER TYPE: N/A
 RIG TYPE: N/A
 DRILLED BY: Fugro
 LOGGED BY: F De Paola
 CHECKED BY: T Chen

LOG OF BORING NO. 2019-CPT-01
 Laney College Library Learning Resource Center
 Oakland, California

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	LOCATION:	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S _u ksf	OTHER TESTS
						N 37.794900+/- E 122.261959+/- WGS84 SURFACE EL: 14.1 ft +/- (rel. NAVD88 datum)							
						FILL: 0 TO 6 FEET SILTY SAND with GRAVEL (SM): medium dense, light gray, dry, fine- to medium-grained, trace coarse-grained, silty, with gravel (fine to coarse, subangular to subrounded)							
						PEAT (PT): very soft to soft, black, dry, with organic odor.		55					
						Fat CLAY (CH): soft, gray, moist, trace sand (fine-grained), trace small shell fragments, few organics, with strong organic odor		58					
						NOTES: 1. Terms and symbols defined on Plate A-1.							

BORING DEPTH: 6.0 ft
 BACKFILL: Cement Grout
 DEPTH TO WATER: Not Encountered
 FIELDWORK DATE: March 29, 2019
 DRILLING METHOD: 3-in dia Hand Auger

HAMMER TYPE: N/A
 RIG TYPE: N/A
 DRILLED BY: Fugro
 LOGGED BY: F De Paola
 CHECKED BY: T Chen

LOG OF BORING NO. 2019-CPT-02
 Laney College Library Learning Resource Center
 Oakland, California

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	LOCATION: N 37.794463+/- E 122.262030+/- WGS84 SURFACE EL: 16.3 ft +/- (rel. NAVD88 datum)	MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S _u ksf	OTHER TESTS
5						FILL: 0 TO 6 FEET Lean CLAY with GRAVEL (CL): soft to medium stiff, mottled gray brown, dry, with gravel (fine to coarse, subangular to rounded), few sand (fine- to coarse-grained) CLAYEY GRAVEL with SAND (GC): loose, mottled gray brown, dry to moist, fine to coarse, subangular to rounded, clayey, with sand (fine- to coarse-grained) CLAYEY SAND (SC): loose to medium dense, dark brown, moist, fine- to coarse-grained, clayey, few gravel (fine, subangular to subrounded) NOTES: 1. Terms and symbols defined on Plate A-1.		13	20					

BORING DEPTH: 5.0 ft
 BACKFILL: Cement Grout
 DEPTH TO WATER: Not Encountered
 FIELDWORK DATE: March 29, 2019
 DRILLING METHOD: 3-in dia Hand Auger

HAMMER TYPE: N/A
 RIG TYPE: N/A
 DRILLED BY: Fugro
 LOGGED BY: F De Paola
 CHECKED BY: T Chen

LOG OF BORING NO. 2019-CPT-03
 Laney College Library Learning Resource Center
 Oakland, California

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	LOCATION:	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S _u ksf	OTHER TESTS
							N 37.794856+/- E 122.262089+/- WGS84 SURFACE EL: 17.5 ft +/- (rel. NAVD88 datum)							
							MATERIAL DESCRIPTION							
							FILL: 0 TO 19.5 FEET SILTY SAND with GRAVEL (SM): loose to medium dense, brown, dry, fine- to medium-grained, trace coarse-grained, silty, with gravel (fine to coarse, angular to subangular)							
							SILTY GRAVEL with SAND (GM): medium dense, mottled gray brown, dry, fine to coarse, angular to subrounded, sandy (fine- to coarse-grained), silty, trace clay with rock fragments up to 2", dry to moist at 5'							
							Fat CLAY with SAND (CH): medium stiff, mottled black green dark gray, dry, with sand (fine- to coarse-grained), trace organics, trace glass fragments, with organic odor							
							SILTY SAND with GRAVEL (SM): medium dense, mottled brown gray, dry, fine- to coarse-grained, silty, with gravel (fine to coarse, angular to subangular), a large brick fragment at 11' with abundant wood chips at 12' to 13', trace glass fragments, moist below 12.5'	91	24	21				MA
							Poorly-graded SAND with SILT and GRAVEL (SP-SM): medium dense, mottled brown gray, moist, fine- to coarse-grained, with silt, with abundant wood chips, with brick and glass fragments, trace clay chunks	95	26	6				MA
							samll rock fragments at 16.5' to 17' ORGANIC CLAY with SAND (OH): soft to medium stiff, mottled brown dark gray, moist, with peat, with sand (fine- to coarse-grained), trace gravel (fine, angular to subangular), few wood chips		82					Organic = 5% Organic = 21.2%
							NATIVE: 19.5 TO 76.5 FEET Fat CLAY (CH): medium stiff, gray, moist, trace wood chips		53					Organic = 6.6%
							very soft to soft, trace wood chips							
							soft to medium stiff, trace sand (fine-grained), trace rootlets, a 2" rock fragment at 30'	69	58	93	73	43	0.5 Q	MA
							Poorly-graded SAND with SILT (SP-SM): medium dense, gray, wet, fine- to medium-grained, with silt, trace small shell fragments	94	27	8				MA
							3" rock fragment at 35'							
							Fat CLAY (CH): soft to medium stiff, gray, moist							

Continued

BORING DEPTH: 76.5 ft
 BACKFILL: Cement Grout
 DEPTH TO WATER: Not Established
 FIELDWORK DATE: January 7, 2020
 DRILLING METHOD: 4-in. dia. Solid Stem Auger/Rotary Wash

HAMMER TYPE: Automatic Trip
 RIG TYPE: CME 75 Track
 DRILLED BY: Geo-Ex
 LOGGED BY: T Chen
 CHECKED BY: A Johan

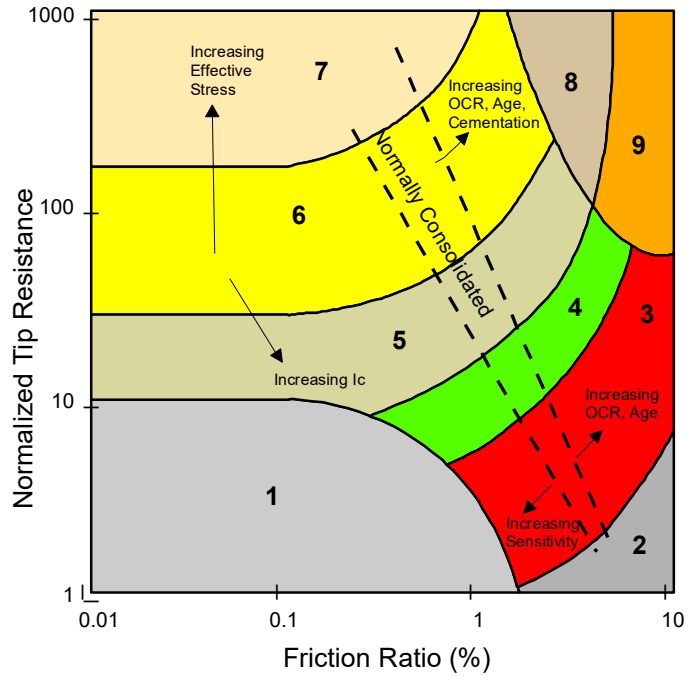
LOG OF BORING NO. 2020-B-01
 Laney College Library Learning Resource Center
 Oakland, California

F:\PROJECTS\LOCATION-72\201904\72190021 LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER\06 FIELD AND LAB\06 BORINGS\01 GINTLANEY COLLEGE - 2020 BORING.GPJ OGEW_LIB_2019_10_31_TC.GLB 2/5/20 02:30 p

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	LOCATION:	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S _u , ksf	OTHER TESTS
							N 37.794856+/- E 122.262089+/- WGS84 SURFACE EL: 17.5 ft +/- (rel. NAVD88 datum)							
							MATERIAL DESCRIPTION							
-25	45		S13	200 psi 650 psi	(5)	18" 18"	medium stiff	59	71				0.7 Q	
-30	50		S14	26 24 14	(24)	18" 18"	SILTY SAND (SM): medium dense to dense, gray, wet, fine- to medium-grained, silty							
-35	55		S15	49 50 1/4"	(32) 4"	10" 10"	SANDY Lean CLAY (CL): very stiff, mottled gray yellowish brown, moist, sandy (fine- to medium-grained)	112	18	16				MA
-40	60		S16	35 50	(32) 6"	12" 12"	SILTY SAND (SM): dense to very dense, gray, wet, fine- to medium-grained, silty, trace shell fragments	116	17	17				MA
-45	65		S17	7 10 11	21	18" 18"	very dense, fine- to medium-grained, with coarse-grained, with silt, few gravel (fine, angular to subangular)							
-50	70		S18				Lean CLAY (CL): very stiff to hard, light brown, moist							
-55	75		S18				NOTES: 1. Terms and symbols defined on Plate A-1.		37					

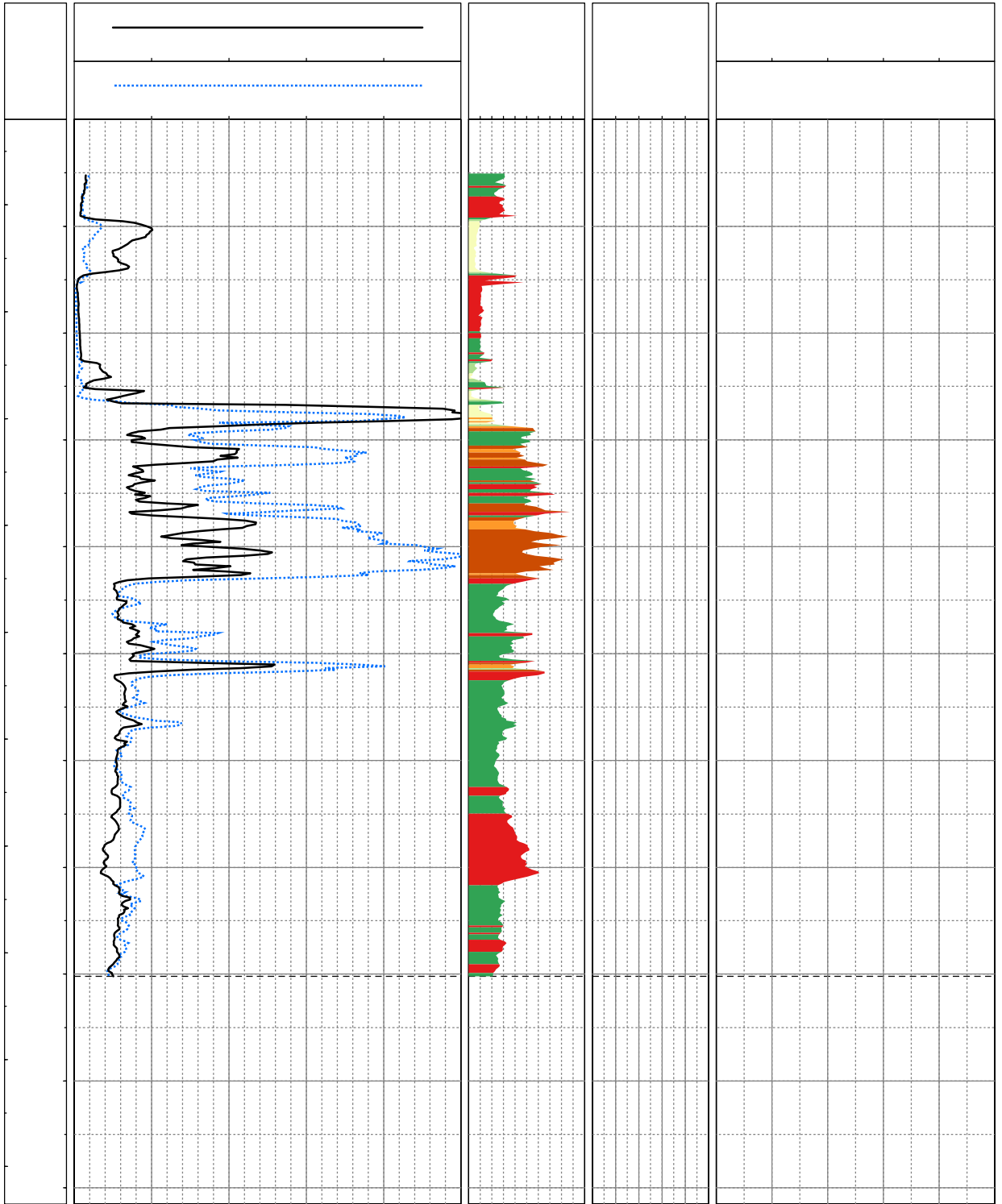
LOG OF BORING NO. 2020-B-01
 Laney College Library Learning Resource Center
 Oakland, California

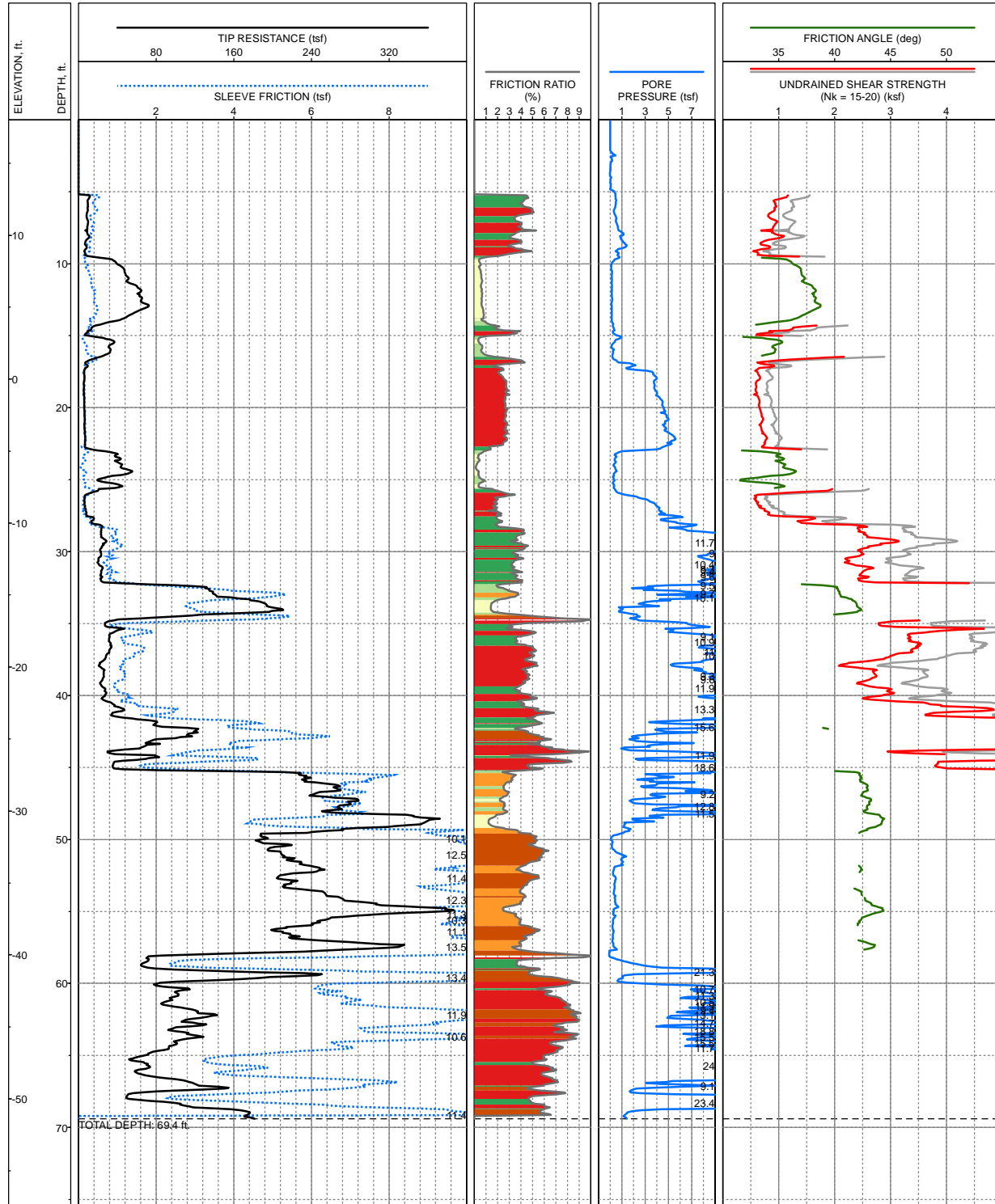
**CPT CORRELATION CHART
(Robertson 1990)**



Zone	Soil Behavior Type
1	Sensitive Fine-grained
2	Organic Soils, Peats
3	Clays - Clay to Silty Clay
4	Silt Mixtures - Clayey Silt to Silty Clay
5	Sand Mixtures - Silty Sand to Sandy Silt
6	Sands - Clean Sand to Silty Sand
7	Gravelly Sand to Sand
8	Very Stiff Sand to Clayey Sand
9	Very Stiff Fine-Grained

Plate A-7: Key to CPT Interpretation



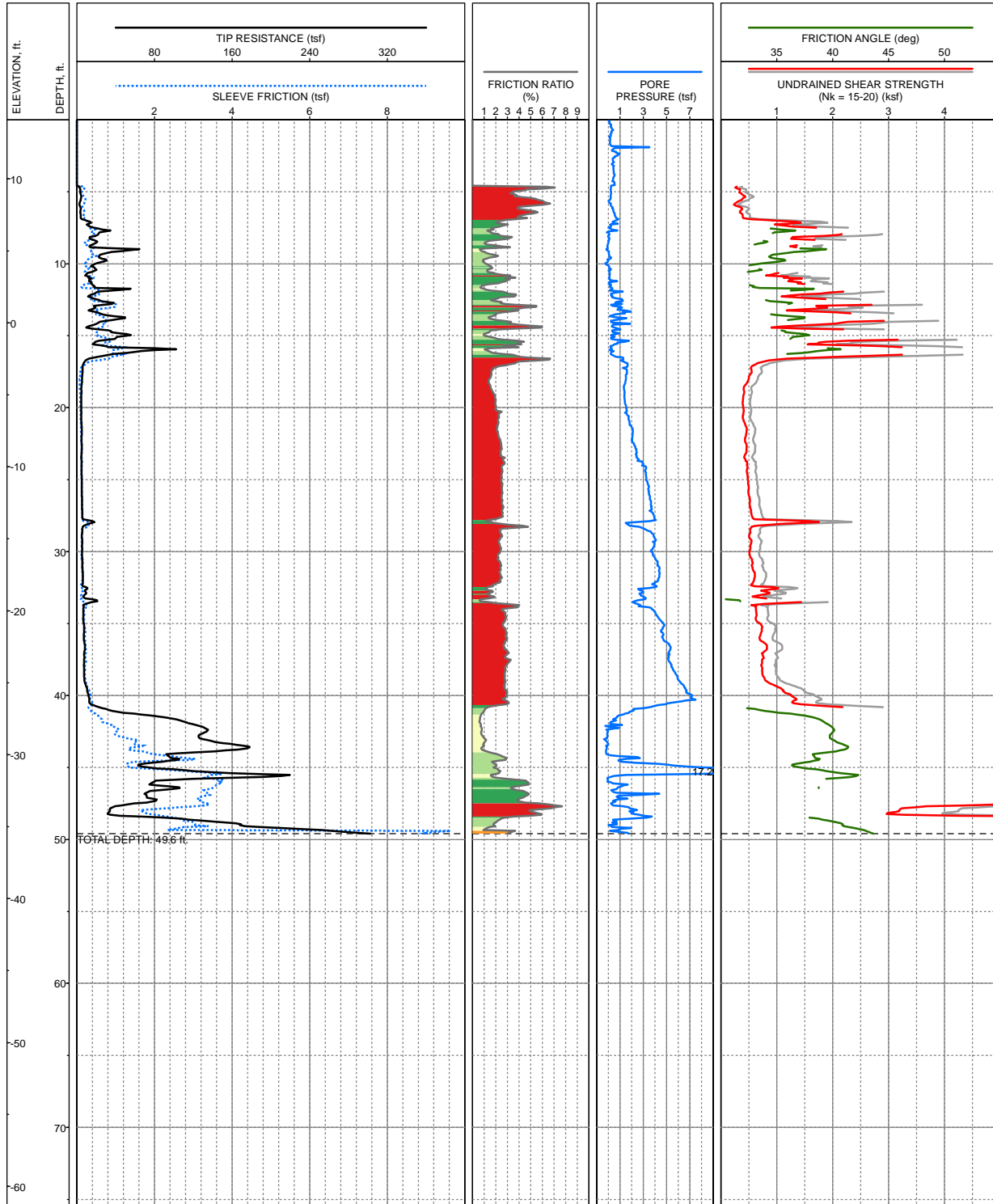


LOCATION: E6,052,365, N2,116,794, NAD83 SP CA Z3 FT
 SURFACE EL: 18ft +/-
 COMPLETION DEPTH: 69.4ft
 TESTDATE: 3/29/2019

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.59

PLATE A-8: LOG OF 2019-CPT-01



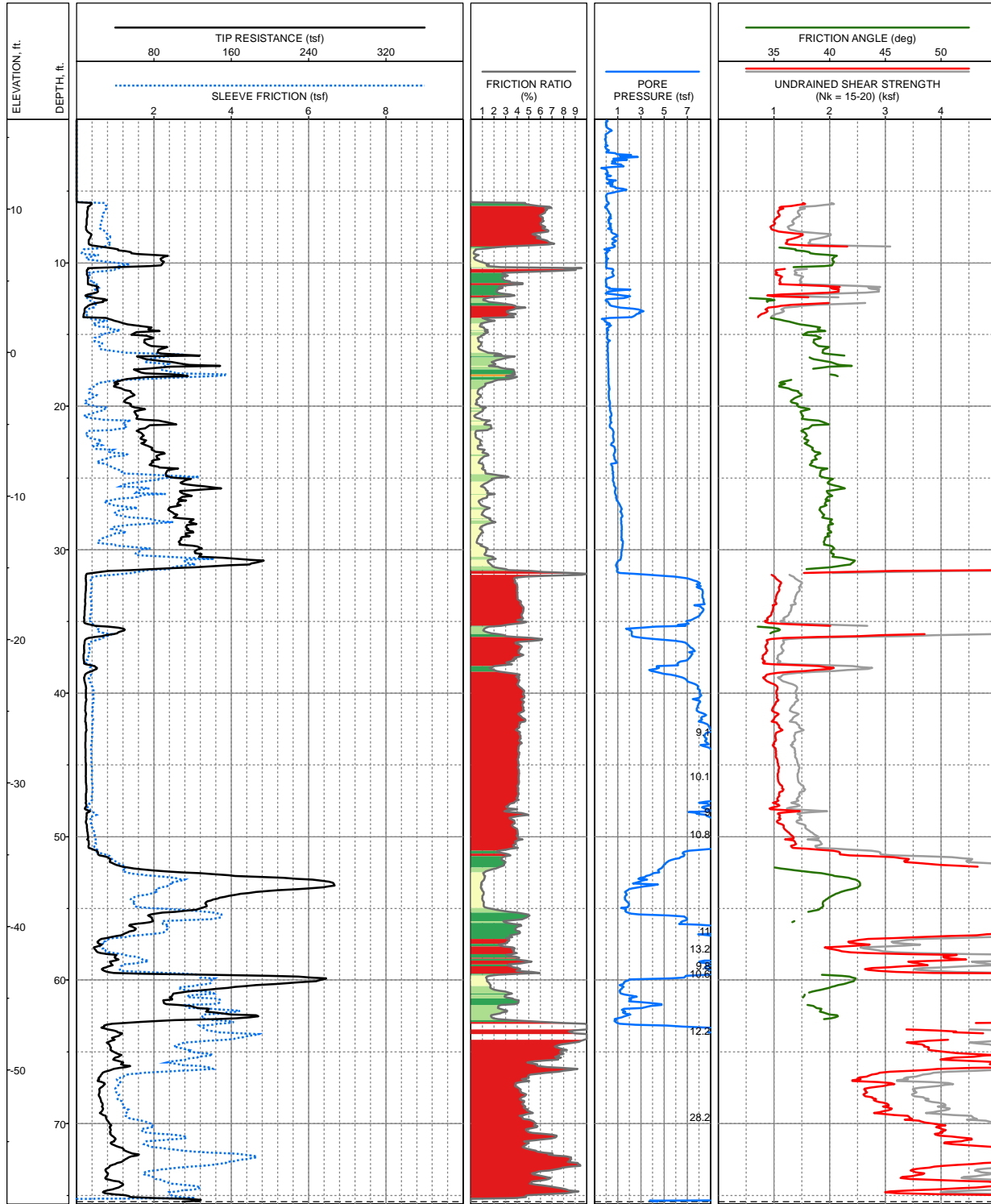


LOCATION: E6,052,593, N2,116,694, NAD83 SP CA Z3 FT
 SURFACE EL: 14ft +/-
 COMPLETION DEPTH: 49.6ft
 TESTDATE: 3/29/2019

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.59

PLATE A-9: LOG OF 2019-CPT-02

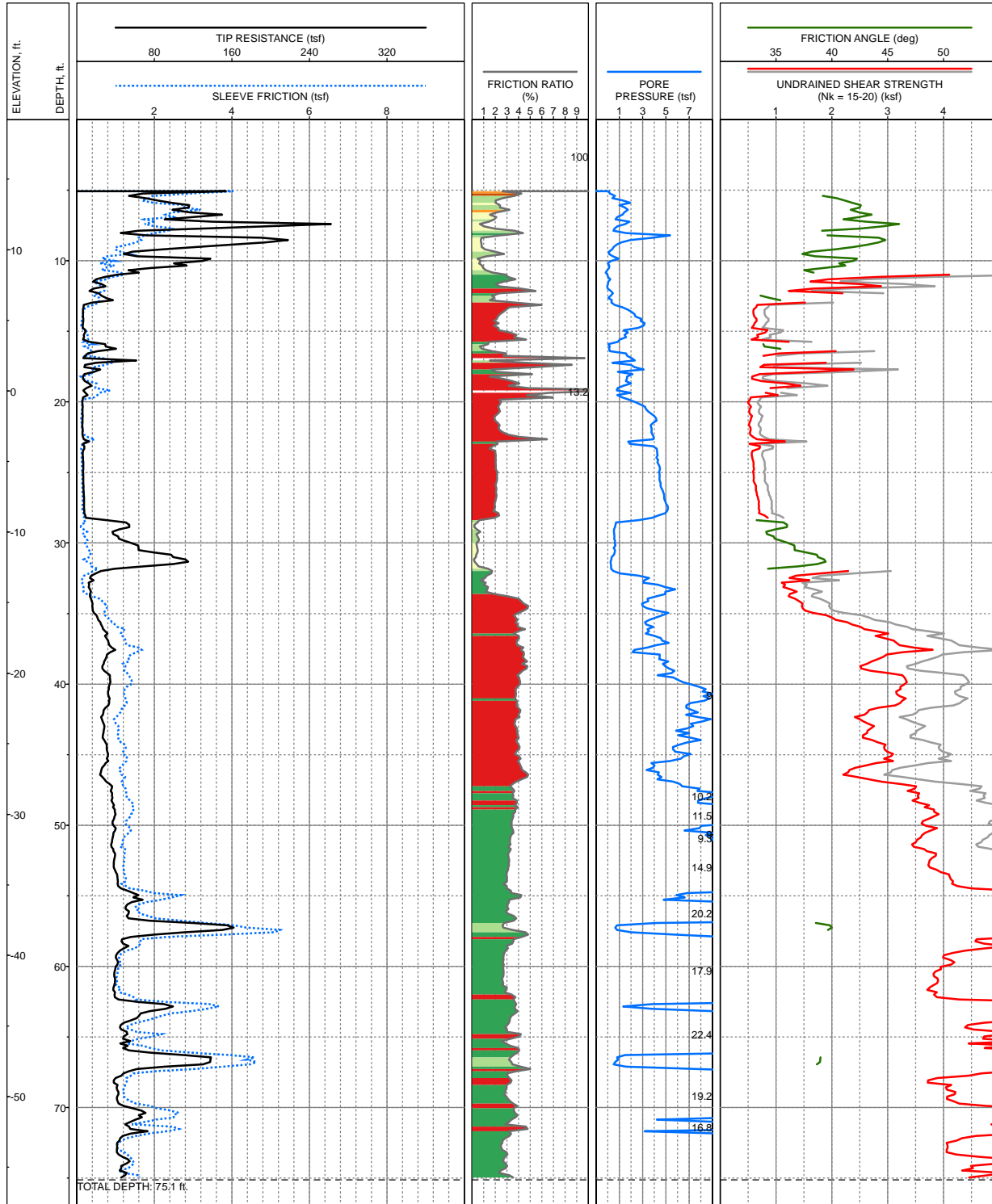




LOCATION: E6,052,570, N2,116,535, NAD83 SP CA Z3 FT
 SURFACE EL: 16ft +/-
 COMPLETION DEPTH: 75.4ft
 TESTDATE: 3/29/2019

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.59

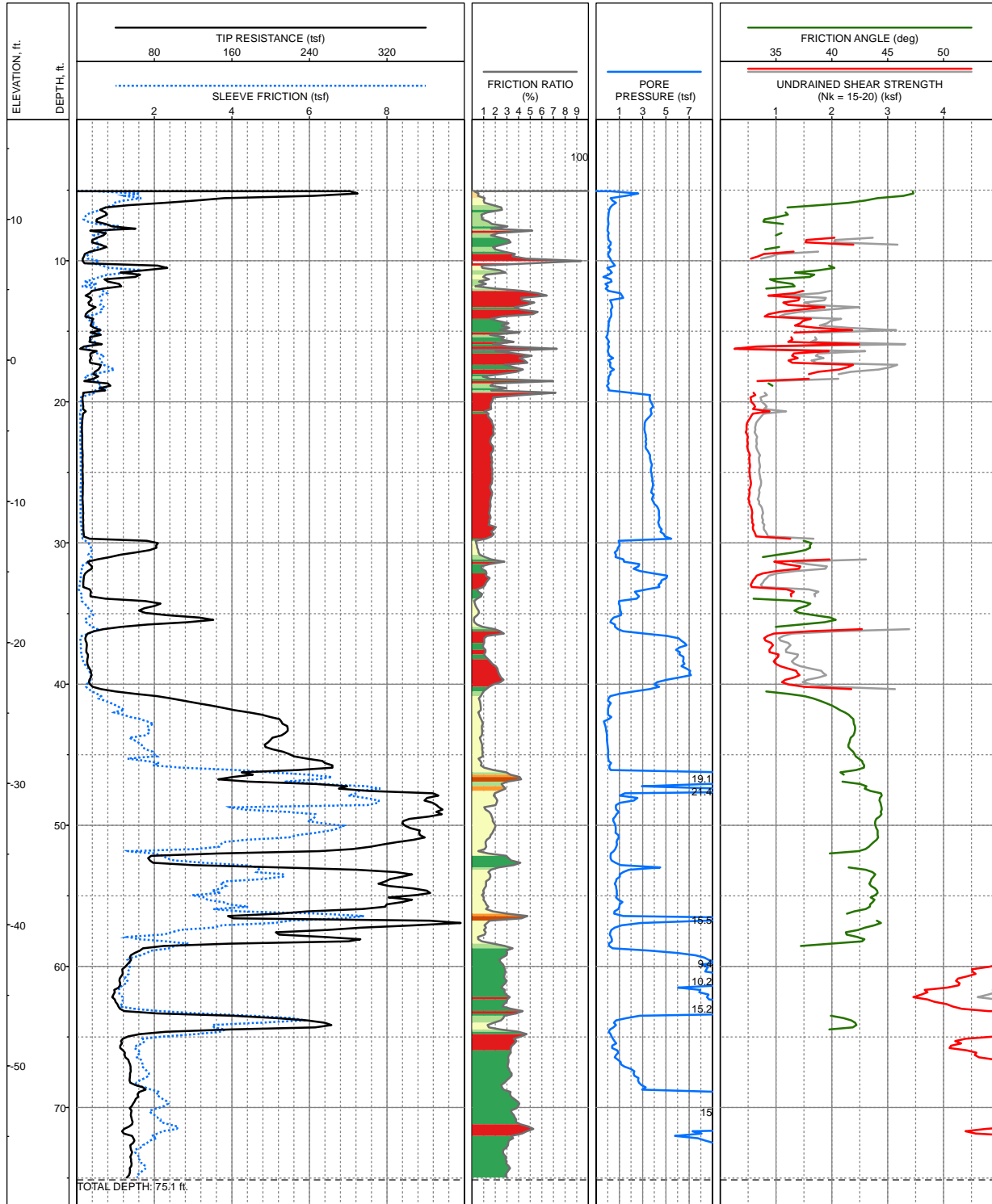
PLATE A-10: LOG OF 2019-CPT-03



LOCATION: E6,052,490, N2,116,767, NAD83 SP CA Z3 FT
 SURFACE EL: 19.2ft
 COMPLETION DEPTH: 75.1ft
 TESTDATE: 1/3/2020

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.80

PLATE A-11: LOG OF 2020-CPT-04

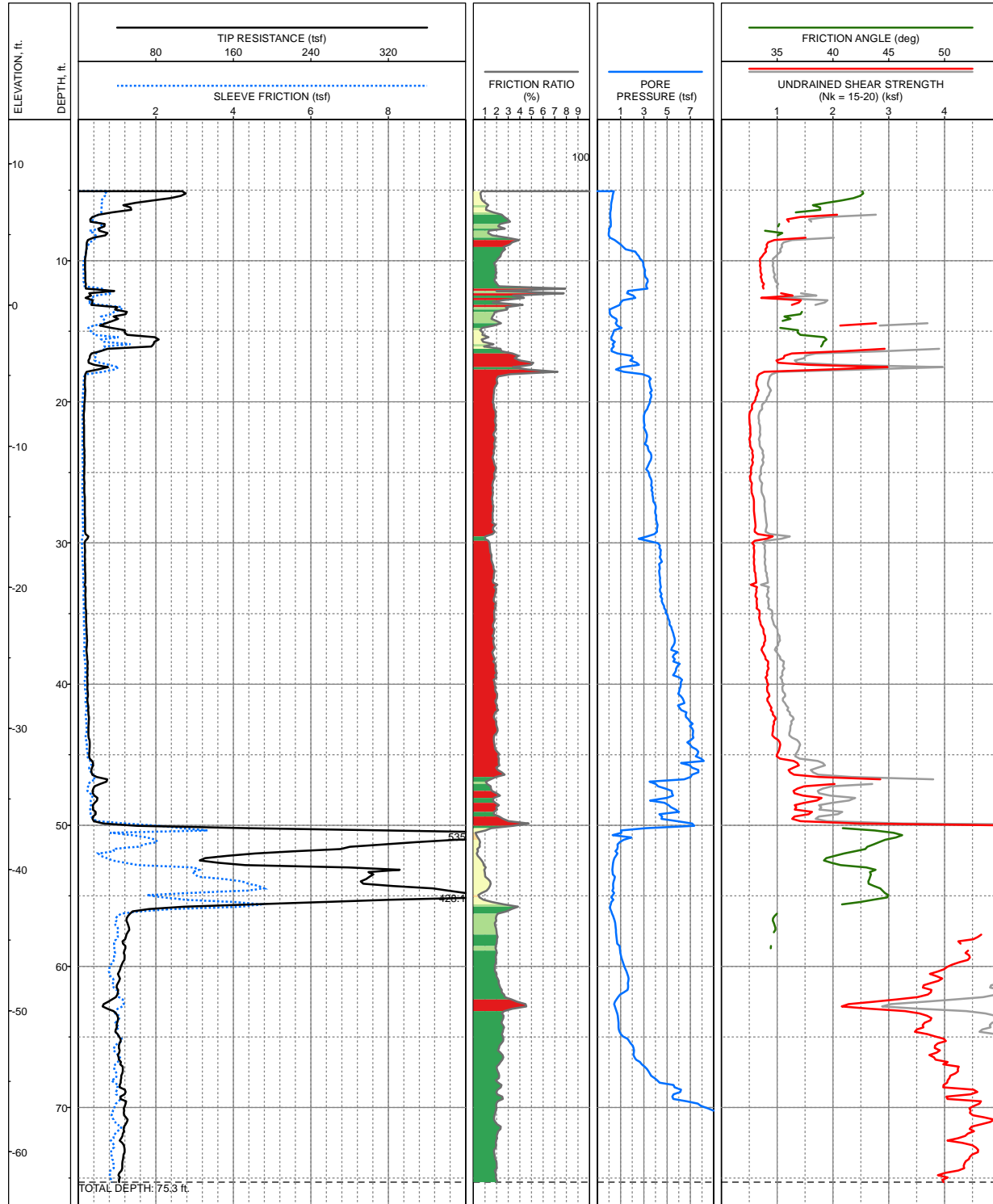


LOCATION: E6,052,557, N2,116,734, NAD83 SP CA Z3 FT
 SURFACE EL: 17.1ft
 COMPLETION DEPTH: 75.1ft
 TESTDATE: 1/3/2020

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.80

PLATE A-12: LOG OF 2020-CPT-05

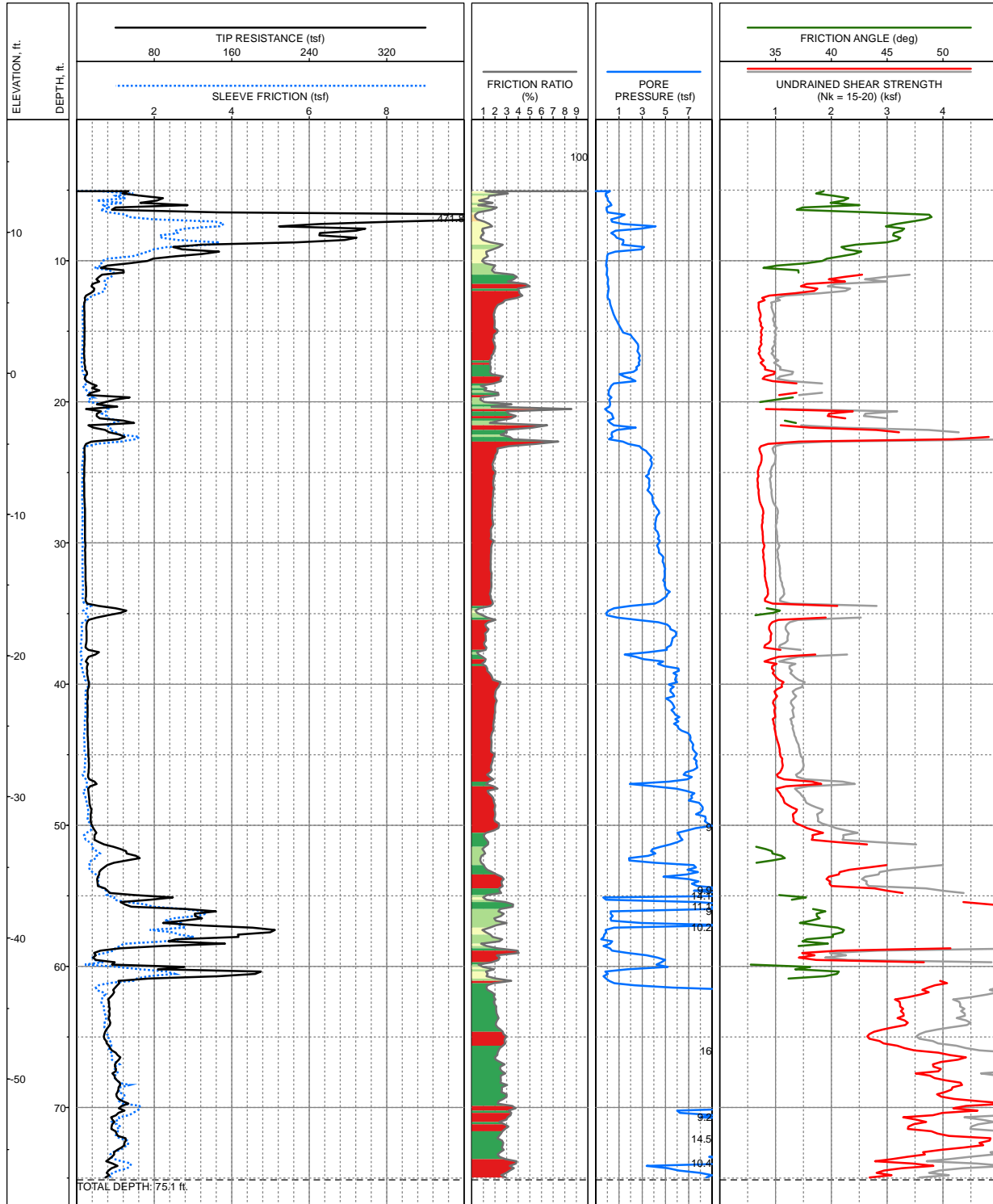




LOCATION: E6,052,632, N2,116,632, NAD83 SP CA Z3 FT
 SURFACE EL: 13.1ft
 COMPLETION DEPTH: 75.3ft
 TESTDATE: 1/3/2020

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.80

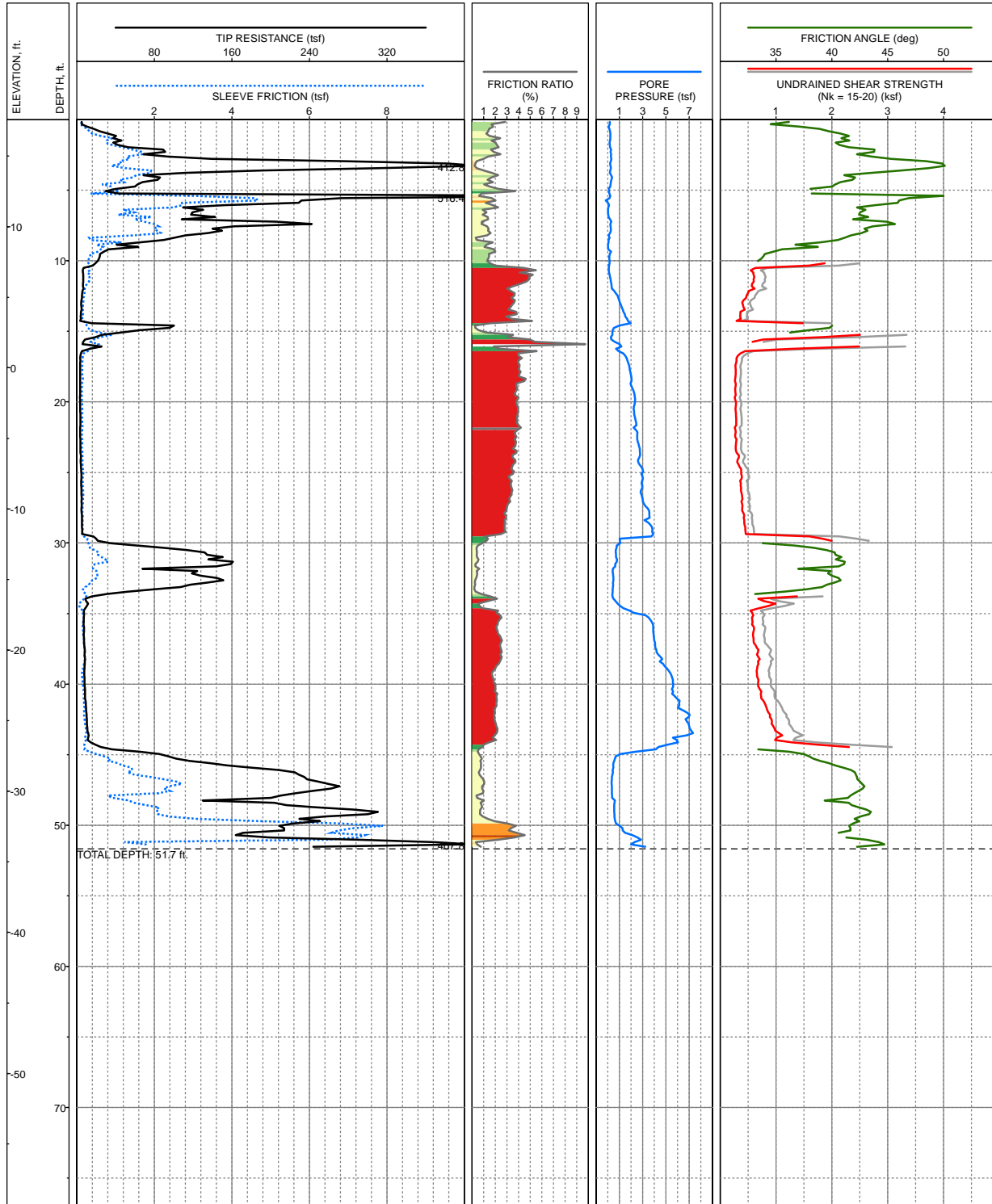
PLATE A-13: LOG OF 2020-CPT-06



LOCATION: E6,052,572, N2,116,598, NAD83 SP CA Z3 FT
 SURFACE EL: 18.0ft
 COMPLETION DEPTH: 75.1ft
 TESTDATE: 1/3/2020

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.80

PLATE A-14: LOG OF 2020-SCPT-07

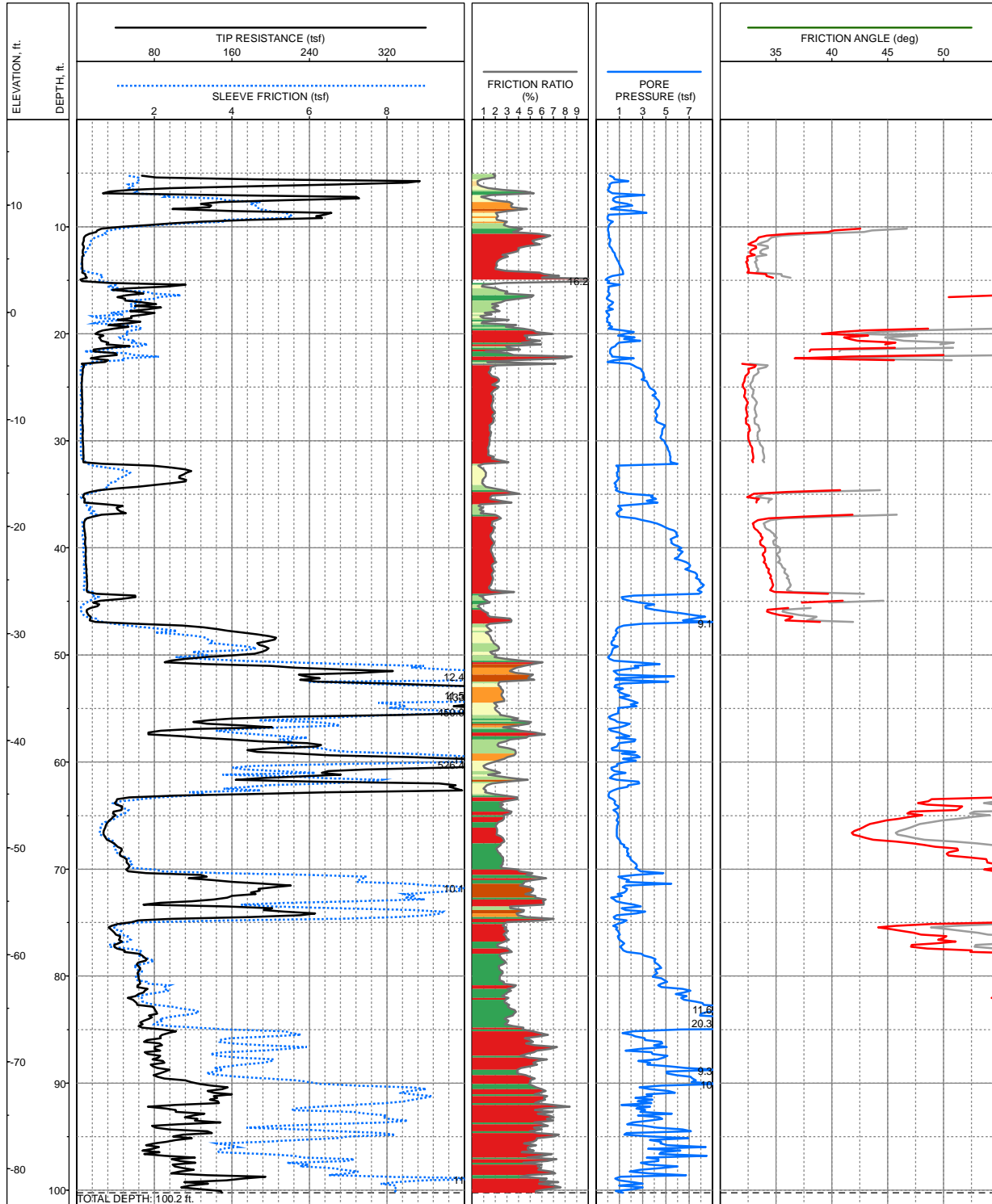


LOCATION: E6,052,485, N2,116,625, NAD83 SP CA Z3 FT
 SURFACE EL: 17.6ft
 COMPLETION DEPTH: 51.7ft
 TESTDATE: 1/2/2020

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.80

PLATE A-15: LOG OF 2020-CPT-08



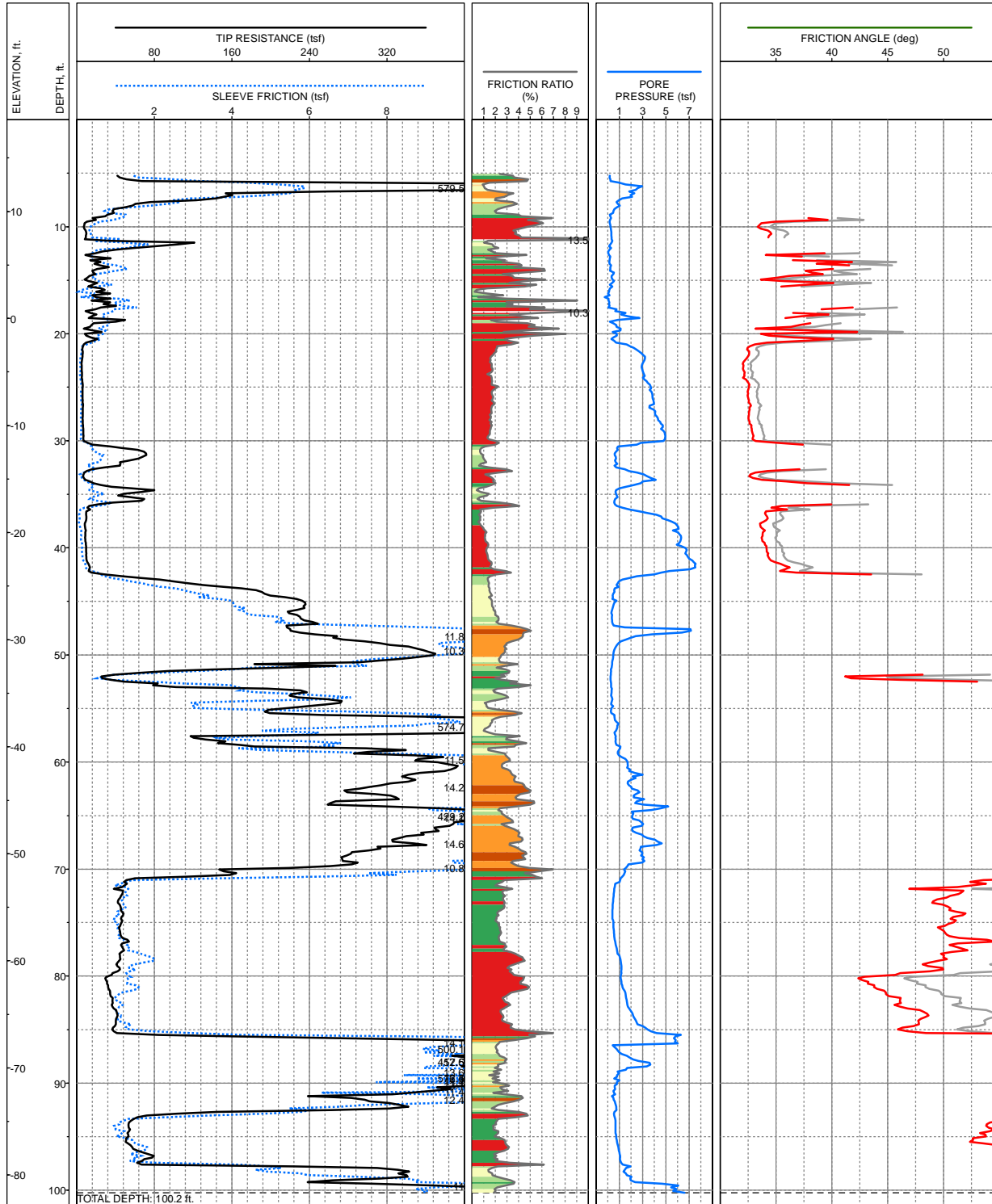


LOCATION: E6,052,530, N2,116,637, NAD 1983 State Plane CA, Zone 3
 SURFACE EL: 18.0ft
 COMPLETION DEPTH: 100.2ft
 TESTDATE: 10/7/2022

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.85

PLATE A-16: LOG OF 2022-CPT-16

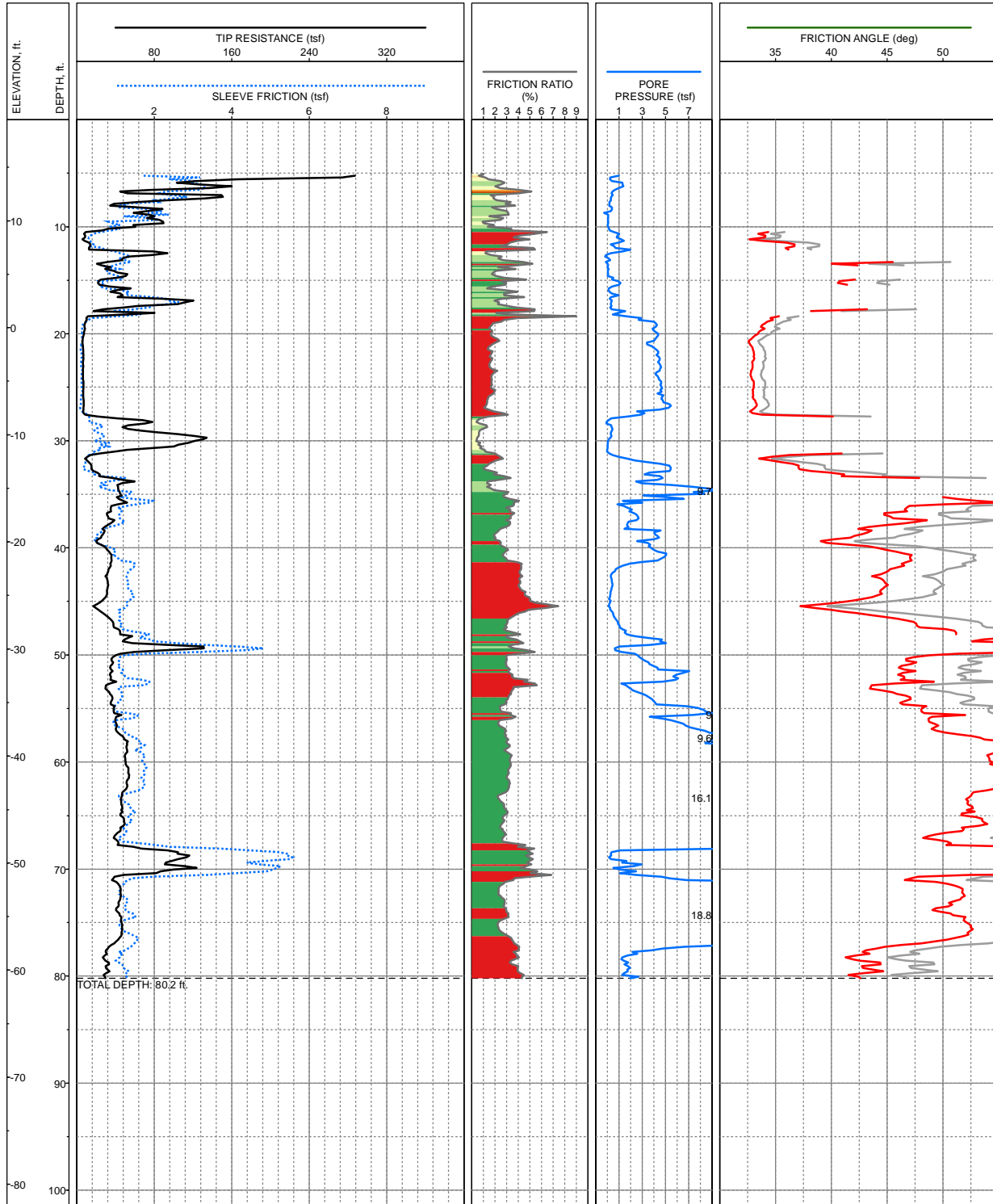




LOCATION: E6,052,534, N2,116,701, NAD 1983 State Plane CA, Zone 3
 SURFACE EL: 18.6ft
 COMPLETION DEPTH: 100.2ft
 TESTDATE: 10/7/2022

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.85

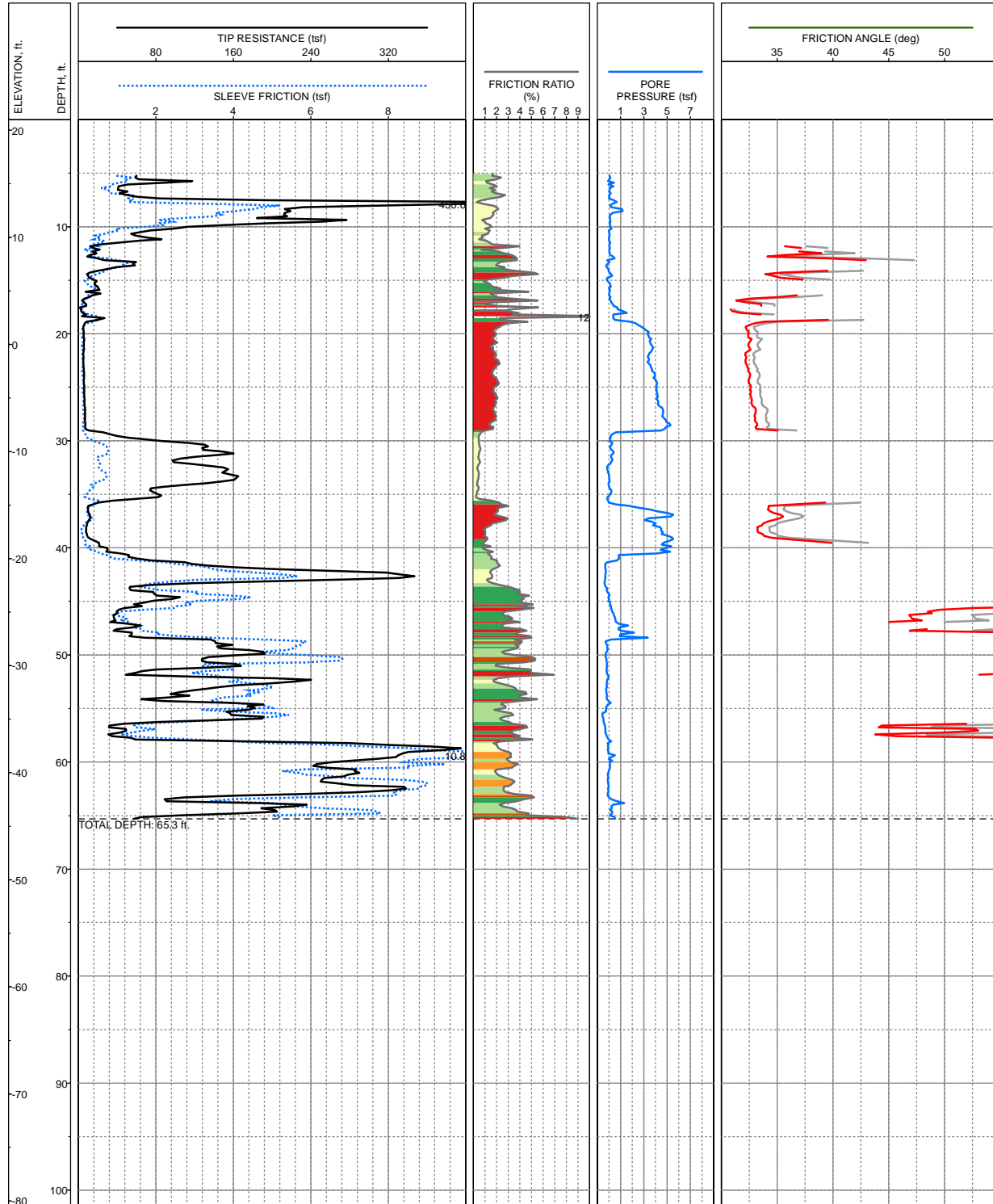
PLATE A-17: LOG OF 2022-CPT-17



LOCATION: E6,052,503, N2,116,793, NAD 1983 State Plane CA, Zone 3
 SURFACE EL: 19.4ft
 COMPLETION DEPTH: 80.2ft
 TESTDATE: 10/7/2022

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.85

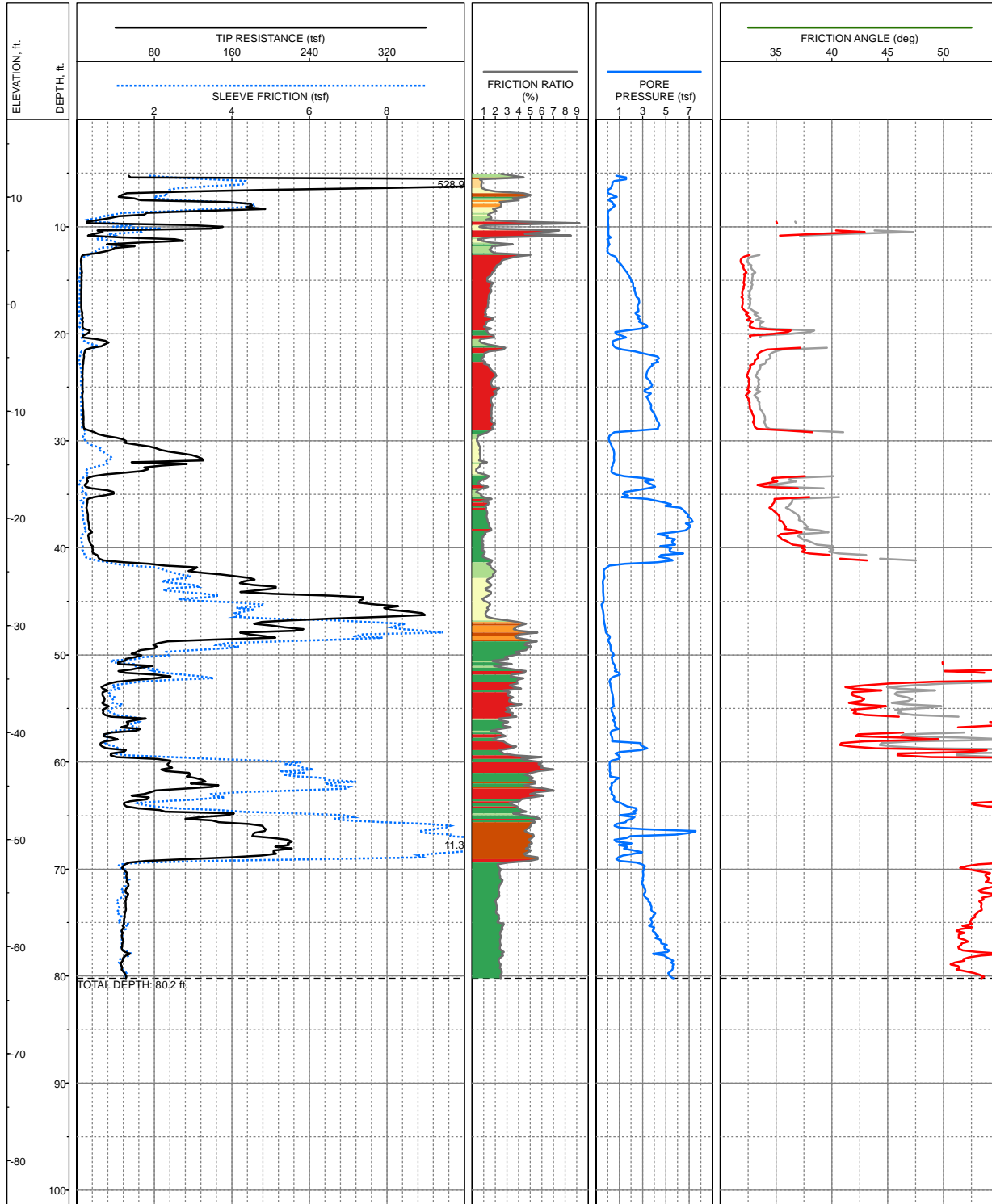
PLATE A-18: LOG OF 2022-CPT-18



LOCATION: E6,052,485, N2,116,730, NAD 1983 State Plane CA, Zone 3
 SURFACE EL: 21.0ft
 COMPLETION DEPTH: 65.3ft
 TESTDATE: 10/7/2022

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.85

PLATE A-19: LOG OF 2022-CPT-19

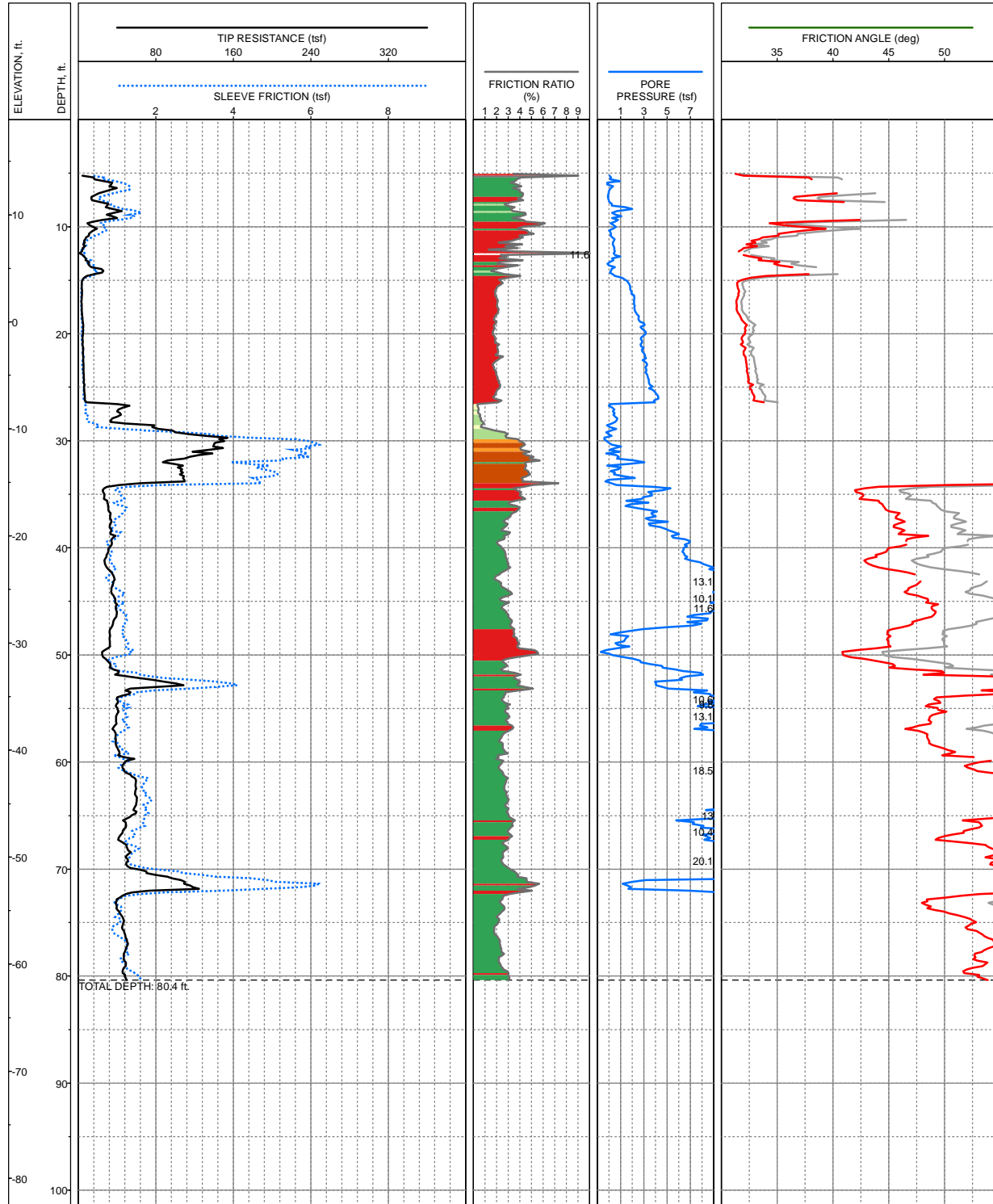


LOCATION: E6,052,442, N2,116,671, NAD 1983 State Plane CA, Zone 3
 SURFACE EL: 17.2ft
 COMPLETION DEPTH: 80.2ft
 TESTDATE: 10/7/2022

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.85

PLATE A-20: LOG OF 2022-CPT-20

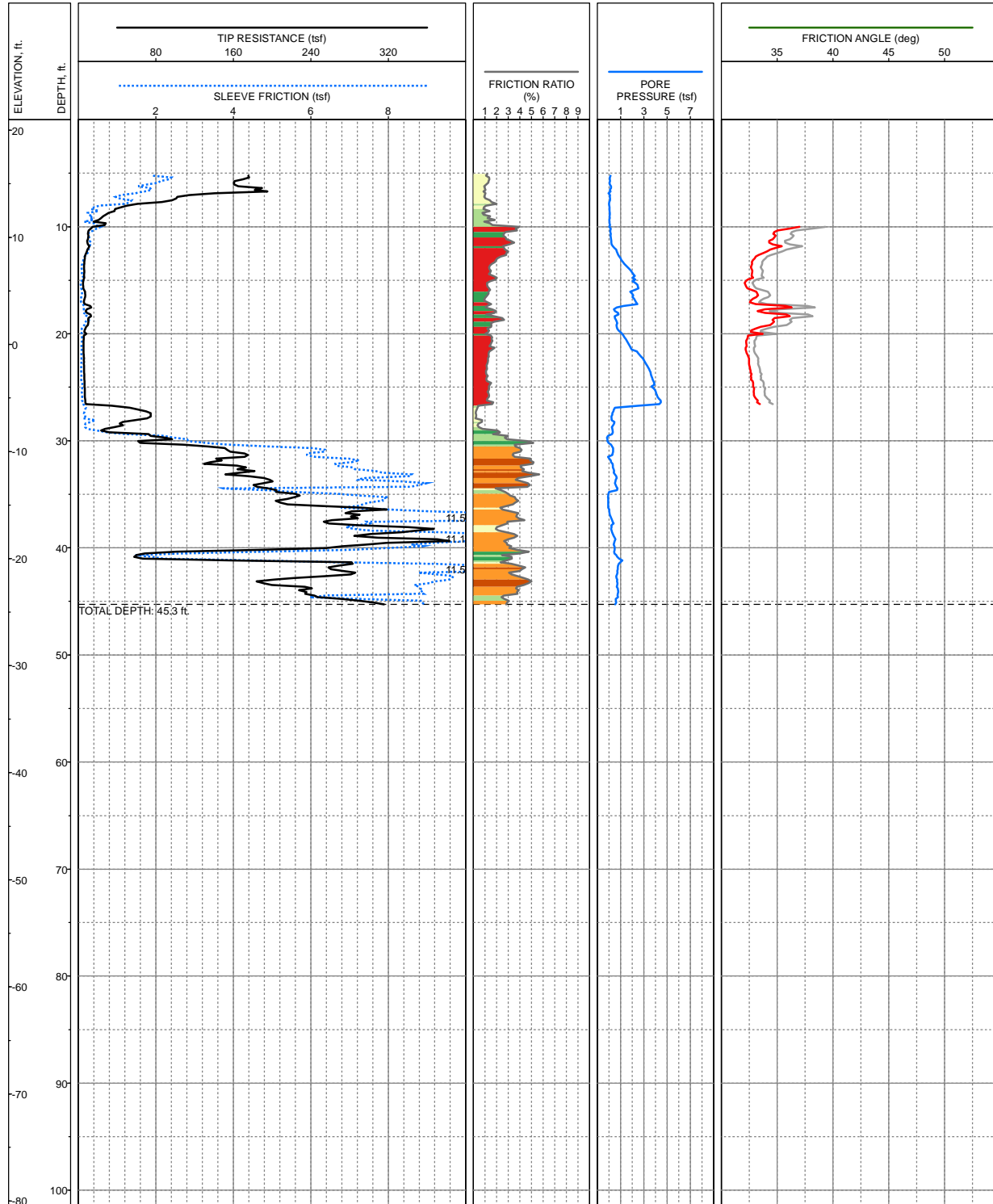




LOCATION: E6,052,457, N2,116,815, NAD 1983 State Plane CA, Zone 3
 SURFACE EL: 18.9ft
 COMPLETION DEPTH: 80.4ft
 TESTDATE: 10/7/2022

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.85

PLATE A-21: LOG OF 2022-CPT-21

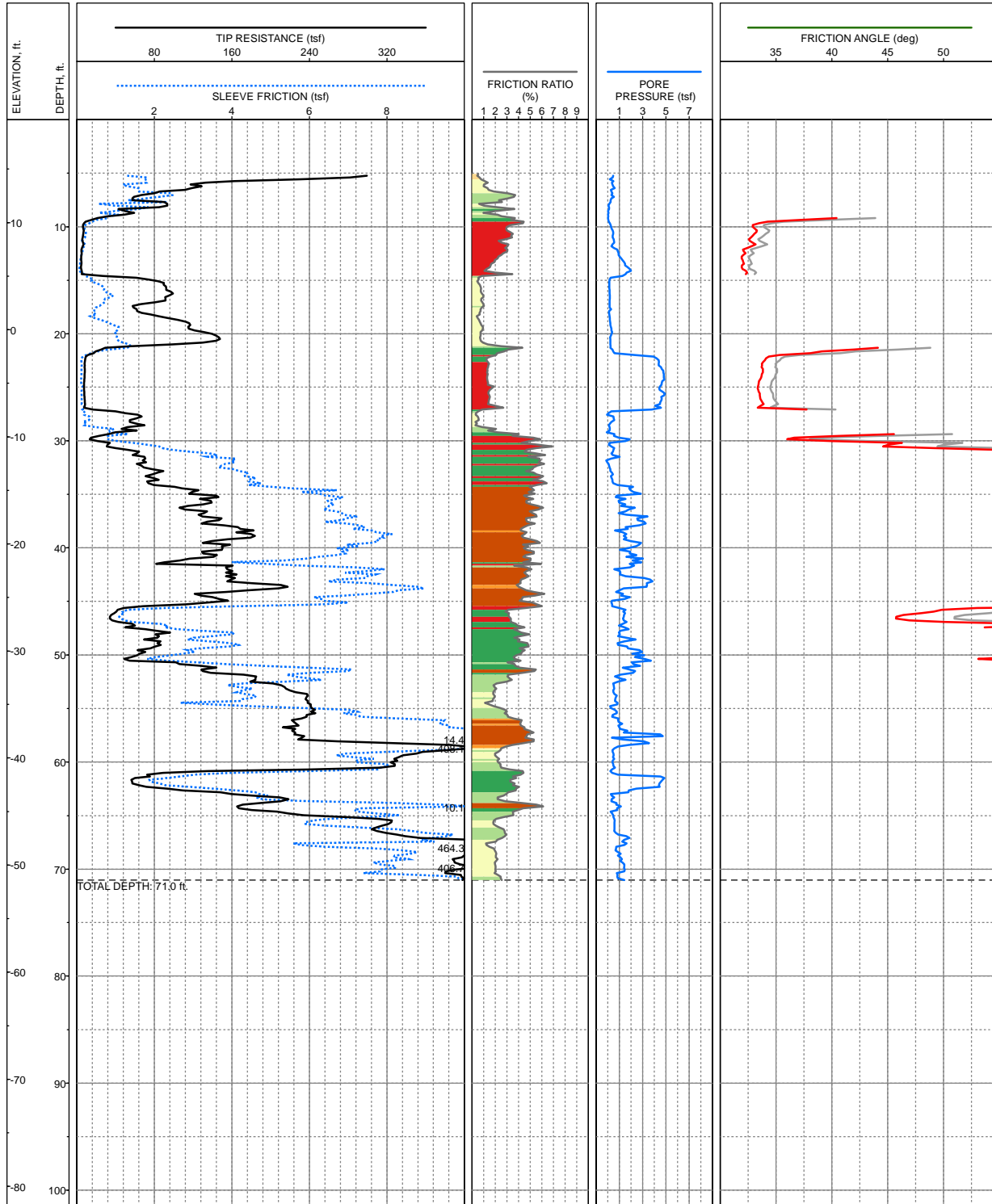


LOCATION: E6,052,429, N2,116,770, NAD 1983 State Plane CA, Zone 3
 SURFACE EL: 21.0ft
 COMPLETION DEPTH: 45.3ft
 TESTDATE: 10/7/2022

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.85

PLATE A-22: LOG OF 2022-CPT-22



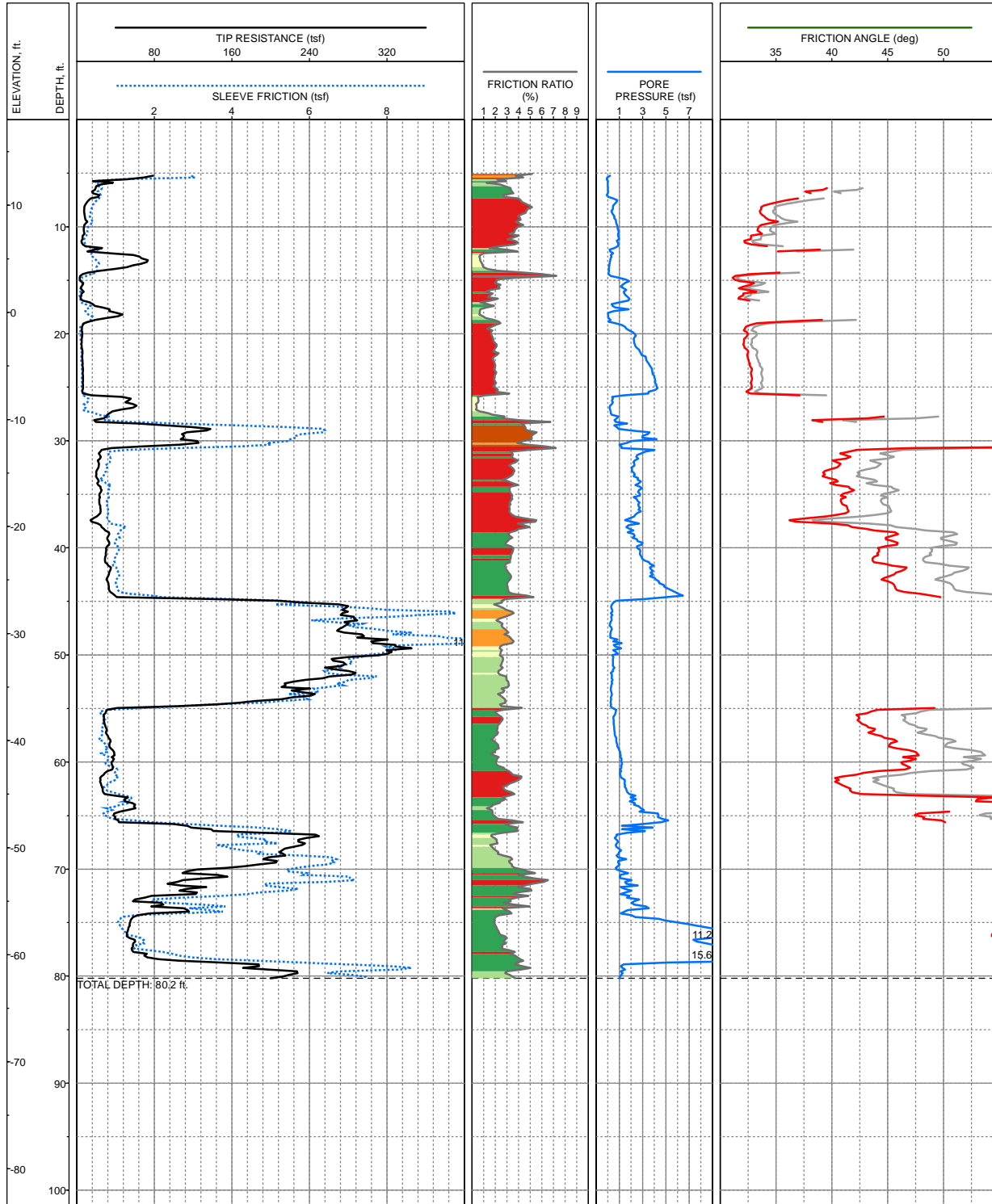


LOCATION: E6,052,417, N2,116,734, NAD 1983 State Plane CA, Zone 3
 SURFACE EL: 19.6ft
 COMPLETION DEPTH: 71.0ft
 TESTDATE: 10/7/2022

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.85

PLATE A-23: LOG OF 2022-CPT-23

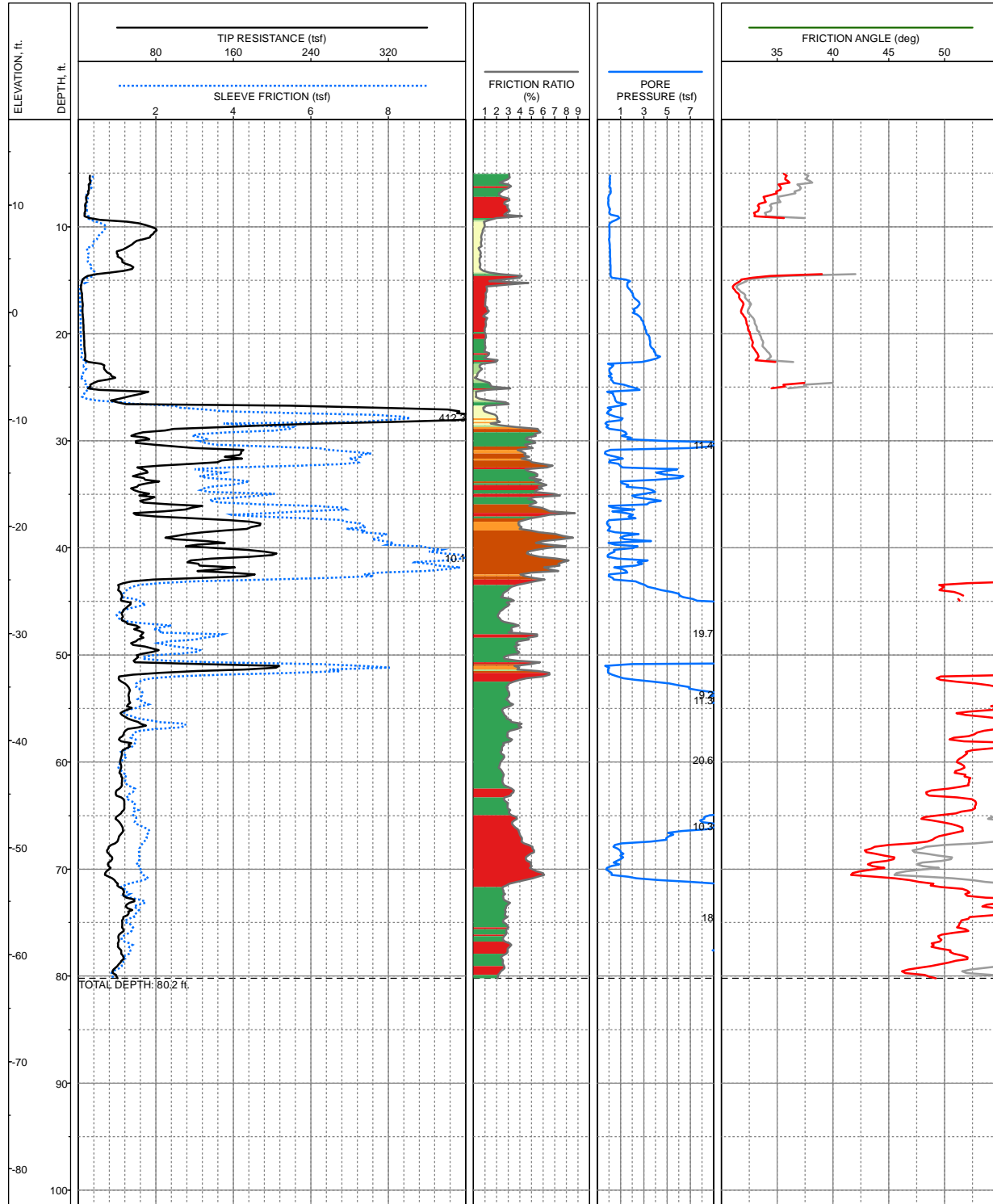




LOCATION: E6,052,359, N2,116,755, NAD 1983 State Plane CA, Zone 3
 SURFACE EL: 18.0ft
 COMPLETION DEPTH: 80.2ft
 TESTDATE: 10/7/2022

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.85

PLATE A-24: LOG OF 2022-CPT-24



LOCATION: E6,052,339, N2,116,824, NAD 1983 State Plane CA, Zone 3
 SURFACE EL: 18.0ft
 COMPLETION DEPTH: 80.2ft
 TESTDATE: 10/7/2022

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: R. Rahimnejad
 CONE AREA RATIO: 0.85

PLATE A-25: LOG OF 2022-CPT-25



Job Number: 04.72190021
Operator: Daniel Garza
Location: Oakland, CA

CPT Number: CPT-01
Date: 29-Mar-2019
Elevation: 0.00

Coordinates: 37.795163 -122.262754
Cone Number: CP15-CF75PB7SN2-P1E1 2598

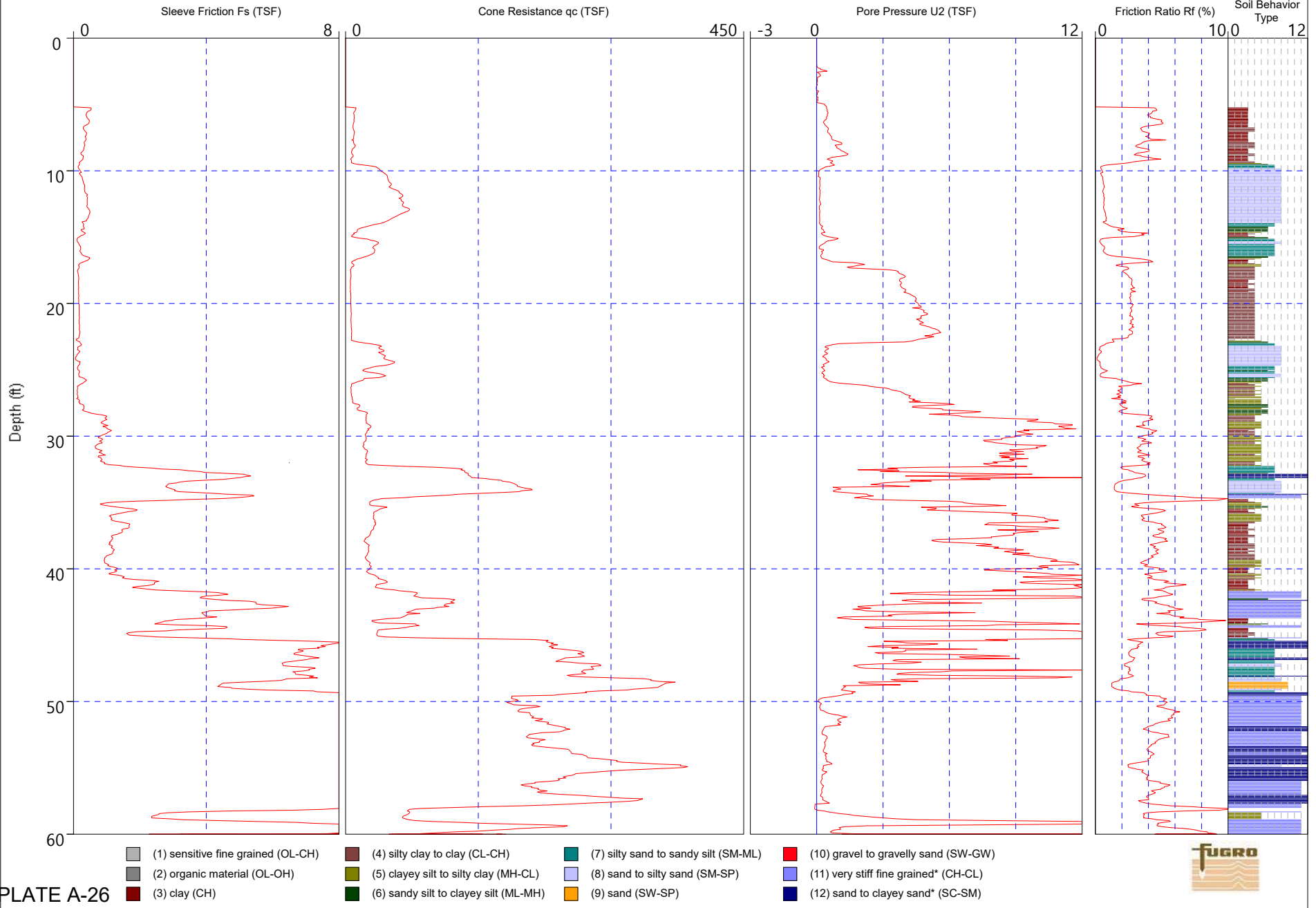


PLATE A-26

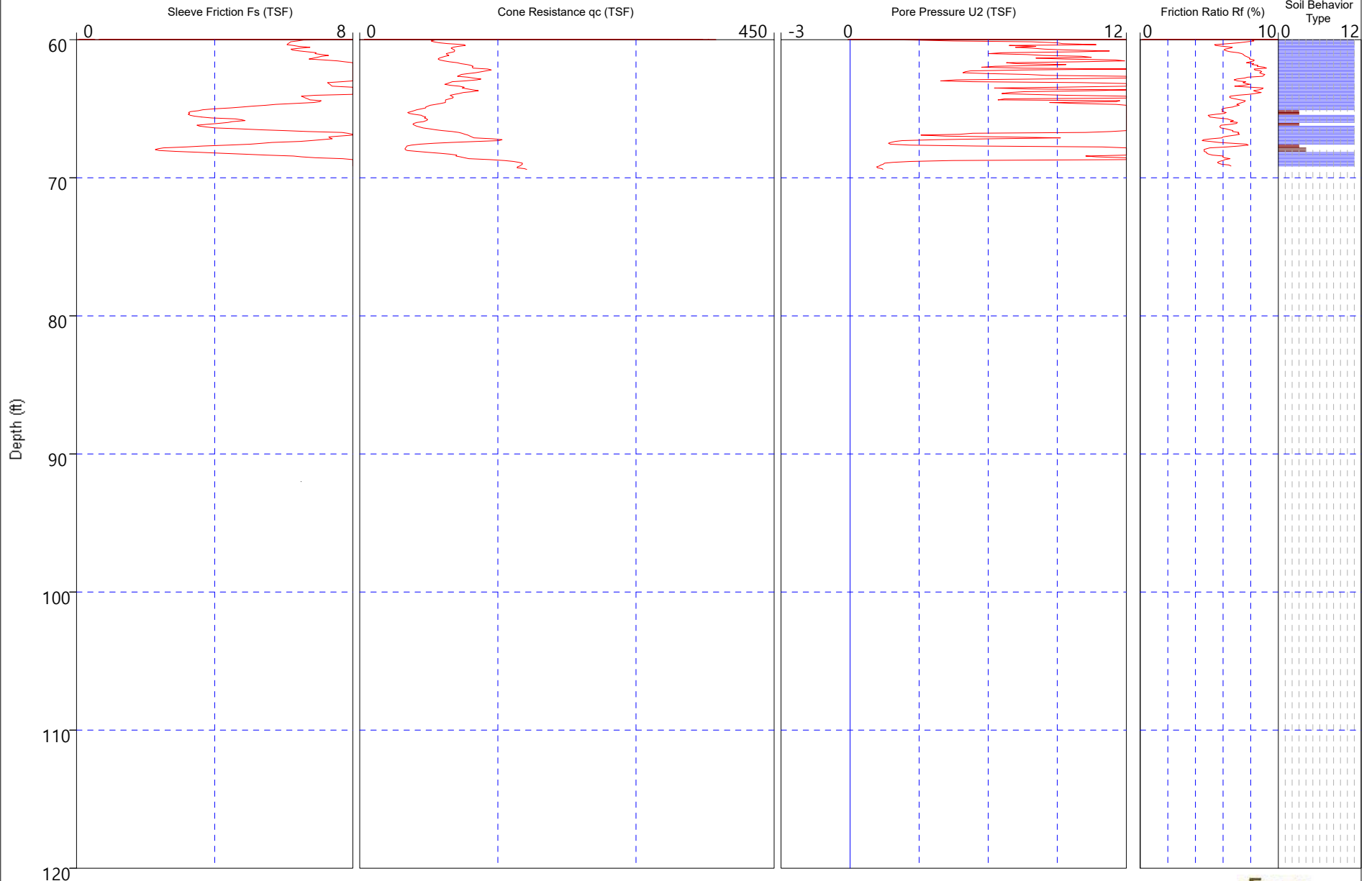
Robertson et al. 1986 *Overconsolidated or Cemented



Job Number: 04.72190021
Operator: Daniel Garza
Location: Oakland, CA

CPT Number: CPT-01
Date: 29-Mar-2019
Elevation: 0.00

Coordinates: 37.795163 -122.262754
Cone Number: CP15-CF75PB7SN2-P1E1 2598



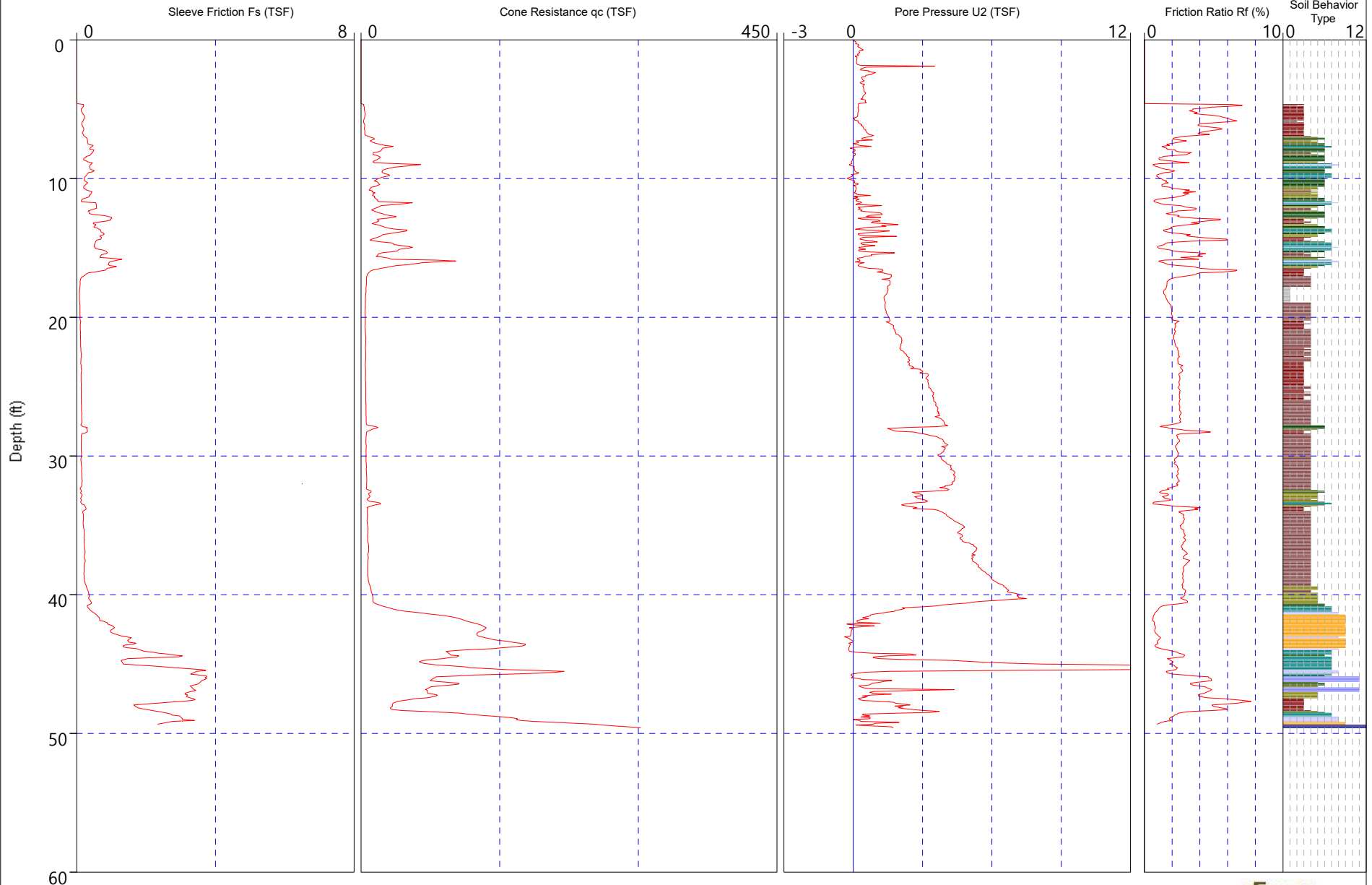
- | | | | |
|------------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|
| (1) sensitive fine grained (OL-CH) | (4) silty clay to clay (CL-CH) | (7) silty sand to sandy silt (SM-ML) | (10) gravel to gravelly sand (SW-GW) |
| (2) organic material (OL-OH) | (5) clayey silt to silty clay (MH-CL) | (8) sand to silty sand (SM-SP) | (11) very stiff fine grained* (CH-CL) |
| (3) clay (CH) | (6) sandy silt to clayey silt (ML-MH) | (9) sand (SW-SP) | (12) sand to clayey sand* (SC-SM) |



Job Number: 04.72190021
Operator: Daniel Garza
Location: Oakland, CA

CPT Number: CPT-02
Date: 29-Mar-2019
Elevation: 0.00

Coordinates: 37.794900 -122.261959
Cone Number: CP15-CF75PB7SN2-P1E1 2598



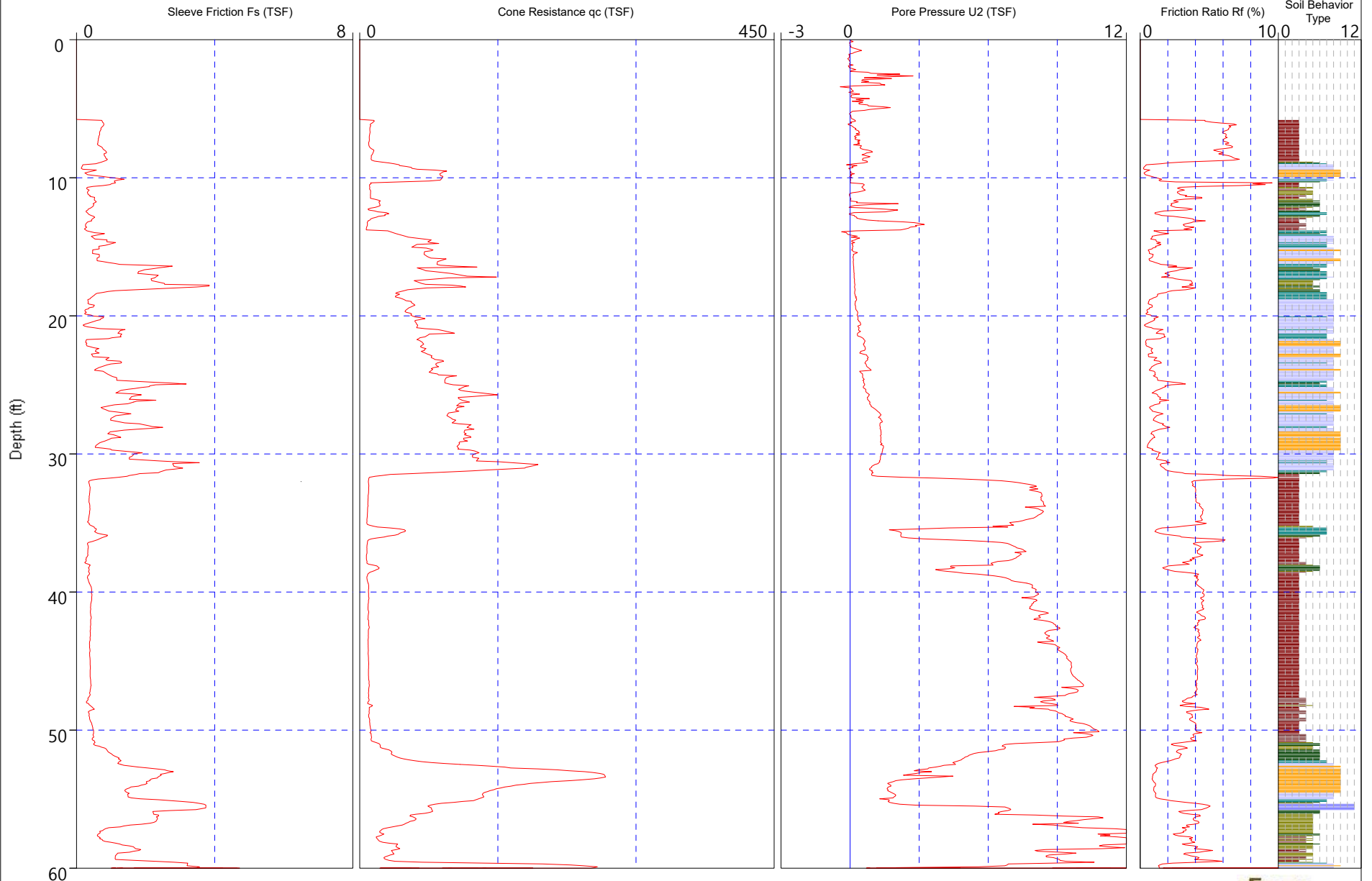
- | | | | |
|------------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|
| (1) sensitive fine grained (OL-CH) | (4) silty clay to clay (CL-CH) | (7) silty sand to sandy silt (SM-ML) | (10) gravel to gravelly sand (SW-GW) |
| (2) organic material (OL-OH) | (5) clayey silt to silty clay (MH-CL) | (8) sand to silty sand (SM-SP) | (11) very stiff fine grained* (CH-CL) |
| (3) clay (CH) | (6) sandy silt to clayey silt (ML-MH) | (9) sand (SW-SP) | (12) sand to clayey sand* (SC-SM) |



Job Number: 04.72190021
Operator: Daniel Garza
Location: Oakland, CA

CPT Number: CPT-03
Date: 29-Mar-2019
Elevation: 0.00

Coordinates: 37.794463 -122.262030
Cone Number: CP15-CF75PB7SN2-P1E1 2598



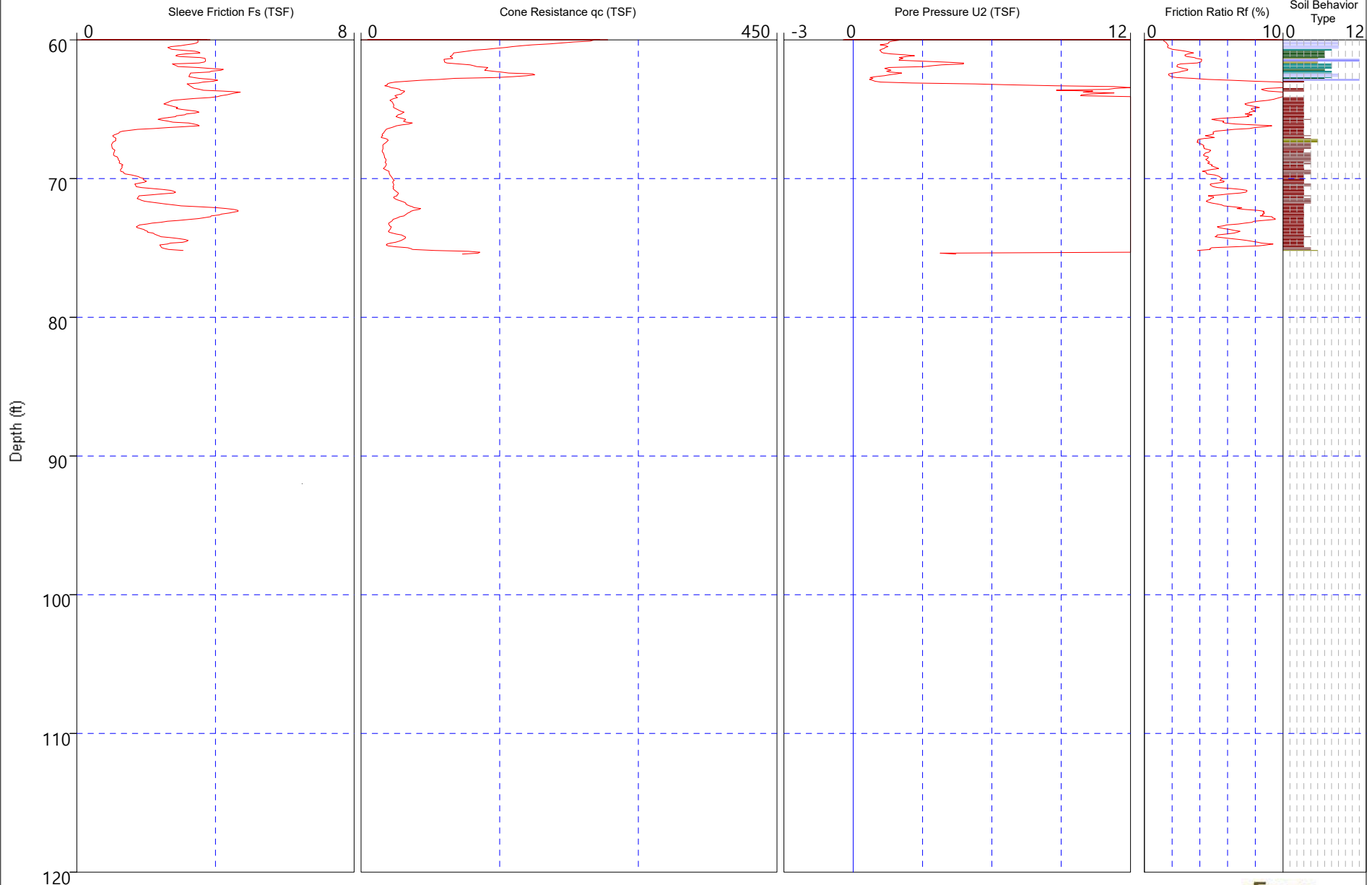
- | | | | |
|------------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|
| (1) sensitive fine grained (OL-CH) | (4) silty clay to clay (CL-CH) | (7) silty sand to sandy silt (SM-ML) | (10) gravel to gravelly sand (SW-GW) |
| (2) organic material (OL-OH) | (5) clayey silt to silty clay (MH-CL) | (8) sand to silty sand (SM-SP) | (11) very stiff fine grained* (CH-CL) |
| (3) clay (CH) | (6) sandy silt to clayey silt (ML-MH) | (9) sand (SW-SP) | (12) sand to clayey sand* (SC-SM) |



Job Number: 04.72190021
Operator: Daniel Garza
Location: Oakland, CA

CPT Number: CPT-03
Date: 29-Mar-2019
Elevation: 0.00

Coordinates: 37.794463 -122.262030
Cone Number: CP15-CF75PB7SN2-P1E1 2598

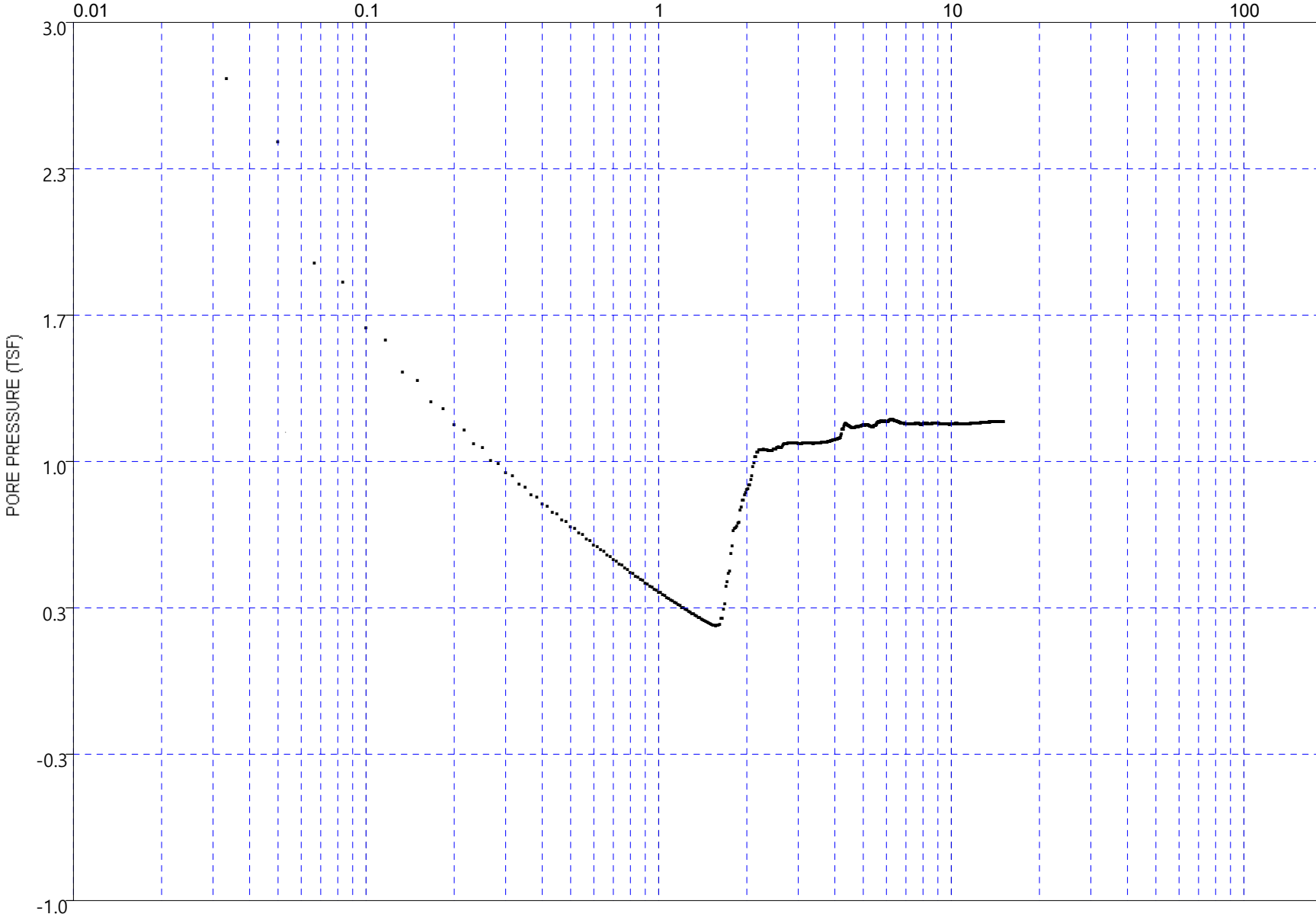


- | | | | |
|------------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|
| (1) sensitive fine grained (OL-CH) | (4) silty clay to clay (CL-CH) | (7) silty sand to sandy silt (SM-ML) | (10) gravel to gravelly sand (SW-GW) |
| (2) organic material (OL-OH) | (5) clayey silt to silty clay (MH-CL) | (8) sand to silty sand (SM-SP) | (11) very stiff fine grained* (CH-CL) |
| (3) clay (CH) | (6) sandy silt to clayey silt (ML-MH) | (9) sand (SW-SP) | (12) sand to clayey sand* (SC-SM) |



PLATE A-30

LOG TIME (MIN)



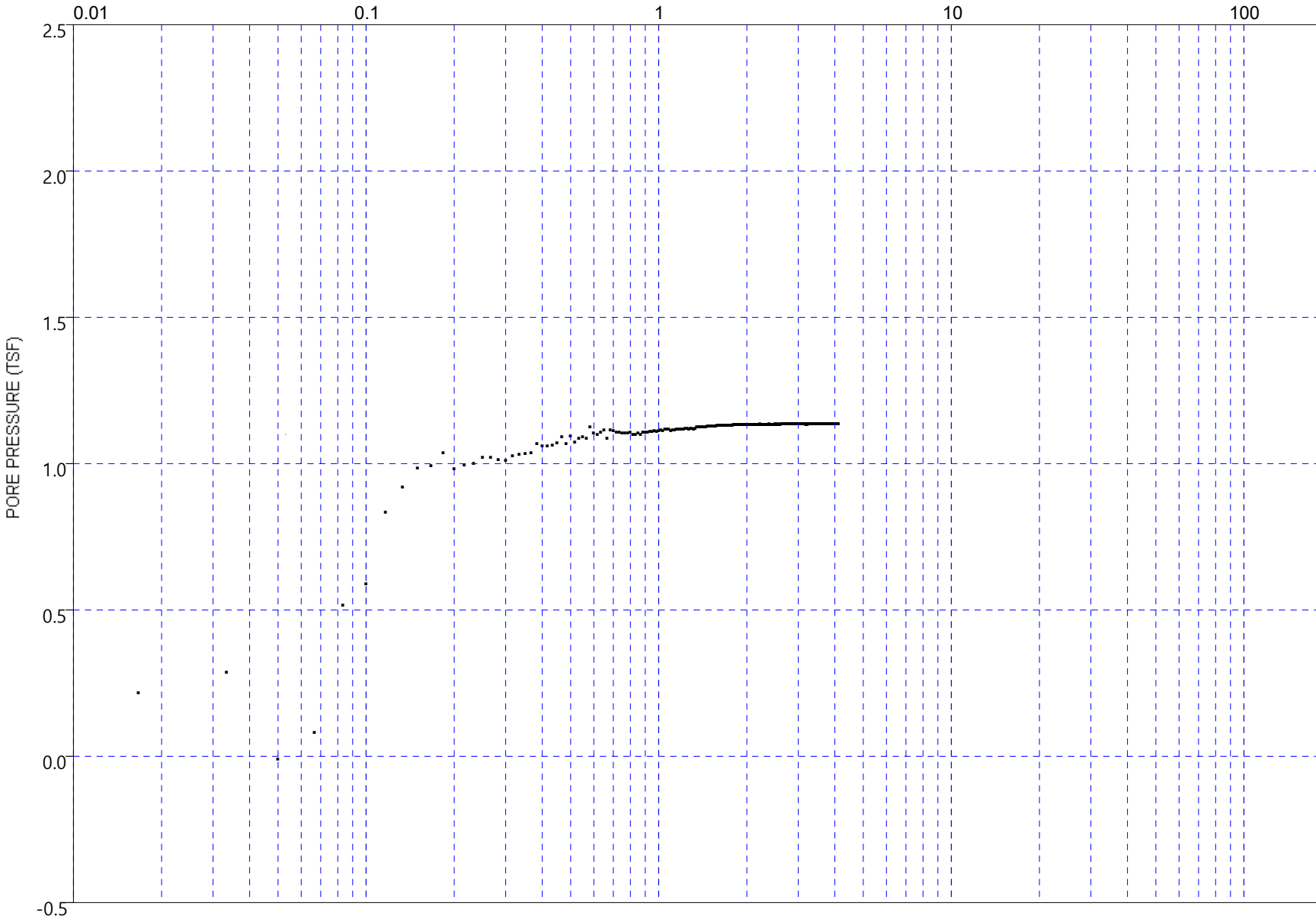
DISSIPATION TEST

CPT Number: CPT-01
Job Number: 04.72190021

Depth: 48.77
Date: 29-Mar-2019



LOG TIME (MIN)



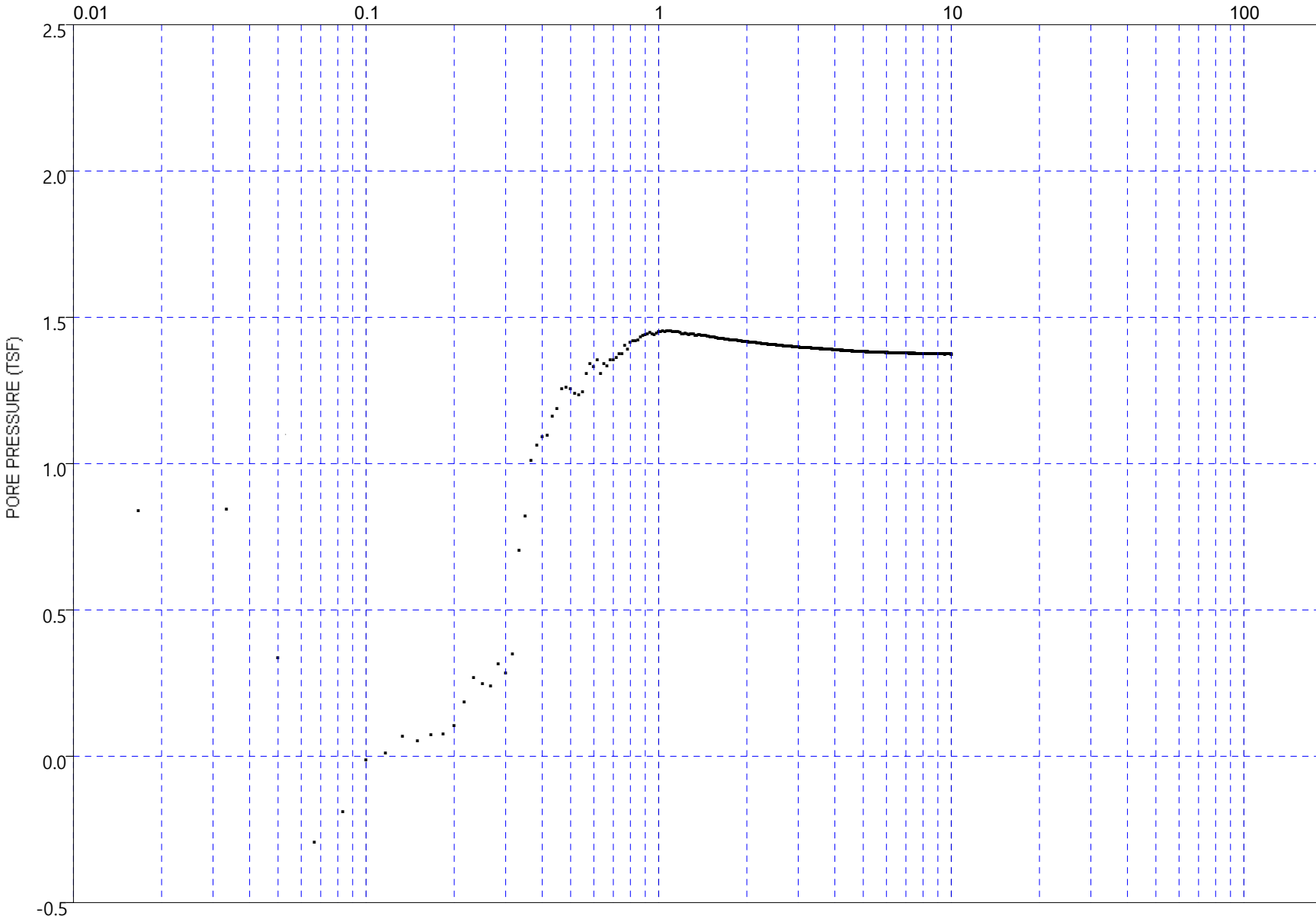
CPT Number: CPT-02
Job Number: 04.72190021

DISSIPATION TEST

Depth: 42.02
Date: 29-Mar-2019



LOG TIME (MIN)



DISSIPATION TEST

CPT Number: CPT-02
Job Number: 04.72190021

Depth: 49.33
Date: 29-Mar-2019





Cone Penetration Test Sounding Summary

-Table 1-

CPT Sounding Identification	Date	Termination Depth (feet)	Depth of Groundwater Samples (feet)	Depth of Soil Samples (feet)	Depth of Pore Pressure Dissipation Tests (feet)
CPT-04	01/03/2020	75.13	-	-	31.3
CPT-05	01/03/2020	75.13	-	-	41.2
CPT-06	01/03/2020	75.30	-	-	-
SCPT-07	01/03/2020	75.13	-	-	57.6
CPT-08	01/02/2020	51.67	-	-	51.7



CLIENT: FUGRO

SITE: LANEY COLLEGE, OAKLAND, CA

FIELD REP: REZA RAHIMNEJAD

Total depth: 75.13 ft, Date: 1/3/2020

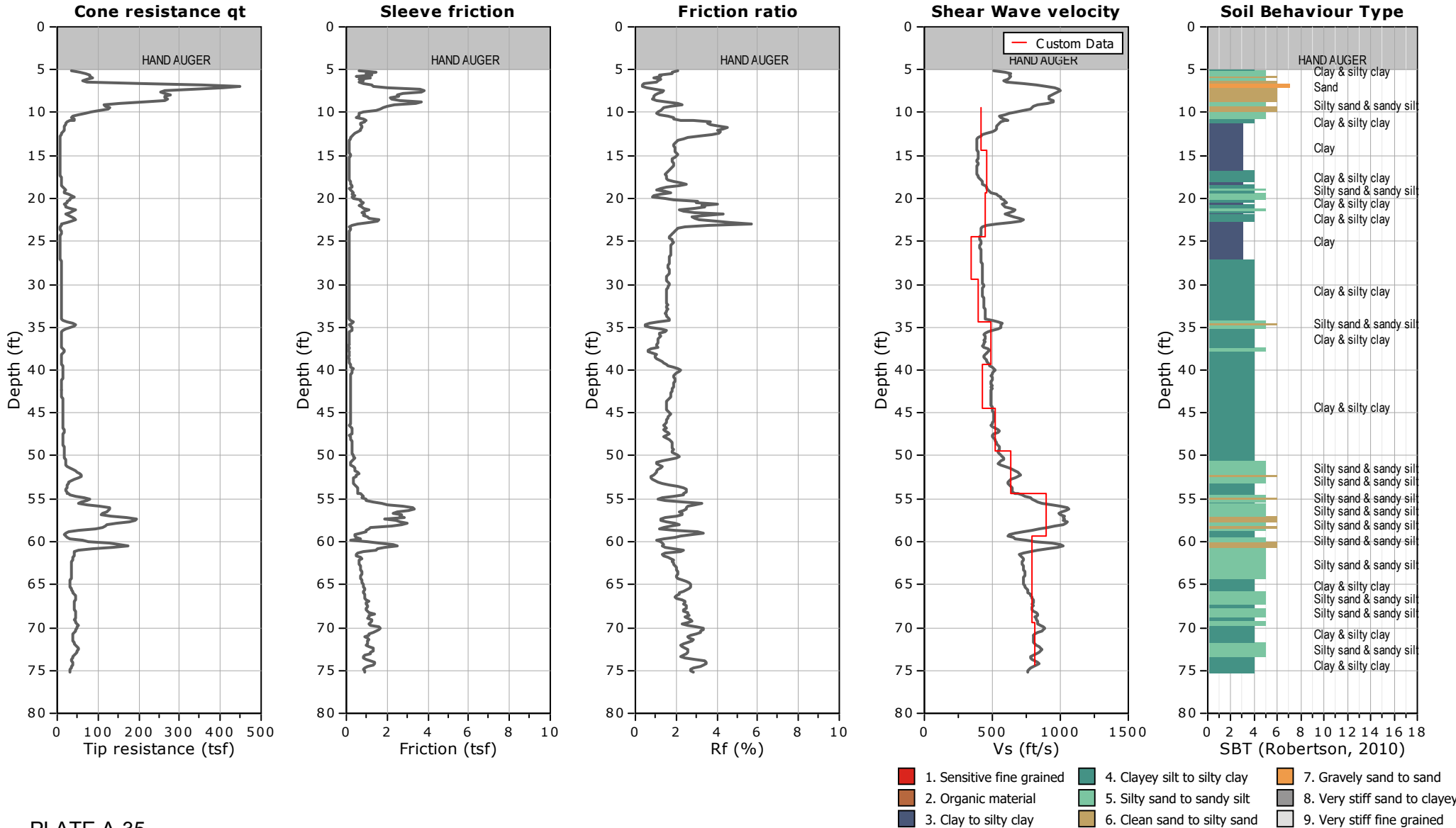


PLATE A-35



CLIENT: FUGRO

SITE: LANEY COLLEGE, OAKLAND, CA

FIELD REP: REZA RAHIMNEJAD

Total depth: 75.13 ft, Date: 1/3/2020

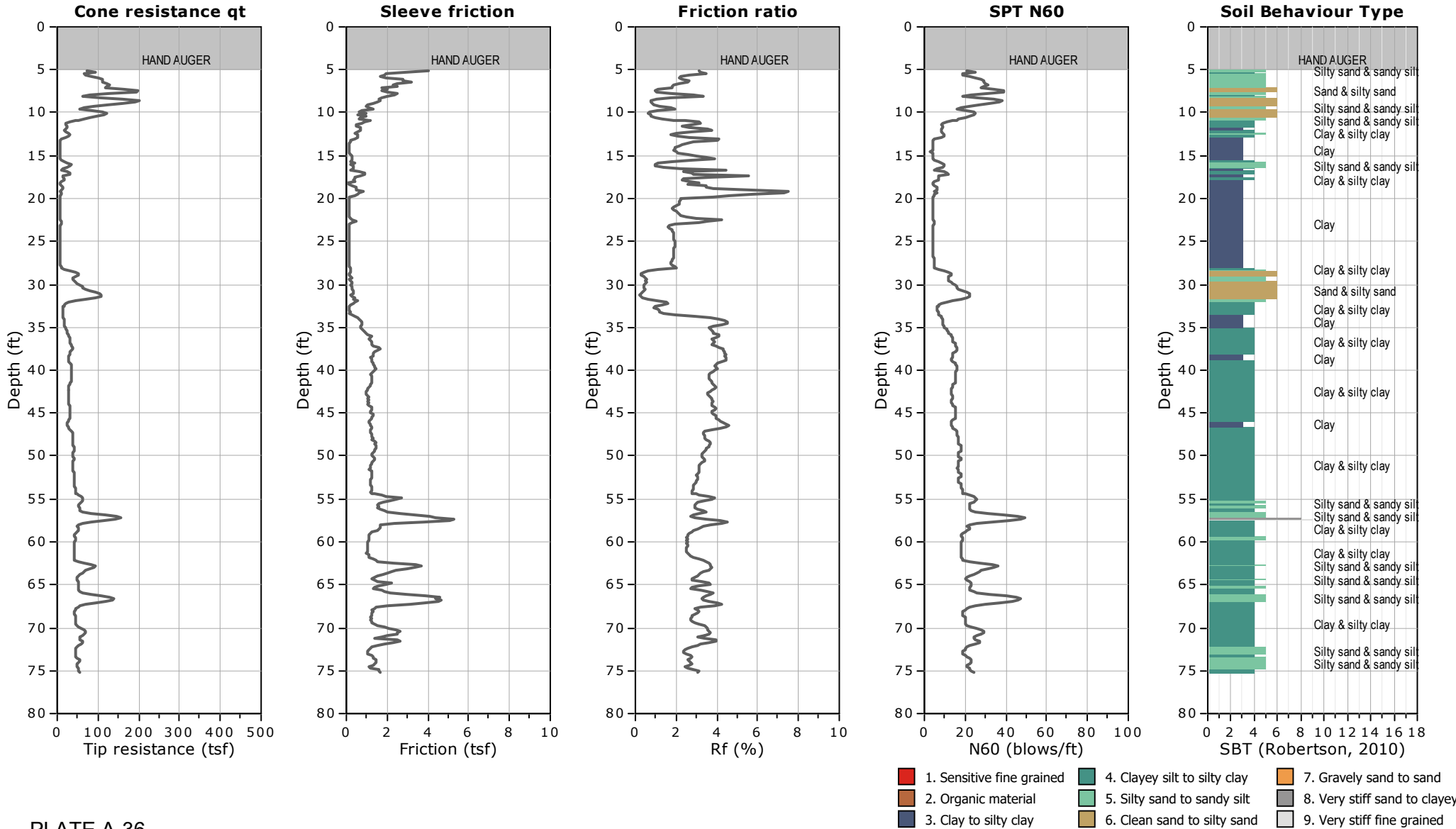


PLATE A-36

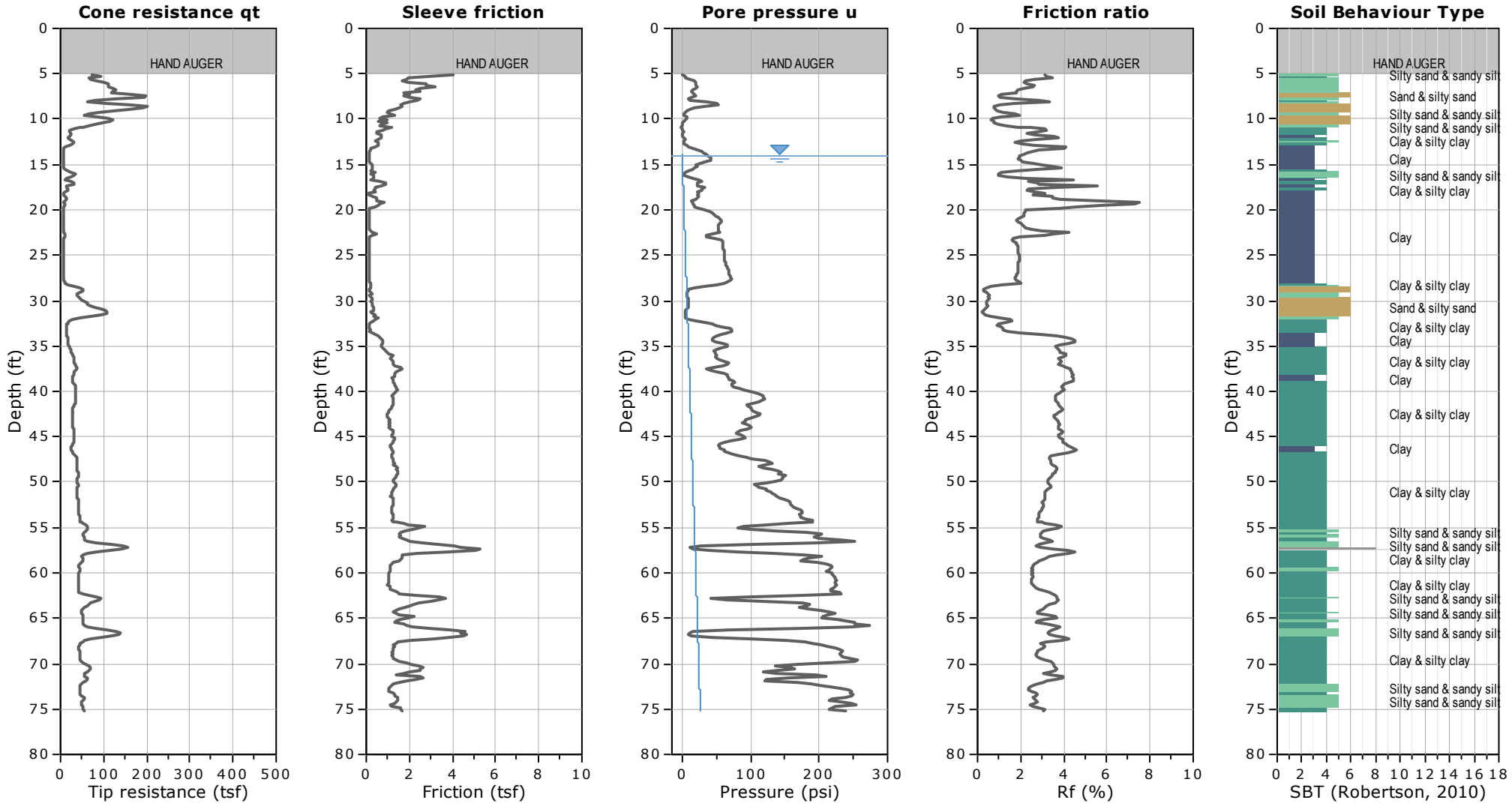


CLIENT: FUGRO

SITE: LANEY COLLEGE, OAKLAND, CA

FIELD REP: REZA RAHIMNEJAD

Total depth: 75.13 ft, Date: 1/3/2020



WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-37



CLIENT: FUGRO

SITE: LANEY COLLEGE, OAKLAND, CA

FIELD REP: REZA RAHIMNEJAD

Total depth: 75.13 ft, Date: 1/3/2020

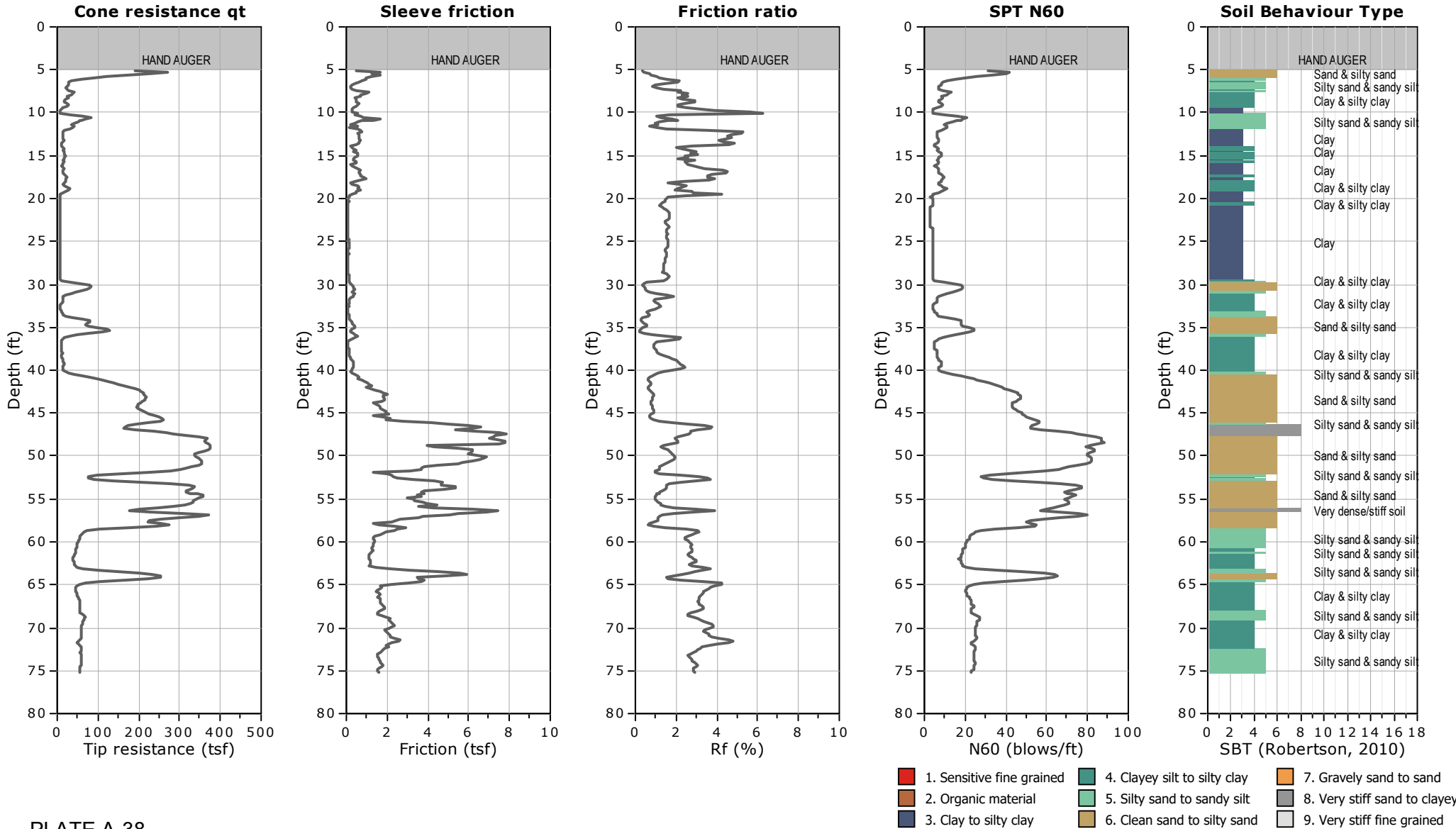


PLATE A-38

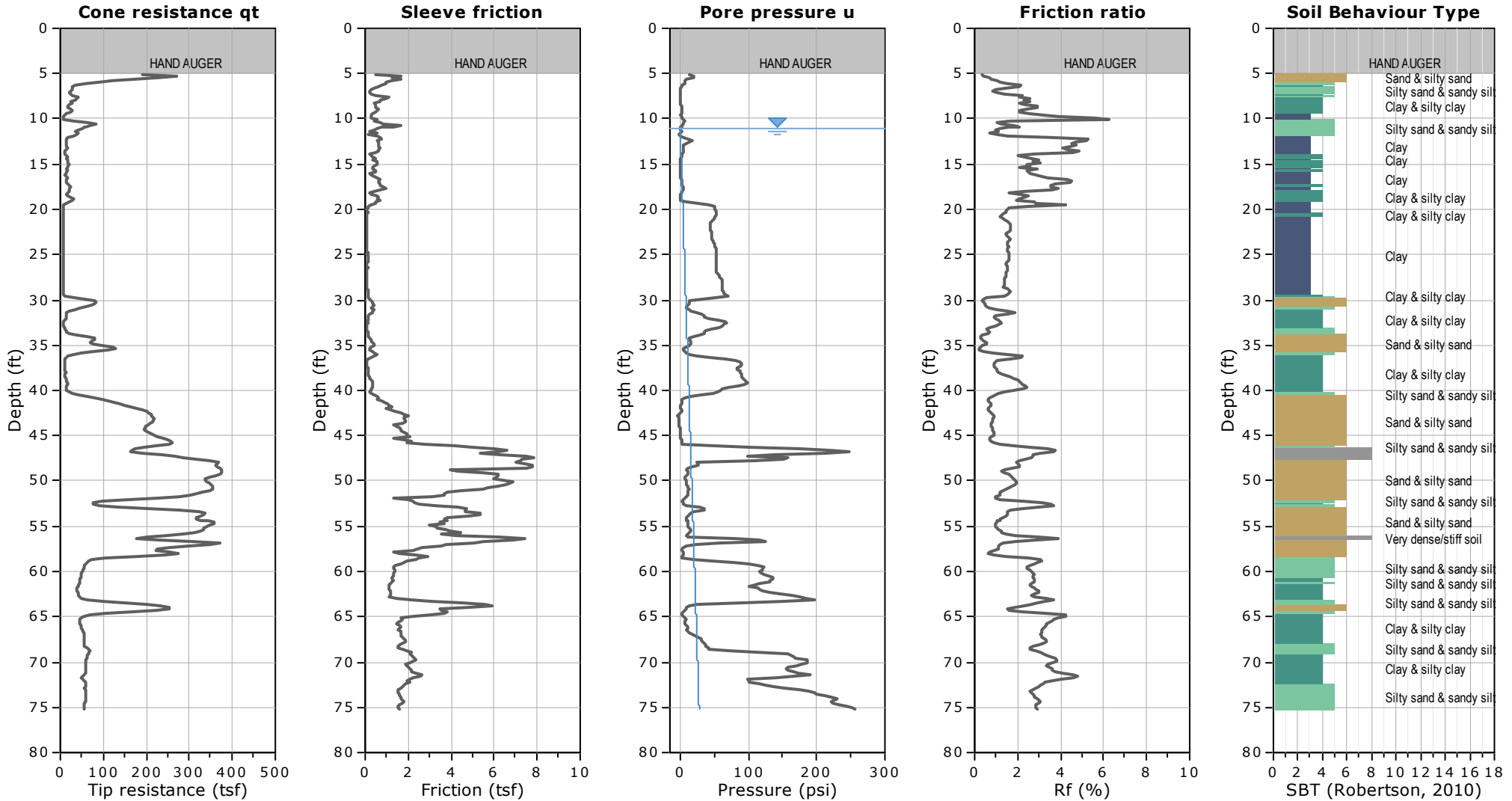


CLIENT: FUGRO

SITE: LANEY COLLEGE, OAKLAND, CA

FIELD REP: REZA RAHIMNEJAD

Total depth: 75.13 ft, Date: 1/3/2020



- 1. Sensitive fine grained
- 4. Clayey silt to silty clay
- 7. Gravely sand to sand
- 2. Organic material
- 5. Silty sand to sandy silt
- 8. Very stiff sand to clayey
- 3. Clay to silty clay
- 6. Clean sand to silty sand
- 9. Very stiff fine grained

WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-39



CLIENT: FUGRO

SITE: LANEY COLLEGE, OAKLAND, CA

FIELD REP: REZA RAHIMNEJAD

Total depth: 75.30 ft, Date: 1/3/2020

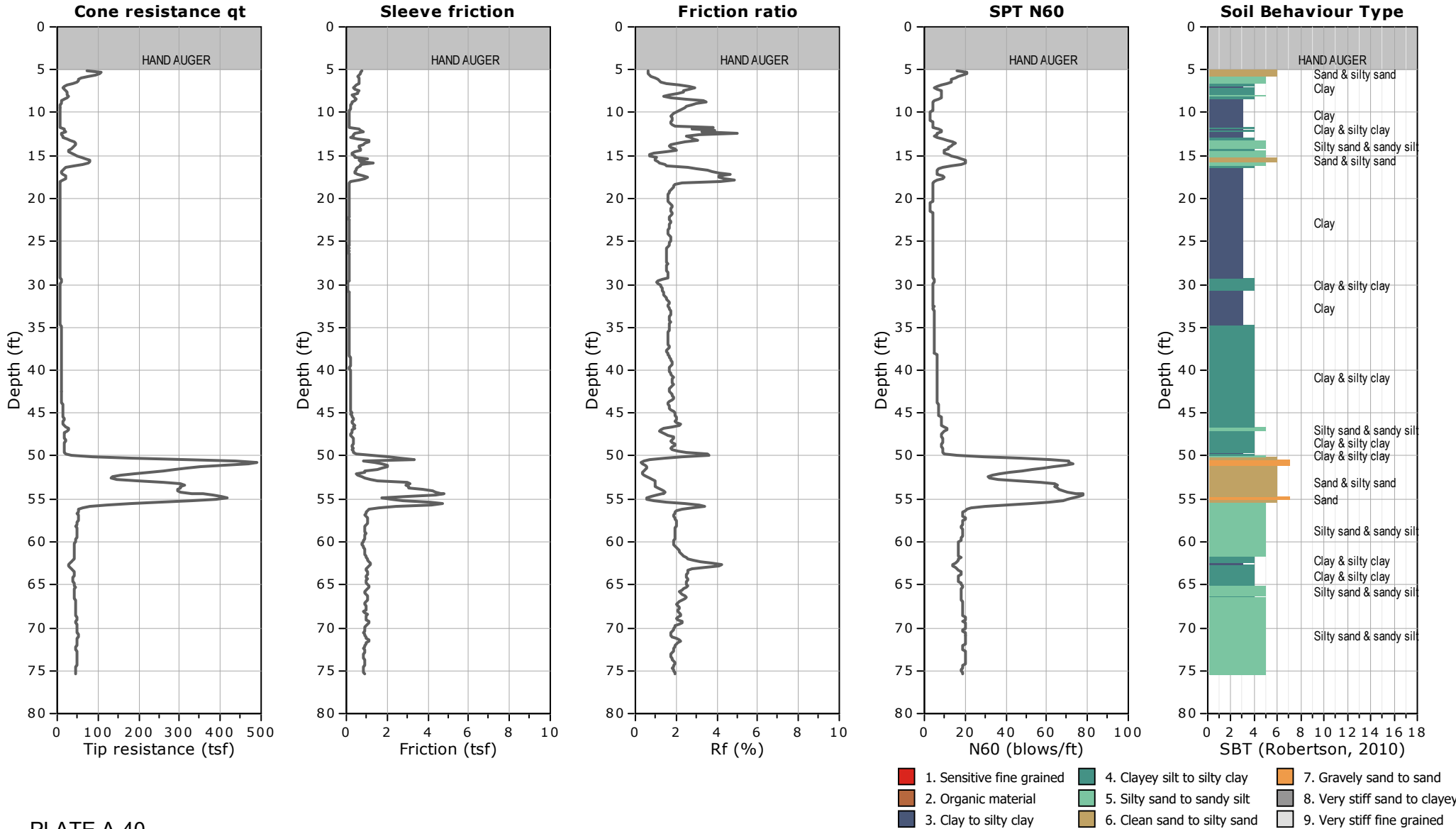


PLATE A-40

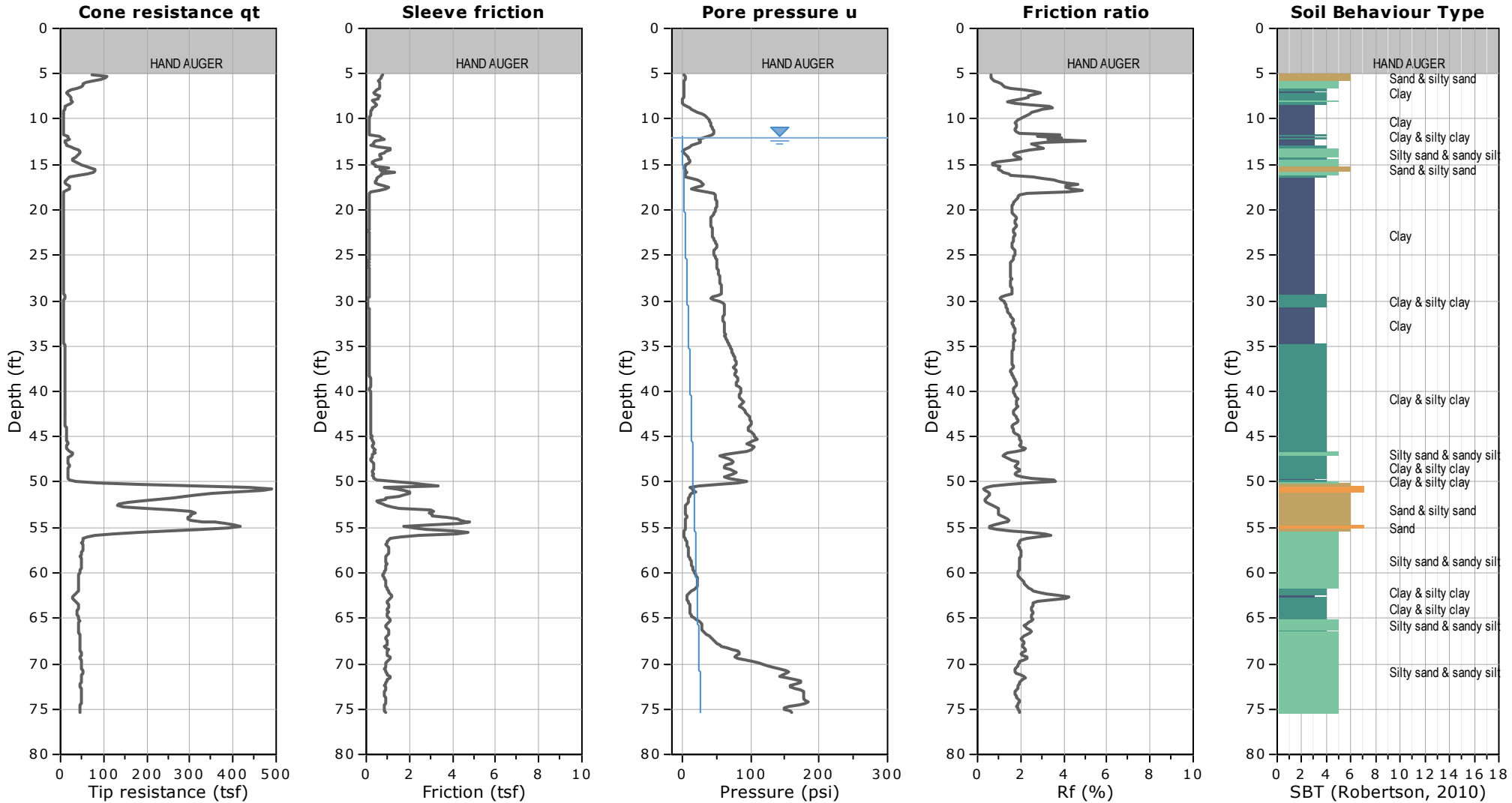


CLIENT: FUGRO

SITE: LANEY COLLEGE, OAKLAND, CA

FIELD REP: REZA RAHIMNEJAD

Total depth: 75.30 ft, Date: 1/3/2020



- | | | |
|---------------------------|------------------------------|------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravely sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-41



CLIENT: FUGRO

SITE: LANEY COLLEGE, OAKLAND, CA

FIELD REP: REZA RAHIMNEJAD

Total depth: 75.13 ft, Date: 1/3/2020

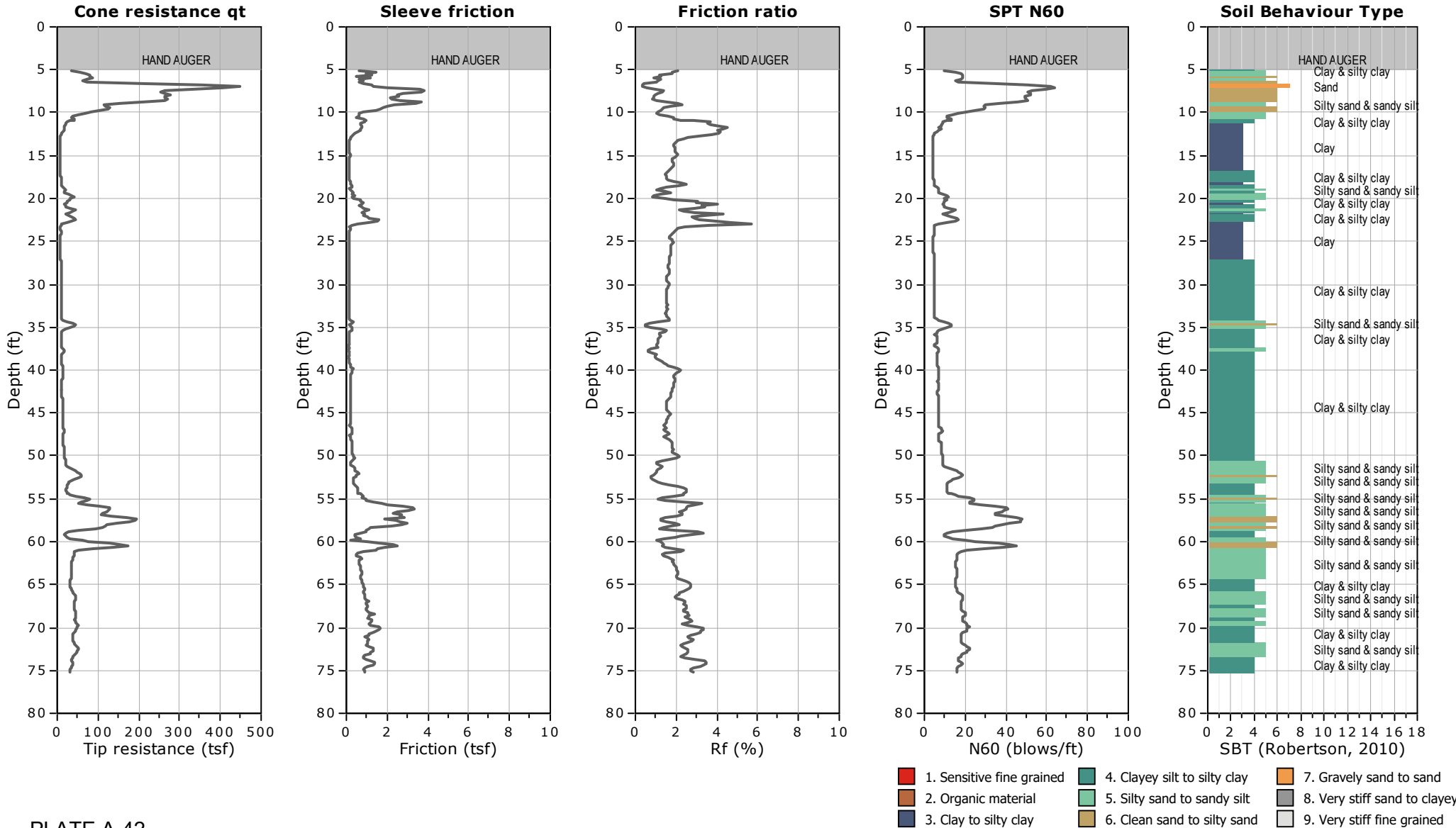


PLATE A-42

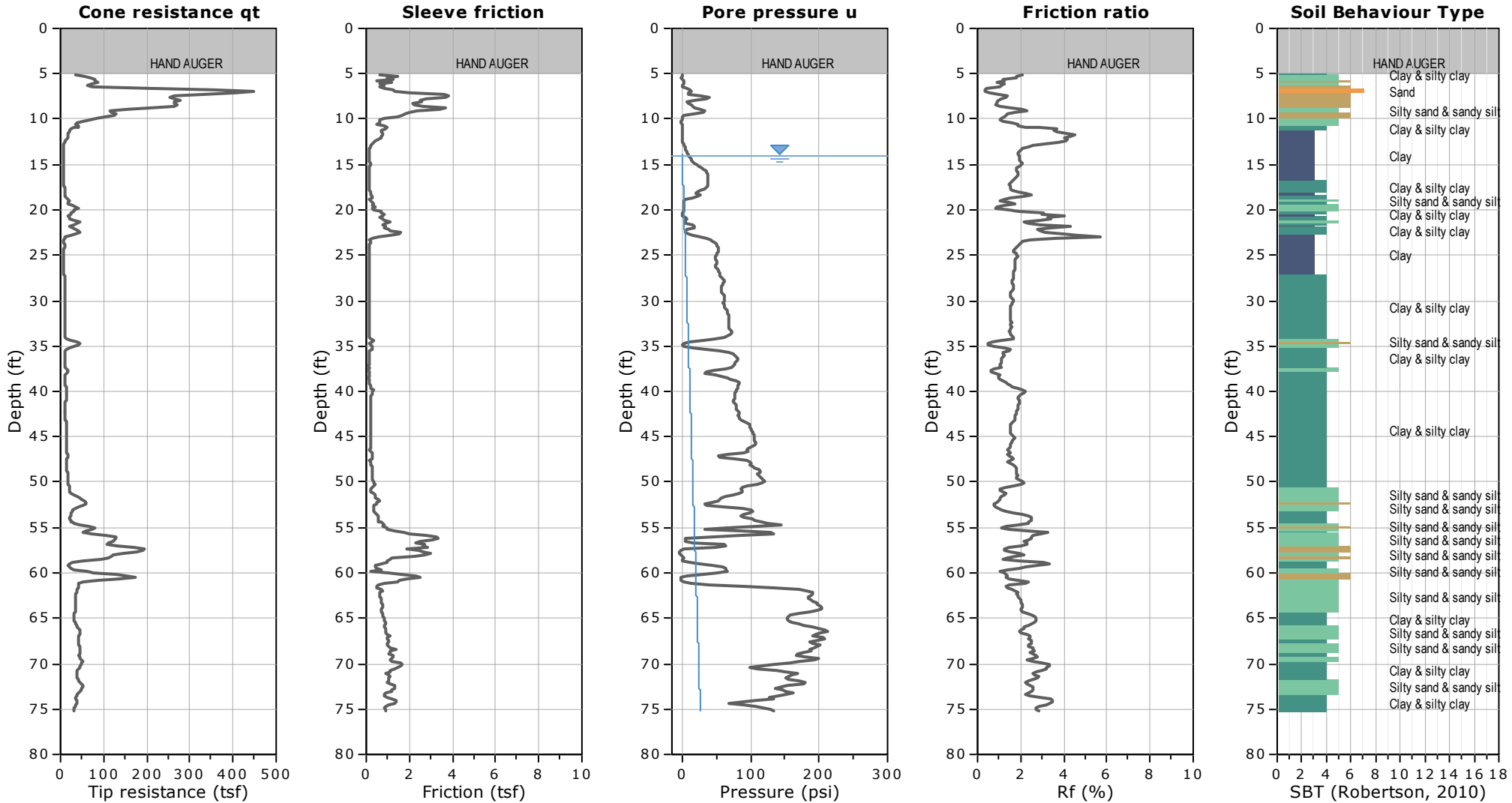


CLIENT: FUGRO

FIELD REP: REZA RAHIMNEJAD

SITE: LANEY COLLEGE, OAKLAND, CA

Total depth: 75.13 ft, Date: 1/3/2020



- | | | |
|---------------------------|------------------------------|------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravely sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-43



CLIENT: FUGRO

SITE: LANEY COLLEGE, OAKLAND, CA

FIELD REP: REZA RAHIMNEJAD

Total depth: 51.67 ft, Date: 1/2/2020

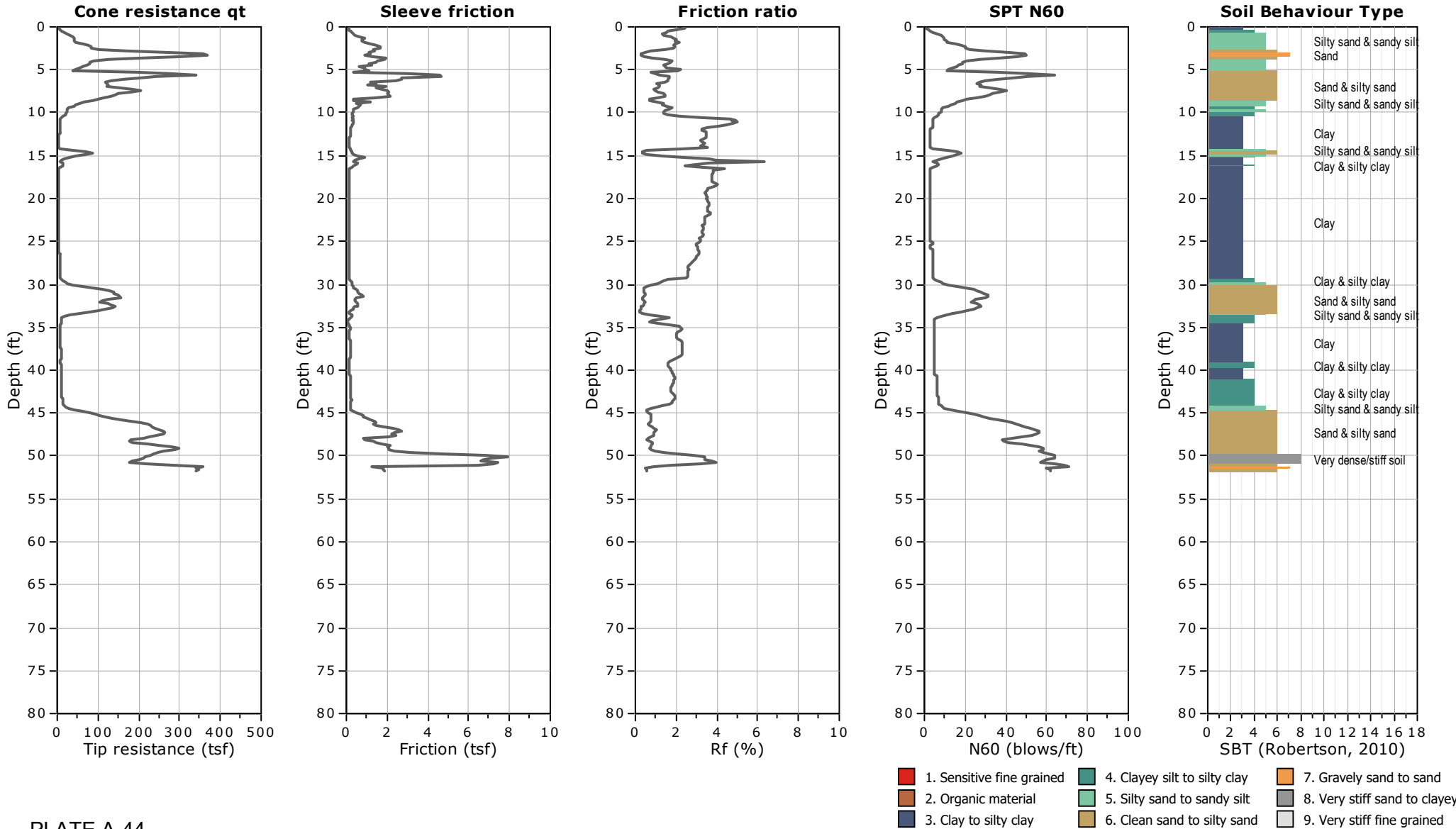


PLATE A-44

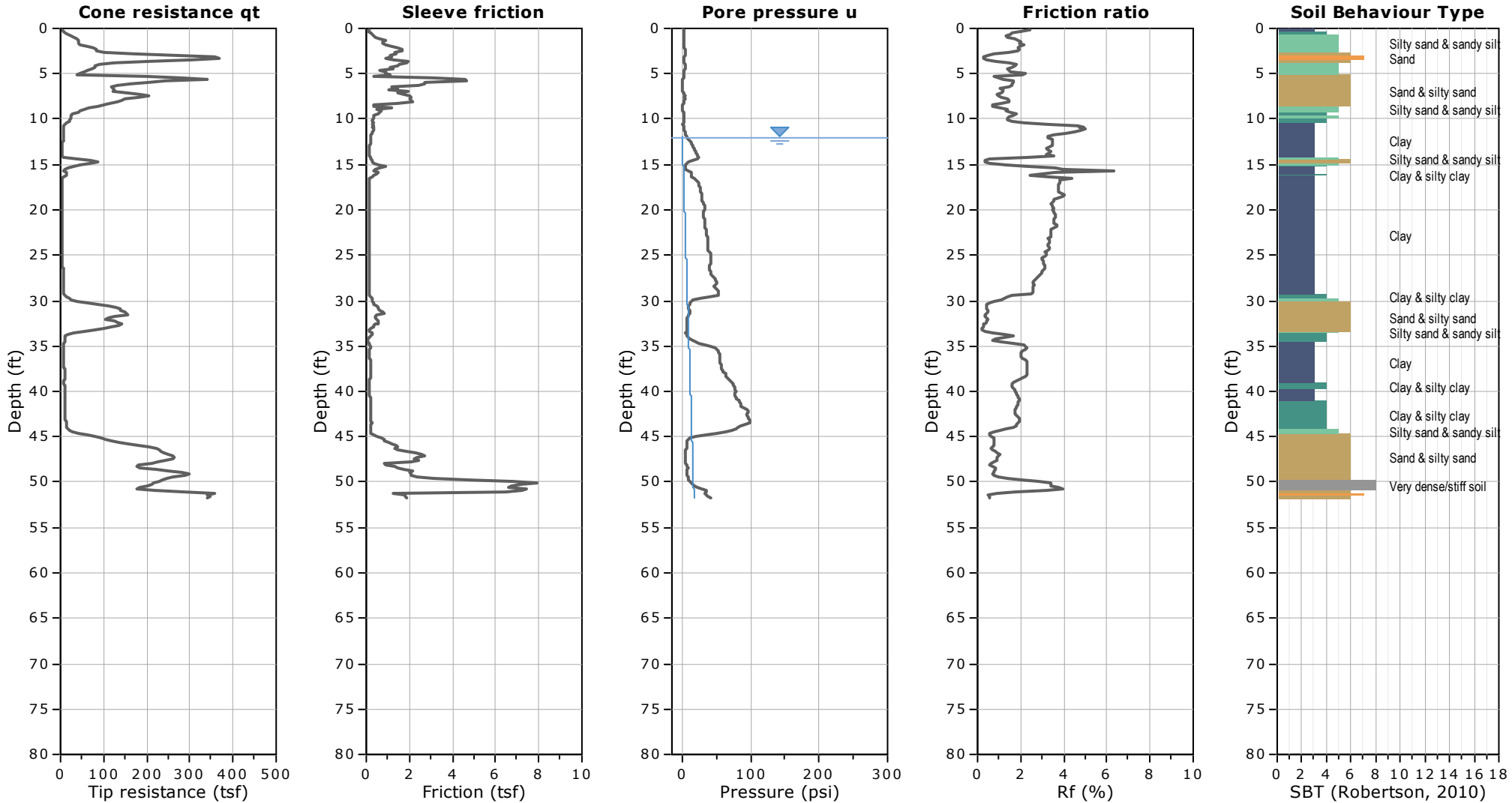


CLIENT: FUGRO

SITE: LANEY COLLEGE, OAKLAND, CA

FIELD REP: REZA RAHIMNEJAD

Total depth: 51.67 ft, Date: 1/2/2020

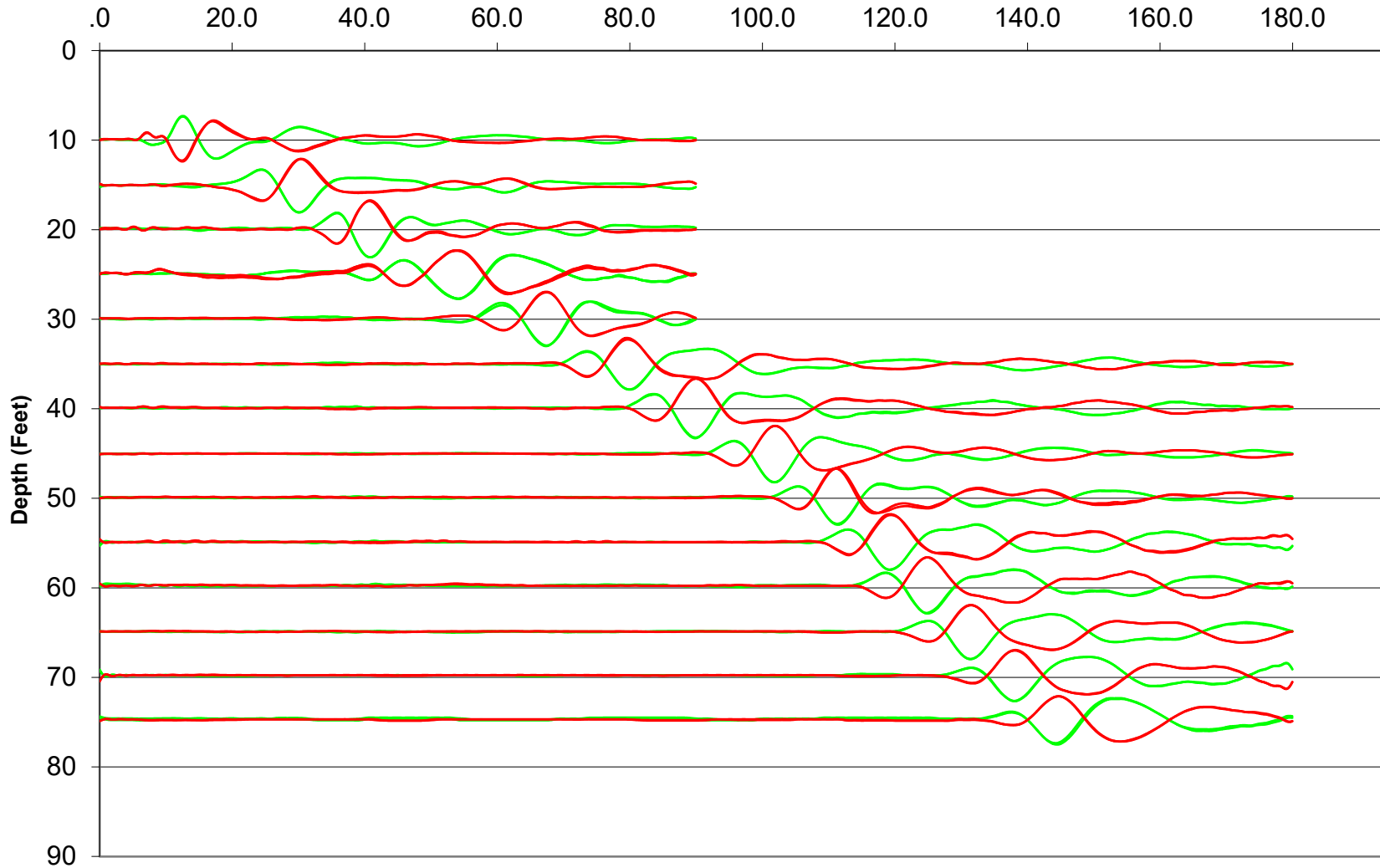


WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-45



Waveforms for Sounding SCPT-07 Time (ms)





Shear Wave Velocity Calculations

Laney College

SCPT-07

Geophone Offset: 0.66 Feet
Source Offset: 1.67 Feet

01/03/20

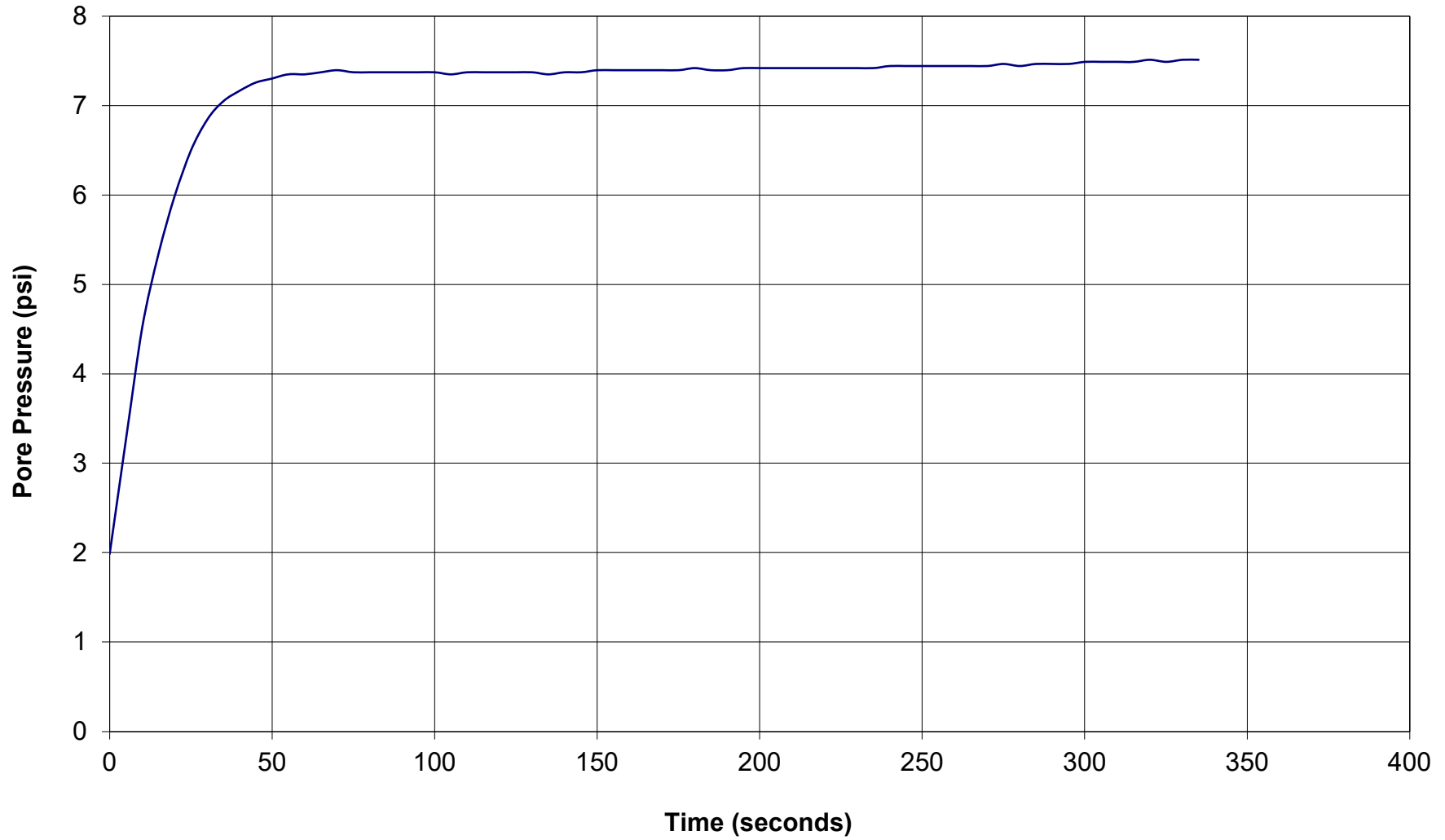
Test Depth (Feet)	Geophone Depth (Feet)	Waveform Ray Path (Feet)	Incremental Distance (Feet)	Characteristic Arrival Time (ms)	Incremental Time Interval (ms)	Interval Velocity (Ft/Sec)	Interval Depth (Feet)
10.01	9.35	9.49	9.49	14.8000			
15.09	14.43	14.53	5.03	27.0000	12.2000	412.6	11.89
20.01	19.35	19.42	4.90	37.7000	10.7000	457.7	16.89
25.10	24.44	24.50	5.07	49.0500	11.3500	446.7	21.90
30.02	29.36	29.41	4.91	63.5000	14.4500	339.9	26.90
35.10	34.44	34.49	5.08	76.2500	12.7500	398.3	31.90
40.03	39.37	39.40	4.92	86.2000	9.9500	494.1	36.91
45.11	44.45	44.48	5.08	98.1500	11.9500	425.2	41.91
50.03	49.37	49.40	4.92	107.6500	9.5000	517.7	46.91
55.12	54.46	54.48	5.08	115.6000	7.9500	639.3	51.92
60.04	59.38	59.40	4.92	121.1000	5.5000	894.4	56.92
65.12	64.46	64.49	5.08	127.5500	6.4500	788.1	61.92
70.05	69.39	69.41	4.92	133.8000	6.2500	787.2	66.93
75.13	74.47	74.49	5.08	140.0500	6.2500	813.4	71.93



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: CPT-04
Depth (ft): 31.33
Site: Laney College
Engineer: Reza Rahimnejad

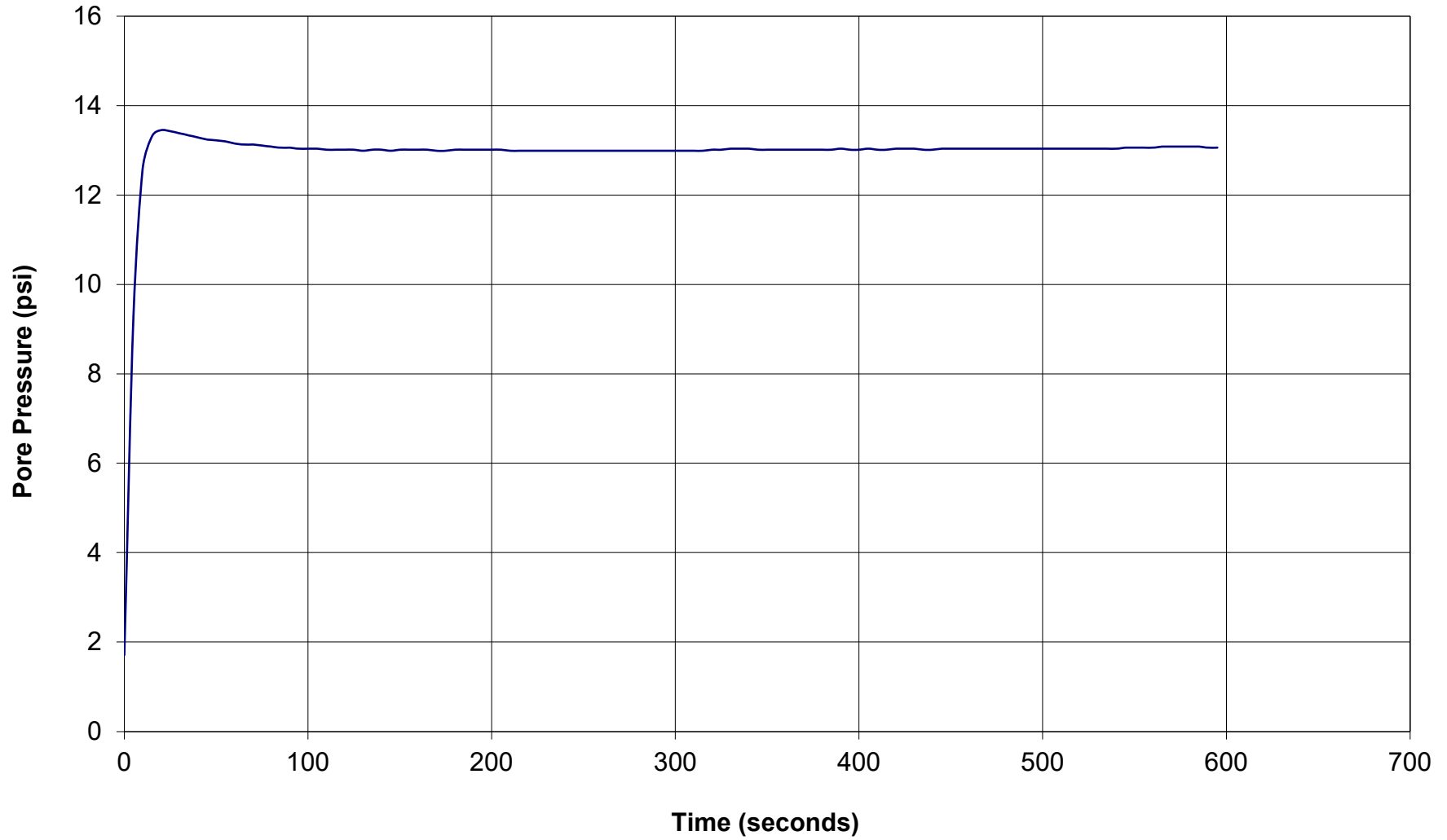




GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: CPT-05
Depth (ft): 41.17
Site: Laney College
Engineer: Reza Rahimnejad

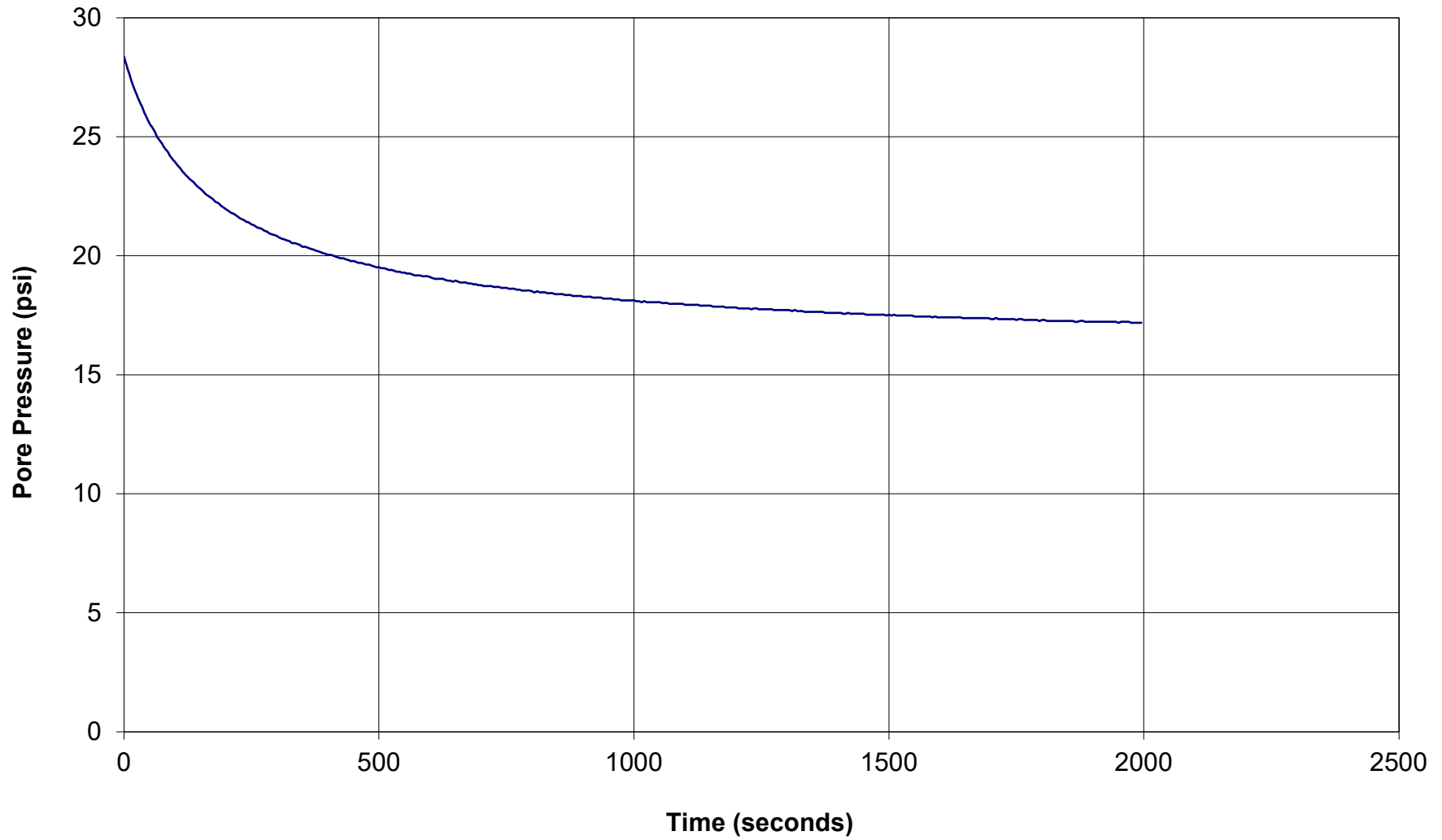




GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: CPT-08
Depth (ft): 51.67
Site: Laney College
Engineer: Reza Rahimnejad





GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: SCPT-07
Depth (ft): 57.58
Site: Laney College
Engineer: Reza Rahimnejad

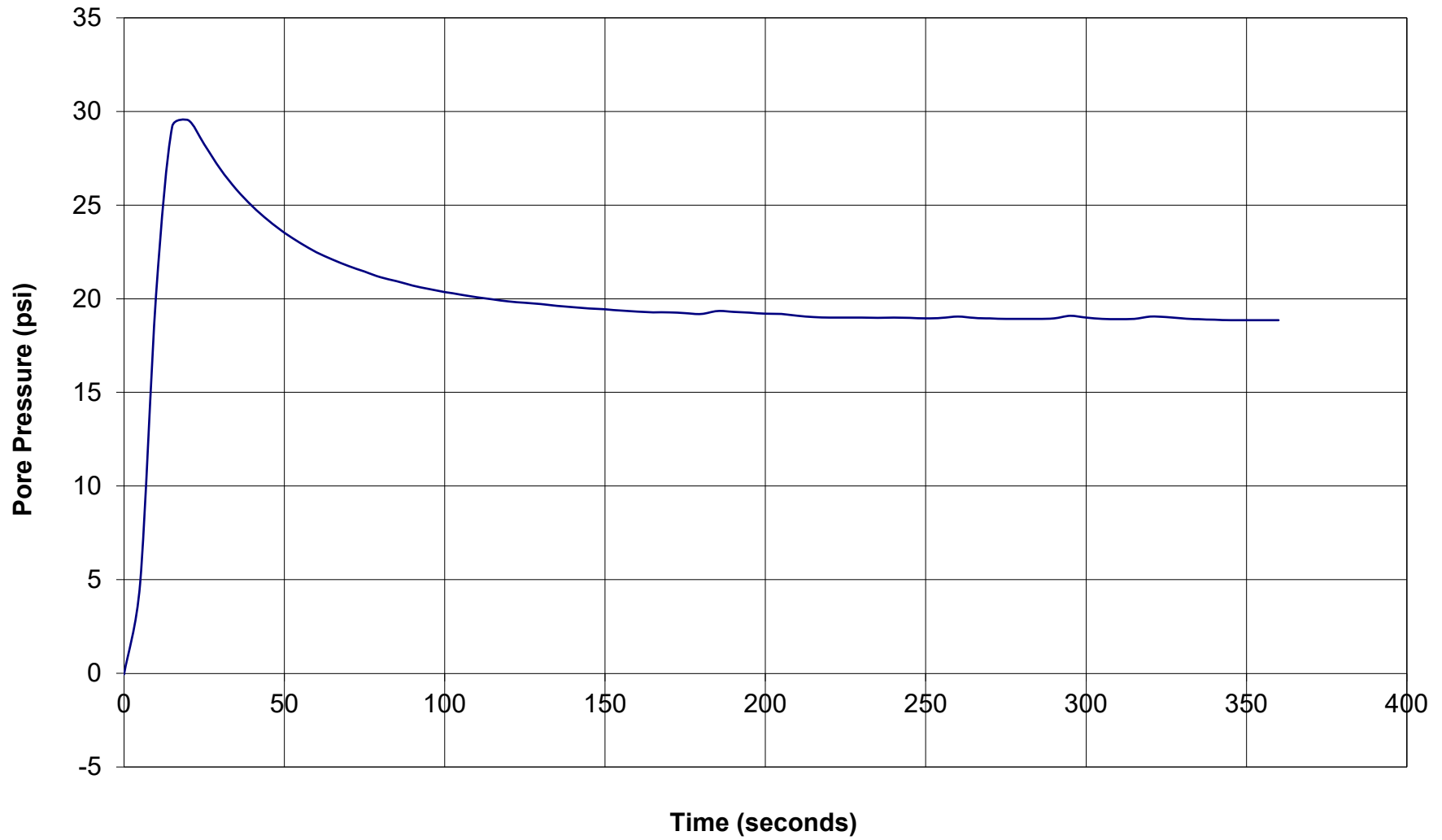


Table 1: Cone Penetration Testing Summary

CPT Sounding Identification	Date	Termination Depth (ft)	Depth of Soil Samples (ft)	Depth of Groundwater Samples (ft)	Depth of Pore Pressure Dissipation Tests (ft)
CPT-16	11/22/2022	100.23	-	-	48.06
CPT-17	11/22/2022	100.23	-	-	-
CPT-18	11/18/2022	80.22	-	-	-
CPT-19	11/17/2022	65.29	-	-	30.02
CPT-20	11/17/2022	80.22	-	-	-
CPT-21	11/18/2022	80.38	-	-	-
CPT-22	11/17/2022	45.28	-	-	-
CPT-23	11/17/2022	71.03	-	-	-
CPT-24	11/17/2022	80.22	-	-	-
CPT-25	11/18/2022	80.22	-	-	27.23



CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 100.23 ft, Date: 11/22/2022

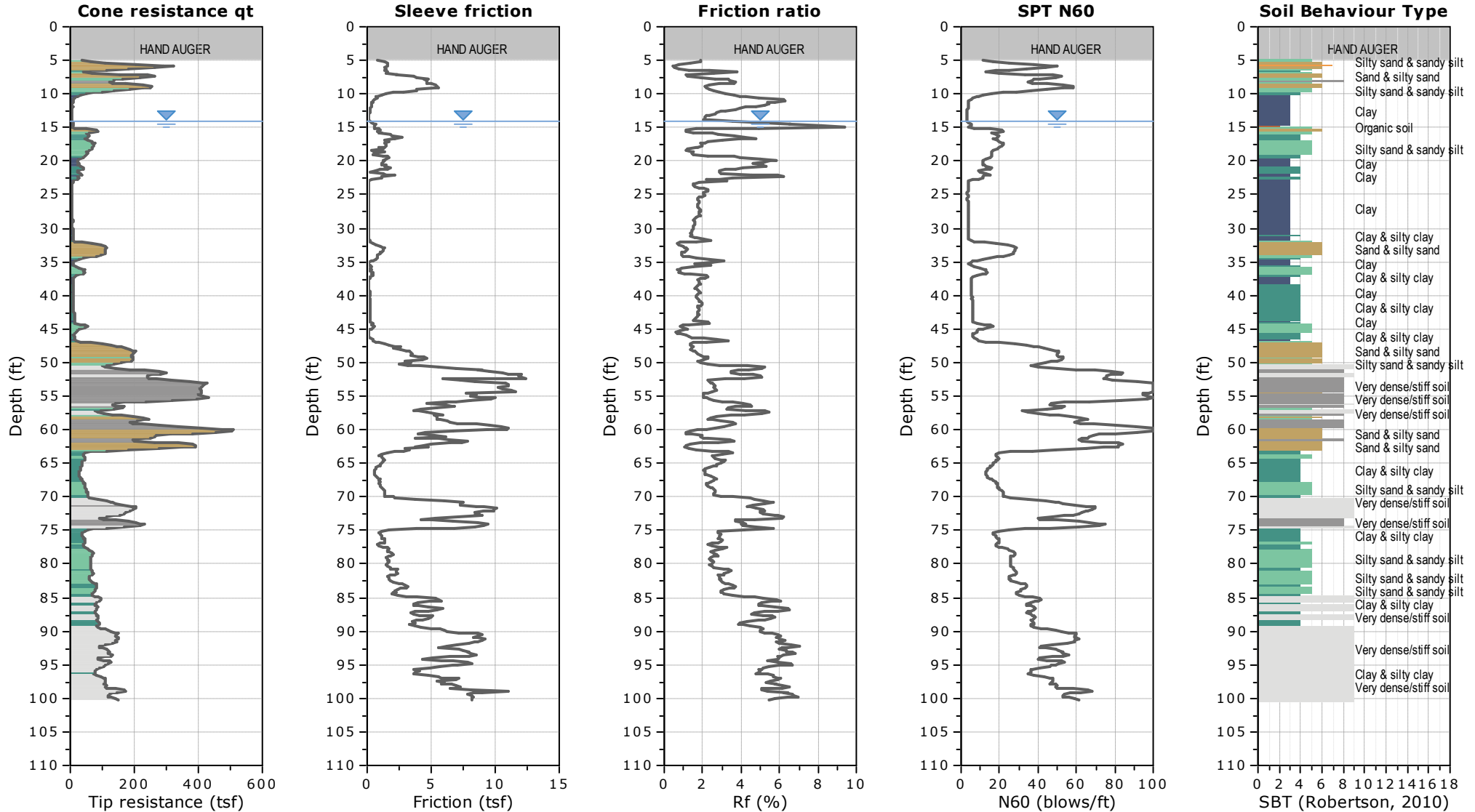


PLATE A-53

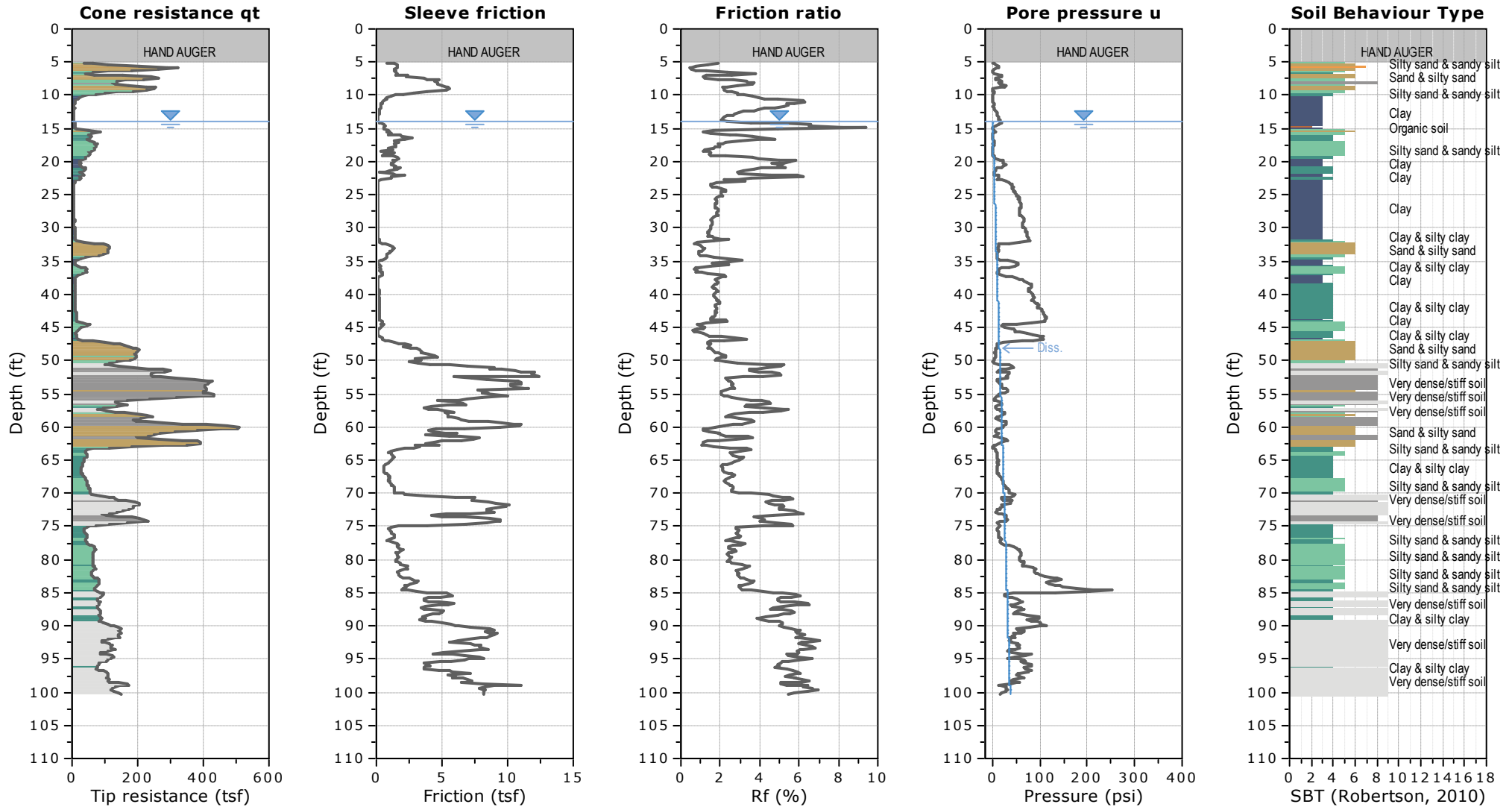


CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 100.23 ft, Date: 11/22/2022



WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-54



CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 100.23 ft, Date: 11/22/2022

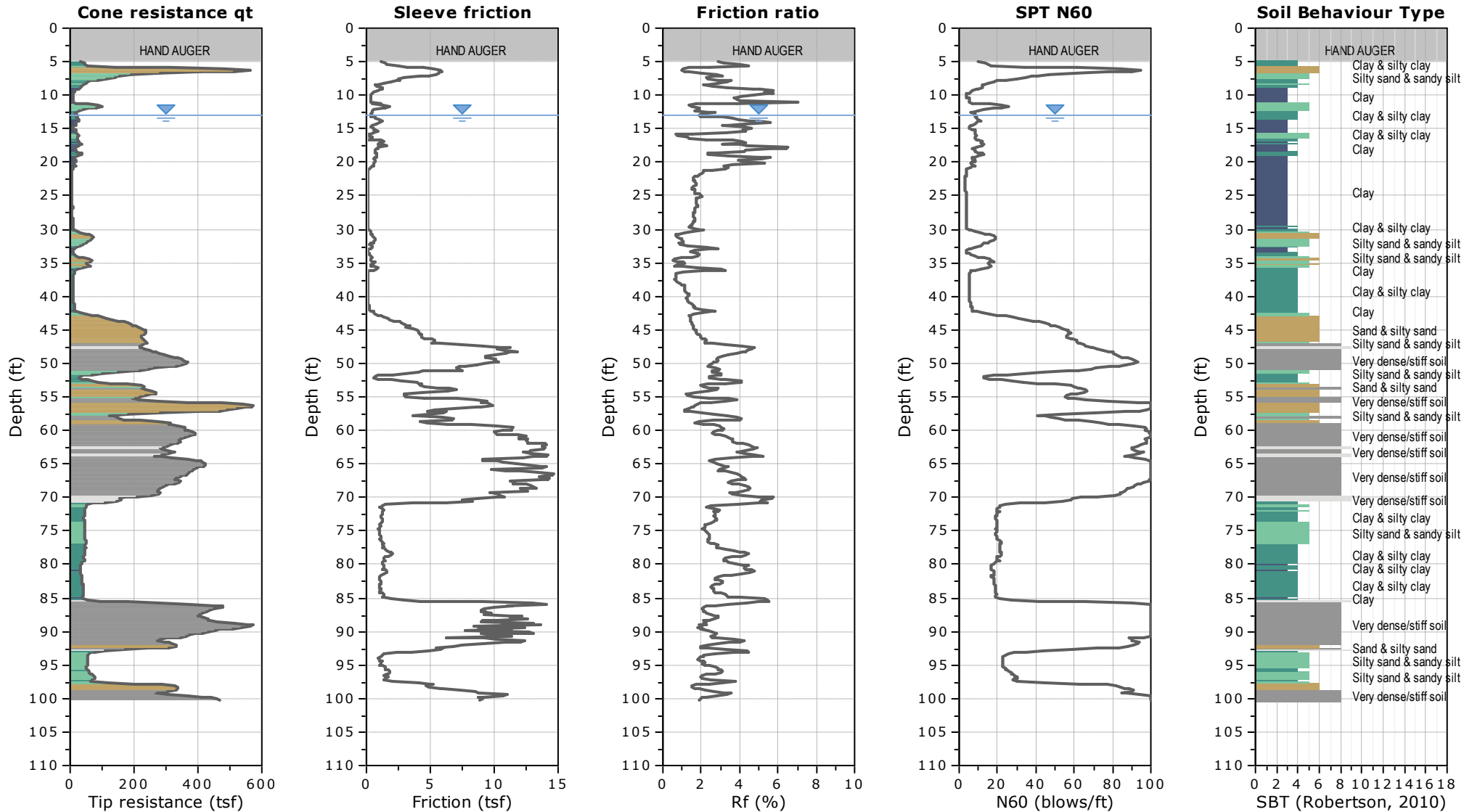


PLATE A-55

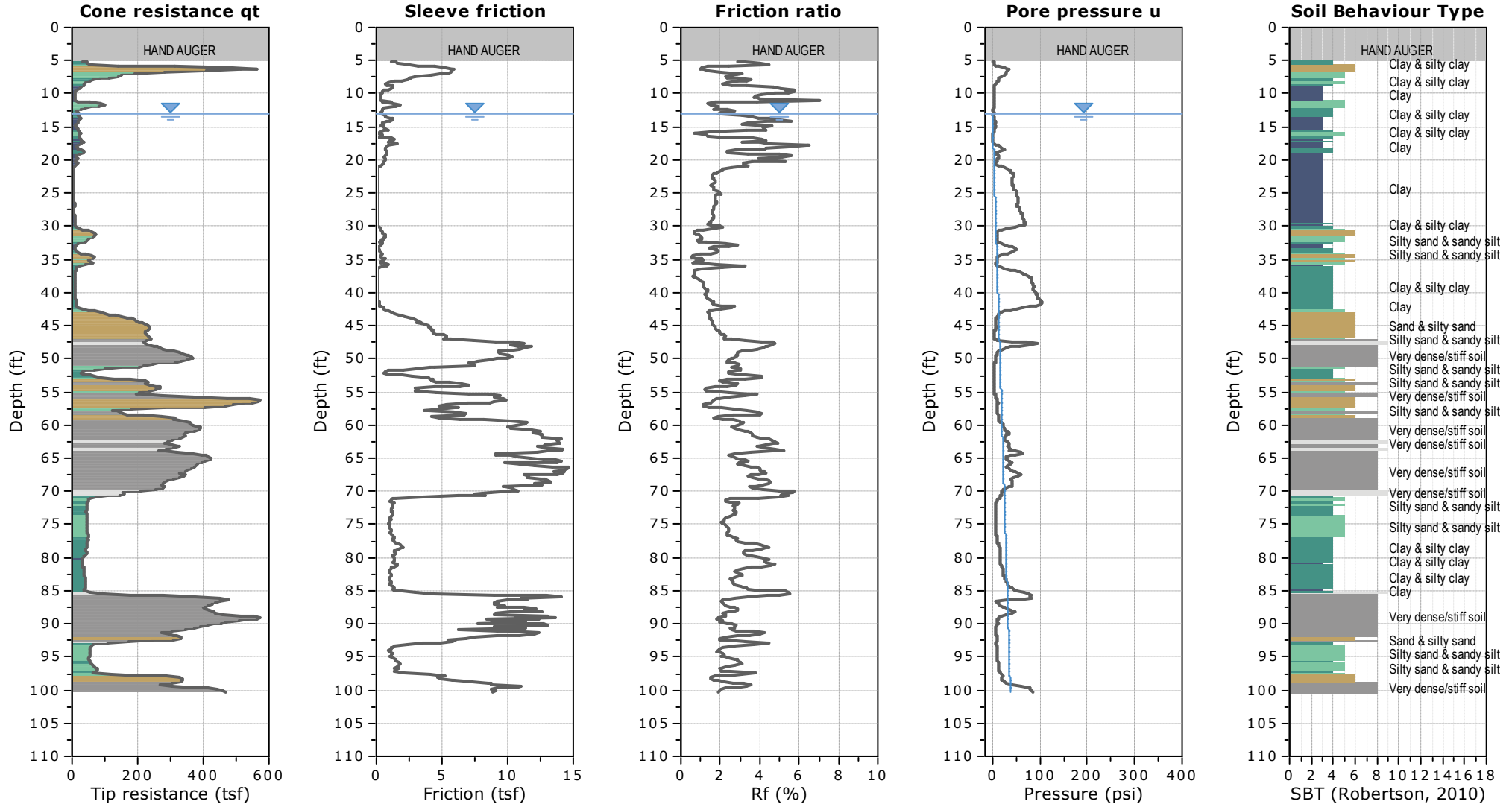


CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 100.23 ft, Date: 11/22/2022



WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-56



CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 80.22 ft, Date: 11/18/2022

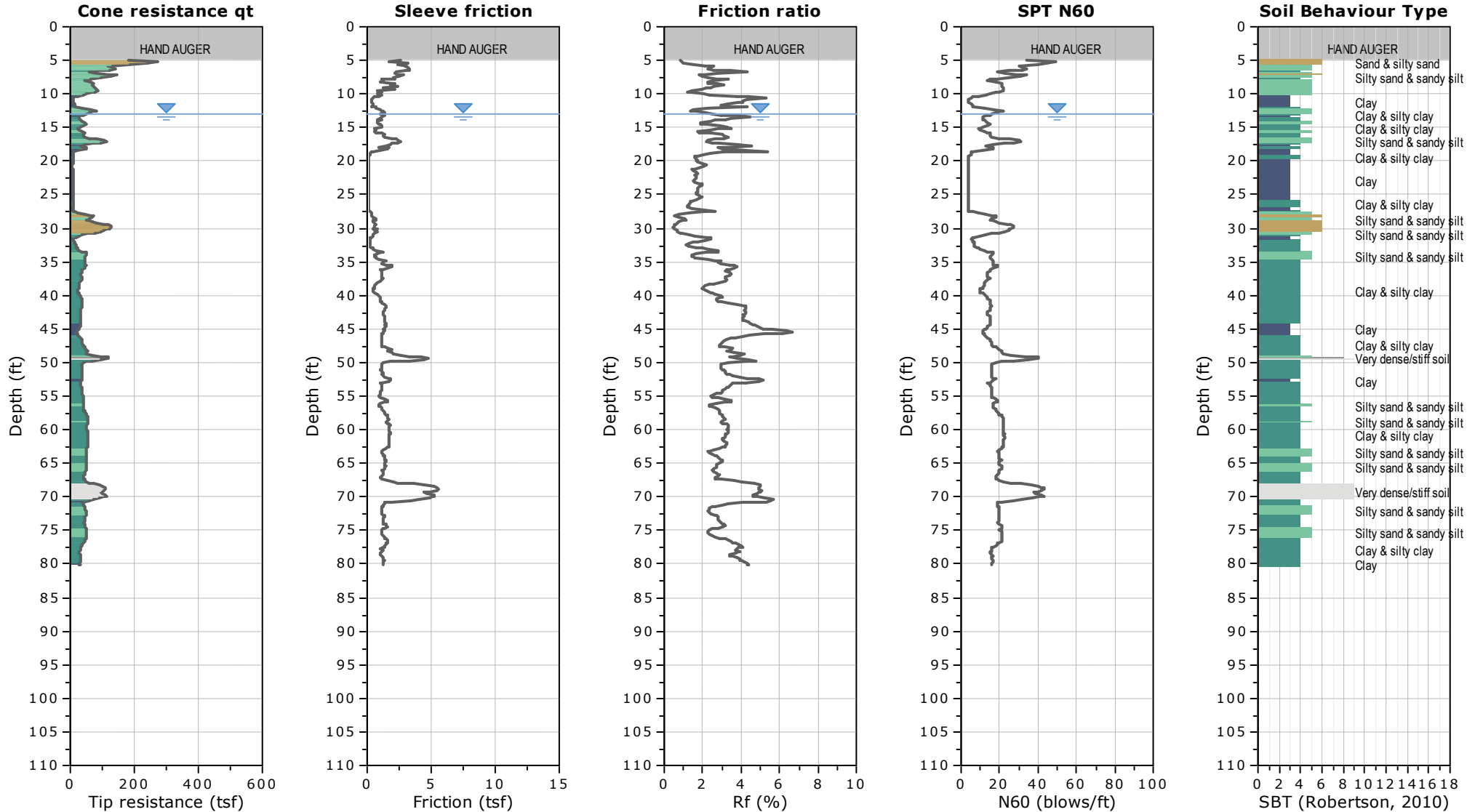


PLATE A-57

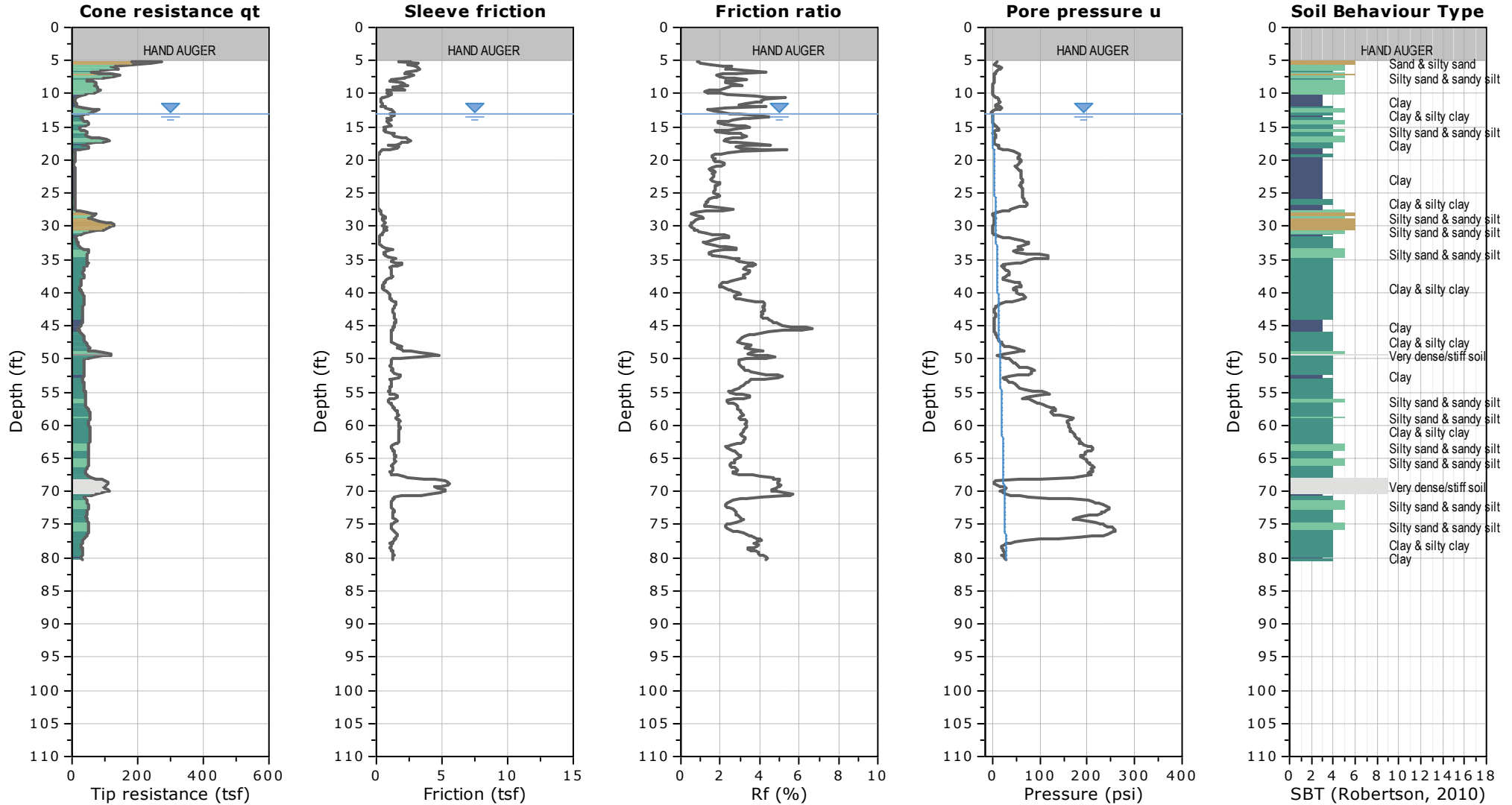


CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 80.22 ft, Date: 11/18/2022



WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-58



CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 65.29 ft, Date: 11/17/2022

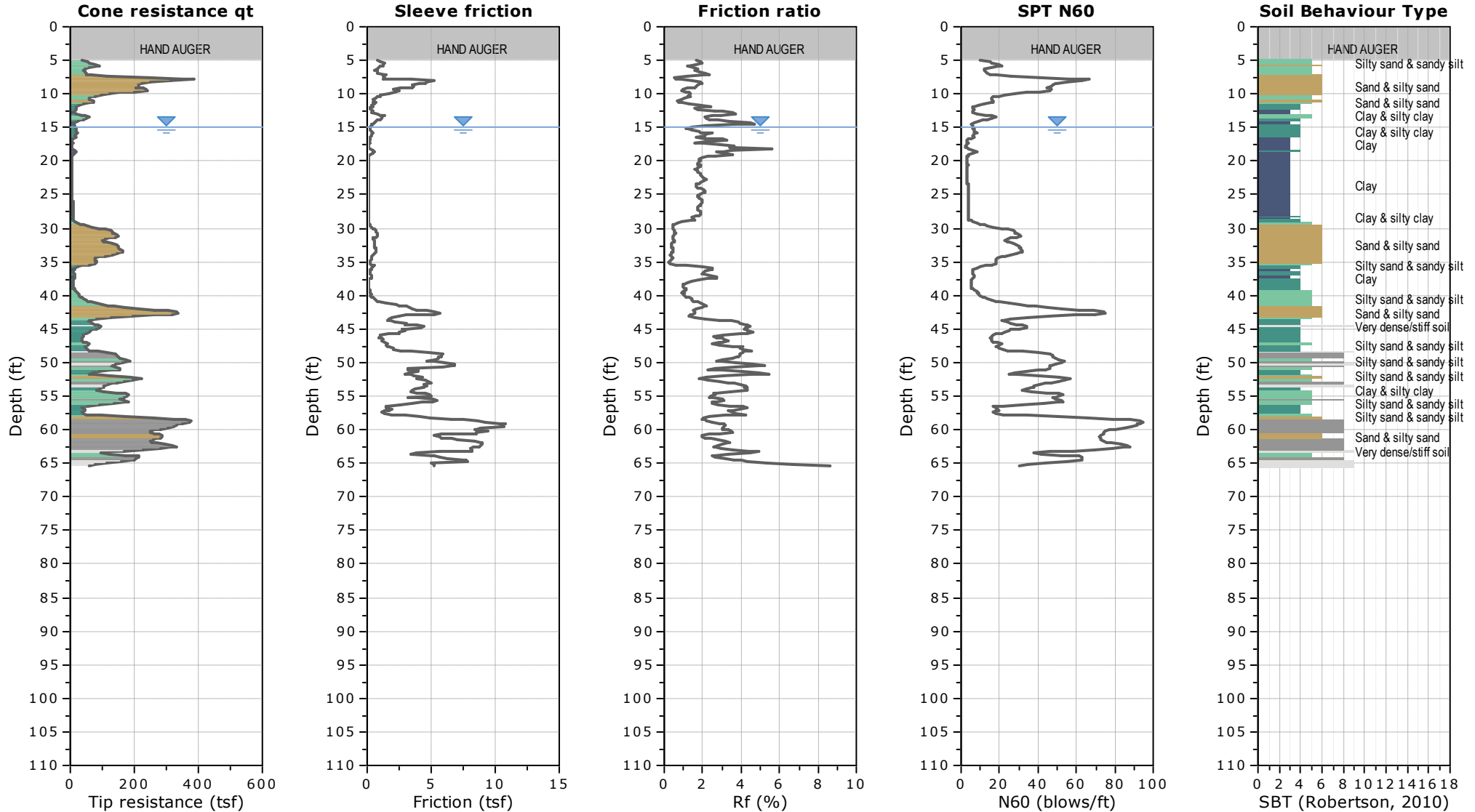


PLATE A-59

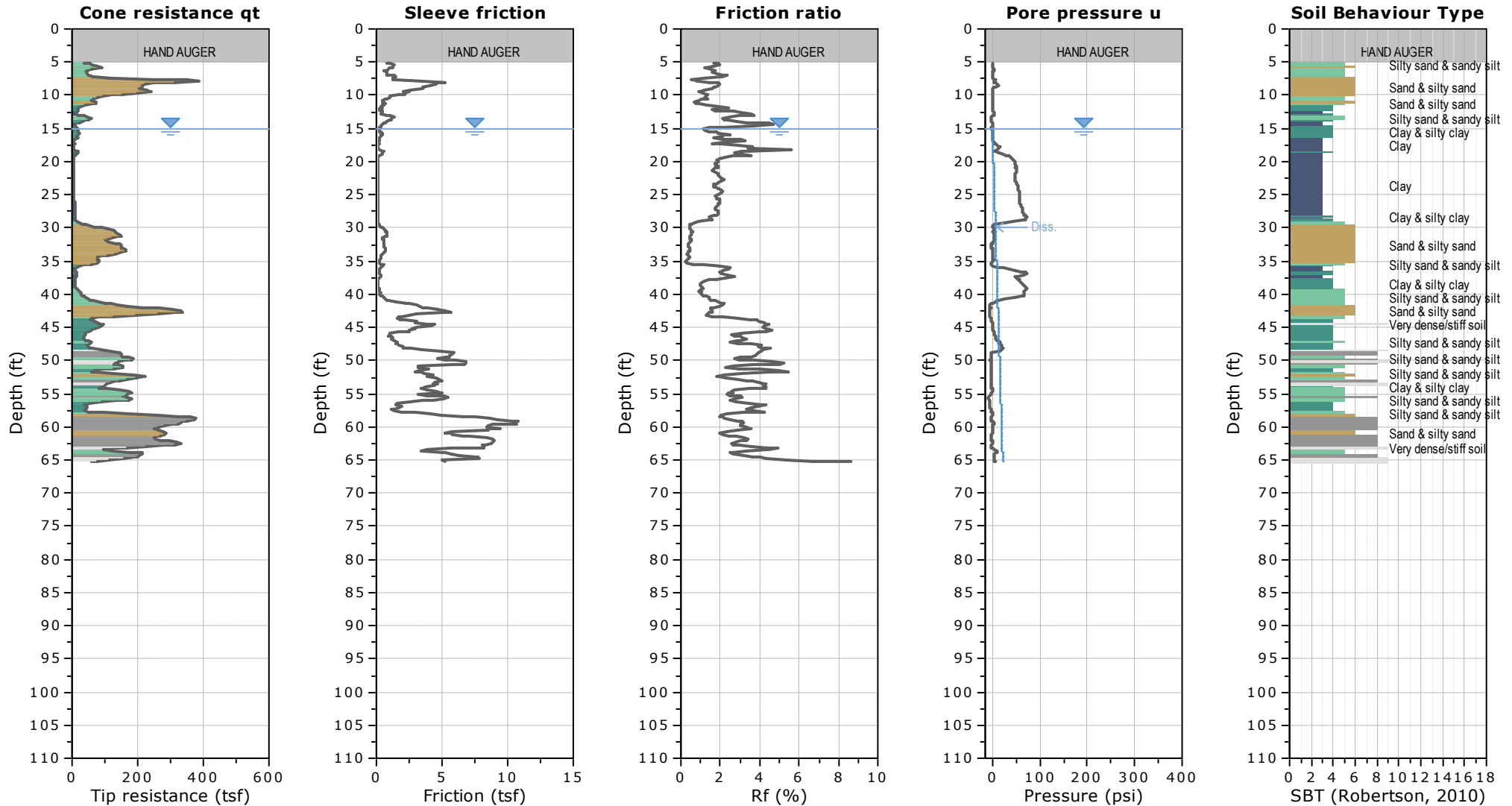


CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 65.29 ft, Date: 11/17/2022



WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-60



CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 80.22 ft, Date: 11/17/2022

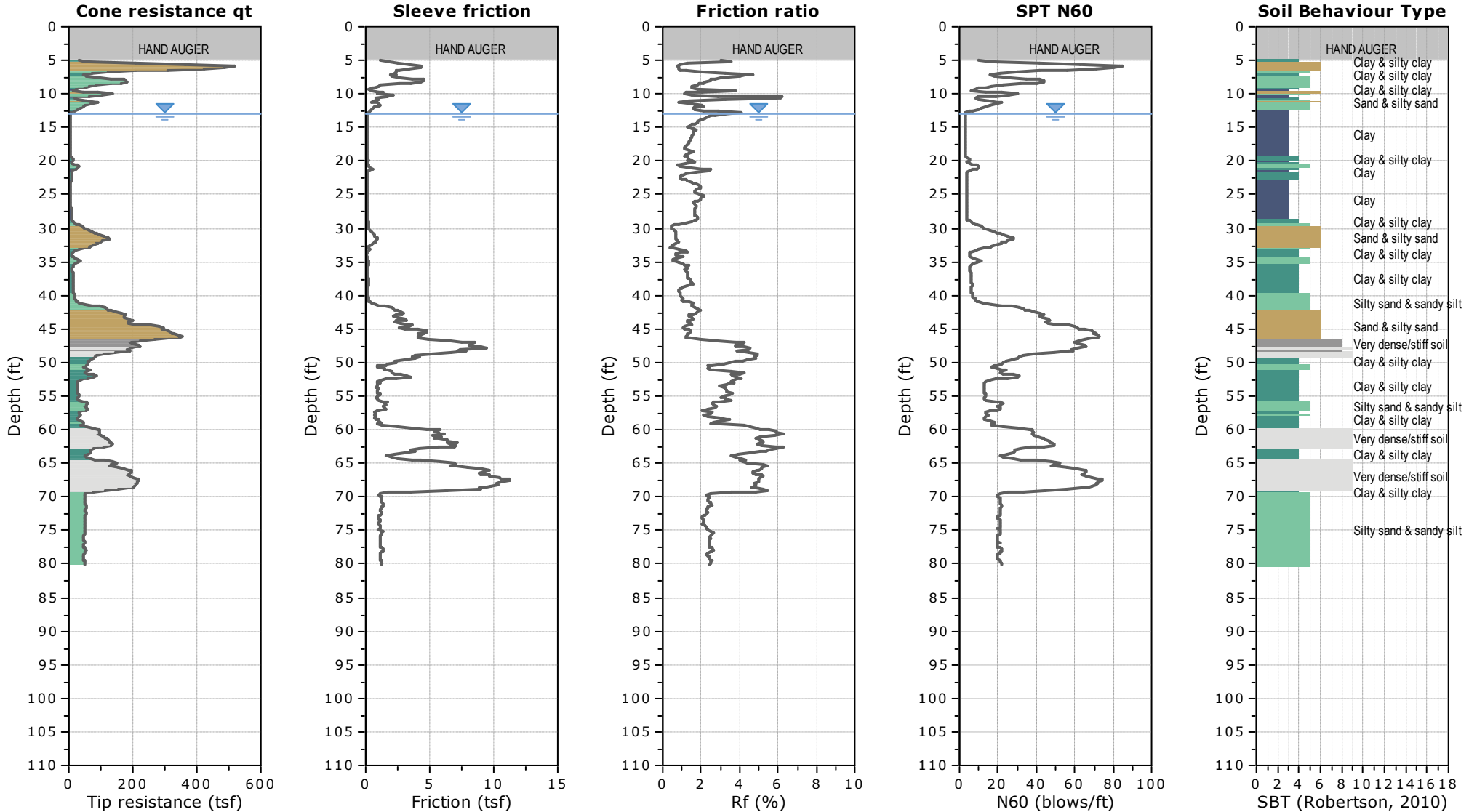


PLATE A-61

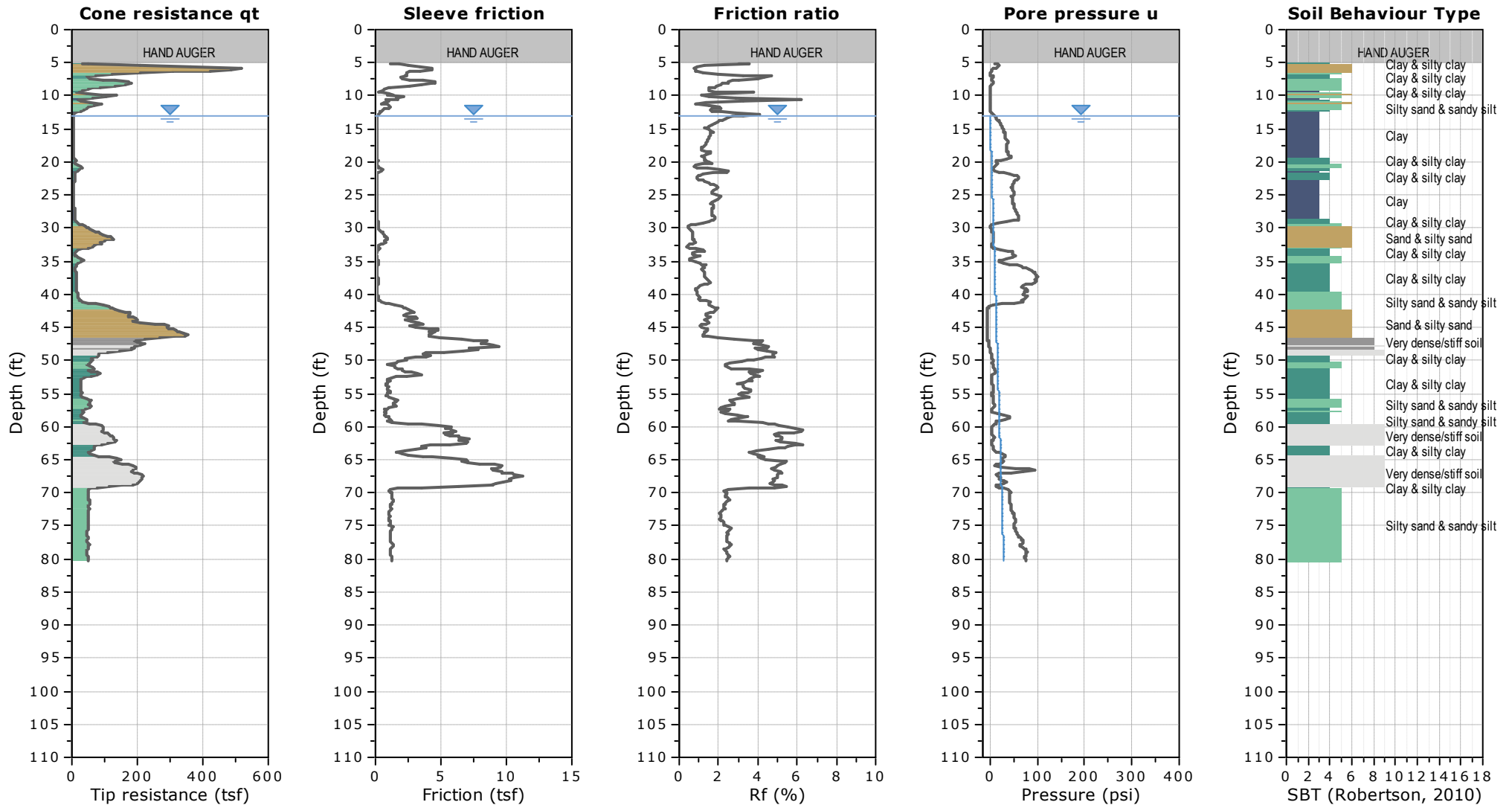


CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 80.22 ft, Date: 11/17/2022



WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-62



CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 80.38 ft, Date: 11/18/2022

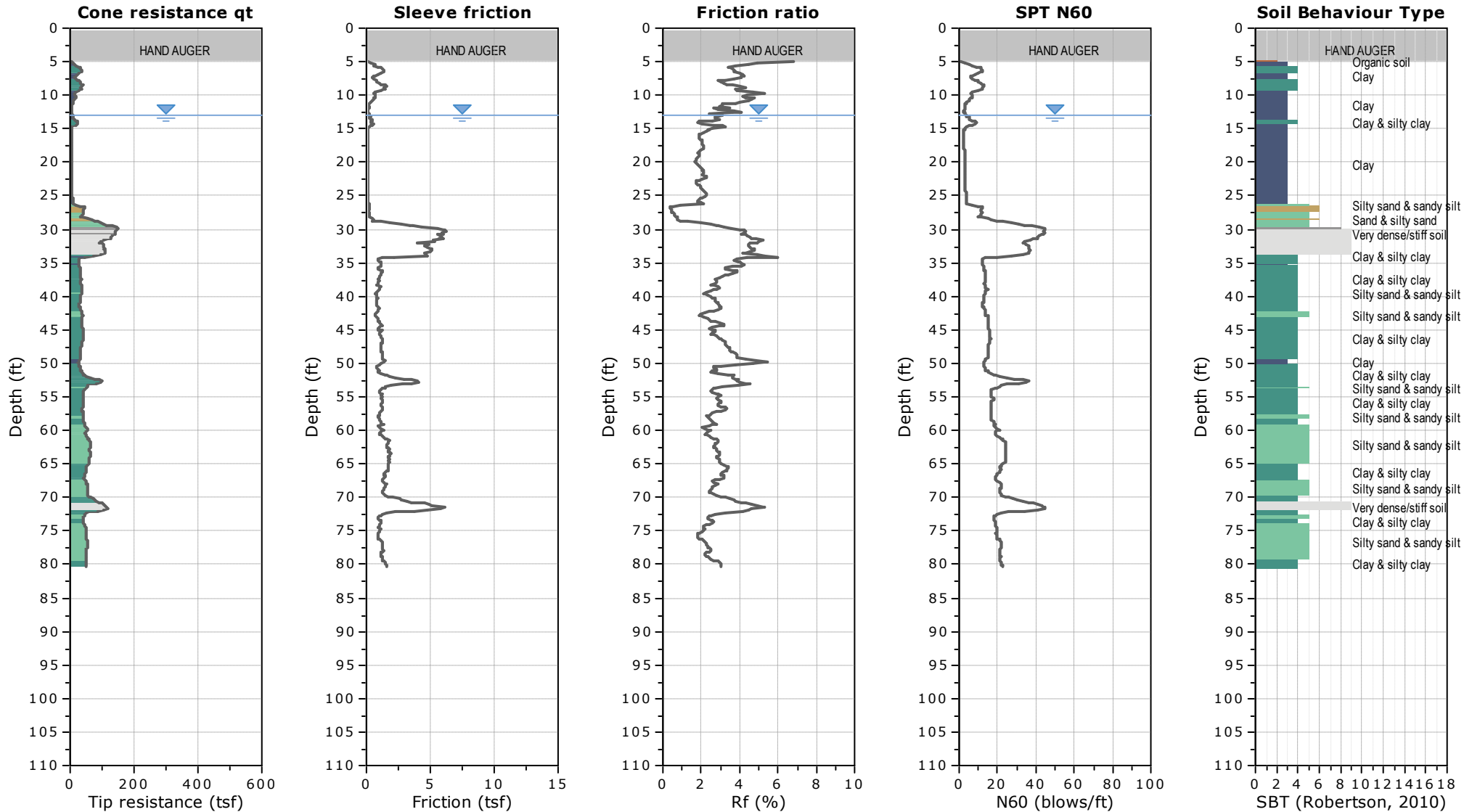


PLATE A-63

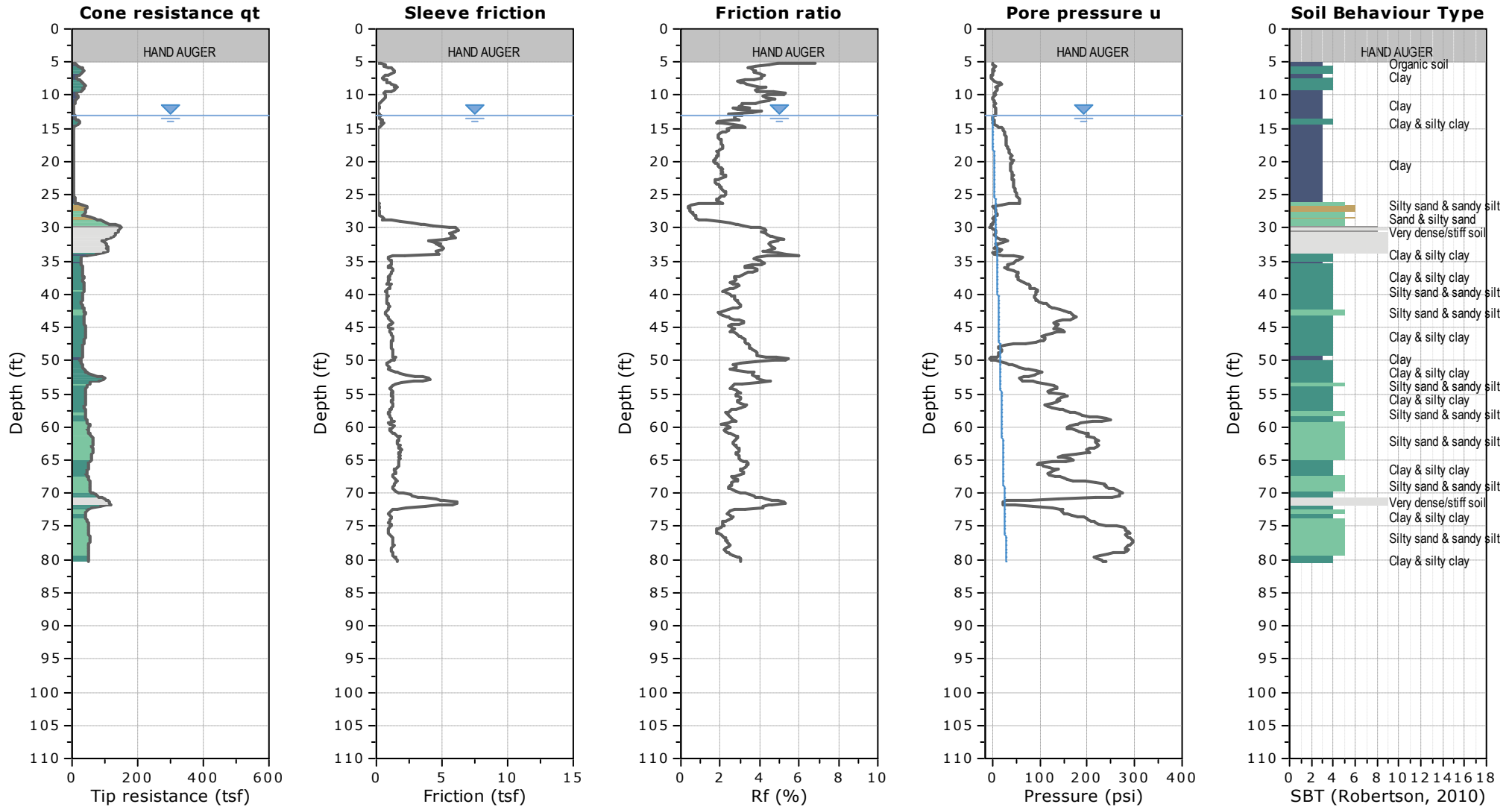


CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 80.38 ft, Date: 11/18/2022



WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-64



CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 45.28 ft, Date: 11/17/2022

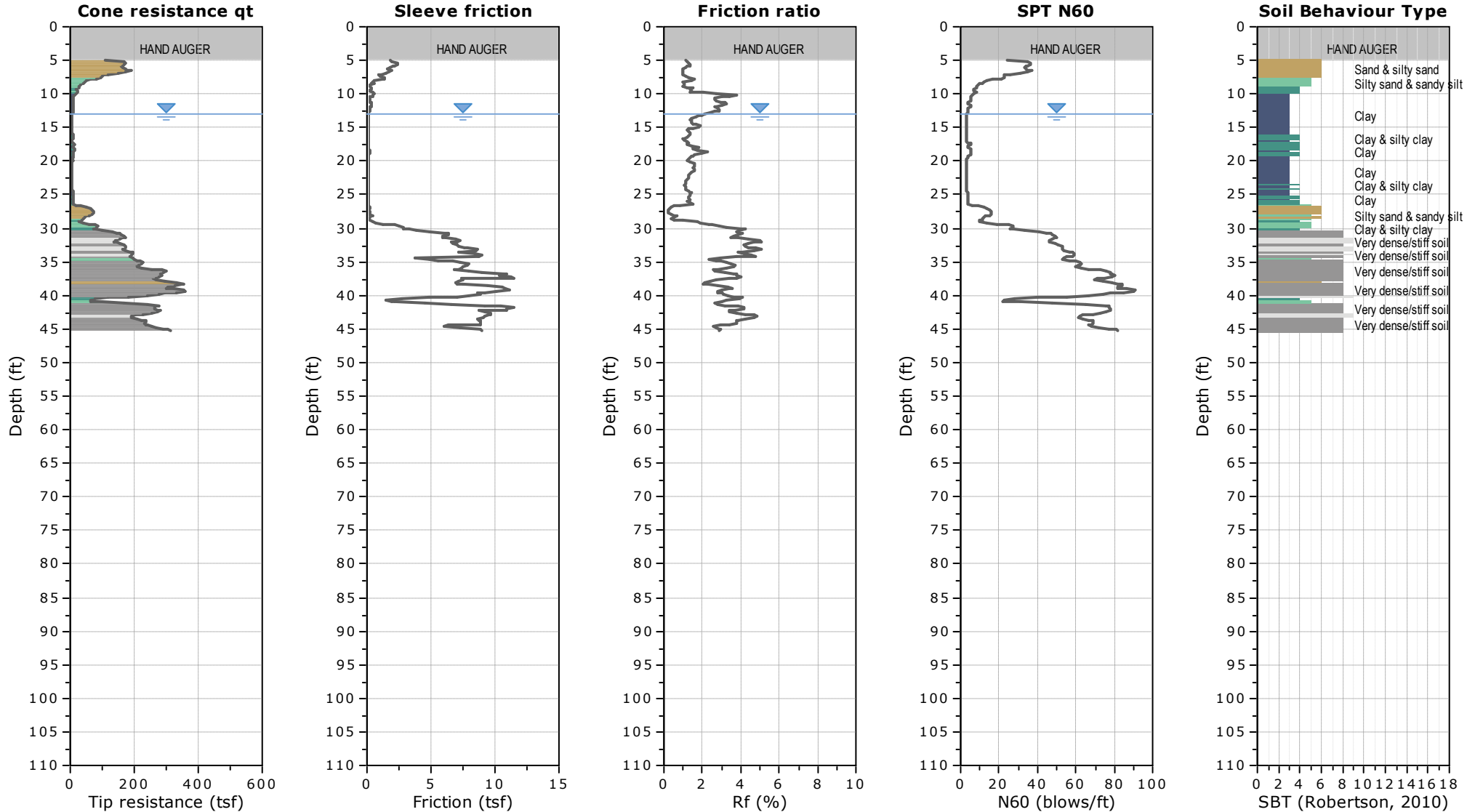


PLATE A-65

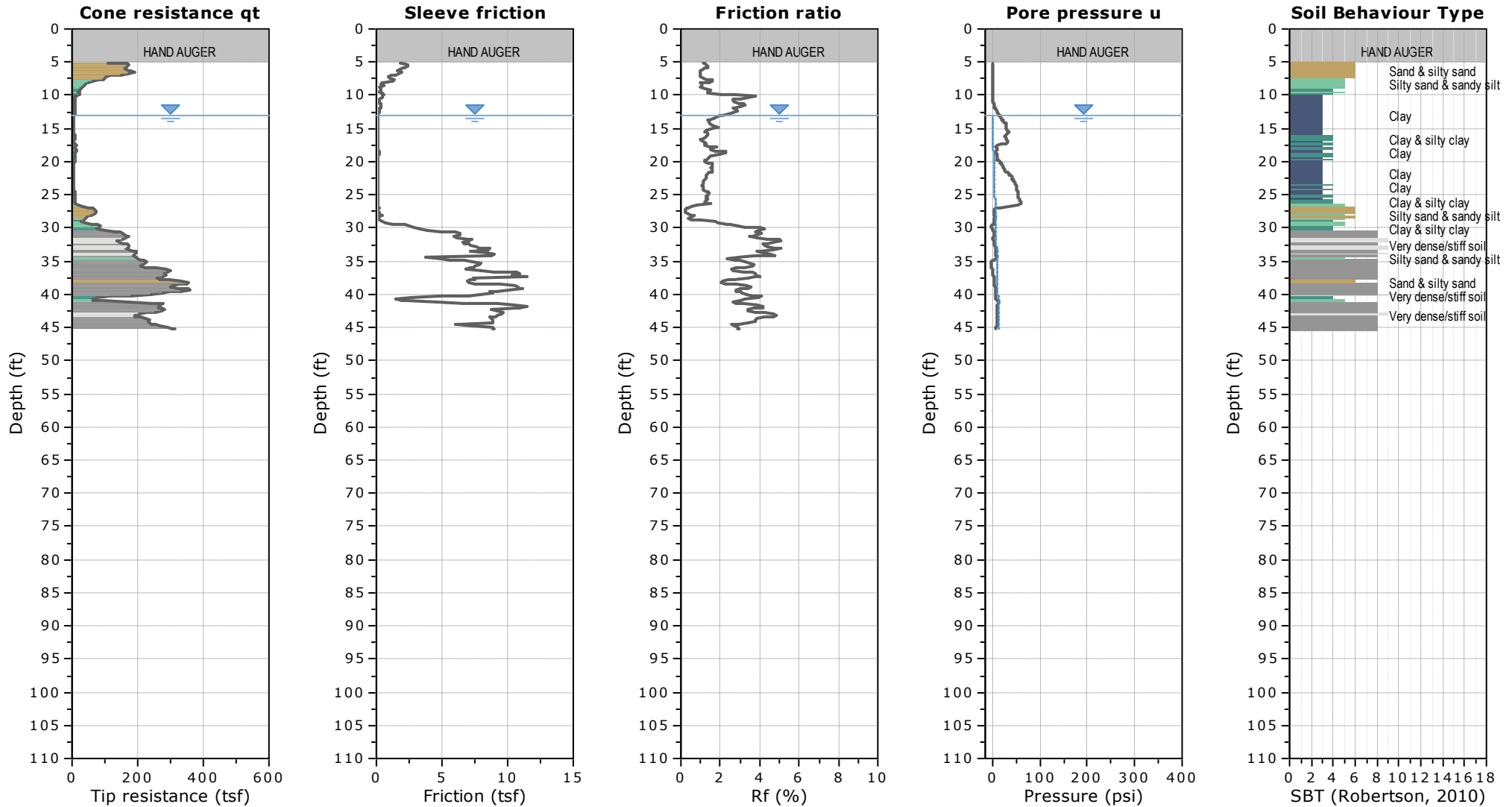


CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 45.28 ft, Date: 11/17/2022



WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-66



CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 71.03 ft, Date: 11/17/2022

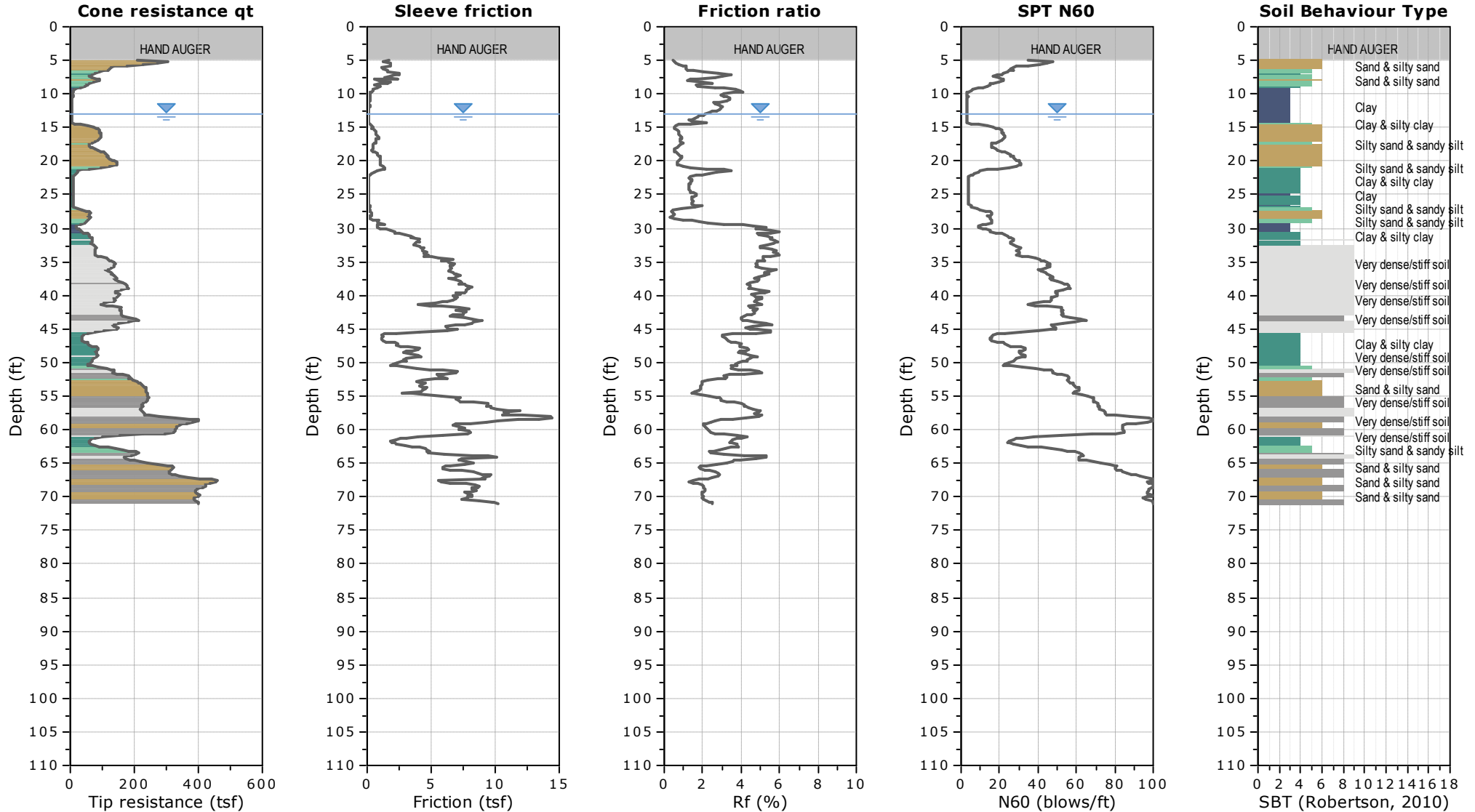


PLATE A-67

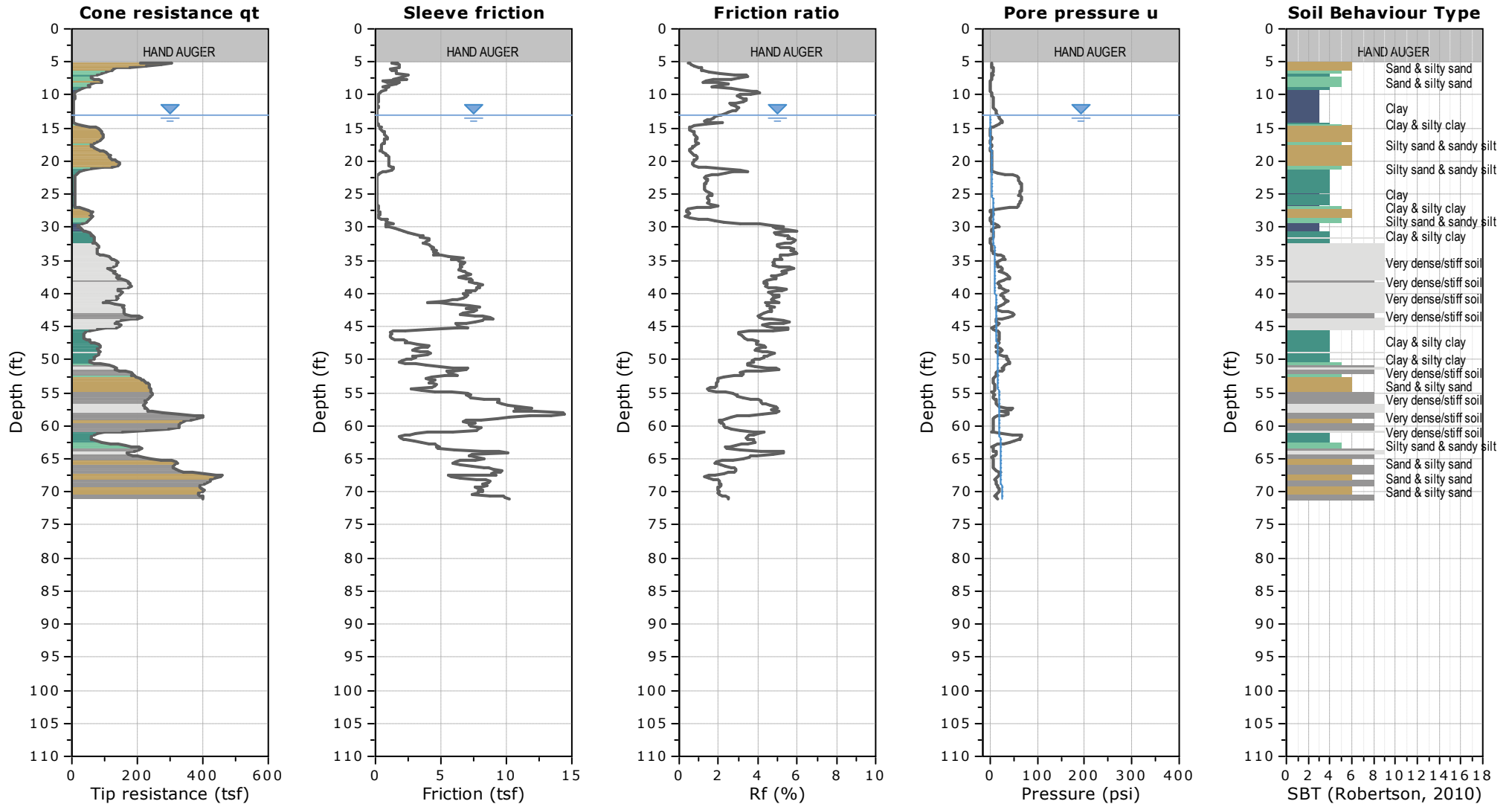


CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 71.03 ft, Date: 11/17/2022



WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-68



CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 80.22 ft, Date: 11/17/2022

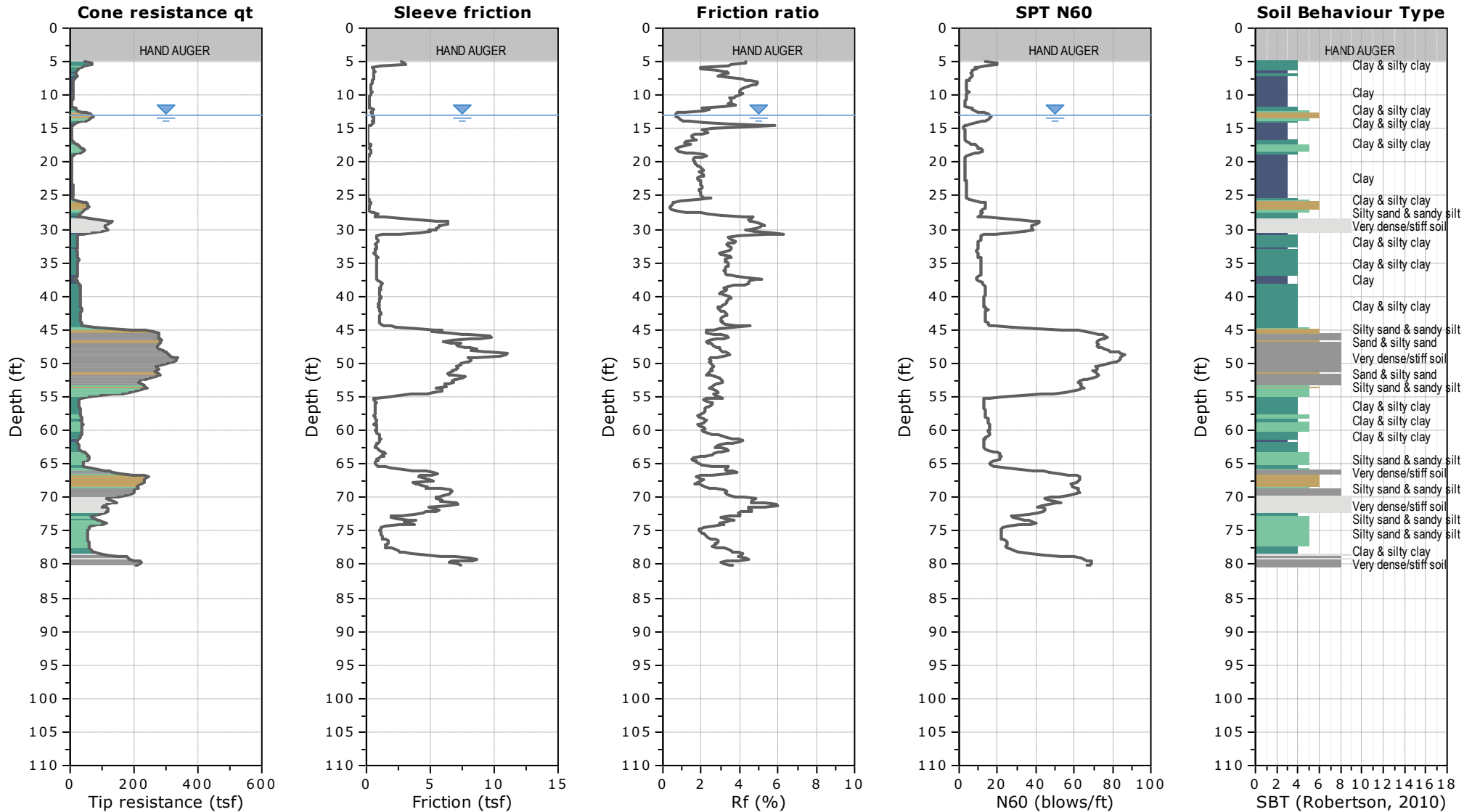


PLATE A-69

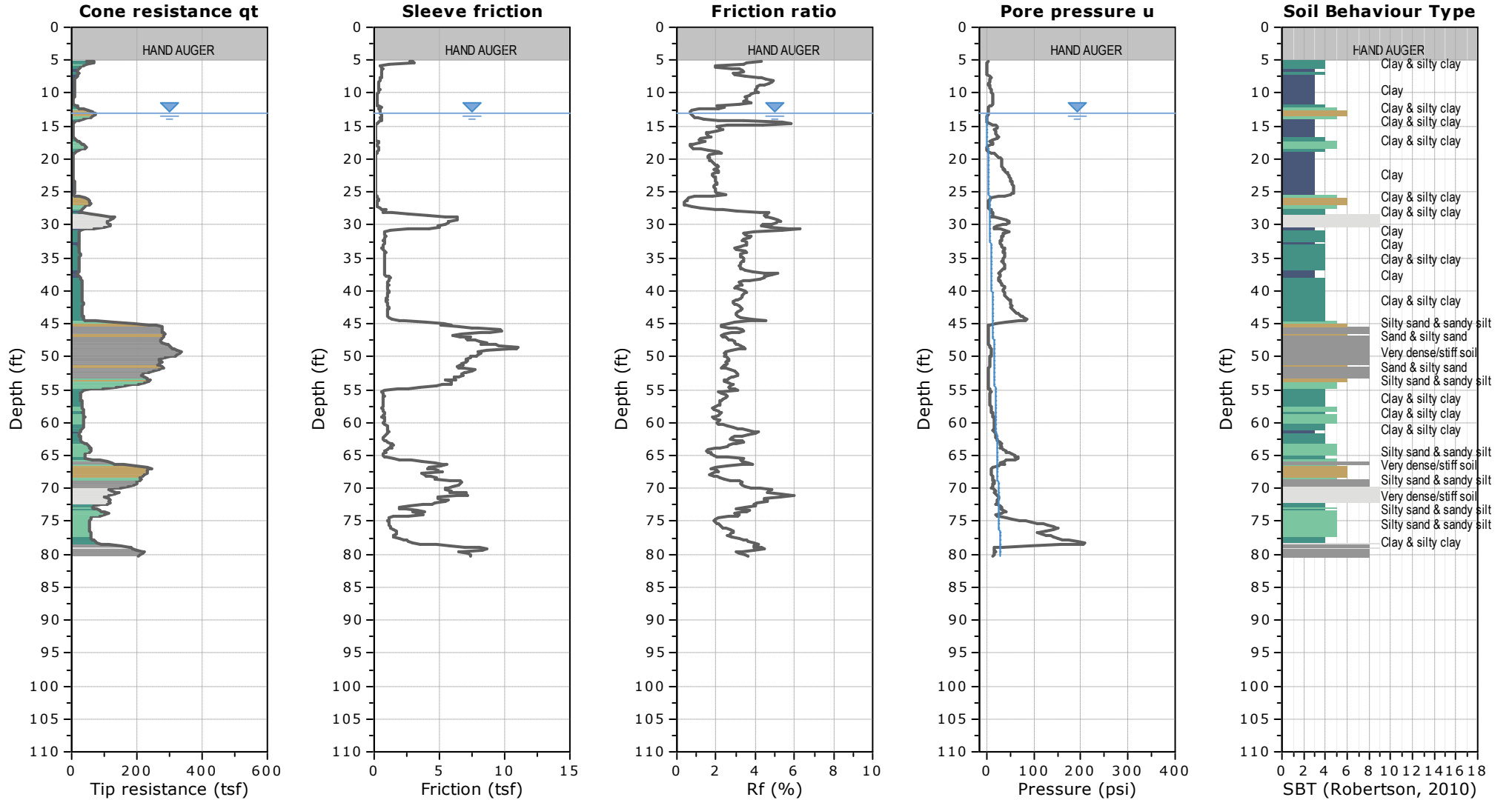


CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 80.22 ft, Date: 11/17/2022



WATER TABLE FOR ESTIMATING PURPOSES ONLY

PLATE A-70



CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 80.22 ft, Date: 11/18/2022

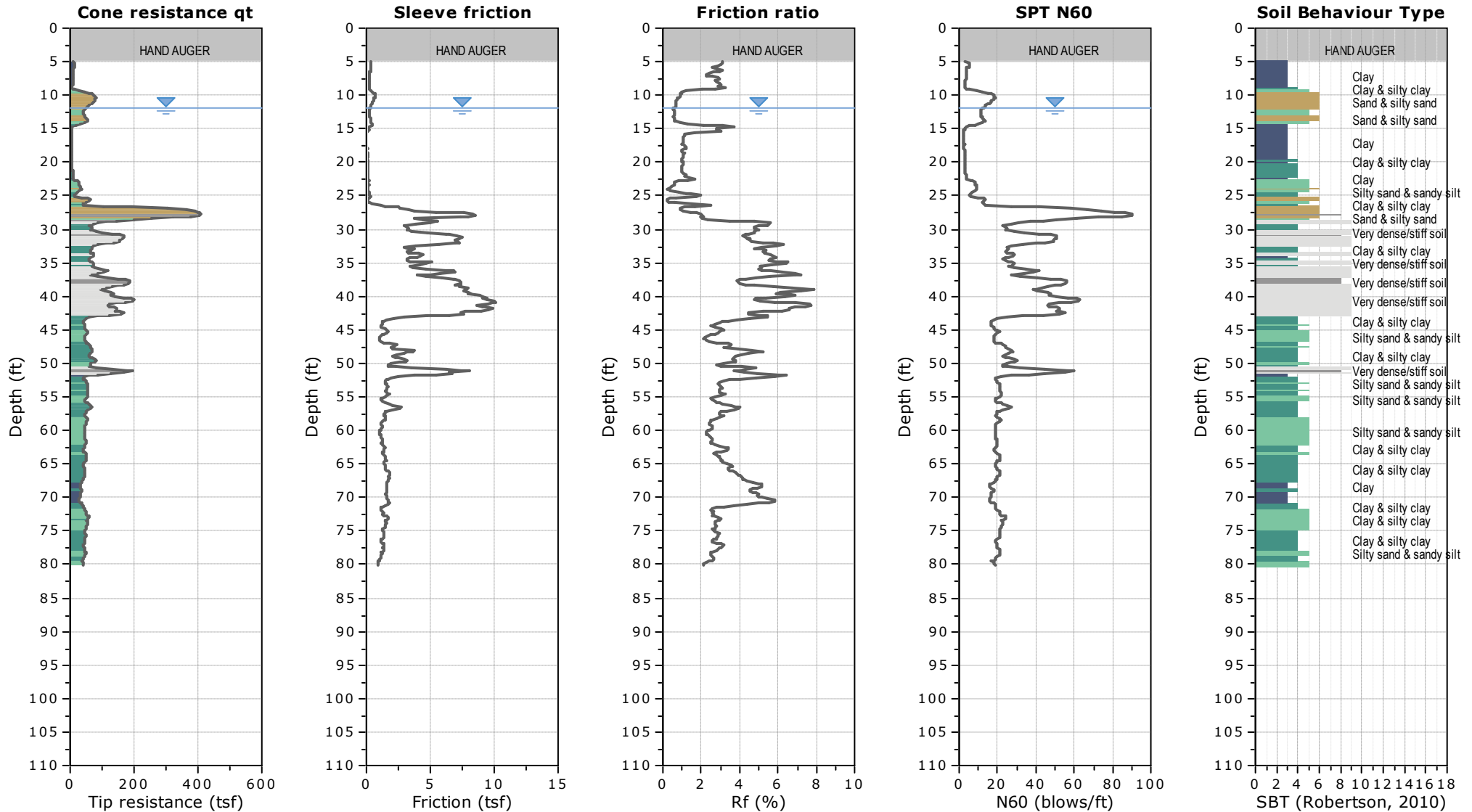


PLATE A-71

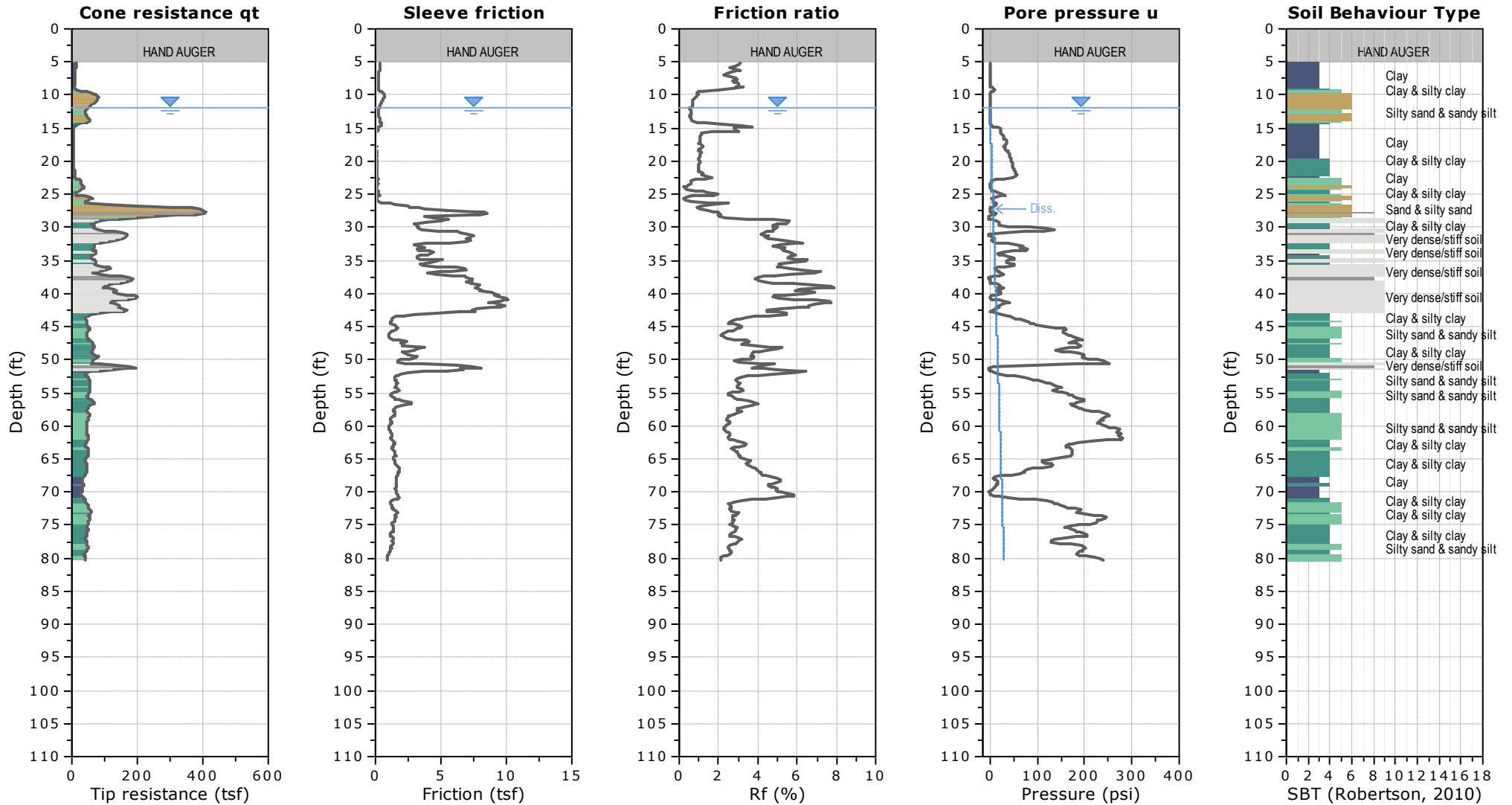


CLIENT: FUGRO USA LAND, INC.

FIELD REP: ABDUL SADAT
Cone ID: GDC-24

SITE: LANEY COLLEGE LLRC BLDG, OAKLAND, CA

Total depth: 80.22 ft, Date: 11/18/2022



WATER TABLE FOR ESTIMATING PURPOSES ONLY

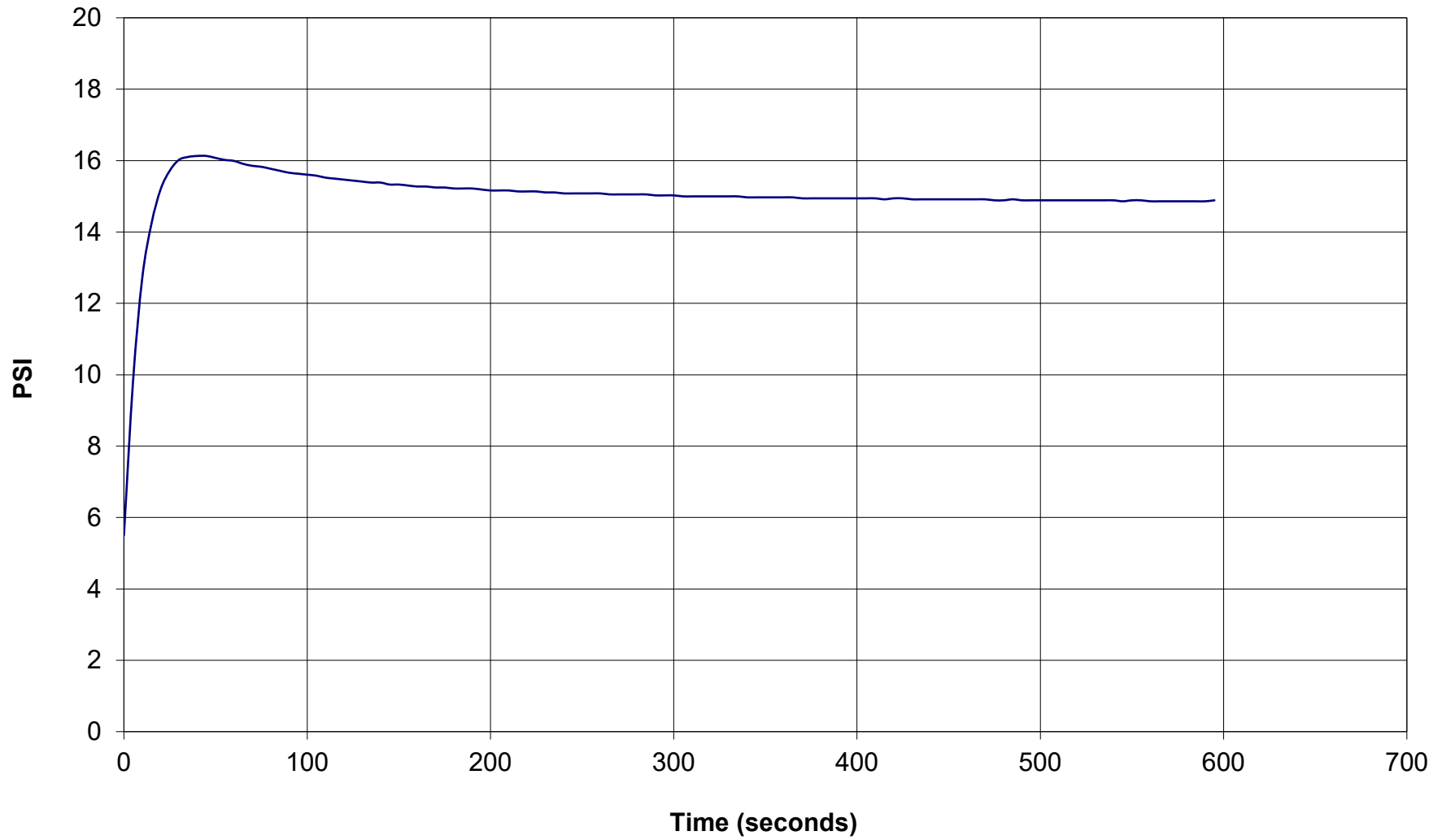
PLATE A-72



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: CPT-16
Depth (ft): 48.06
Site: Laney College
Engineer: Abdul Sadat

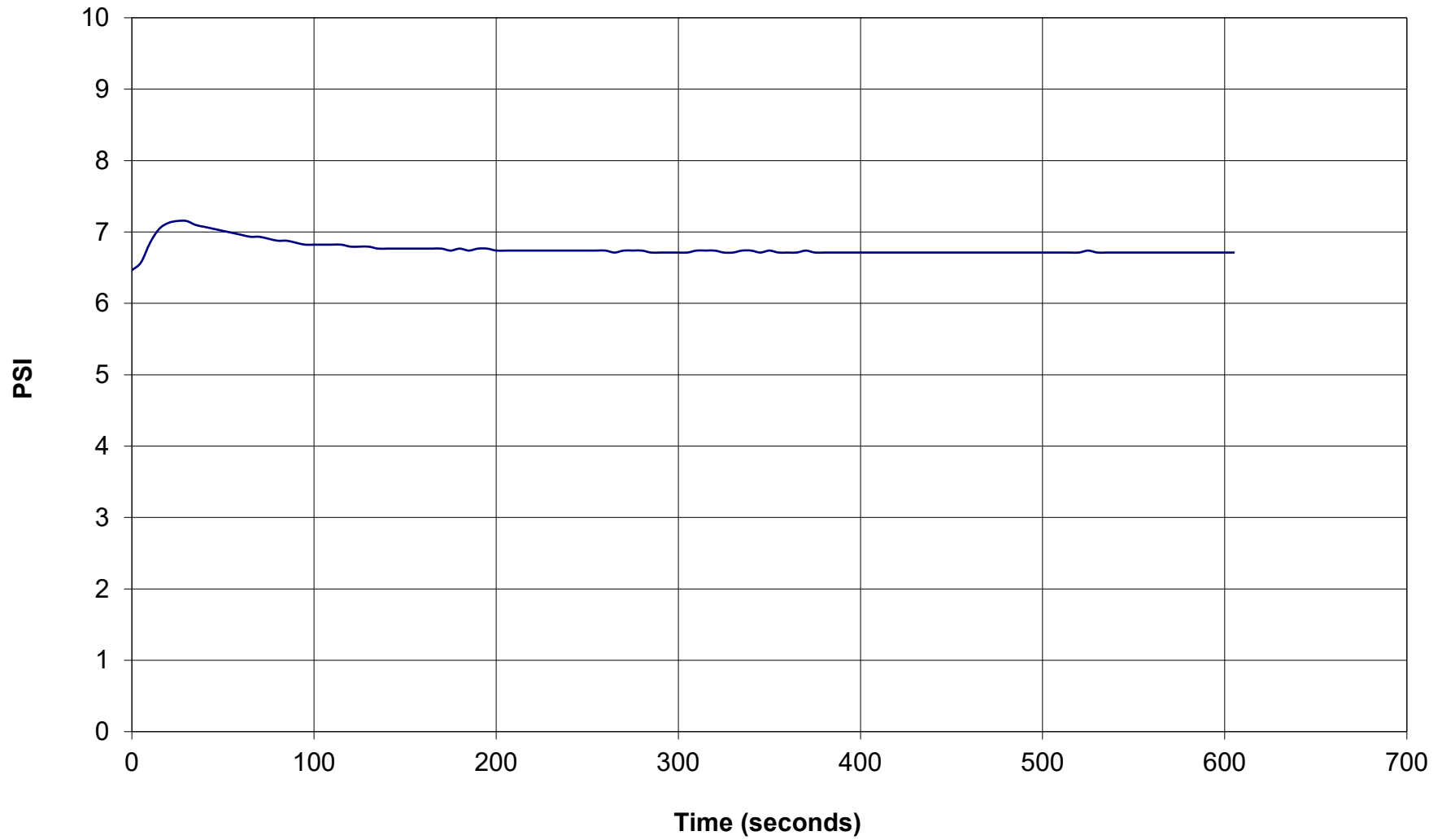




GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: CPT-19
Depth (ft): 30.02
Site: Laney College
Engineer: Abdul Sadat

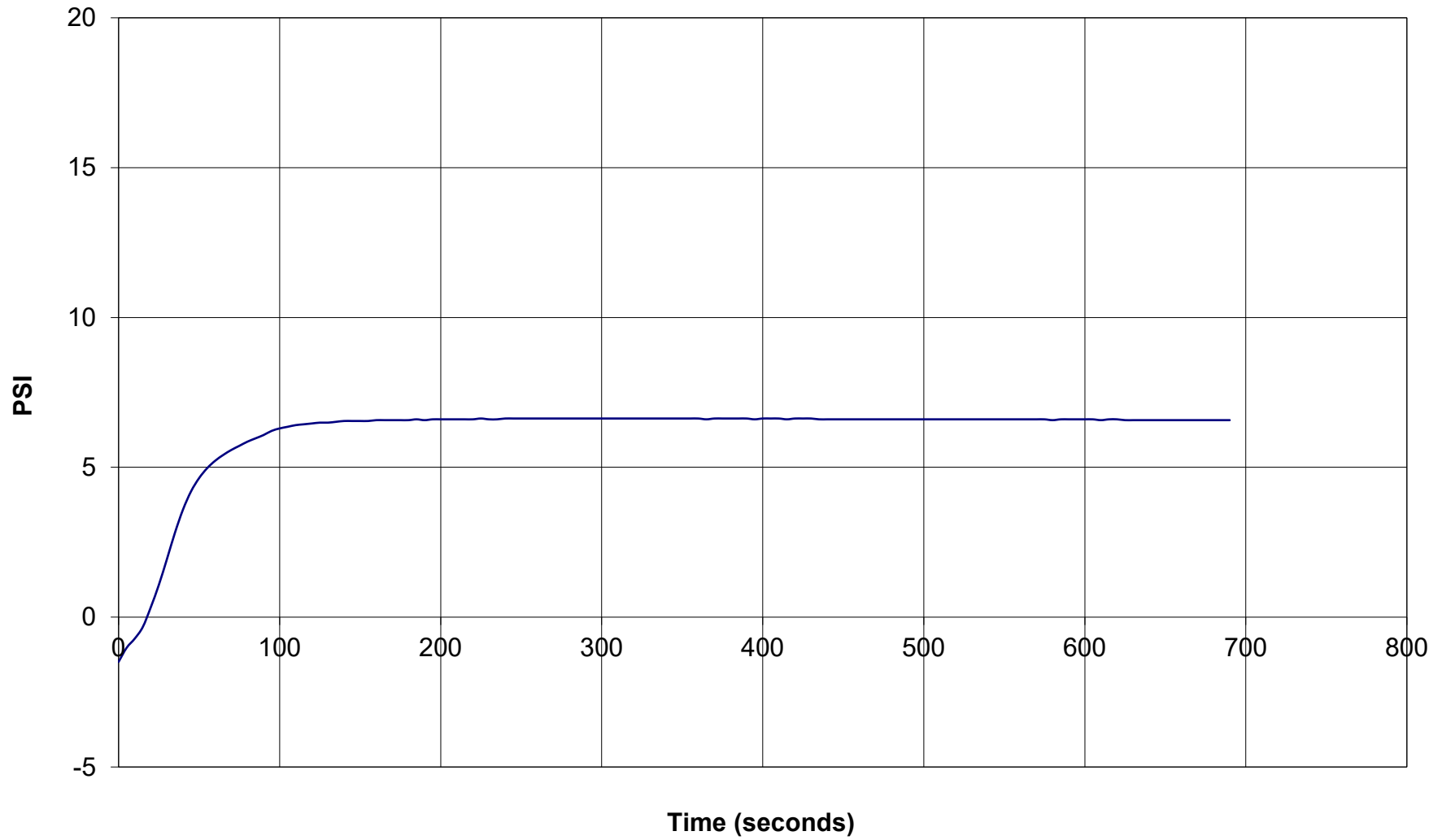




GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: CPT-25
Depth (ft): 27.23
Site: Laney College
Engineer: Abdul Sadat



Supplement B

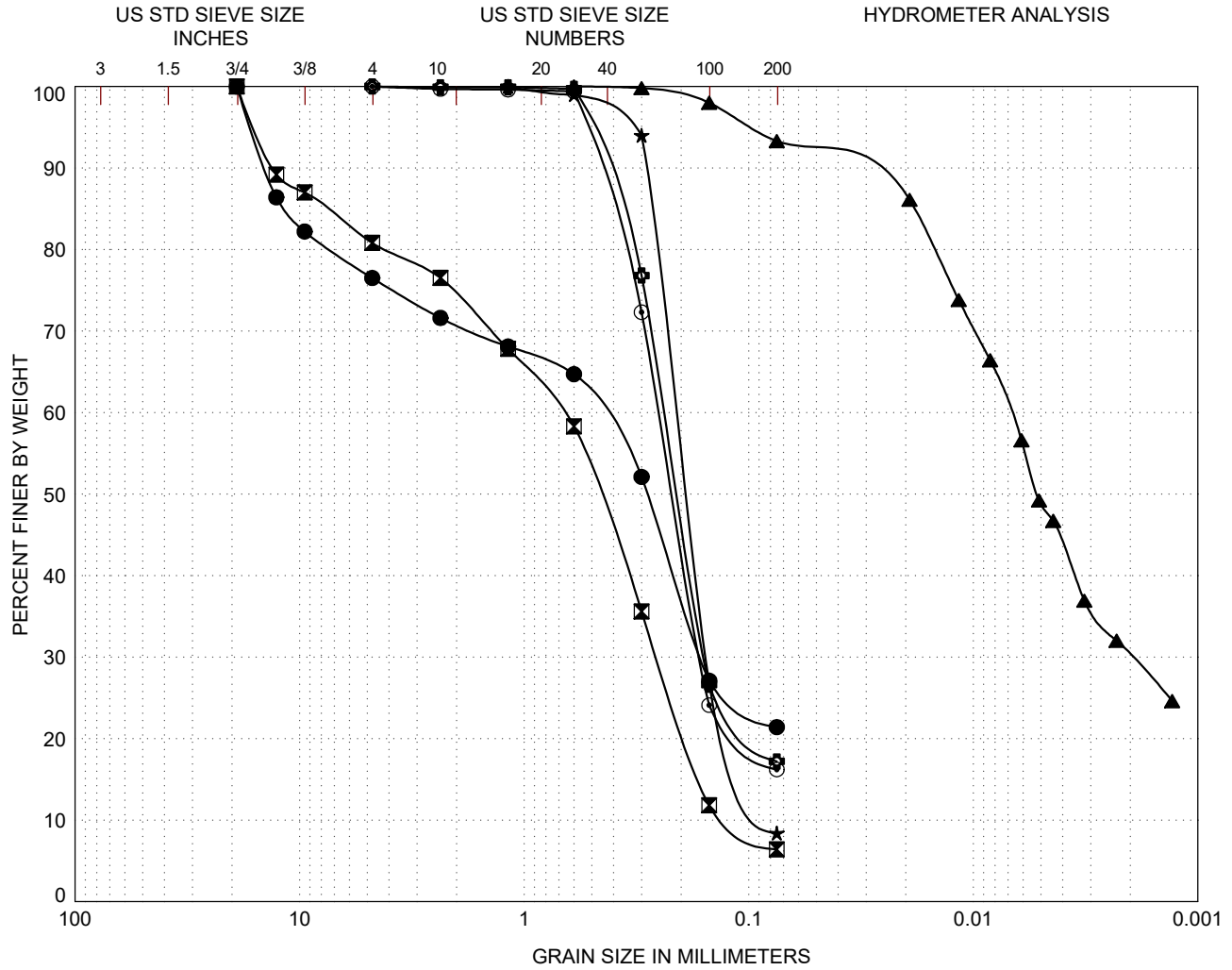
Laboratory Testing Program



SUM-1 LAB_SUMMARY (W:\PROJECTS\LOCATION-72190021\LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER\06_FIELD_AND_LAB\06 BORINGS\01 GINT\LANEY COLLEGE - 2020 BORING GPJ) \VTA-2192928

DRILL HOLE	DEPTH, ft	SAMPLE NUMBER	MATERIAL DESCRIPTION	UWW pcf	UDW pcf	MC%	FINES %	ATTERBURG LIMITS		COMPACTION TEST		DIRECT SHEAR		COMPRESSIVE STRENGTH TESTS		CORROSIVITY TESTS				R-VALUE	EXPANSION INDEX	ORGANIC CONTENT (%)	TEST LISTING
								LL	PI	MAX DD pcf	OPT MC %	C ksf	PHI deg	Qu, ksf	S _u (Cell Prs.), ksf	R	pH	Cl	So ₄				
2019-CPT-01	2.5	S1	SILTY SAND (SM)													6400	7.59	N.D.	22			Co	
2019-CPT-02	4.5	S2	PEAT (PT)				55															M	
2019-CPT-02	5.5	S3	Fat CLAY (CH)				58															M	
2019-CPT-03	4.0	S1	CLAYEY SAND (SC)				13	20								2600	7.97	N.D.	16			M, FC, Co	
2020-B-01	11.0	S5	SILTY SAND with GRAVEL (SM)	112	91	24	21															T, M, S	
2020-B-01	16.0	S7	Poorly-graded SAND with SILT (SP-SM)	119	95	26	6														5	T, M, O, S	
2020-B-01	17.0	S8	ORGANIC CLAY with SAND (OH)				82														21.2	M, O	
2020-B-01	21.0	S9	Fat CLAY (CH)				53														6.6	M, O	
2020-B-01	27.0	S10	Fat CLAY (CH)	95	52	83																T, M, C	
2020-B-01	30.0	S11	Fat CLAY (CH)	109	69	58	93	73	43				0.48(2.2)										T, M, A, S, Q
2020-B-01	31.0	S11	Poorly-graded SAND with SILT (SP-SM)	120	94	27	8																T, M, S
2020-B-01	40.5	S13	Fat CLAY (CH)	101	59	71							0.73(2.6)										T, M, Q
2020-B-01	51.0	S15	SILTY SAND (SM)	132	112	18	16																T, M, S
2020-B-01	55.0	S16	SILTY SAND (SM)	135	116	17	17																T, M, S
2020-B-01	66.0	S17	SILTY SAND (SM)				19	19															M, FC
2020-B-01	76.0	S18	Lean CLAY (CL)				37																M
Classification Tests UWW = Unit Wet Weight UDW = Unit Dry Weight MC = Moisture Content Fines = % Passing #200 Sieve LL = Liquid Limit PI = Plasticity Index				Direct Shear Test C = Assigned Cohesion, ksf PHI = Assigned Friction Angle, degrees Compaction Test MAX DD = Maximum Dry Density OPT MC = Optimum Moisture Content				Compressive Strength Tests Qu = Unconfined Compression Su = Undrained Shear Strength u = Unconsolidated Undrained p = Pocket Penetrometer t = Torvane m = Miniature Vane				Corrosivity Tests R = Resistivity, ohm-cm pH = pH Cl = Chloride, ppm SO ₄ = Sulfate, ppm				Test Listing Abbreviations M = Moisture Content T = Total & Dry Unit Weight S = Sieve Analysis FC = % Passing #200 Sieve H = Hydrometer Analysis A = Atterberg Limits P = Compaction Test				Test Listing Abbreviations D = Direct Shear Test C = Consolidation Test Co = Corrosivity Tests CU = CU Triaxial U = UU Triaxial R = R-Value SE = Sand Equivalent O = Organic Content			

SUMMARY OF LABORATORY TEST RESULTS
Laney College Library Learning Resource Center
Oakland, California

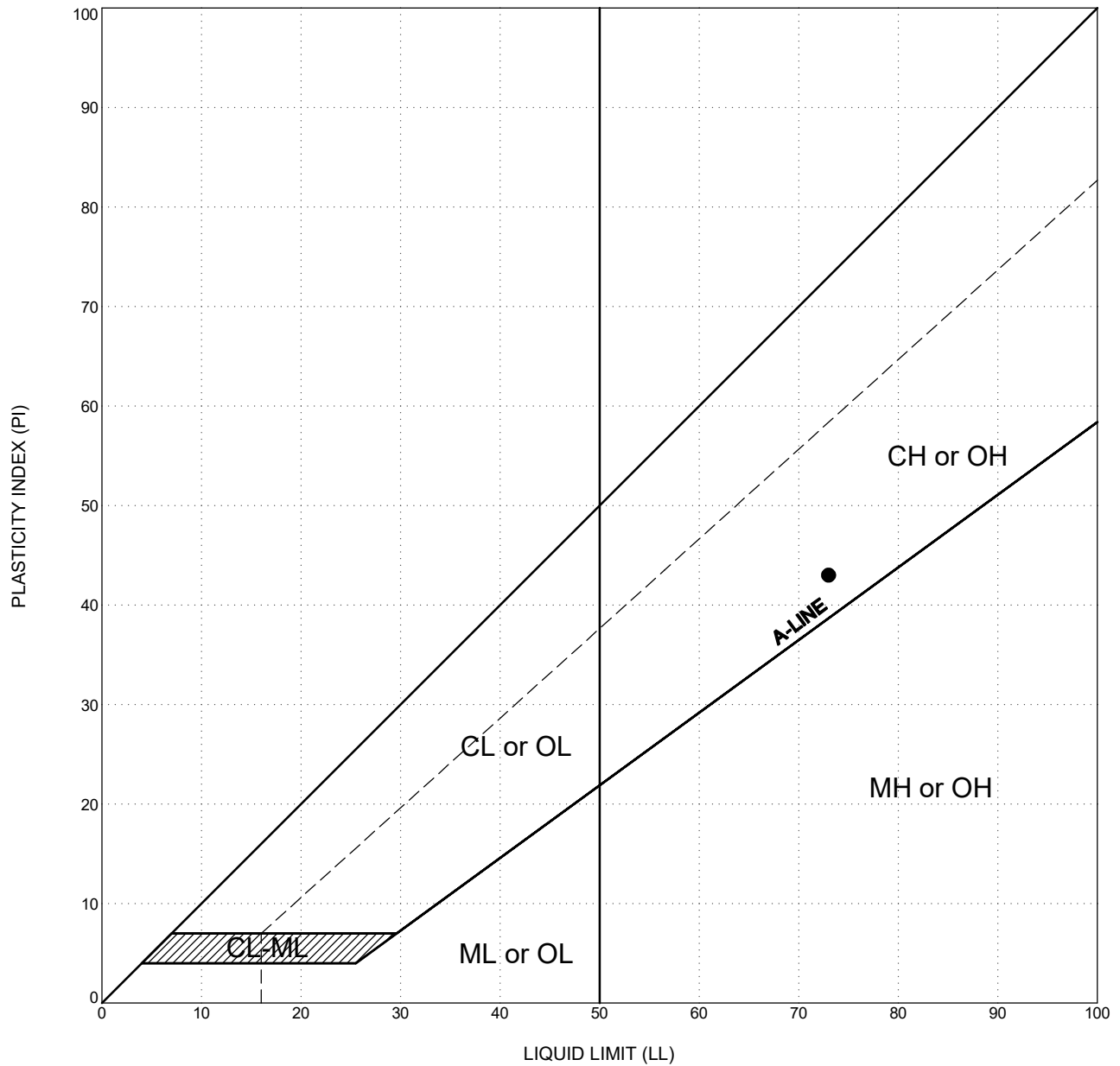


GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

LEGEND	
(location)	(depth,ft)
●	2020-B-01 11.0
⊠	2020-B-01 16.0
▲	2020-B-01 30.0
★	2020-B-01 31.0
⊙	2020-B-01 51.0
⊕	2020-B-01 55.0

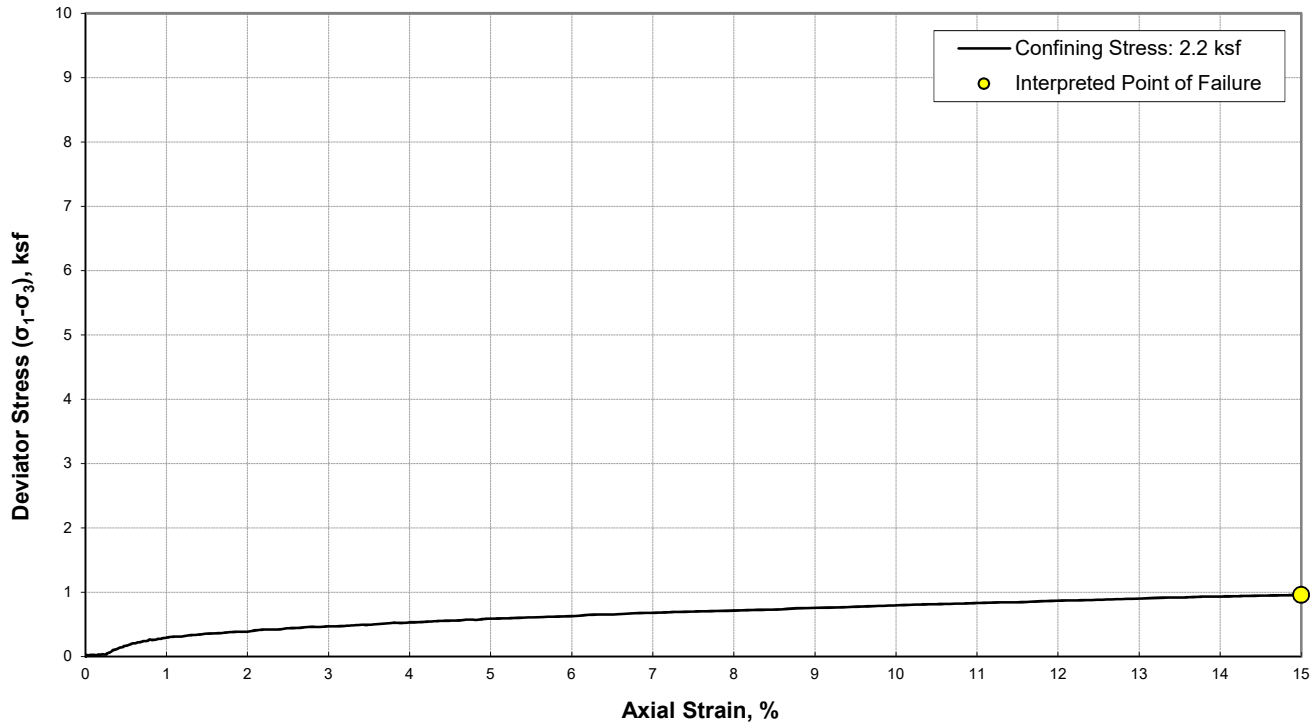
CLASSIFICATION		C _c	C _u	D ₁₀	D ₃₀	D ₆₀
SILTY SAND with GRAVEL (SM)					0.16	0.46
Poorly-graded SAND with SILT (SP-SM)		0.8	5.7	0.12	0.25	0.68
Fat CLAY (CH)					0.00	0.01
Poorly-graded SAND with SILT (SP-SM)		1.4	2.7	0.08	0.16	0.21
SILTY SAND (SM)					0.16	0.25
SILTY SAND (SM)					0.16	0.24

GRAIN SIZE CURVES
 Laney College Library Learning Resource Center
 Oakland, California

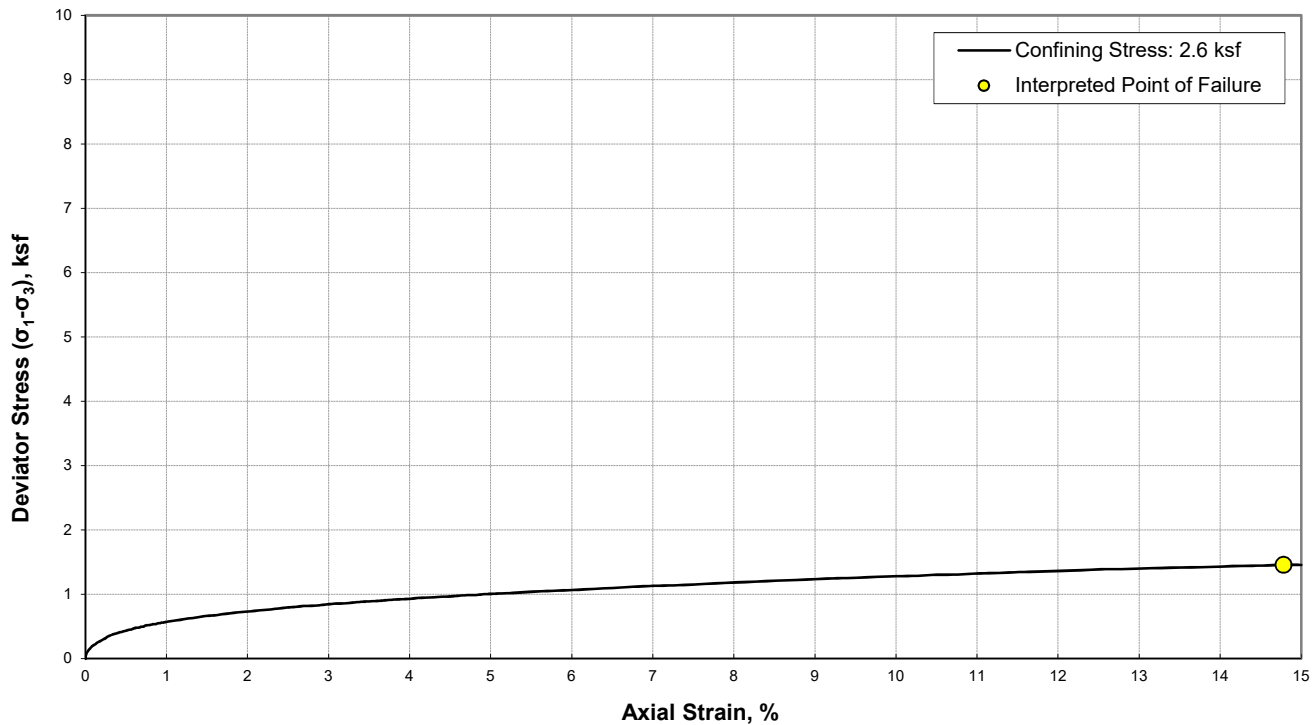


LEGEND		CLASSIFICATION	ATTERBERG LIMITS TEST RESULTS		
location	depth, ft		LIQUID LIMIT(LL)	PLASTIC LIMIT(PL)	PLASTICITY INDEX (PI)
● 2020-B-01	30.0	Fat CLAY (CH)	73	30	43

PLASTICITY CHART
 Laney College Library Learning Resource Center
 Oakland, California



SAMPLE ID	Boring Number: B-01 Sample Number: S11 Sample Depth: 30.0 ft USCS Classification: Fat CLAY (CH): olive gray		CLASSIFICATION	Sieve Size	% Passing	Other Parameters	
				# 3/8-in. (9.5mm)	---	Liquid Limit	---
				# 4 (4.75mm)	---	Plastic Limit	---
				# 16 (1.18mm)	---	Plasticity Index	---
				# 30 (0.6mm)	---	Estimated Gs	2.65
				# 100 (0.150mm)	---	S _u from T _v , ksf	---
				# 200 (0.075mm)	---	S _u from PP, ksf	---
SAMPLE PROPERTIES	Water Content, %	58.3%	TEST SUMMARY	Maximum Deviator Stress, ksf		0.96	
	Dry Unit Weight, pcf	68.7		Undrained Shear Strength, ksf		0.48	
Diameter, in	2.39	Axial Strain at Failure, %		15.0			
Height, in	5.60	Strain Rate, %/min		1.0			
		Cell Pressure, ksf		2.2			
		Tested By:		JB			
		Date Tested:		1/20/20			
SAMPLE IMAGES			REMARKS	Test Method: ASTM 2850			
				Note presence of approximate 2" sized gravel in upper portion of UU test sample.			



SAMPLE ID	Boring Number: B-01 Sample Number: S13 Sample Depth: 40.5 ft USCS Classification: Fat CLAY (CH): olive gray		CLASSIFICATION	Sieve Size	% Passing	Other Parameters	
				# 3/8-in. (9.5mm)	---	Liquid Limit	---
SAMPLE PROPERTIES	Water Content, %	71.3%	TEST SUMMARY	# 4 (4.75mm)	---	Plastic Limit	---
	Dry Unit Weight, pcf	59.1		# 16 (1.18mm)	---	Plasticity Index	---
SAMPLE IMAGES	Diameter, in	2.39	REMARKS	# 30 (0.6mm)	---	Estimated Gs	2.65
	Height, in	5.79		# 100 (0.150mm)	---	S _u from T _v , ksf	---
				# 200 (0.075mm)	---	S _u from PP, ksf	---
				Maximum Deviator Stress, ksf	1.46		
				Undrained Shear Strength, ksf	0.73		
				Axial Strain at Failure, %	14.8		
				Strain Rate, %/min	1.0		
				Cell Pressure, ksf	2.6		
				Tested By:	JB		
				Date Tested:	1/20/20		
				Test Method: ASTM 2850			



SUMMARY OF LABORATORY TEST RESULTS

Project: Laney College Library Learning Resource Center
Address: Oakland, California
Owner: Peralta Community College District

Job Number: 04.72190021
Date: 1/28/2020
Lab ID: 10044

Source:

Location Sampled: B-01, Laney College Library
Date Sampled: N/A
Sample By: N/A
Test Methods: ASTM D2974

Sample No.	Depth (ft)	Sample Description	Water Content (%)	Ash Content (%)	Organic Content (%)
B-01	16	Poorly Graded SAND with SILT (SP - SM)	25.9	95.0	5.0
B-01	17	Organic CLAY with SAND (OH)	82.5	78.8	21.2
B-01	21	Fat CLAY (CH)	53.4	93.4	6.6

Remarks: None

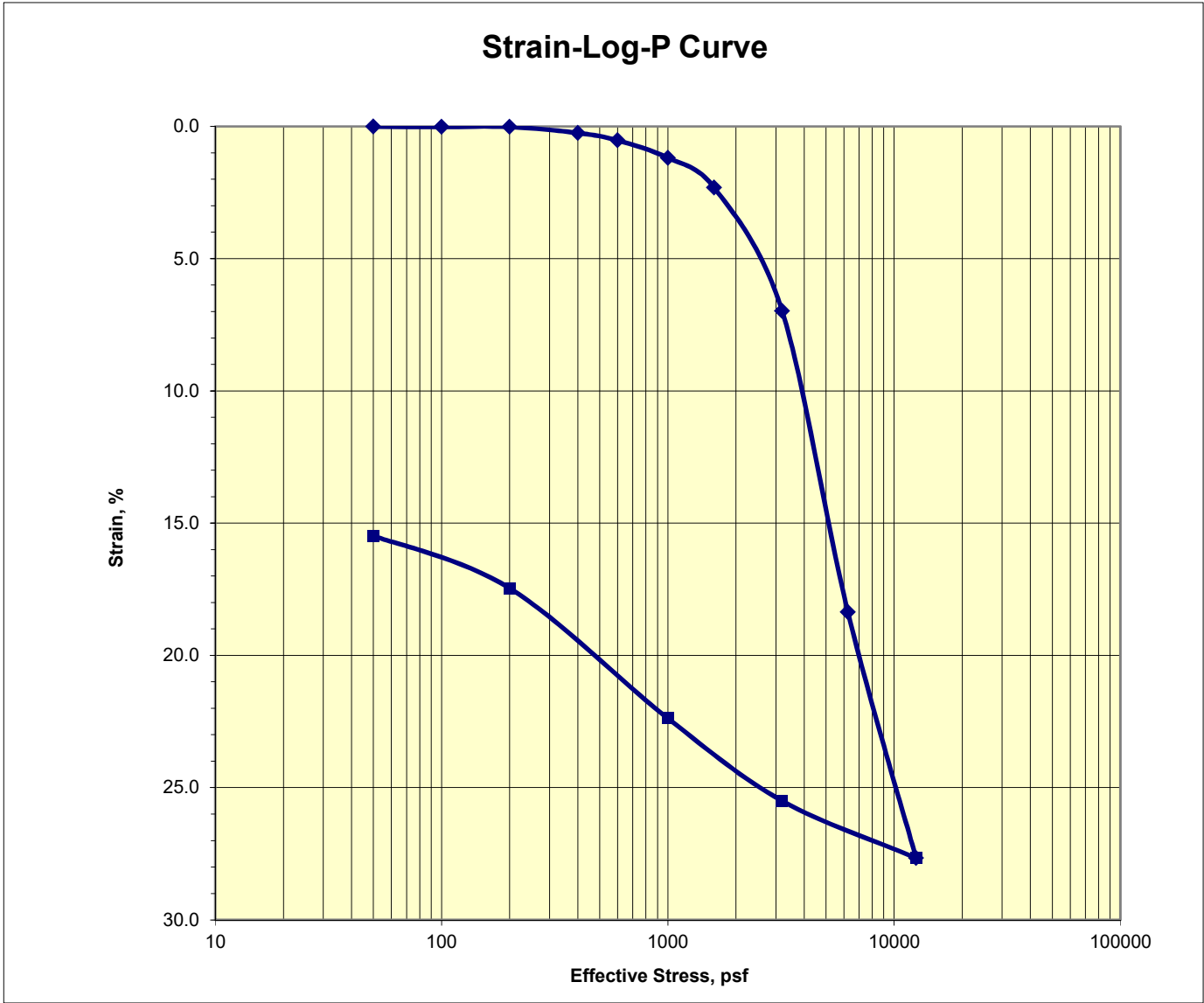
Distribution:



Consolidation Test

ASTM D2435

Job No.: 446-303	Boring: B-01	Run By: MD
Client: Fugro USA Land, Inc.	Sample:	Reduced: PJ
Project: 04.72190021	Depth, ft.: 25-27.5(Tip-3")	Checked: PJ/DC
Soil Type: Greenish Gray CLAY (Bay Mud)		Date: 2/4/2020



Assumed Gs	2.75	Initial	Final
Moisture %:		82.9	65.6
Dry Density, pcf:		51.8	61.2
Void Ratio:		2.316	1.804
% Saturation:		98.4	100.0

Remarks:

10 April 2019

Job No. 1904058

Cust. No. 11608

Mr. Franco A. DePaola
Fugro Consultants, Inc.
1777 Botelho Drive, Suite 262
Walnut Creek, CA 94596

Subject: Project No.: 04.72190021
Project Name: Laney College, 900 Fallon St., Oakland, CA
Corrosivity Analysis – ASTM Test Methods with Brief Evaluation

Dear Mr. DePaola:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on April 05, 2019. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity measurements, both samples are classified as “moderately corrosive”. All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentrations reflect none detected with a reporting limit of 15 mg/kg.

The sulfate ion concentrations are 16 & 22 mg/kg and are determined to be insufficient to damage reinforced concrete structures and cement mortar-coated steel at these locations.

The pH of the soils are 7.59 & 7.97, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.


The redox potentials are 270 & 280-mV. These samples are indicative of potentially “slightly corrosive” soils resulting from anaerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc.* at (925) 927-6630.

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,

CERCO ANALYTICAL, INC.


J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

PLATE B-8



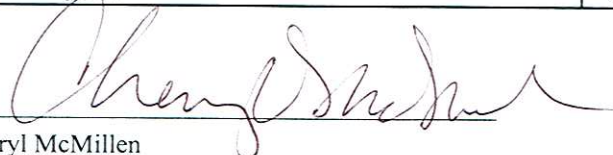
1100 Willow Pass Court, Suite A
 Concord, CA 94520-1006
 925 462 2771 Fax. 925 462 2775
 www.cercoanalytical.com

Client: Fugro West, Inc.
 Client's Project No.: 04.72190021
 Client's Project Name: Laney College, 900 Fallon St., Oakland, CA
 Date Sampled: 29-Mar-19
 Date Received: 5-Apr-19
 Matrix: Soil
 Authorization: Signed Chain of Custody

Date of Report: 11-Apr-2019

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1904058-001	CPT-03 @ 4' - 5' (S-3)	270	7.97	-	2,600	-	N.D.	16
1904058-002	CPT-01 @ 2.5' - 3' (S-1)	280	7.59	-	6,400	-	N.D.	22

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	9-Apr-2019	9-Apr-2019	-	5-Apr-2019	-	9-Apr-2019	9-Apr-2019


 Cheryl McMillen
 Laboratory Director

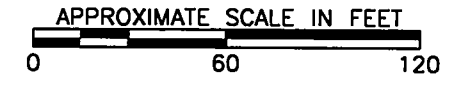
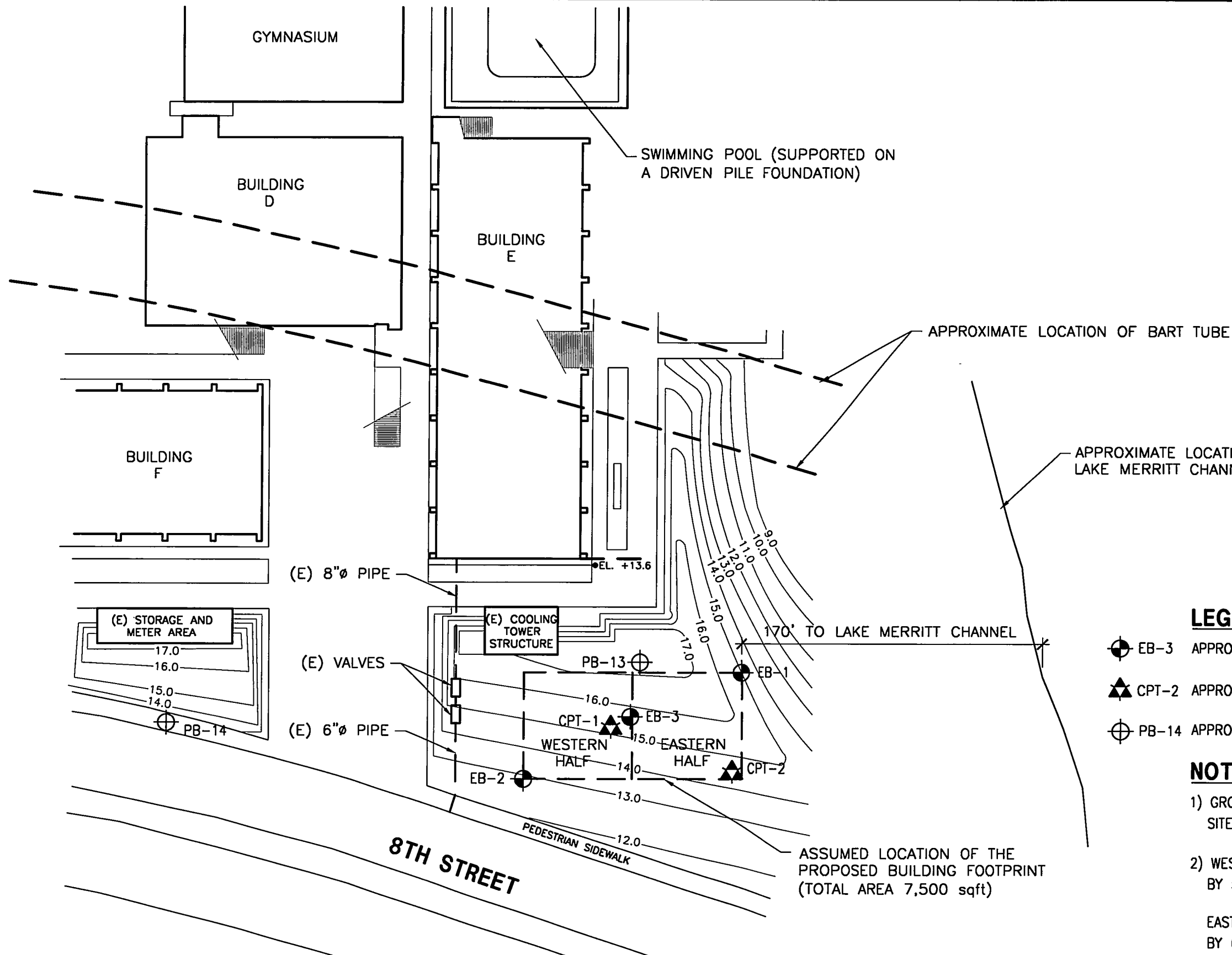
* Results Reported on "As Received" Basis
 N.D. - None Detected

PLATE B-9

Supplement C

Previous Field Exploration Logs
and Laboratory Test Results

C.1 Exploration Boring Logs and CPTs by Fugro, February 2002, Fugro No. 1430.001



LEGEND

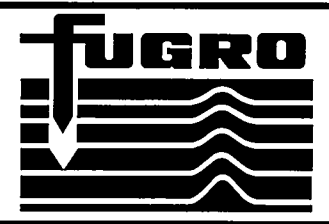
- EB-3 APPROXIMATE LOCATION OF EXPLORATORY BORING (2002)
- ▲ CPT-2 APPROXIMATE LOCATION OF CONE PENETRATION TEST (2002)
- ⊕ PB-14 APPROXIMATE LOCATION OF PREVIOUS BORING BY OTHERS (1968)

NOTE:

- 1) GROUND CONTOUR LINES WERE BASED ON THE 1968 SITE PLAN. IT MAY HAVE CHANGED OVER TIME.
 - 2) WESTERN HALF OF NEW ART BUILDING SUPPORTED BY 50' LONG PILES.
- EASTERN HALF OF NEW ART BUILDING SUPPORTED BY 60' LONG PILES.

ASSUMED LOCATION OF THE PROPOSED BUILDING FOOTPRINT (TOTAL AREA 7,500 sqft)

K:\Projects\1430.001\1430.001-01.dwg, 14:38 27MAR02 PLOTTED BY: ROCealigh



FUGRO WEST INC.
 425 Roland Way.
 Oakland, California. 94621
 Tel:(510)568-4001 Fax:(510)568-2205

DRAWN BY:	ROC
PREP'D BY:	NS
APP'D BY:	SR
SCALE:	1" = 60'
DATE:	25FEB02
DWG FILE:	1430.001-01

SITE PLAN

NEW ART BUILDING AT LANEY COLLEGE
OAKLAND, CALIFORNIA

FIGURE
1
PROJECT No.
1430.001

DRILL RIG	Mobile B-61, HSA	SURFACE ELEVATION	14.4 Feet	LOGGED BY	NS
DEPTH TO GROUND WATER	15 feet	BORING DIAMETER	8-inch	DATE DRILLED	2/26/02

DESCRIPTION AND CLASSIFICATION			DEPTH	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT(%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	OTHER TESTS
DESCRIPTION AND REMARKS	CONSIST	SOIL TYPE	(FEET)						

<p>FILL: CLAY (CL), dark brown, mottled, sandy (fine- to medium-grained), some silt, damp</p> <p>FILL: SAND (SM/SC), brown, mottled, fine- to coarse-grained, silty, some clay, trace gravel and shell fragment, damp</p> <p>grades to gray-brown at 6 feet</p> <p>grades to blue-gray-brown, some silt at 10 feet</p> <p>BAY MUD: CLAY (CH), black, some sand (fine- to coarse-grained), some silt, mild hydrocarbon odor, trace wood fragment, moist</p> <p>grades to wet at 16 feet</p> <p>strong hydrocarbon odor, with high amount of wood fragment, metal pieces, and other debris at 20 feet</p> <p>grades to blue-gray, silty below 23 feet</p>	Firm								
	Medium Dense		19						
			13						
			5						
			21	16	116			PP = 2.5	
			10	49	11	126		% of Passing #200 Sieve = 24	
		Firm		9				No Recovery	
		Soft		6				No Recovery	
				21				See Note 7	
		Firm		9	77	54		PP = 0.5	
			8	74	56	1.1	PP = 1.0		

File Name: G:\ENGINEER\GINT\PROJECTS\21127\G1.GPJ Report Template: FUGRO Output Date: 3/26/02



425 Roland Way
Oakland, CA 94621














EXPLORATORY BORING LOG

**NEW ART BUILDING AT LANEY COLLEGE
Oakland, CA**

PROJECT NO.	DATE	BORING NO.	EB-1
1430.001	February, 2002		

DRILL RIG	Mobile B-61, HSA	SURFACE ELEVATION	14.4 Feet	LOGGED BY	NS
DEPTH TO GROUND WATER	15 feet	BORING DIAMETER	8-inch	DATE DRILLED	2/26/02

DESCRIPTION AND CLASSIFICATION			DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT(%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	OTHER TESTS
DESCRIPTION AND REMARKS	CONSIST	SOIL TYPE							

BAY MUD: CLAY (CH), continued									
SAND (SM) , dark green-gray, fine-grained, silty, some clay, trace shell fragment, wet	Loose		35		10	22	102		PP = 3.0
BAY MUD: CLAY (CH) , blue-gray, silty, trace sand (fine- to medium-grained), wet	Firm		40		9	76	55	0.4*	PP = 1.5, See Note 8
SAND (SM/SC) , blue-gray, fine- to medium-grained, silty, with clay, trace shell fragment, wet	Medium Dense		45		32	16	112		
	Very Dense		50		83/9"				
	Dense		55		37				
	Very Dense				63				

File Name: G:\ENGINEERING\INT\PROJECTS\21127\GI.GPJ Report Template: FUGRO Output Date: 3/26/02







425 Roland Way
Oakland, CA 94621

EXPLORATORY BORING LOG		
NEW ART BUILDING AT LANEY COLLEGE Oakland, CA		
PROJECT NO.	DATE	BORING NO. EB-1
1430.001	February, 2002	

DRILL RIG	Mobile B-61, HSA	SURFACE ELEVATION	14.4 Feet	LOGGED BY	NS
DEPTH TO GROUND WATER	15 feet	BORING DIAMETER	8-inch	DATE DRILLED	2/26/02

DESCRIPTION AND CLASSIFICATION			DEPTH	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT(%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	OTHER TESTS
DESCRIPTION AND REMARKS	CONSIST	SOIL TYPE	(FEET)						

SAND (SM/SC) , continued grades to blue-gray-brown, trace gravel at 60 feet grades to brown, clayey below 63 feet	Dense		65		61	22	105	2.3	% of Passing #200 Sieve = 43 PP = 4.0	
			70		67					PP = 4.5
			75		73					PP = 2.5

Bottom of Boring = 75 Feet

Notes:

- The stratification lines represent the approximate boundaries between material types and the transition may be gradual.
- For an explanation of penetration resistance values, see first page of Appendix A.
- A 140-lb safety hammer falling 30 inches was used to drive the sampler.
- Ground water was encountered originally at depth of about 17 feet, and at depth of about 15 feet two hours later.
- The borehole was backfilled with lean cement immediately upon completion of the drilling.
- PP = Pocket Penetrometer Reading (tsf).
- High value of blow count is due to localized encountering metal, brick, and/or concrete debris.
- Low shear strength was probably caused by severe sample disturbance.

File Name: G:\ENGINEERING\INTW\PROJECTS\21127GI.GPJ Report Template: FUGRO Output Date: 3/26/02



425 Roland Way
Oakland, CA 94621




















EXPLORATORY BORING LOG

**NEW ART BUILDING AT LANEY COLLEGE
Oakland, CA**

PROJECT NO.	DATE	BORING NO.	EB-1
1430.001	February, 2002		

DRILL RIG	Mobile B-61, HSA	SURFACE ELEVATION	12.8 Feet	LOGGED BY	NS
DEPTH TO GROUND WATER	45 feet	BORING DIAMETER	8-inch	DATE DRILLED	2/26/02

DESCRIPTION AND CLASSIFICATION			DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT(%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	OTHER TESTS
DESCRIPTION AND REMARKS	CONSIST	SOIL TYPE							

FILL: CLAY (CL) , dark brown, mottled, sandy (fine- to medium-grained), some silt, damp	Firm								
FILL: SAND (SM) , brown, fine- to coarse-grained, silty, trace clay and gravel, damp	Medium Dense				15	13	110	1.3	PP = 2.0
					23				
	Loose		5		10				
grades to black, gravelly (subangular to subrounded) at 6 feet									
BAY MUD: CLAY (CH) , blue-gray, silty, trace sand (fine- to coarse-grained) and wood fragmentl, moist	Soft		10		3				PP = 0.5
									
	Very Soft		15		2	50	74	0.2	PP < 0.5
grades to mottled shades of black-brown, trace shell fragment at 15 feet									
									
grades to dark gray-brown, mild hydrocarbon odor at 18 feet	Soft		20		4	78	54	0.3	PP = 0.5
									
					4				PP = 1.5

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





425 Roland Way
Oakland, CA 94621

EXPLORATORY BORING LOG		
NEW ART BUILDING AT LANEY COLLEGE Oakland, CA		
PROJECT NO.	DATE	BORING NO. EB-2
1430.001	February, 2002	

DRILL RIG	Mobile B-61, HSA	SURFACE ELEVATION	12.8 Feet	LOGGED BY	NS
DEPTH TO GROUND WATER	45 feet	BORING DIAMETER	8-inch	DATE DRILLED	2/26/02

DESCRIPTION AND CLASSIFICATION			DEPTH	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT(%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	OTHER TESTS
DESCRIPTION AND REMARKS	CONSIST	SOIL TYPE	(FEET)						

BAY MUD: CLAY (CH), continued grades to gravelly (rounded to subrounded), wet at 28 feet CLAY (CL/GC) , blue-gray, gravelly, some silt and sand, wet SAND (SP/SM) , light brown, medium- to coarse-grained, trace gravel (subangular to subrounded) and silt, wet	Soft								
	Hard		30		57	17	114	9.1	
	Dense		35		37				
			40		32				% of Passing #200 Sieve = 19 between 29 feet to 59 feet
			45		32				
									
					37				

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425 Roland Way
Oakland, CA 94621

EXPLORATORY BORING LOG

**NEW ART BUILDING AT LANEY COLLEGE
Oakland, CA**

PROJECT NO.

1430.001

DATE




February, 2002

BORING NO.

EB-2

DRILL RIG	Mobile B-61, HSA	SURFACE ELEVATION	12.8 Feet	LOGGED BY	NS
DEPTH TO GROUND WATER	45 feet	BORING DIAMETER	8-inch	DATE DRILLED	2/26/02

DESCRIPTION AND CLASSIFICATION			DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT(%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	OTHER TESTS
DESCRIPTION AND REMARKS	CONSIST	SOIL TYPE							

SAND (SP/SM), continued	Dense		55						
CLAY (CL), olive-brown, silty, with sand (fine- to medium-grained), wet	Hard		60		67	21	109	12.3	PP = 4.5
grades to dark gray at 69 feet			65						
			70		76				

Bottom of Boring = 70 Feet

Notes:

1. The stratification lines represent the approximate boundaries between soil types and the transition may be gradual.
2. For an explanation of penetration resistance values, see first page of Appendix A.
3. A 140-lb safety hammer falling 30 inches was used to drive the sampler.
4. Ground water was apparently encountered at depth of 45 feet at the time of drilling.
5. The borehole was backfilled with lean cement immediately upon completion of the drilling.
6. PP = Pocket Penetrometer Reading (tsf).



425 Roland Way
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EXPLORATORY BORING LOG

**NEW ART BUILDING AT LANEY COLLEGE
Oakland, CA**

PROJECT NO.

1430.001

DATE


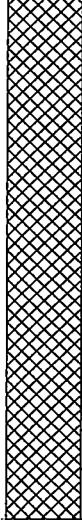
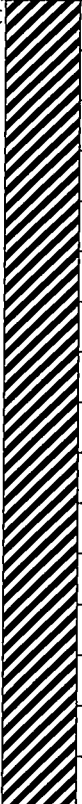
February, 2002

BORING
NO.

EB-2

DRILL RIG	Mobile B-61, HSA	SURFACE ELEVATION	14.3 Feet	LOGGED BY	NS
DEPTH TO GROUND WATER	20 feet	BORING DIAMETER	8-inch	DATE DRILLED	2/26/02

DESCRIPTION AND CLASSIFICATION		DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT(%)	DRY DENSITY (PCF)	UNCOMPRESSED COMPRESSIVE STRENGTH (KSF)	OTHER TESTS
DESCRIPTION AND REMARKS	CONSIST	SOIL TYPE						

<p>FILL: CLAY (CL), dark brown, mottled, sandy (fine- to medium-grained), some silt, damp</p> <p>FILL: SAND (SM), dary gray-brown, mottled shades of green, fine- to coarse-grained, silty, some clay, trace gravel (subangular to subrounded), trace brick pieces, damp</p> <p>hard drilling due to encountering concrete or brick chunk</p>	Firm								
	Medium Dense		5	X	33	15	119	3.2	% of Passing #200 Sieve = 42
	Very Soft		10	X	50/4"				No Recovery
<p>BAY MUD: CLAY (CH), black, mottled shades of blue-gray, silty, mild hydrocarbon odor, moist</p>			15						
			20	X	1	∇			PP < 0.5
			25						

File Name: G:\ENGINEERING\PROJECTS\21127\G.P.J Report Template: FUGRO Output Date: 3/26/02



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EXPLORATORY BORING LOG

**NEW ART BUILDING AT LANEY COLLEGE
Oakland, CA**

PROJECT NO.	DATE	BORING NO.
1430.001	February, 2002	EB-3

DRILL RIG	Mobile B-61, HSA	SURFACE ELEVATION	14.3 Feet	LOGGED BY	NS
DEPTH TO GROUND WATER	20 feet	BORING DIAMETER	8-inch	DATE DRILLED	2/26/02

DESCRIPTION AND CLASSIFICATION		DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT(%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	OTHER TESTS
DESCRIPTION AND REMARKS	CONSIST SOIL TYPE							
BAY MUD: CLAY (CH) , continued	Very Soft							
SAND (SM - SC) , dark gray, medium- to coarse-grained, with silt, strong hydrocarbon odor, trace shell fragment, wet	Loose to medium dense	30		18 8				No Recovery
CLAY (CL) , blue-gray, silty, with sand (fine- to coarse-grained), trace gravel, wet	Very Stiff	40		44	18	112	2.6	
SAND (SM - SC) , dark brown, mottled shades of green, fine- to coarse-grained, clayey, some silt, trace gravel, wet	Dense	45						
		50		52				

Bottom of Boring = 50 Feet

Notes:

1. The stratification lines represent the approximate boundaries between soil types and the transition may be gradual.
2. For an explanation of penetration resistance values, see first page of Appendix A.
3. A 140-lb safety hammer falling 30 inches was used to drive the sampler.
4. Ground water was encountered originally at depth of about 20 feet at the time of drilling.
5. The borehole was backfilled with lean cement immediately upon completion of the drilling.
6. PP = Pocket Penetrometer Reading (tsf).

File Name: G:\ENGINEERING\INT\PROJECTS\2127\G1.GPJ Report Template: FUGRO_Output Date: 3/26/02



425 Roland Way
Oakland, CA 94621

EXPLORATORY BORING LOG

**NEW ART BUILDING AT LANEY COLLEGE
Oakland, CA**

PROJECT NO.

DATE

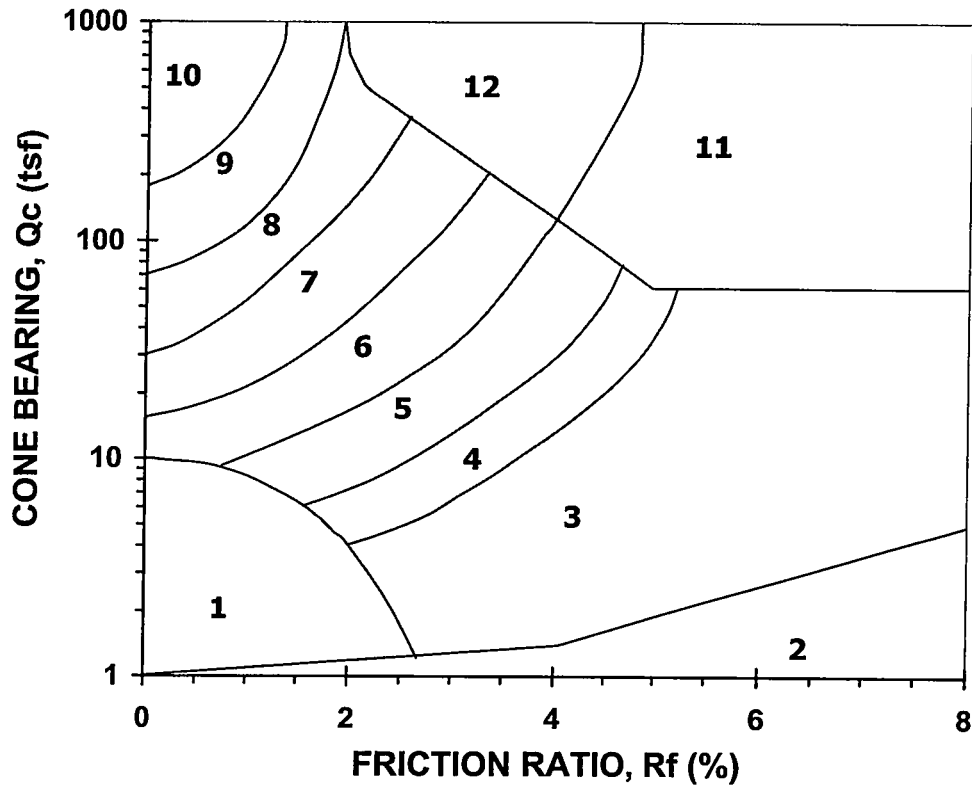
BORING
NO.

1430.001

February, 2002

EB-3

SIMPLIFIED SOIL BEHAVIOR TYPE CLASSIFICATION FOR STANDARD ELECTRONIC CONE PENETROMETER



ZONE	Q_c/N^1	S_u Factor $(Nk)^2$	SOIL BEHAVIOR TYPE ¹
1	2	for Zones 1 to 6 10 for $Q_c \leq 9$ tsf 12 for $Q_c = 9$ to 12 tsf 15 for $Q_c > 12$ tsf	Sensitive Fine Grained Organic Material CLAY
2	1		Silty CLAY to CLAY
3	1		Clayey SILT to Silty CLAY
4	1.5		Sandy SILT to Clayey SILT
5	2		Silty SAND to Sandy SILT
6	2.5		SAND to Silty SAND
7	3	---	SAND
8	4	---	Gravelly SAND to SAND
9	5	---	Very Stiff Fine Grained (*)
10	6	---	SAND to Clayey SAND (*)
11	1	15	
12	2	---	

(*) Overconsolidated or Cemented

Q_c = Tip Bearing

F_s = Sleeve Friction

$R_f = F_s/Q_c * 100 =$ Friction Ratio

References: ¹Robertson, 1986, Olsen, 1988

²Bonaparte & Mitchell, 1979 (young bay mud $Q_c \leq 9$)

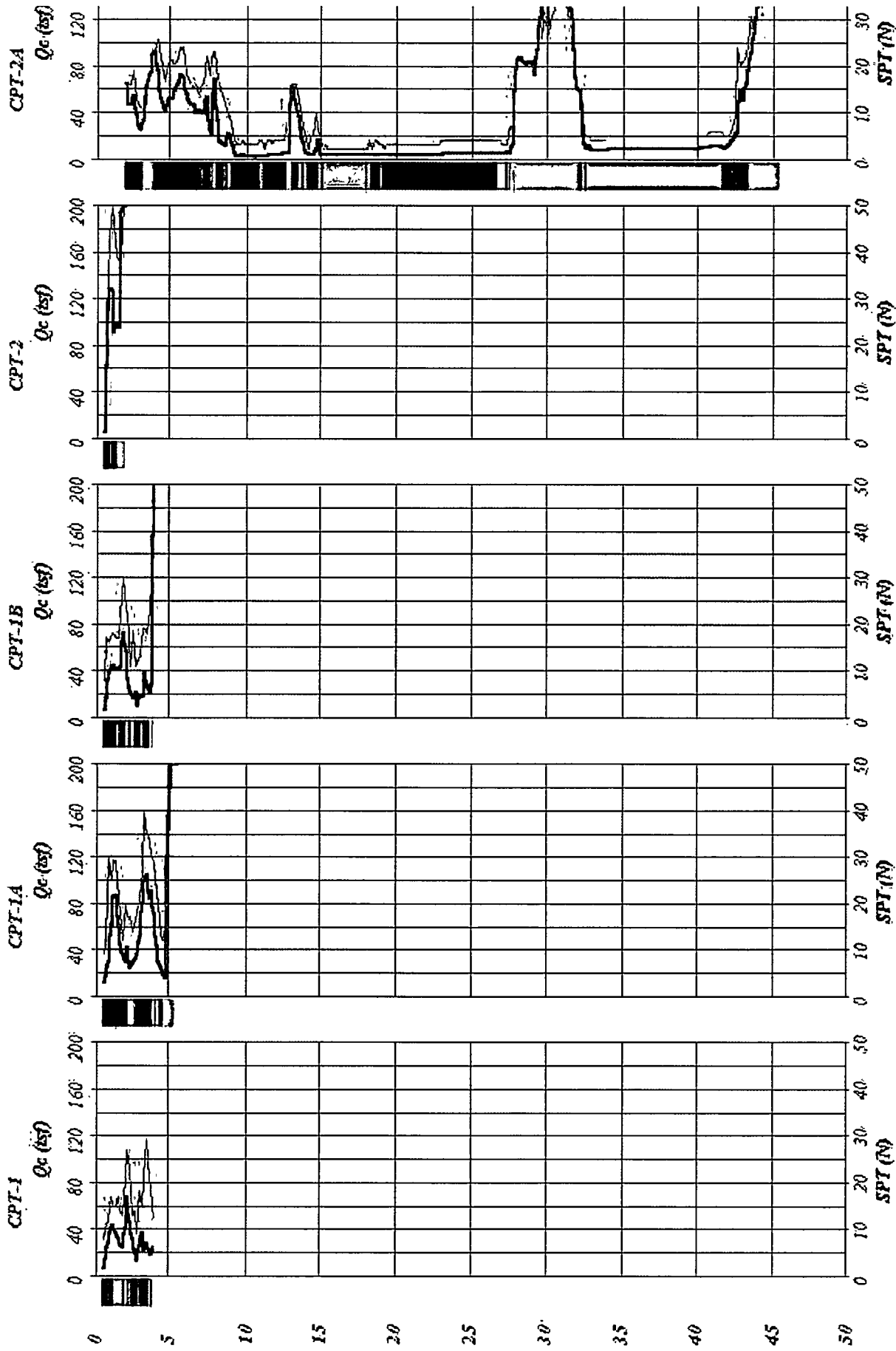
²Estimated from local experience (fine grained soils $Q_c > 9$)

Note: Testing performed in accordance with ASTM D3441

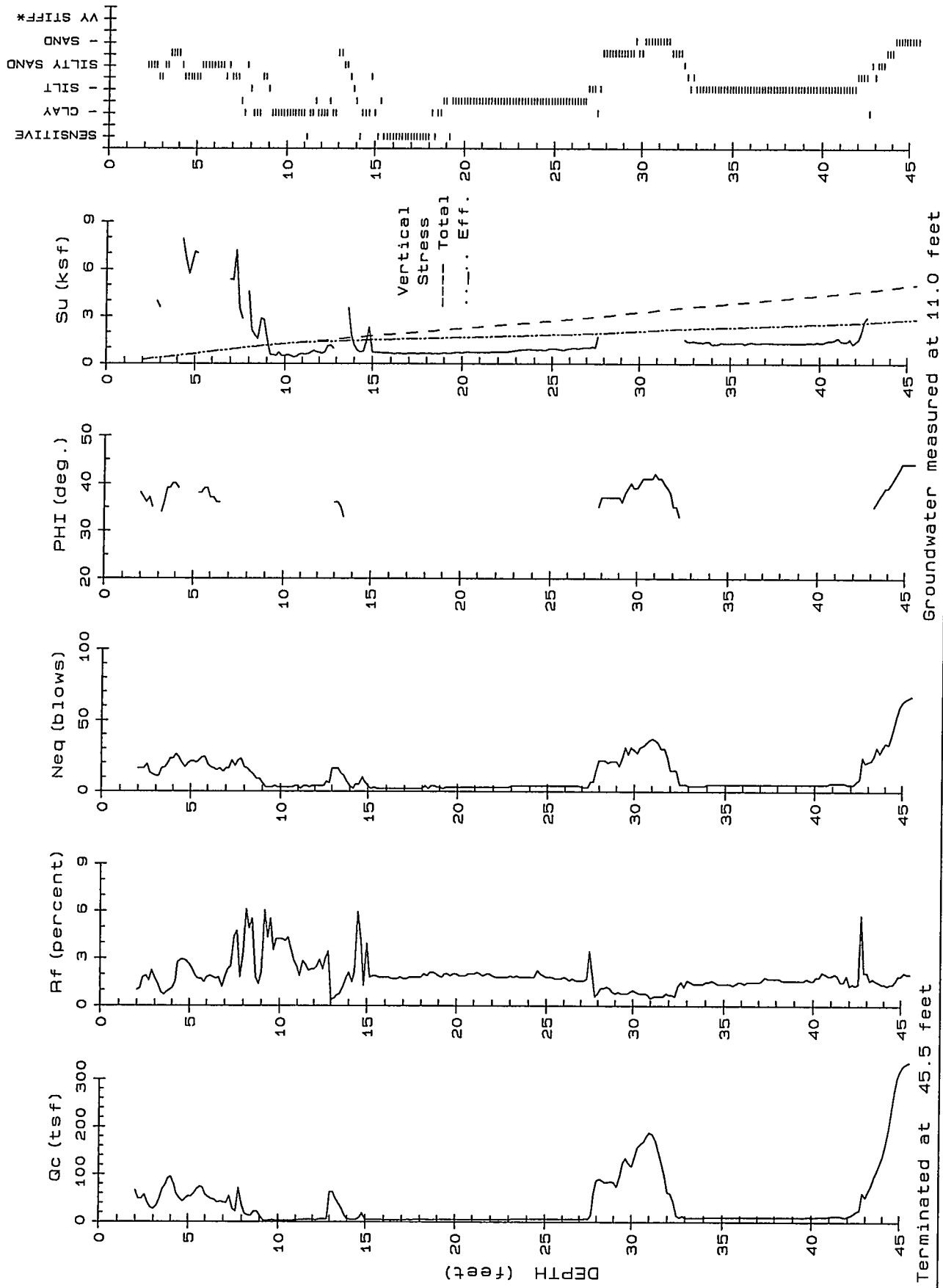
John Sarmiento & Associates

Cone Penetrometer Testing Services

PROJECT: LANEY COLLEGE LOCATION: Oakland CA



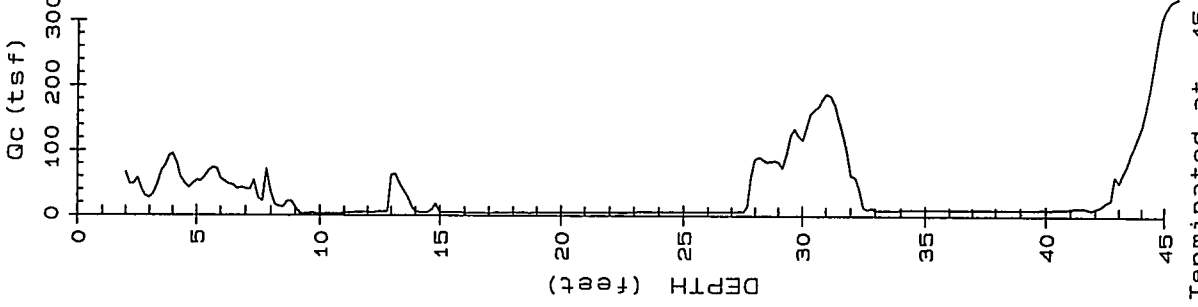
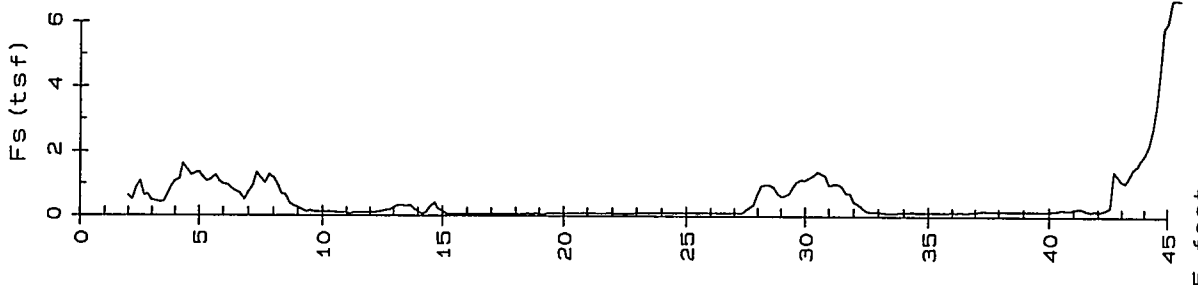
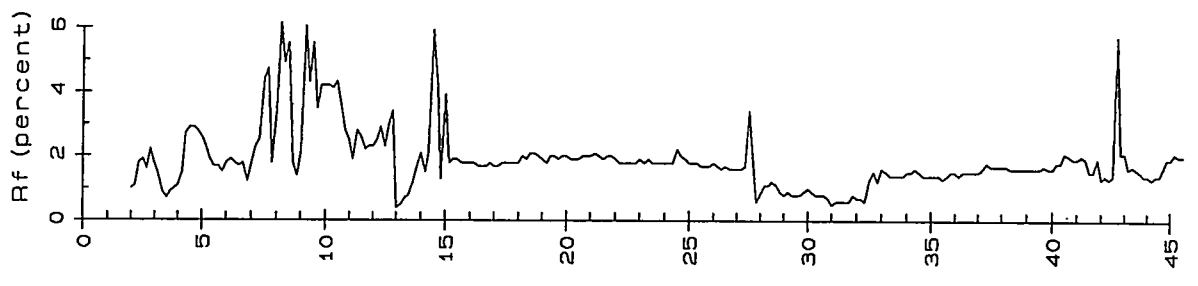
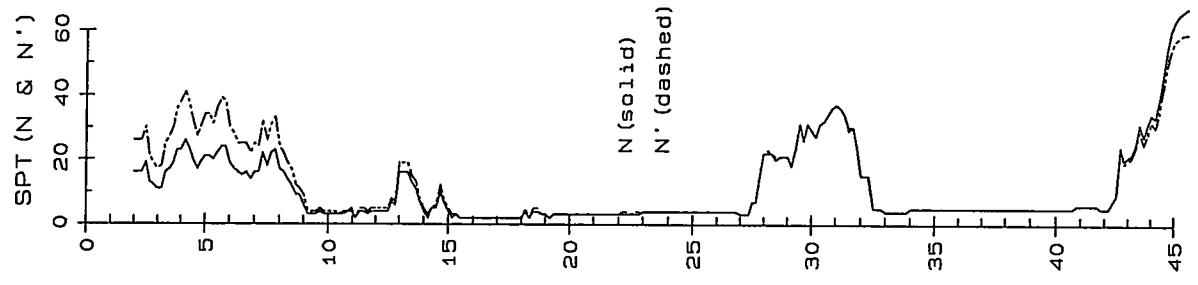
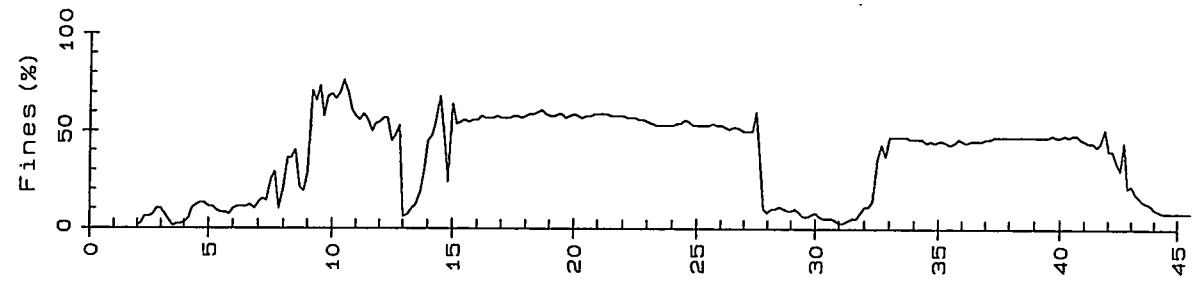
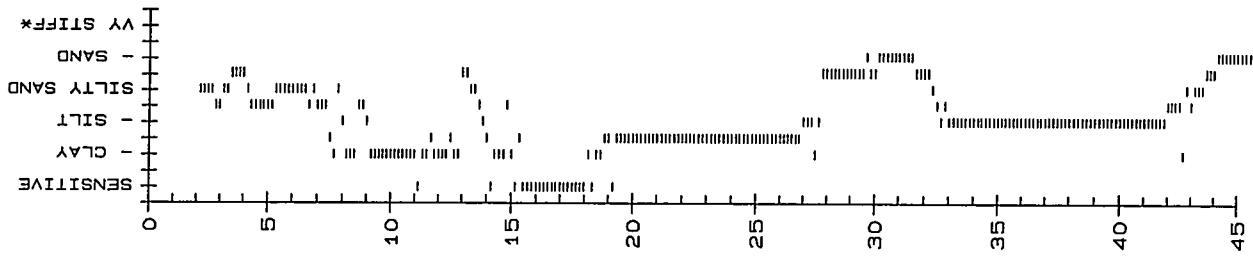
RESULTS OF CONE PENETROMETER TESTS (CPTs)



PROJECT: LANEY COLLEGE
 LOCATION: Oakland CA
 PROJ. NO.: 21127-G1 (MWH-37)

CPT NO.: CPT-2A
 DATE: 02-26-2002

John Sarmiento & Associates
 Cone Penetration Testing Service



Groundwater measured at 11.0 feet

Terminated at 45.5 feet

CPT NO.: CPT-2A
 DATE : 02-26-2002

PROJECT: LANEY COLLEGE
 LOCATION: Oakland CA
 PROJ. NO.: 21127-G1 (MWH-37)

John Sarmiento & Associates
 Cone Penetration Testing Service

PROJECT: LANEY COLLEGE
 LOCATION: Oakland CA
 PROJ. NO.: 21127-G1(MMH-37)

CPT NO.: CPT-2A Page 1 of 2
 DATE : 02-26-2002
 Groundwater measured at 11.0 feet

DEPTH (feet)	Qc (tsf)	Fs (tsf)	Rf (%)	SPT (N)	SPT (N')	TotHzStr (ksf)	PHI (deg.)	SU (ksf)	SOIL BEHAVIOR TYPE	DENSITY RANGE (pcf)
2.00	65.31	0.633	1.0	16	26	0.25	38	----	SAND to Silty SAND	..
2.50	55.84	1.069	1.9	19	30	0.31	37	----	Silty SAND to Sandy SILT	130-140
3.00	26.84	0.490	1.8	11	17	0.37	----	3.55	Sandy SILT to Clayey SILT	120-130
3.50	68.70	0.451	0.7	17	27	0.43	39	----	SAND to Silty SAND	..
4.00	93.79	1.068	1.1	23	38	0.50	40	----	..	..
4.50	49.78	1.437	2.9	20	32	0.56	----	6.60	Sandy SILT to Clayey SILT	130-140
5.00	53.17	1.359	2.6	21	34	0.63	----	7.05	..	..
5.50	67.05	1.135	1.7	22	36	0.70	38	----	Silty SAND to Sandy SILT	..
6.00	56.26	0.986	1.8	19	30	0.77	37	----	..	..
6.50	46.38	0.771	1.7	15	25	0.83	36	----	..	..
7.00	40.32	0.739	1.8	16	25	0.90	----	5.32	Sandy SILT to Clayey SILT	..
7.50	26.43	1.166	4.4	18	26	0.97	----	3.46	Silty CLAY to CLAY	..
8.00	34.45	1.180	3.4	17	24	1.03	----	4.52	Clayey SILT to Silty CLAY	..
8.50	12.15	0.668	5.5	12	17	1.10	----	1.55	CLAY	120-130
9.00	12.82	0.270	2.1	6	9	1.16	----	1.63	Clayey SILT to Silty CLAY	110-120
9.50	3.06	0.167	5.5	3	4	1.20	----	0.49	CLAY	90-100
10.00	3.14	0.131	4.2	3	4	1.25	----	0.50	..	..
10.50	2.67	0.114	4.3	3	3	1.30	----	0.40	..	..
11.00	3.82	0.096	2.5	4	5	1.35	----	0.63	..	..
11.50	4.21	0.110	2.6	4	5	1.39	----	0.70	..	..
12.00	4.25	0.097	2.3	4	5	1.44	----	0.71	..	..
12.50	6.40	0.149	2.3	4	5	1.49	----	1.13	Silty CLAY to CLAY	..
13.00	62.43	0.258	0.4	16	19	1.54	36	----	SAND to Silty SAND	120-130
13.50	38.26	0.318	0.8	13	15	1.60	33	----	Silty SAND to Sandy SILT	110-120
14.00	6.53	0.139	2.1	4	5	1.66	----	1.14	Silty CLAY to CLAY	90-100
14.50	4.72	0.276	5.9	5	6	1.70	----	0.77	CLAY	100-110
15.00	4.41	0.172	3.9	4	5	1.76	----	0.71	..	90-100
15.50	4.27	0.080	1.9	2	2	1.81	----	0.67	Sensitive Fine Grained	..
16.00	4.19	0.075	1.8	2	2	1.85	----	0.65	..	..
16.50	4.13	0.072	1.7	2	2	1.90	----	0.64	..	85-90
17.00	4.17	0.072	1.7	2	2	1.94	----	0.64	..	..
17.50	4.17	0.075	1.8	2	2	1.99	----	0.63	..	90-100
18.00	4.24	0.076	1.8	2	2	2.04	----	0.64	..	..
18.50	4.23	0.090	2.1	4	5	2.08	----	0.64	CLAY	..
19.00	4.39	0.085	1.9	3	3	2.13	----	0.67	Silty CLAY to CLAY	..
19.50	4.45	0.089	2.0	3	3	2.18	----	0.67	..	..
20.00	4.47	0.089	2.0	3	3	2.23	----	0.67	..	..
20.50	4.70	0.091	1.9	3	3	2.27	----	0.71	..	..
21.00	4.68	0.093	2.0	3	3	2.32	----	0.70	..	..
21.50	4.74	0.092	1.9	3	3	2.37	----	0.71	..	..
22.00	4.80	0.093	1.9	3	3	2.42	----	0.72	..	..
22.50	4.86	0.089	1.8	3	3	2.46	----	0.73	..	..
23.00	5.38	0.100	1.9	4	4	2.51	----	0.82	..	..
23.50	5.77	0.106	1.8	4	4	2.56	----	0.90	..	..
24.00	5.81	0.104	1.8	4	4	2.61	----	0.90	..	..
24.50	5.73	0.125	2.2	4	4	2.65	----	0.88	..	..
25.00	5.95	0.108	1.8	4	4	2.70	----	0.92	..	..
25.50	5.87	0.102	1.7	4	4	2.75	----	0.90	..	..
26.00	6.01	0.109	1.8	4	4	2.80	----	0.92	..	..
26.50	6.11	0.102	1.7	4	4	2.84	----	0.94	..	..
27.00	6.52	0.105	1.6	3	3	2.89	----	1.02	Clayey SILT to Silty CLAY	..
27.50	6.50	0.224	3.4	7	7	2.94	----	1.01	CLAY	100-110
28.00	86.18	0.708	0.8	22	22	3.00	37	----	SAND to Silty SAND	120-130
28.50	81.76	0.985	1.2	20	21	3.06	37	----	..	..
29.00	82.38	0.631	0.8	21	21	3.13	37	----	..	..
29.50	122.59	0.928	0.8	31	31	3.19	39	----	..	..
30.00	116.31	1.119	1.0	29	29	3.25	39	----	..	..
30.50	161.98	1.367	0.8	32	32	3.31	41	----	SAND	..
31.00	185.64	0.963	0.5	37	37	3.38	42	----	..	..
31.50	147.89	0.941	0.6	30	29	3.44	40	----	..	..
32.00	61.40	0.446	0.7	15	15	3.50	35	----	SAND to Silty SAND	..
32.50	13.03	0.172	1.3	5	5	3.56	----	1.50	Sandy SILT to Clayey SILT	100-110
33.00	8.97	0.147	1.6	4	4	3.61	----	1.43	Clayey SILT to Silty CLAY	..
33.50	8.49	0.122	1.4	4	4	3.66	----	1.33	..	90-100
34.00	9.09	0.134	1.5	5	5	3.71	----	1.21	..	..

John Sarmiento & Associates
 Cone Penetration Testing Service

PROJECT: LANEY COLLEGE
 LOCATION: Oakland CA
 PROJ. NO.: 21127-G1(MWH-37)

CPT NO.: CPT-2A
 DATE : 02-26-2002
 Groundwater measured at 11.0 feet

DEPTH (feet)	Qc (tsf)	Fs (tsf)	Rf (%)	SPT (N)	SPT (N')	TotHzStr (ksf)	PHI (deg.)	SU (ksf)	SOIL BEHAVIOR TYPE	DENSITY RANGE (pcf)
34.50	9.78	0.143	1.5	5	5	3.75	----	1.32	..	..
35.00	9.60	0.138	1.4	5	5	3.80	----	1.28	..	..
35.50	9.93	0.126	1.3	5	5	3.85	----	1.33	..	..
36.00	9.83	0.147	1.5	5	5	3.90	----	1.31	..	..
36.50	9.82	0.144	1.5	5	5	3.95	----	1.31	..	100-110
37.00	9.93	0.153	1.5	5	5	4.00	----	1.32	..	90-100
37.50	9.82	0.168	1.7	5	5	4.05	----	1.30	..	100-110
38.00	9.79	0.163	1.7	5	5	4.10	----	1.29	..	..
38.50	9.87	0.161	1.6	5	5	4.16	----	1.30	..	..
39.00	9.87	0.161	1.6	5	5	4.21	----	1.29	..	..
39.50	10.14	0.167	1.6	5	5	4.26	----	1.33	..	..
40.00	10.14	0.165	1.6	5	5	4.31	----	1.33	..	..
40.50	10.91	0.227	2.1	5	5	4.37	----	1.46	..	..
41.00	11.94	0.232	1.9	6	6	4.42	----	1.62	..	..
41.50	12.51	0.191	1.5	6	6	4.48	----	1.37	..	..
42.00	12.66	0.161	1.3	5	5	4.53	----	1.39	..	..
42.50	22.52	0.304	1.4	9	9	4.58	----	2.70	Sandy SILT to Clayey SILT	..
43.00	52.04	1.108	2.1	21	20	4.65	----	6.63	..	110-120
43.50	92.46	1.483	1.6	31	29	4.72	37	----	..	130-140
44.00	137.71	1.911	1.4	34	32	4.78	39	----	Silty SAND to Sandy SILT	..
44.50	232.01	3.349	1.4	46	42	4.85	42	----	SAND to Silty SAND	..
45.00	314.60	5.980	1.9	63	57	4.92	44	----	SAND	..
45.50	332.90	6.687	2.0	67	59	4.99	44	----	..	..

DEPTH = Sampling interval (2 inches)

Qc = Tip bearing resistance
 Fs = Sleeve friction resistance
 Rf = Tip/Sleeve ratio
 SPT = Equivalent Standard Penetration Test*

TotStr = Total Stress using est. density**

Phi = Soil friction angle*

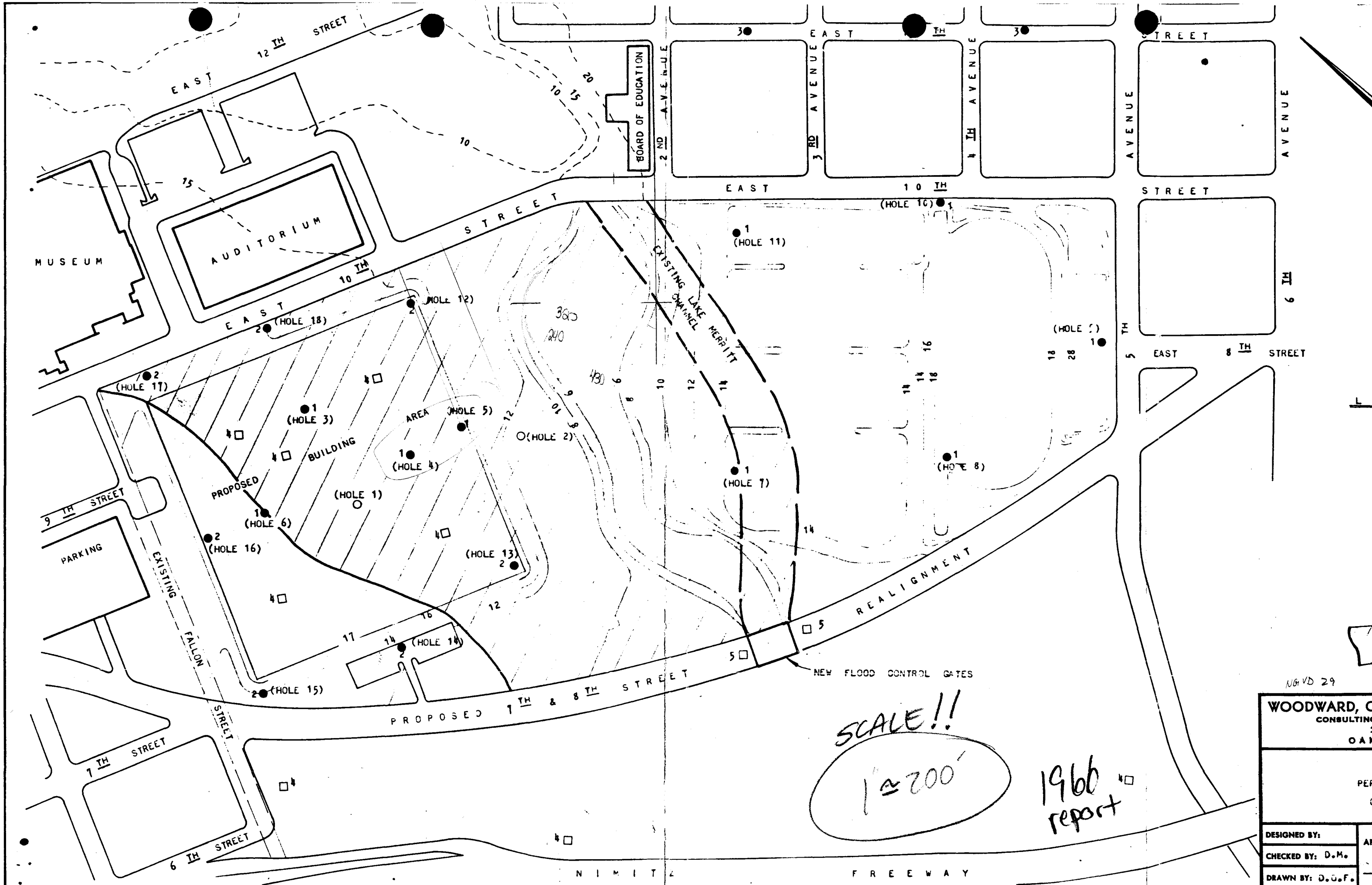
Su = Undrained Soil Strength* (Nk=10 for Qc<9 tsf)

(Nk=12 for Qc=9 to 12 tsf) (Nk=15 for Qc>12 tsf)

References: * Robertson and Campanella, 1988

** Olsen, 1989 *** Durgunoglu & Mitchell, 1975

**C.2 Exploratory Boring Logs and Lab Results by WCS, November 1965, WCS
No. S10312**



SCALE!!

1" = 200'

1966 report

NGVD 29

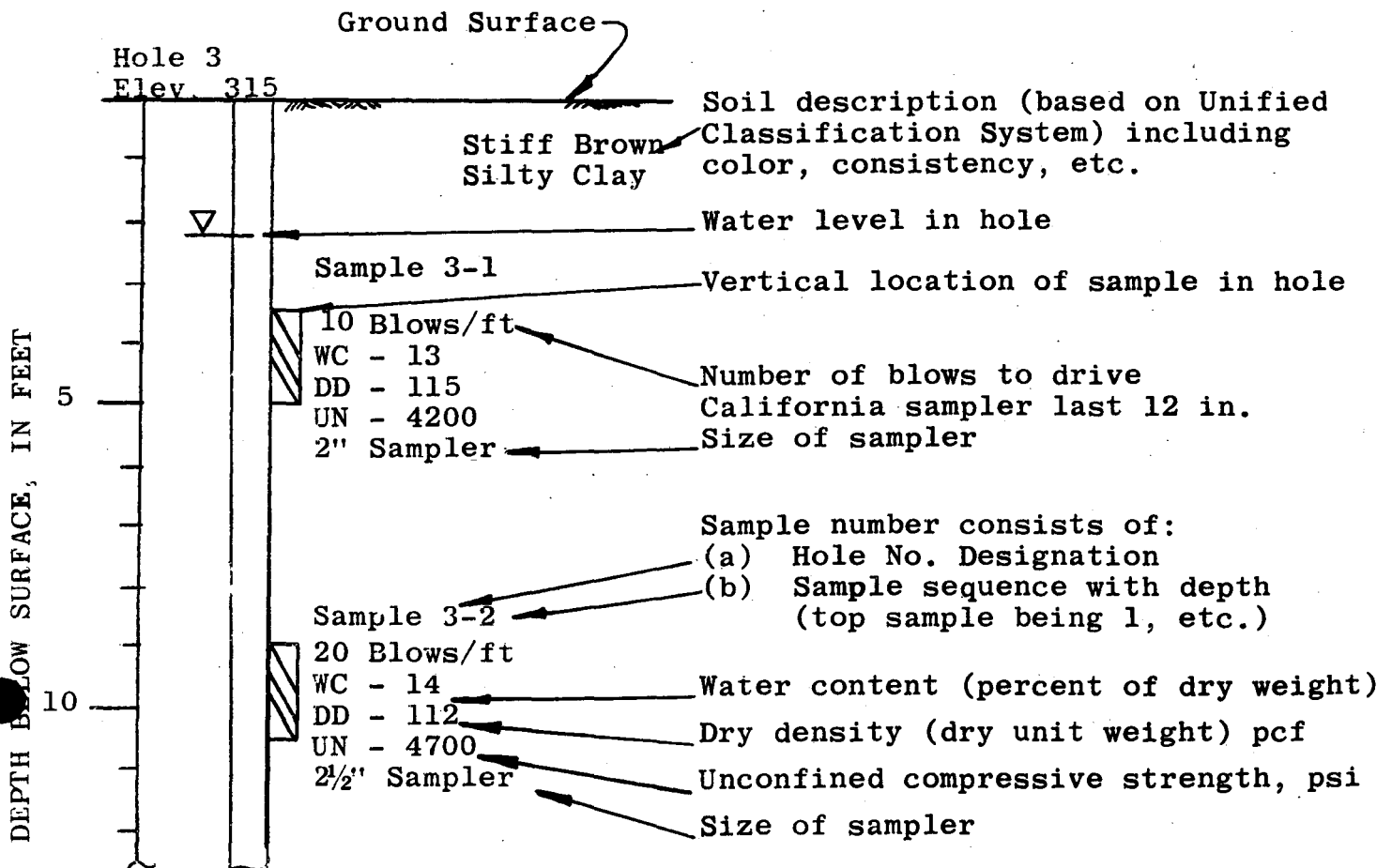
WOODWARD, C	
CONSULTING	
2	
OAK	
DESIGNED BY:	API
CHECKED BY: D.M.	
DRAWN BY: D.G.F.	

A P P E N D I X

NOTES ON FIELD INVESTIGATION

1. Borings were advanced with a 6-in. diameter continuous flight power auger and by wash boring.
2. The Engineering Geologist were M. Conant, R. Russell and C. Taylor
3. In-place samples of the soils were obtained with either drive samplers or Shelby tube samplers. The size of sampler used is indicated at the sample location on the logs of borings.
 - a) The 2-in. sampler measures 2-in. I.D. and 2½-in. O.D.. Thin brass liners are enclosed in the sampler. The sampler is driven 18-in. into the soil at the bottom of the holes with a 140 lb. hammer falling 30 in.
 - b) The 2½-in. sampler measures 2½-in. I.D. and 2¾-in. O.D. and also contains brass liners. This sampler is driven 24-in. into the soil with a 140 lb. hammer falling 30 in.
 - c) Shelby tube samplers are thin-walled brass tubes, measuring either 2.8 or 3.2 I.D., and are pushed into the soil by hydraulic mechanism. Loss of the sample is prevented by either a fixed piston in the Osterberg type sampler or by ball check valve in the open type sampler.
4. When the sampler was withdrawn from the test holes, the brass tubes containing the soils samples were removed, carefully sealed to preserve the natural moisture content, and returned to the laboratory for testing.
5. Classifications are based on the Unified Classification System and are made in the field by our Engineer or Geologist. Classifications of in-place samples are verified by an examination by the Staff Engineer.

KEY TO BORING LOGS



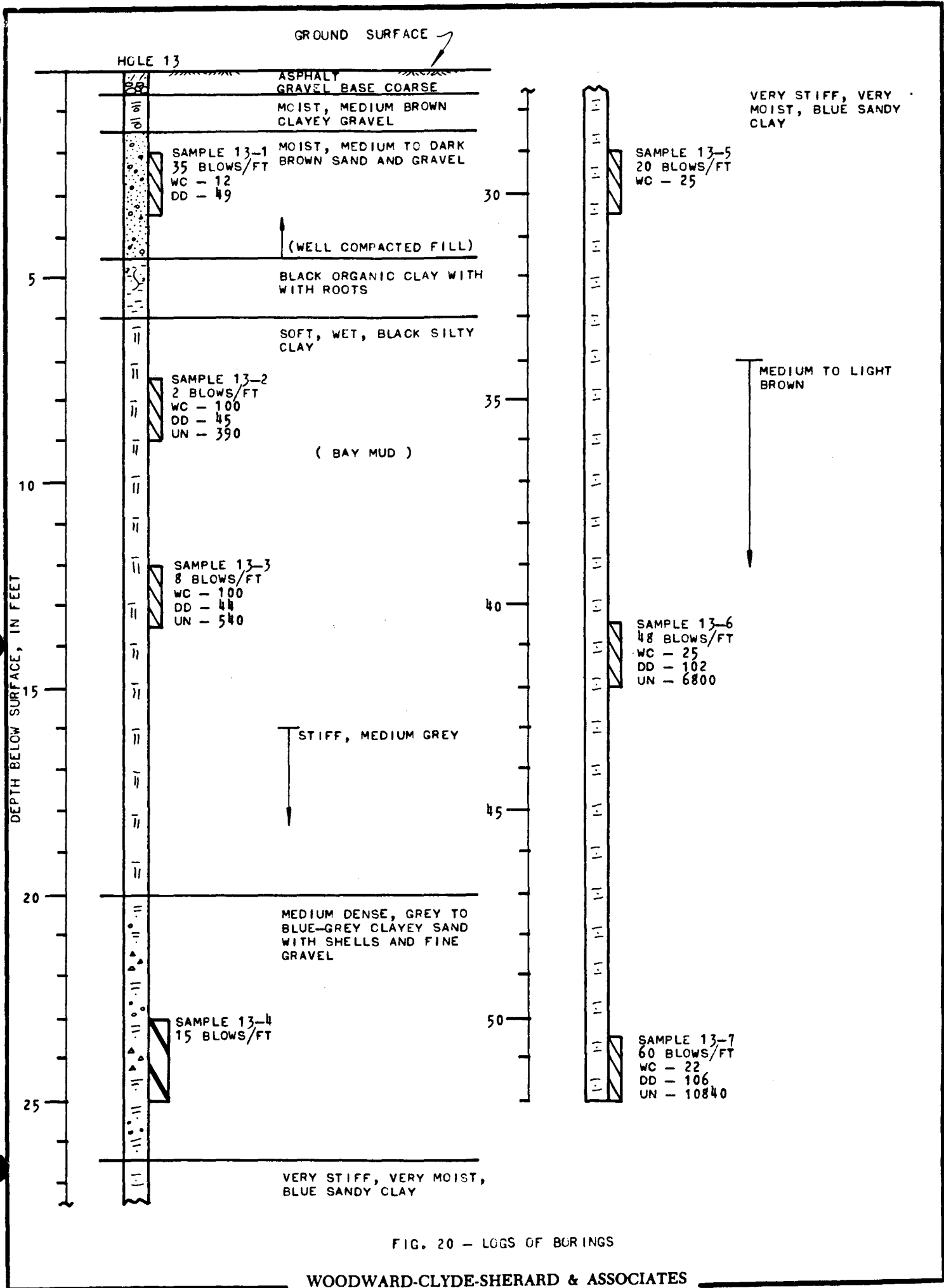


FIG. 20 - LOGS OF BORINGS

17/6, CUL & HS

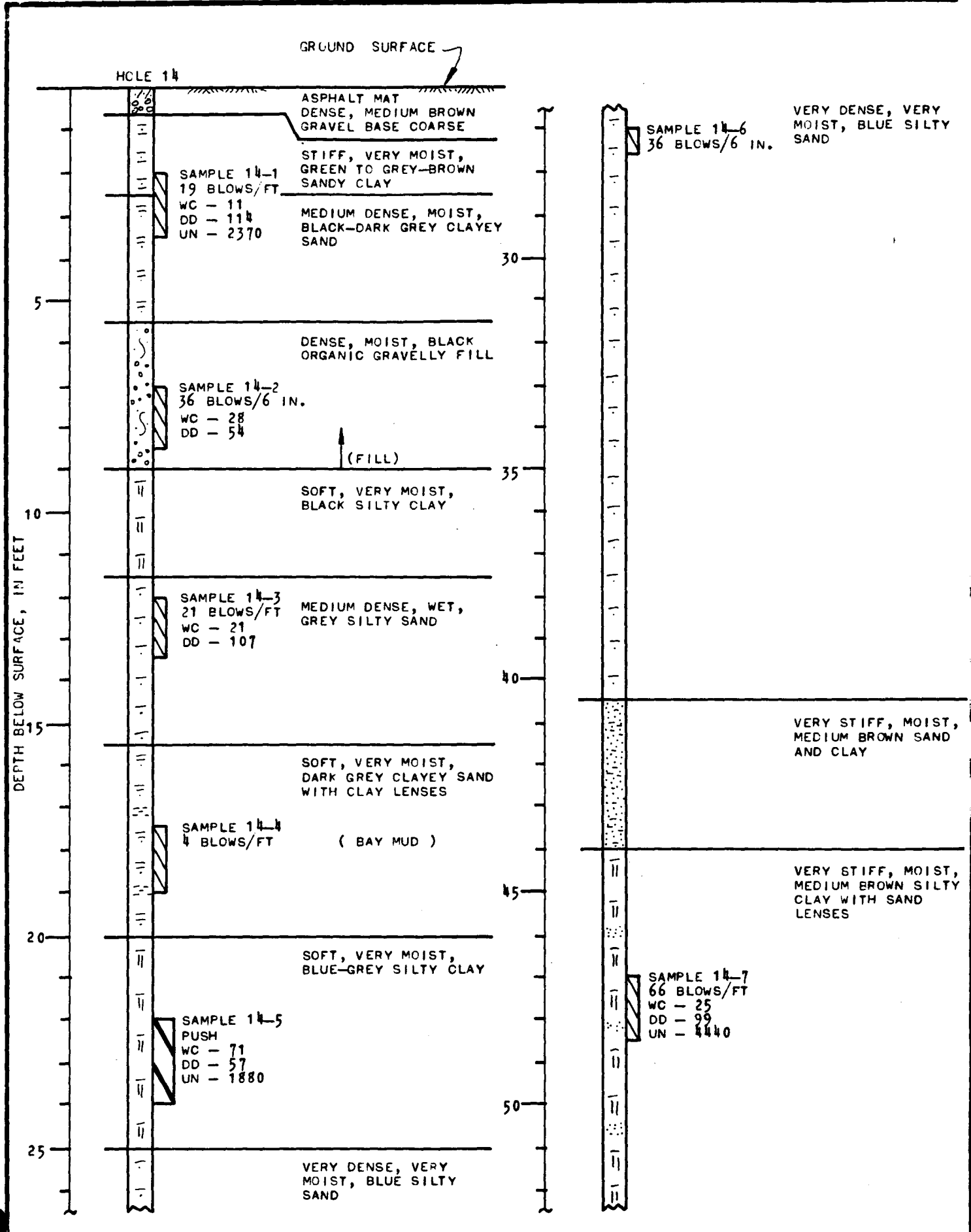


FIG. 21 - LOGS OF BORINGS

UKE & HS
14/11/07

HOLE 14 (CONT'D)

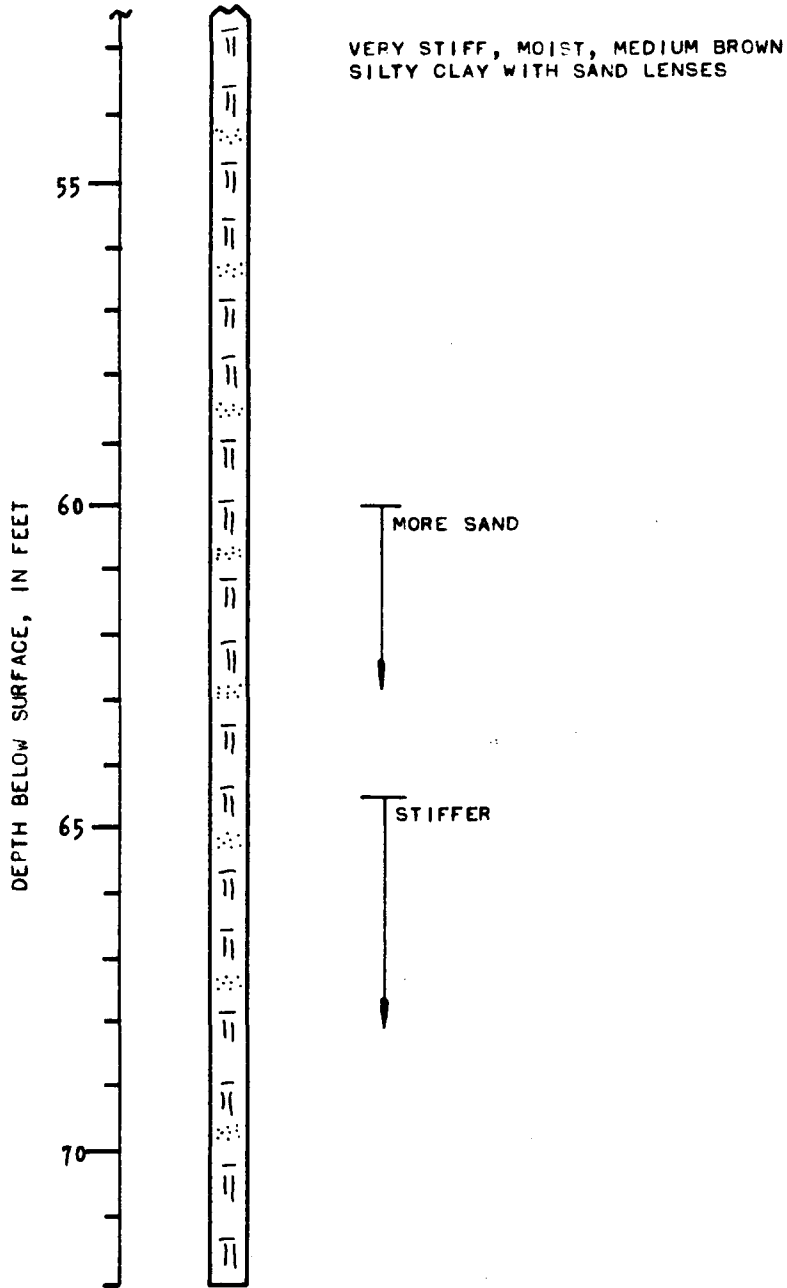
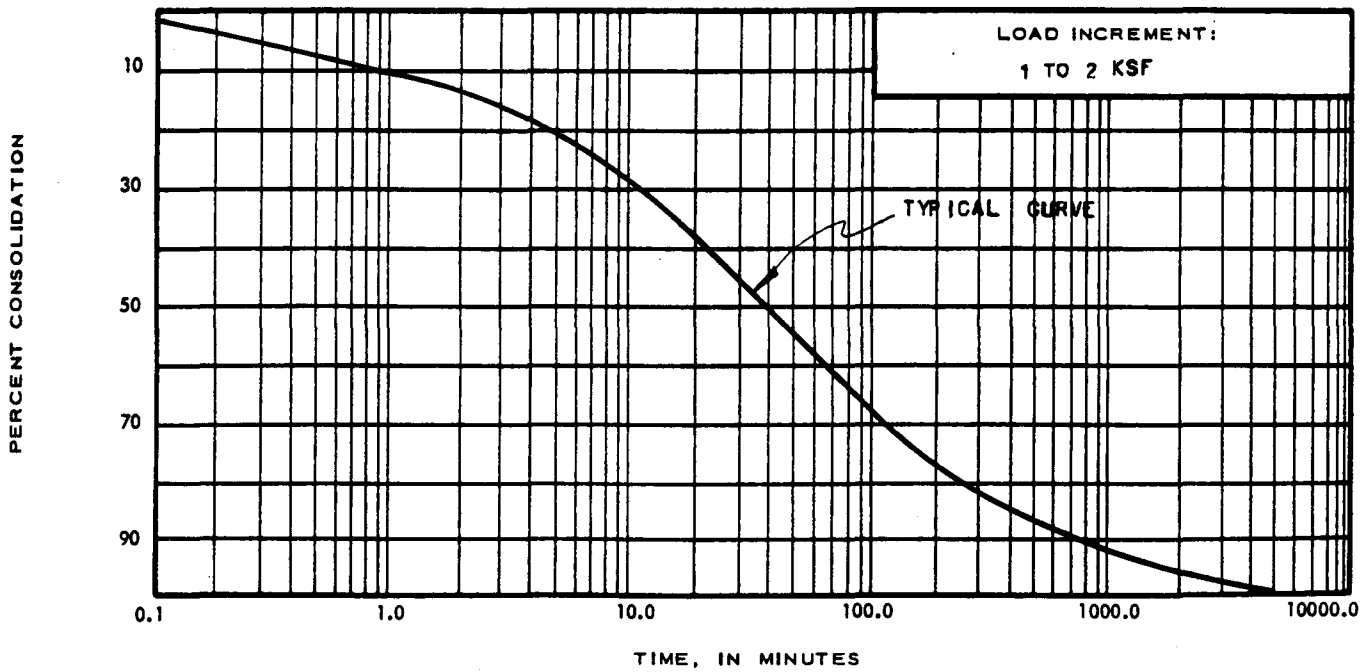
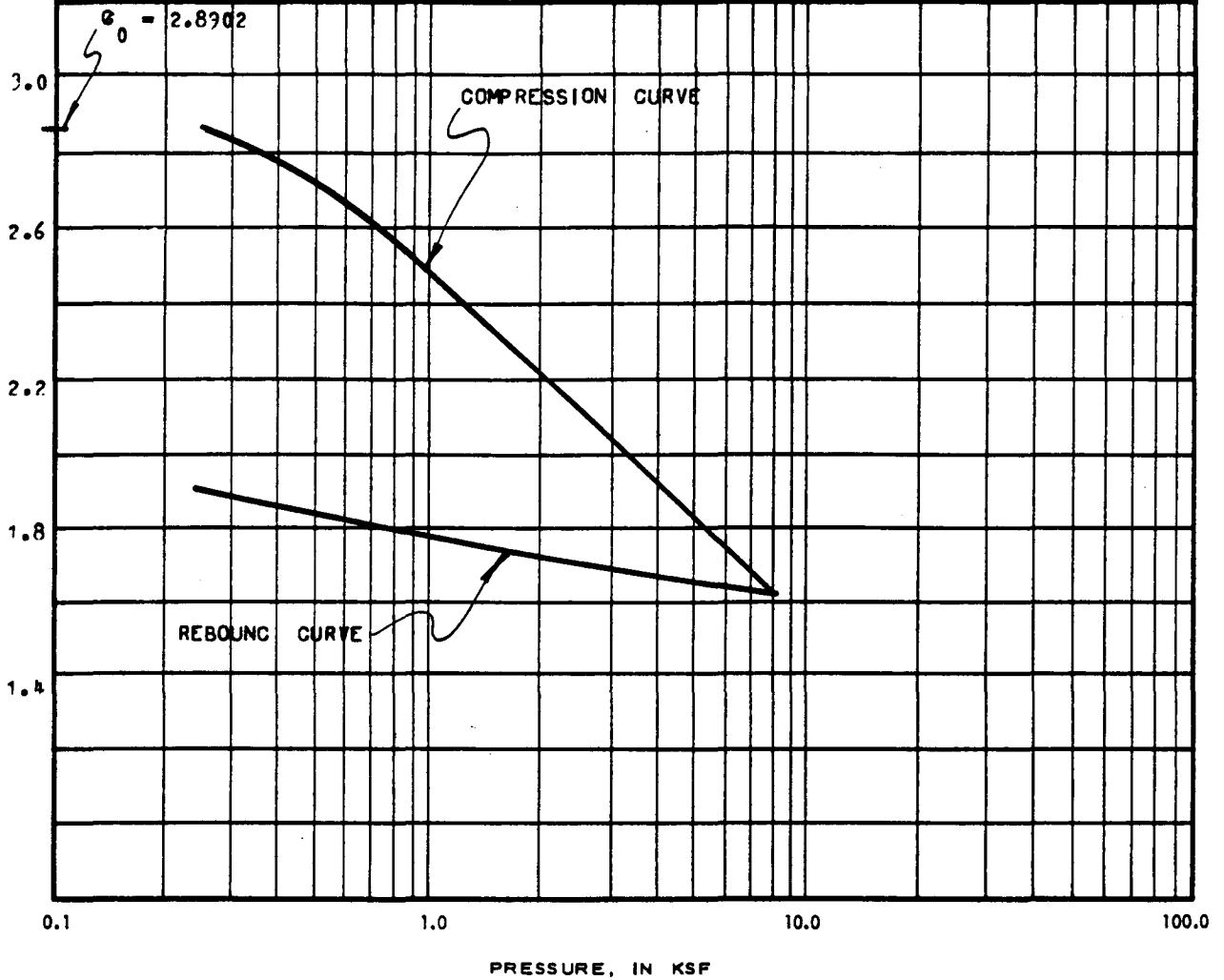


FIG. 22 - LOGS OF BORINGS

SAMPLE NO. 13-3-9	SUMMARY OF TEST RESULTS					
	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	2.75	102.24	44.10	97.28	.8981	1.94
FINAL		68.96	52.17	99.81	.6694	



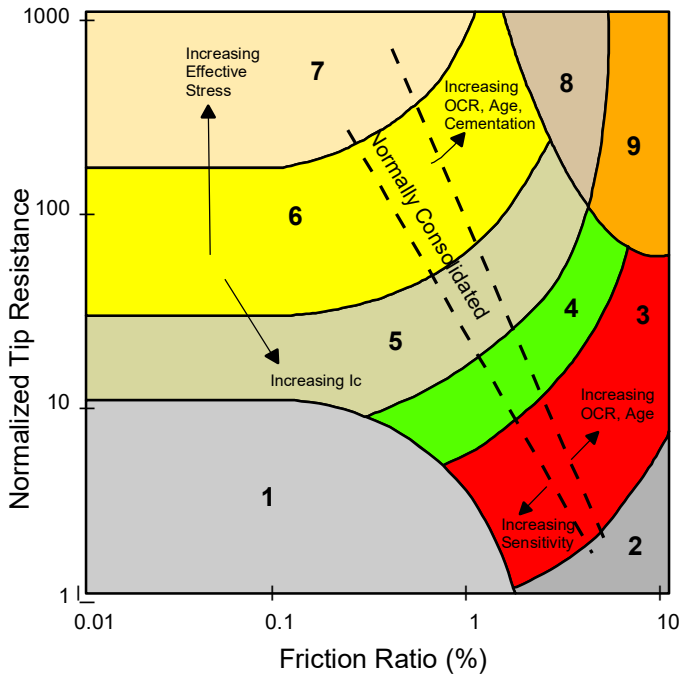
CONSOLIDATION TEST

Supplement D

Liquefaction Triggering and

Post-Liquefaction Deformation Analyses

**CPT CORRELATION CHART
(Robertson 1990)**



Zone	Soil Behavior Type
1	Sensitive Fine-grained
2	Peats
3	Silty Clay to Clay
4	Clayey Silt to Silty Clay
5	Silty Sand to Sandy Silt
6	Clean Sand to Silty Sand
7	Gravelly Sand to Dense Sand
8	Very Stiff Sand to Clayey Sand*
9	Very Stiff Fine-Grained*

*heavily overconsolidated or cemented

CPT LOG COMPONENTS

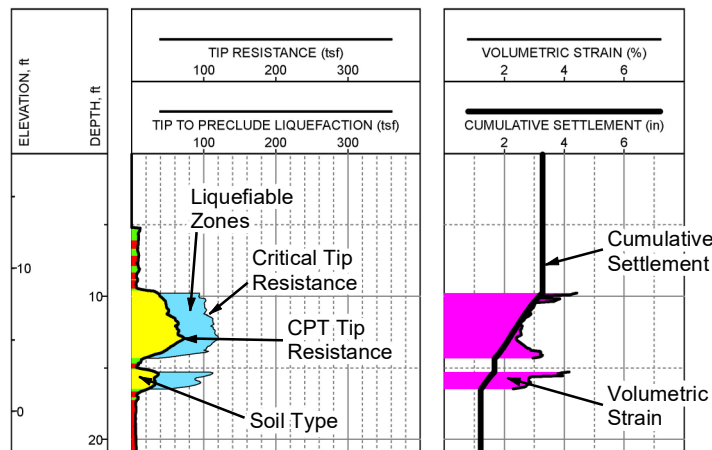
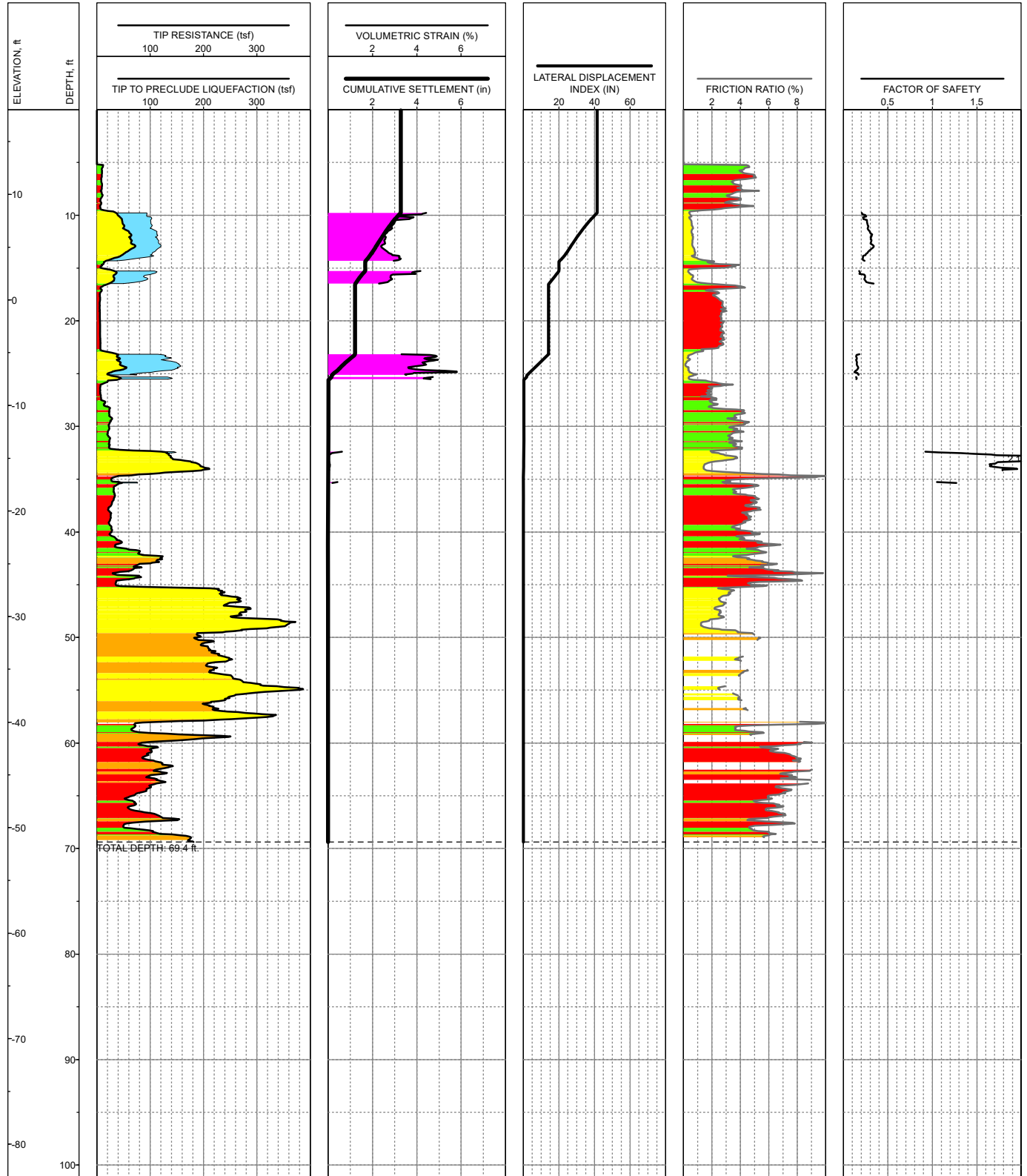


PLATE D-0: KEY TO LIQUEFACTION LOGS





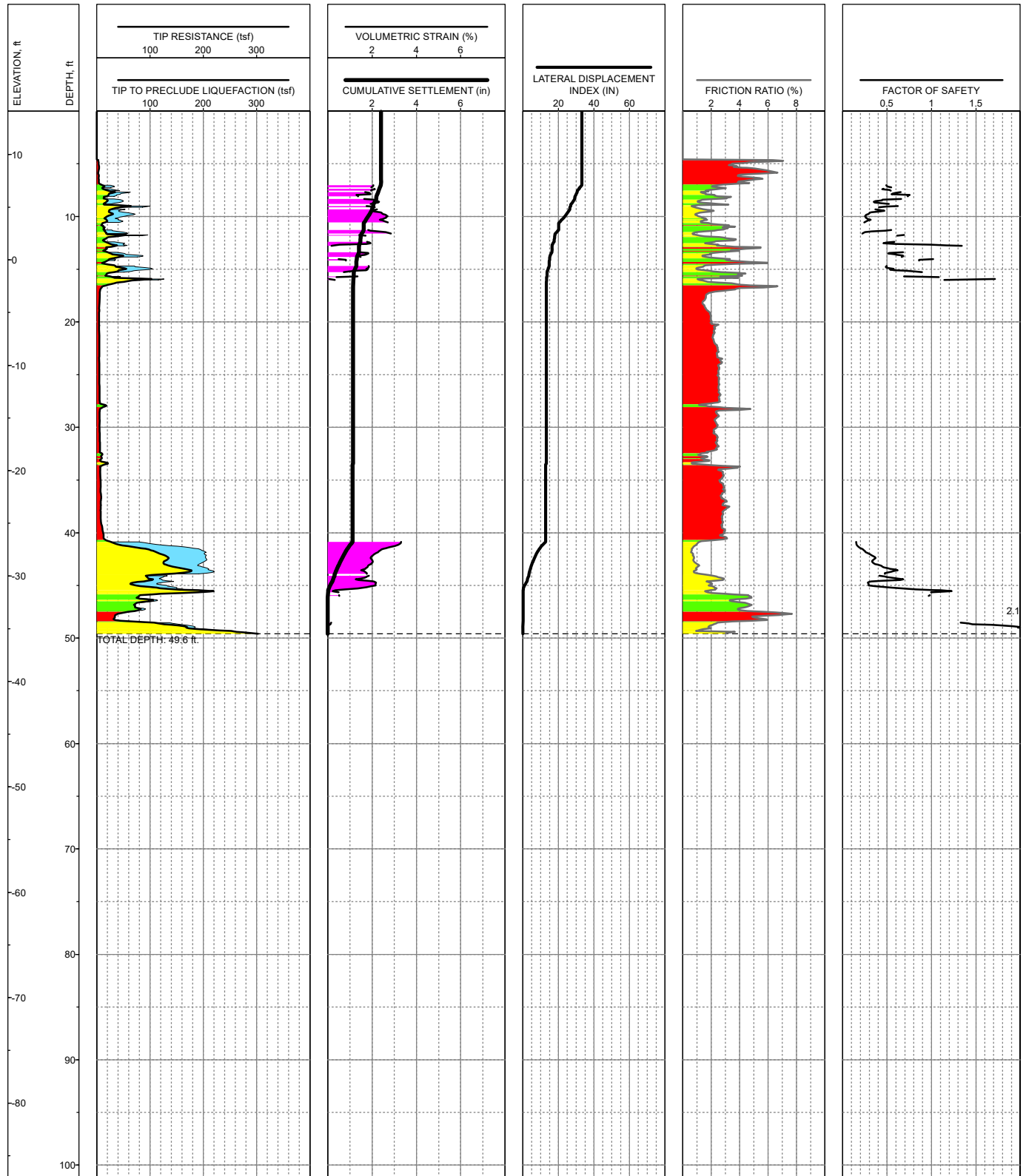
LOCATION: E6,052,365, N2,116,794, NAD83 SP CA Z3 FT
 SURFACE EL: 18.02 ft
 COMPLETION DEPTH: 69.4 ft
 TESTDATE: 3/29/2019

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.59
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-1: LOG OF 2019-CPT-01 – M=7.0, PGA=0.810, N, TL, TR



W:\Projects\Location-72190021\201904\72190021_Laney College Library Learning Resource Center\08_GIS\01_Explorations\CPT\2019\Logs\2019_06_18_Logs_M7_0_a0_810_N_TL_TR\MXD\CPT_Logs_M7_0_a0_810_N_TL_TR_6/21/2019_A.Ramirez

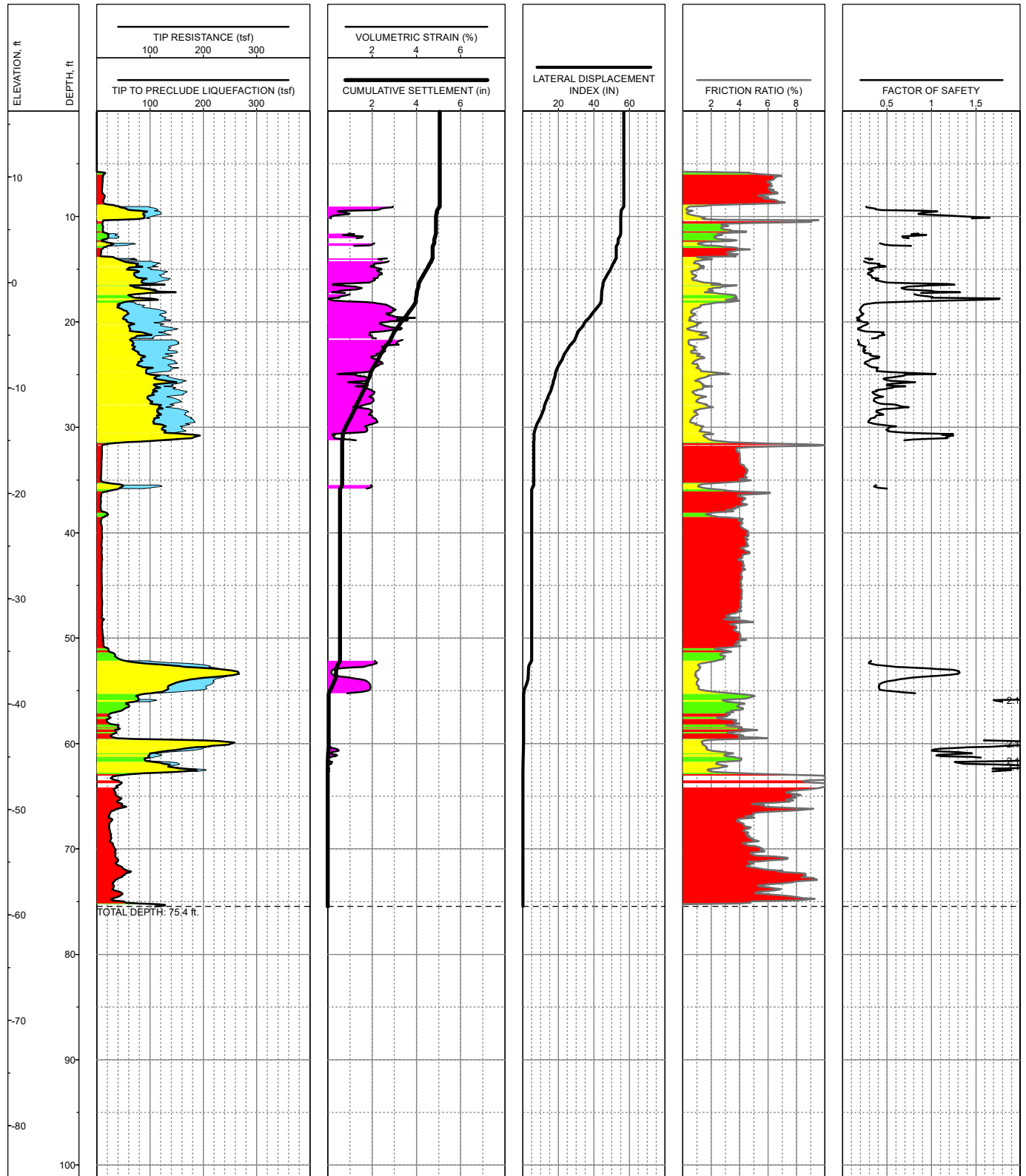


LOCATION: E6,052,593, N2,116,694, NAD83 SP CA Z3 FT
 SURFACE EL: 14.11 ft
 COMPLETION DEPTH: 49.6 ft
 TESTDATE: 3/29/2019

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.59
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-2: LOG OF 2019-CPT-02 – M=7.0, PGA=0.810, N, TL, TR

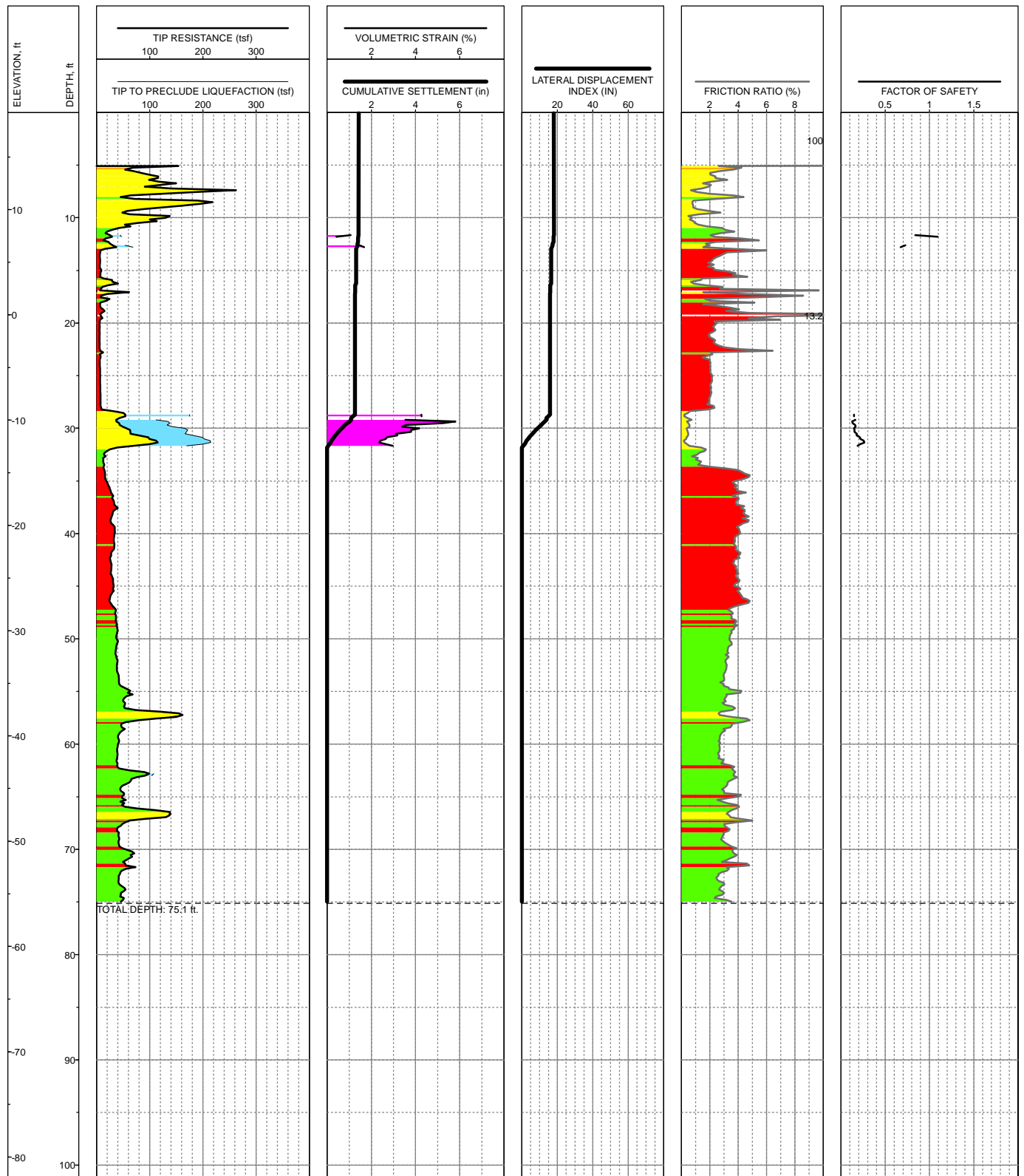




LOCATION: E6,052,570, N2,116,535, NAD83 SP CA Z3 FT
 SURFACE EL: 16.26 ft
 COMPLETION DEPTH: 75.4 ft
 TESTDATE: 3/29/2019

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.59
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-3: LOG OF 2019-CPT-03 – M=7.0, PGA=0.810, N, TL, TR

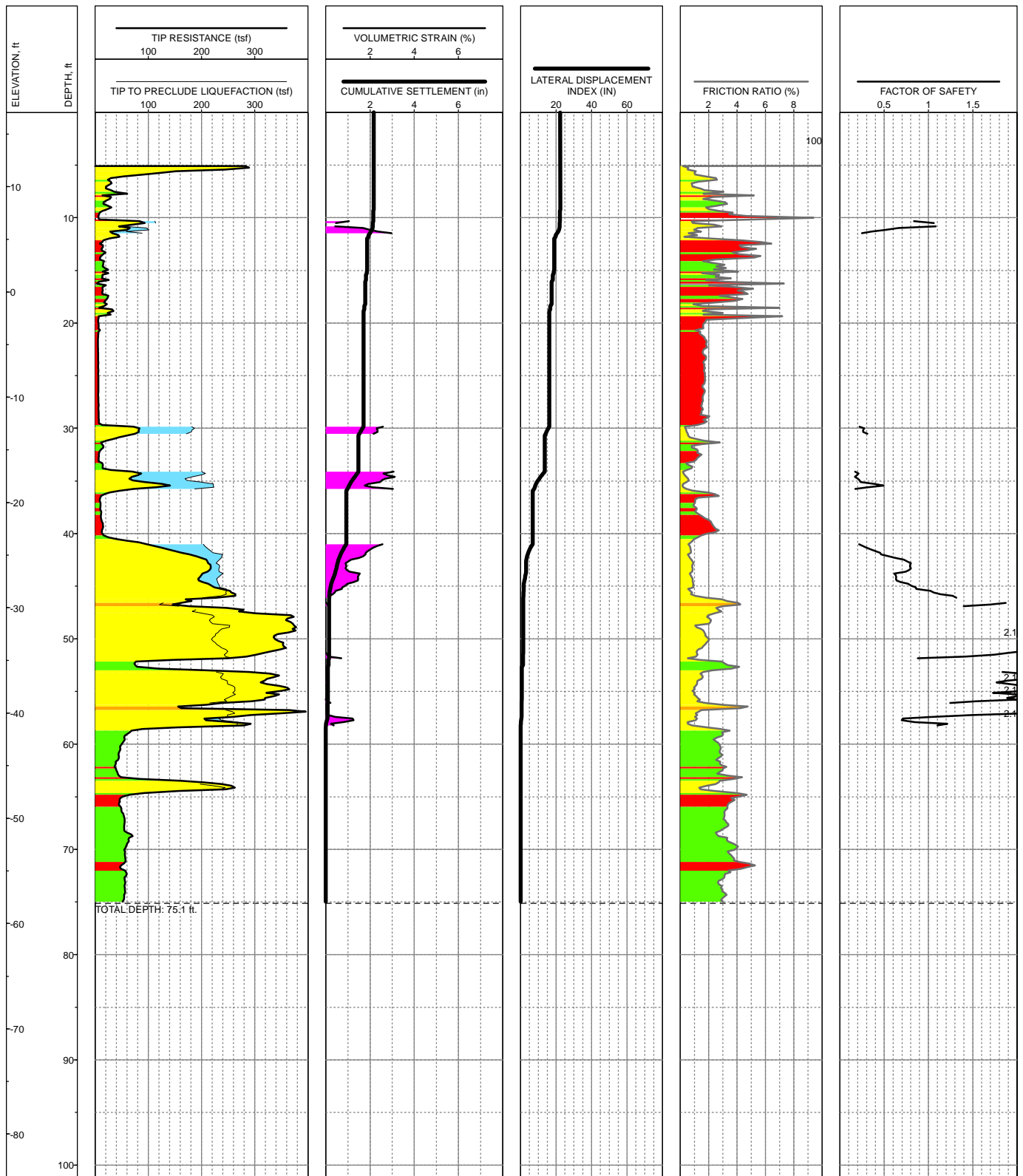


LOCATION: E6,052,490, N2,116,767, NAD83 SP CA Z3 FT
 SURFACE EL: 19.2 ft
 COMPLETION DEPTH: 75.1 ft
 TESTDATE: 3.01.2020

EXPLORATION METHOD: CPT
 PERFORMED BY: GREGG DRILLING
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.80
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-4: LOG OF 2020-CPT-04 – M=7.0, PGA=0.810, N, TL, TR

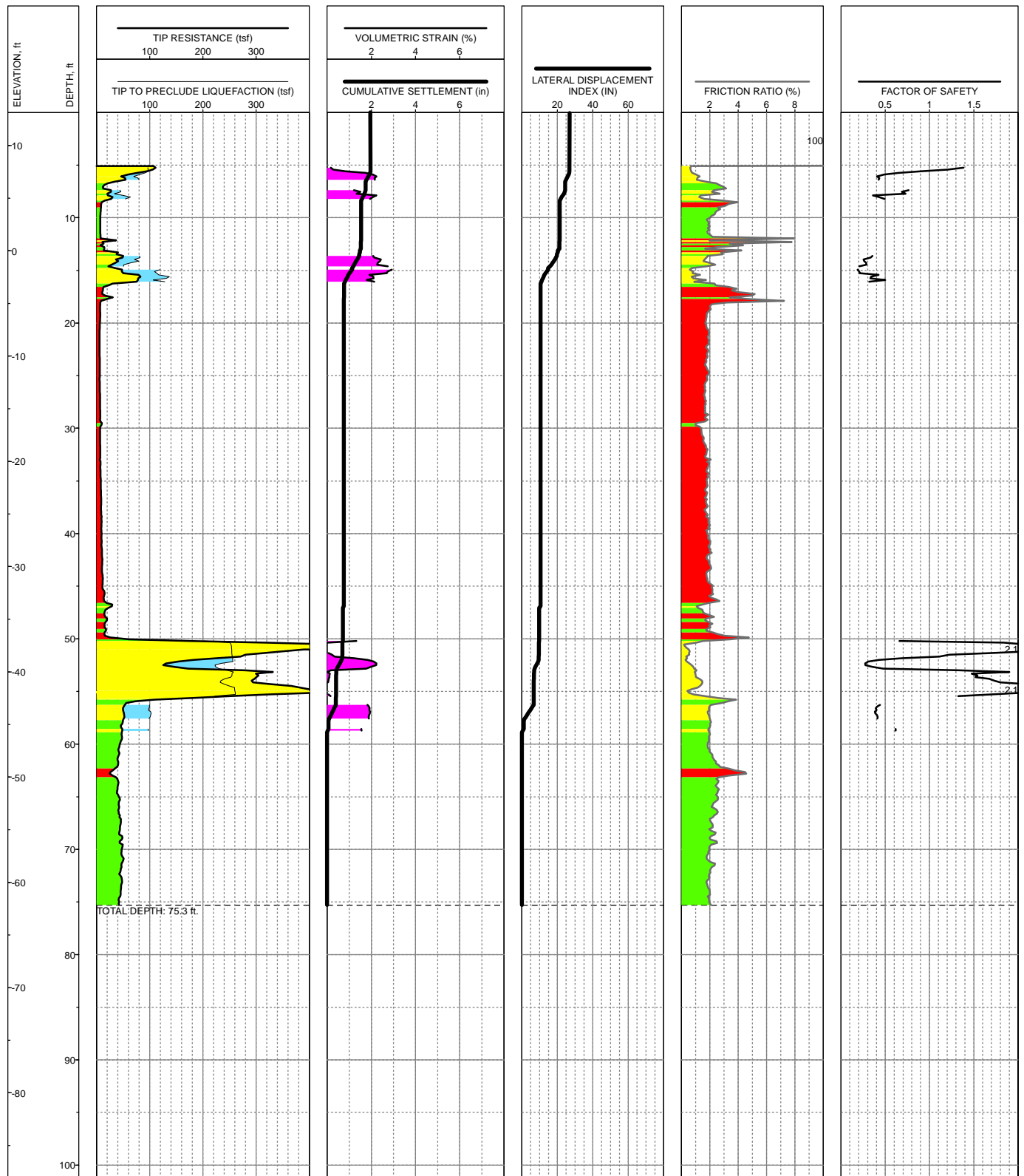




LOCATION: E6,052,557, N2,116,734, NAD83 SP CA Z3 FT
 SURFACE EL: 17.1 ft
 COMPLETION DEPTH: 75.1 ft
 TESTDATE: 3.01.2020

EXPLORATION METHOD: CPT
 PERFORMED BY: GREGG DRILLING
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.80
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

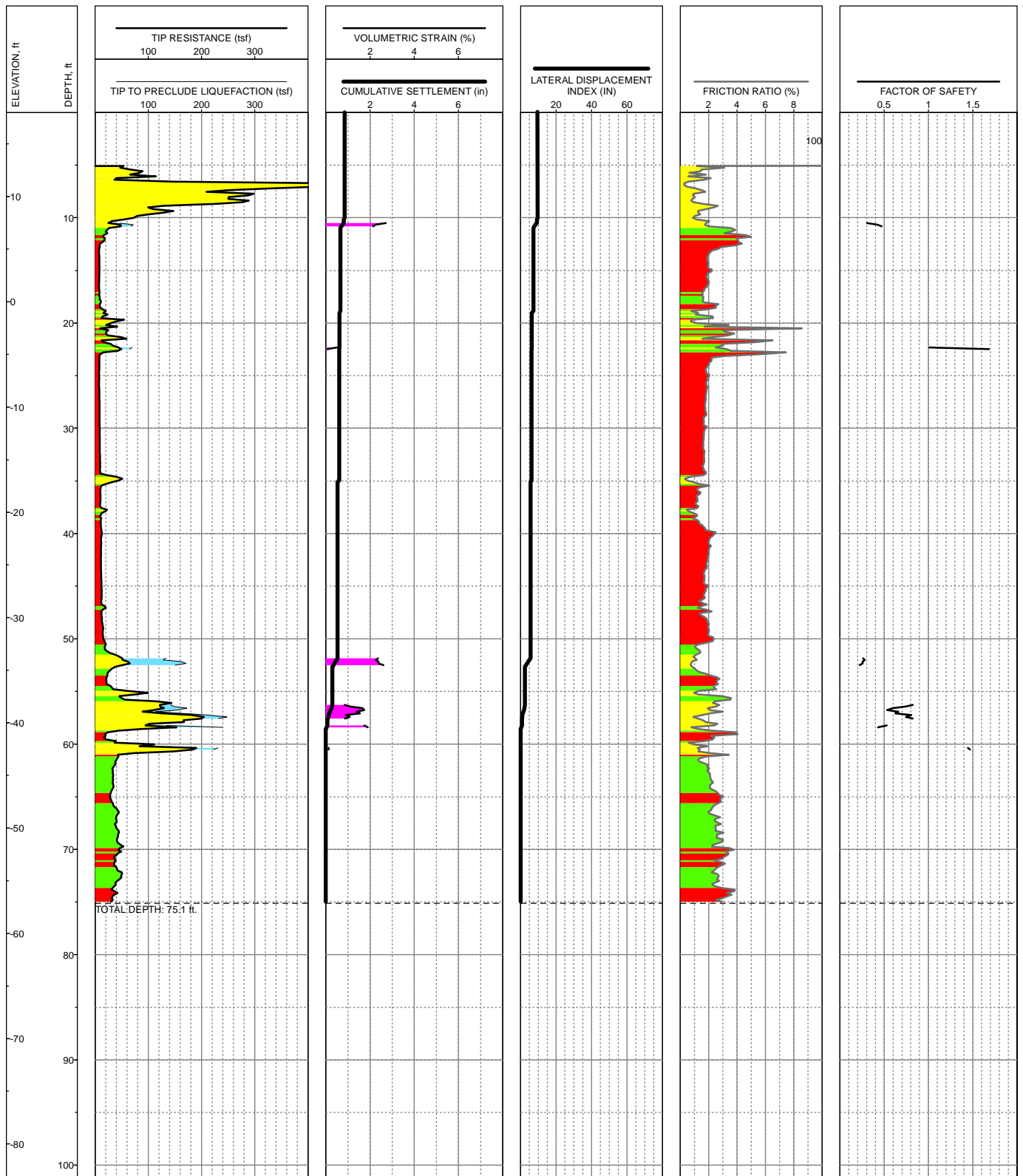
PLATE D-5: LOG OF 2020-CPT-05 – M=7.0, PGA=0.810, N, TL, TR



LOCATION: E6,052,632, N2,116,632, NAD83 SP CA Z3 FT
 SURFACE EL: 13.1 ft
 COMPLETION DEPTH: 75.3 ft
 TESTDATE: 3.01.2020

EXPLORATION METHOD: CPT
 PERFORMED BY: GREGG DRILLING
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.80
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-6: LOG OF 2020-CPT-06 – M=7.0, PGA=0.810, N, TL, TR

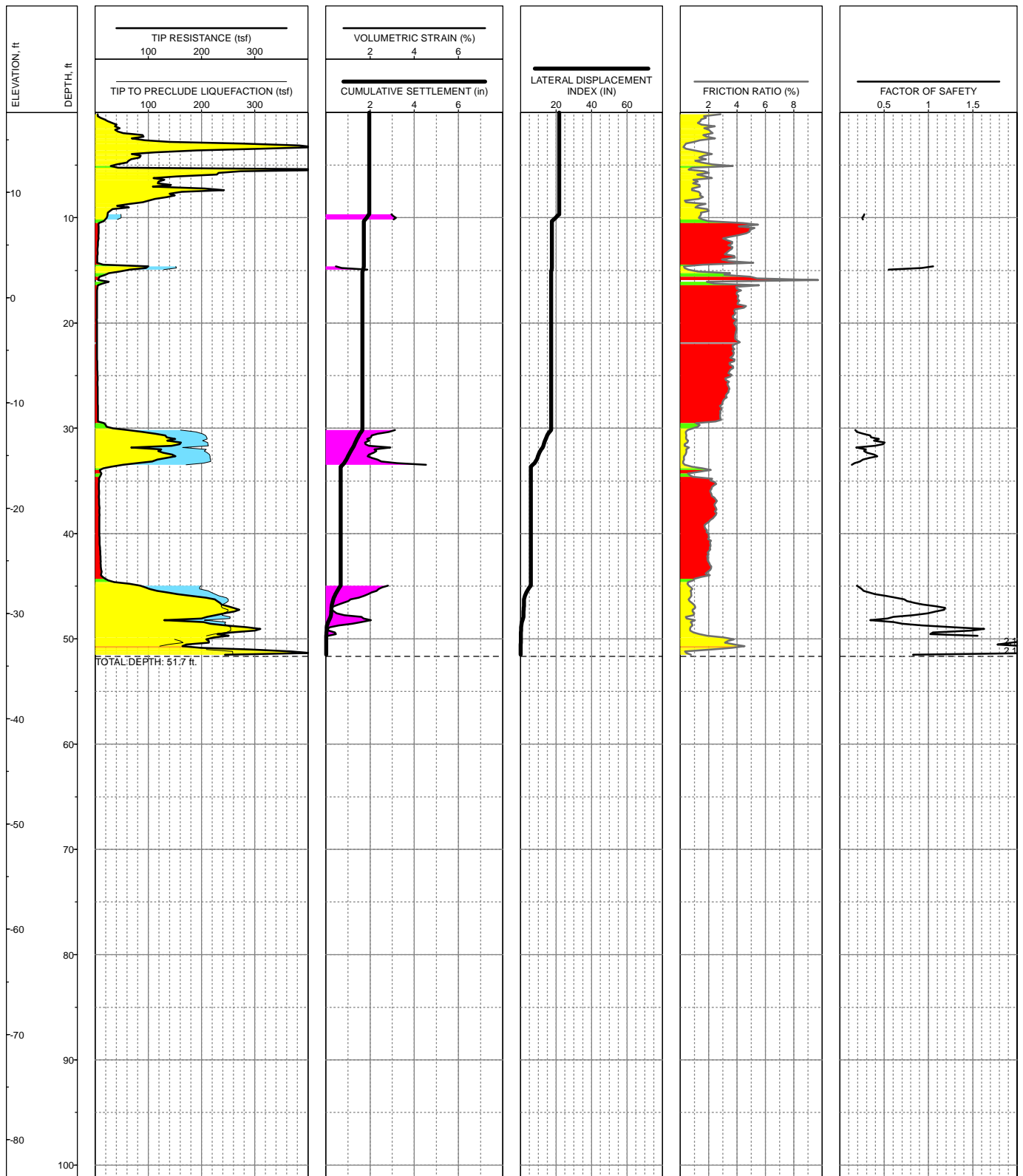


LOCATION: E6,052,572, N2,116,598, NAD83 SP CA Z3 FT
 SURFACE EL: 18.0 ft
 COMPLETION DEPTH: 75.1 ft
 TESTDATE: 3.01.2020

EXPLORATION METHOD: CPT
 PERFORMED BY: GREGG DRILLING
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.80
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-7: LOG OF 2020-CPT-07 – M=7.0, PGA=0.810, N, TL, TR

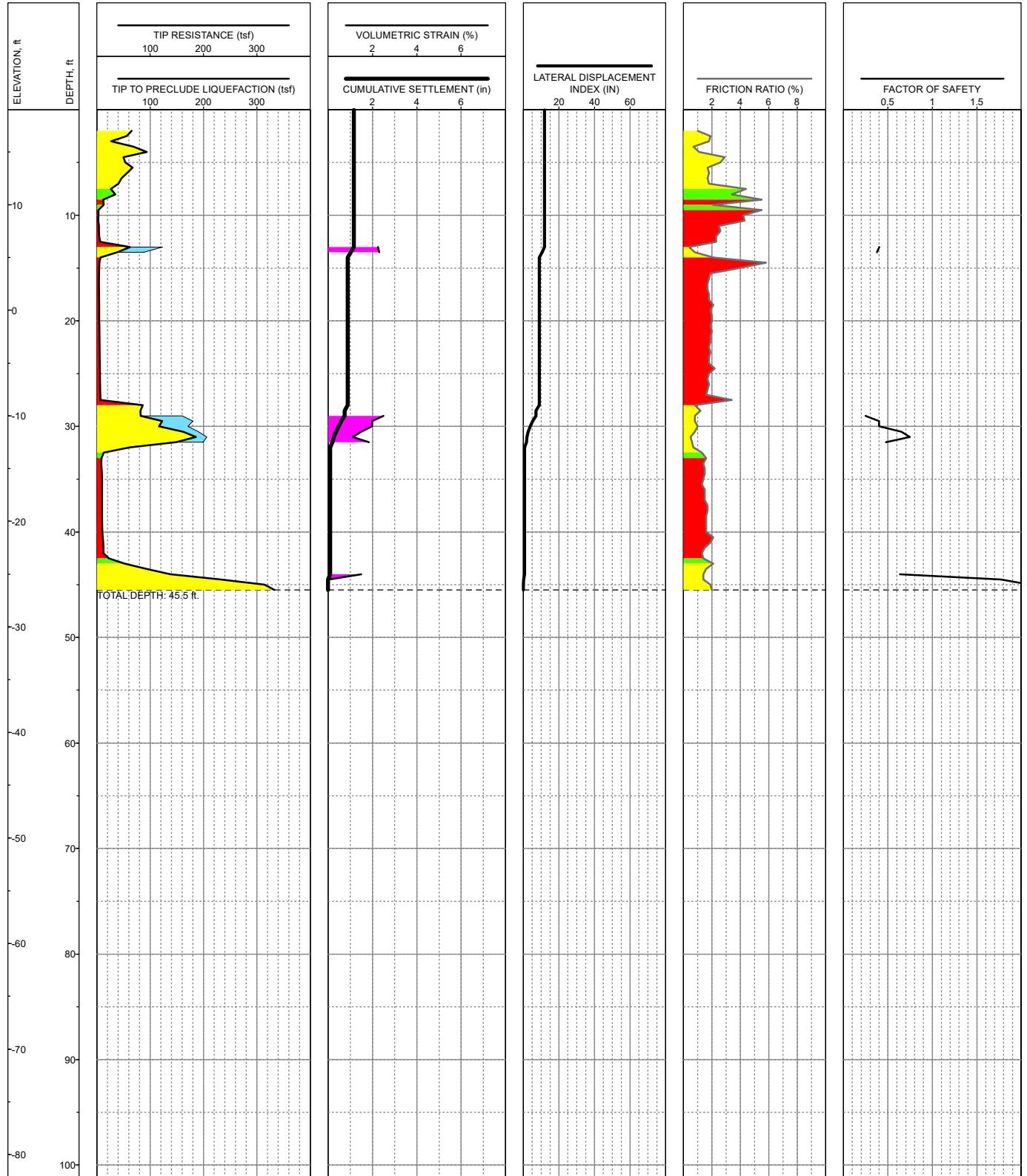




LOCATION: E6,052,485, N2,116,625, NAD83 SP CA Z3 FT
 SURFACE EL: 17.6 ft
 COMPLETION DEPTH: 51.7 ft
 TESTDATE: 2.01.2020

EXPLORATION METHOD: CPT
 PERFORMED BY: GREGG DRILLING
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.80
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-8: LOG OF 2020-CPT-08 – M=7.0, PGA=0.810, N, TL, TR

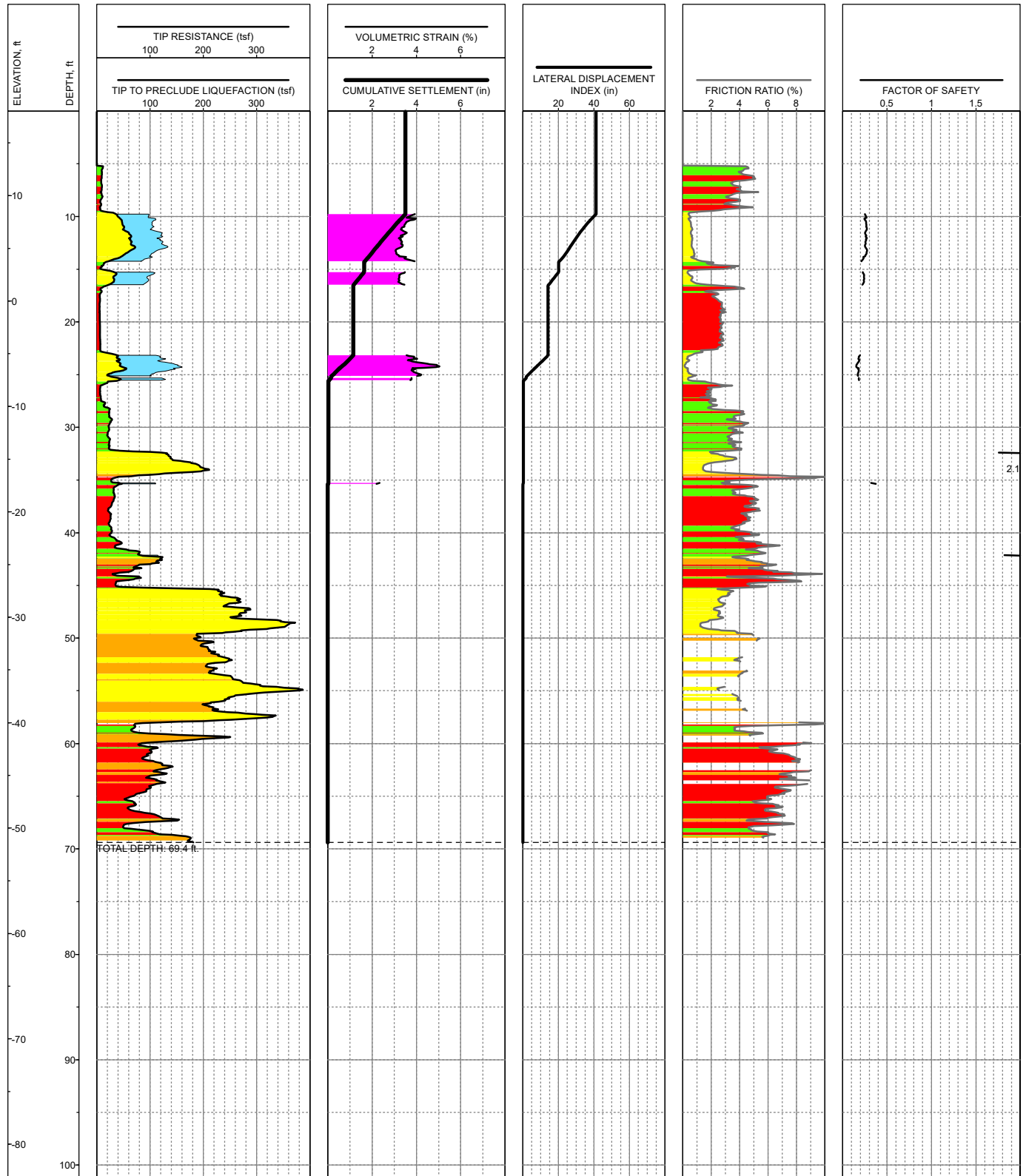


LOCATION: E6,052,497, N2,116,672, NAD83 SP CA Z3 FT
 SURFACE EL: 19.00 ft
 COMPLETION DEPTH: 45.5 ft
 TESTDATE: 2/26/2002

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.59

LIQUEFACTION ANALYSIS GROUNDWATER DEPTH: 8 ft

PLATE D-9: LOG OF 2002-CPT-2 – M=7.0, PGA=0.810, N, TL, TR

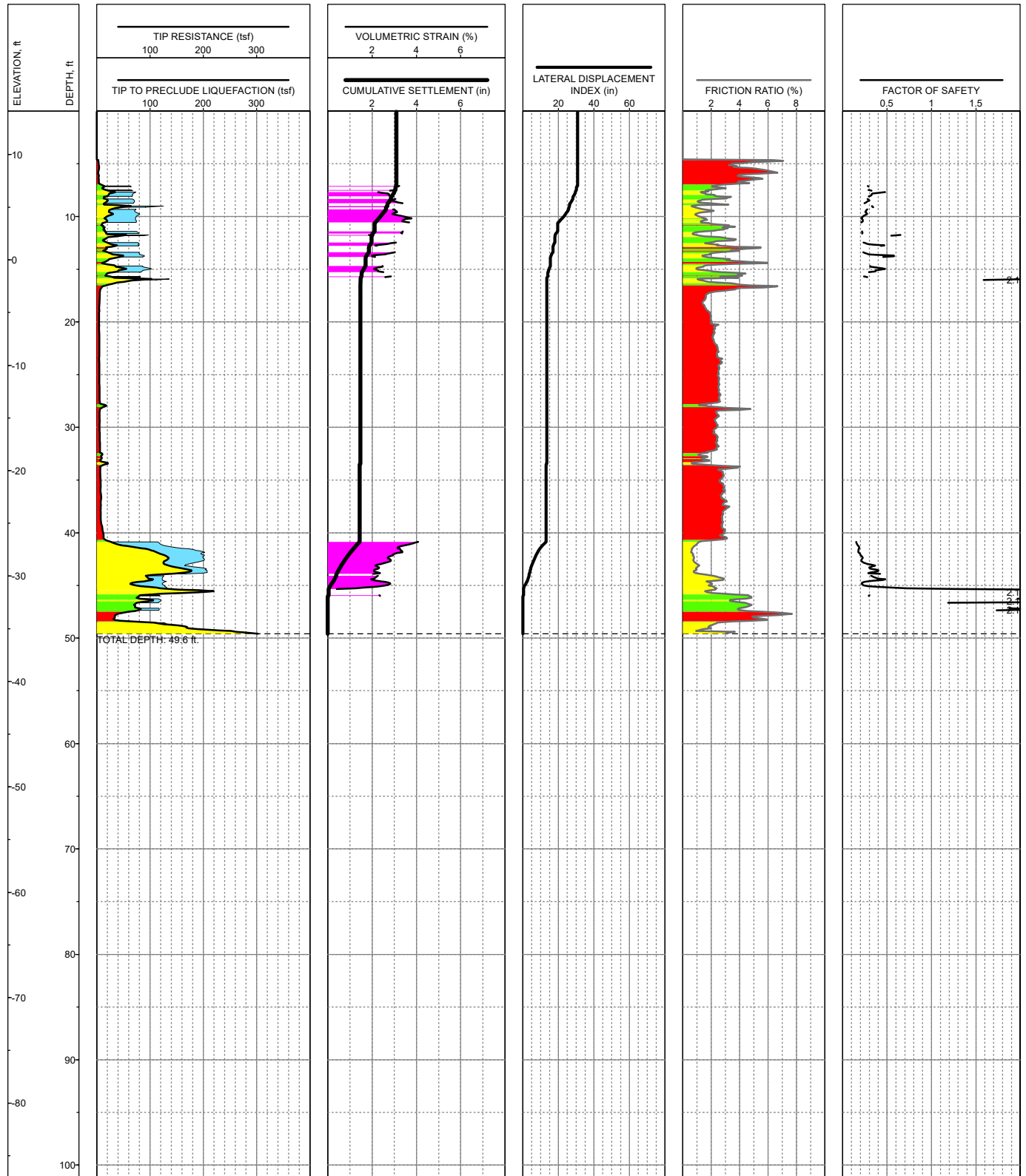


LOCATION: E6,052,365, N2,116,794, NAD83 SP CA Z3 FT
 SURFACE EL: 18.02 ft
 COMPLETION DEPTH: 69.4 ft
 TESTDATE: 3/29/2019

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.59
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-10: LOG OF 2019-CPT-01 – M=7.0, PGA=0.810, B, TL, TR



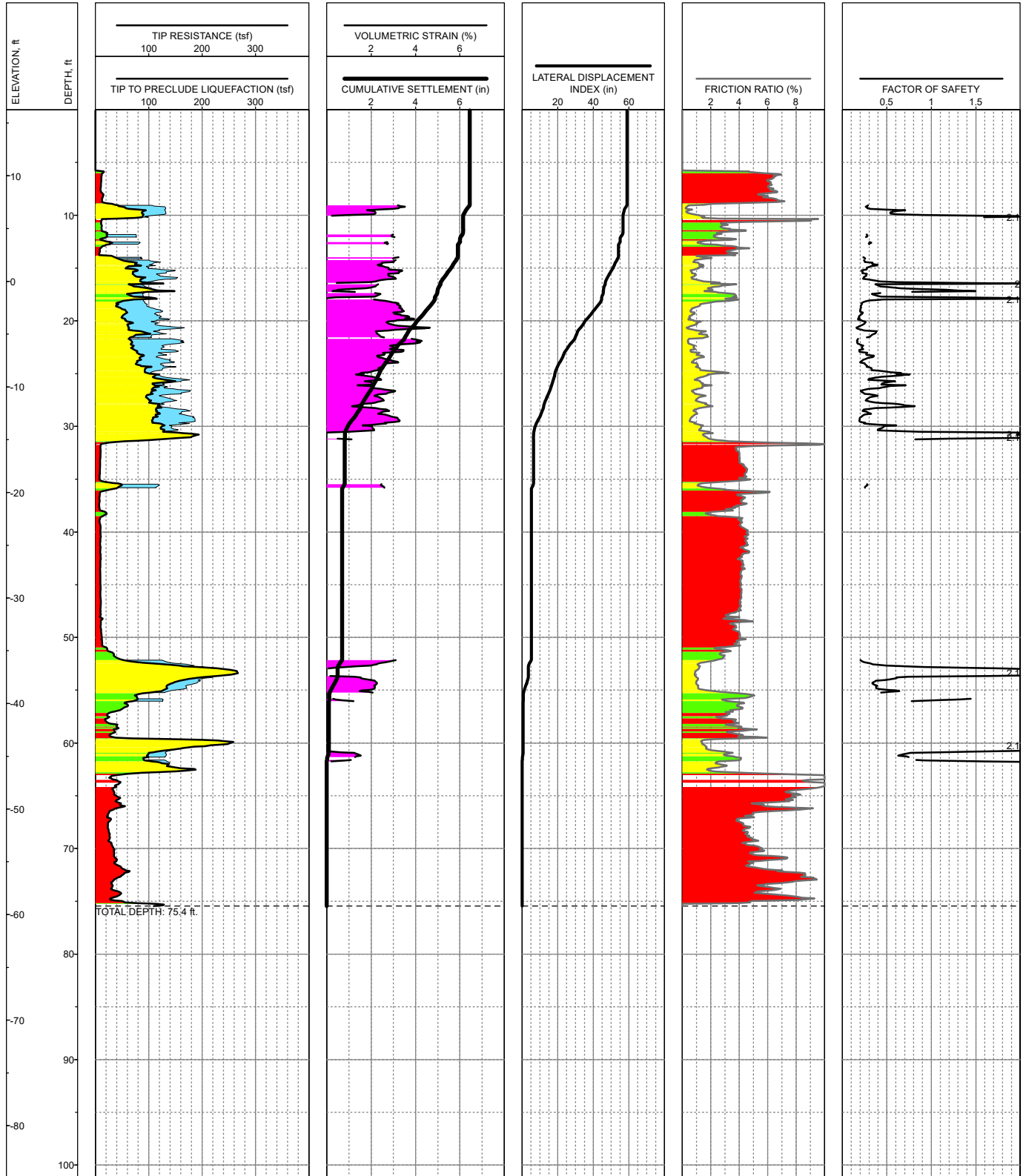


LOCATION: E6,052,593, N2,116,694, NAD83 SP CA Z3 FT
 SURFACE EL: 14.11 ft
 COMPLETION DEPTH: 49.6 ft
 TESTDATE: 3/29/2019

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.59
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-11: LOG OF 2019-CPT-02 – M=7.0, PGA=0.810, B, TL, TR



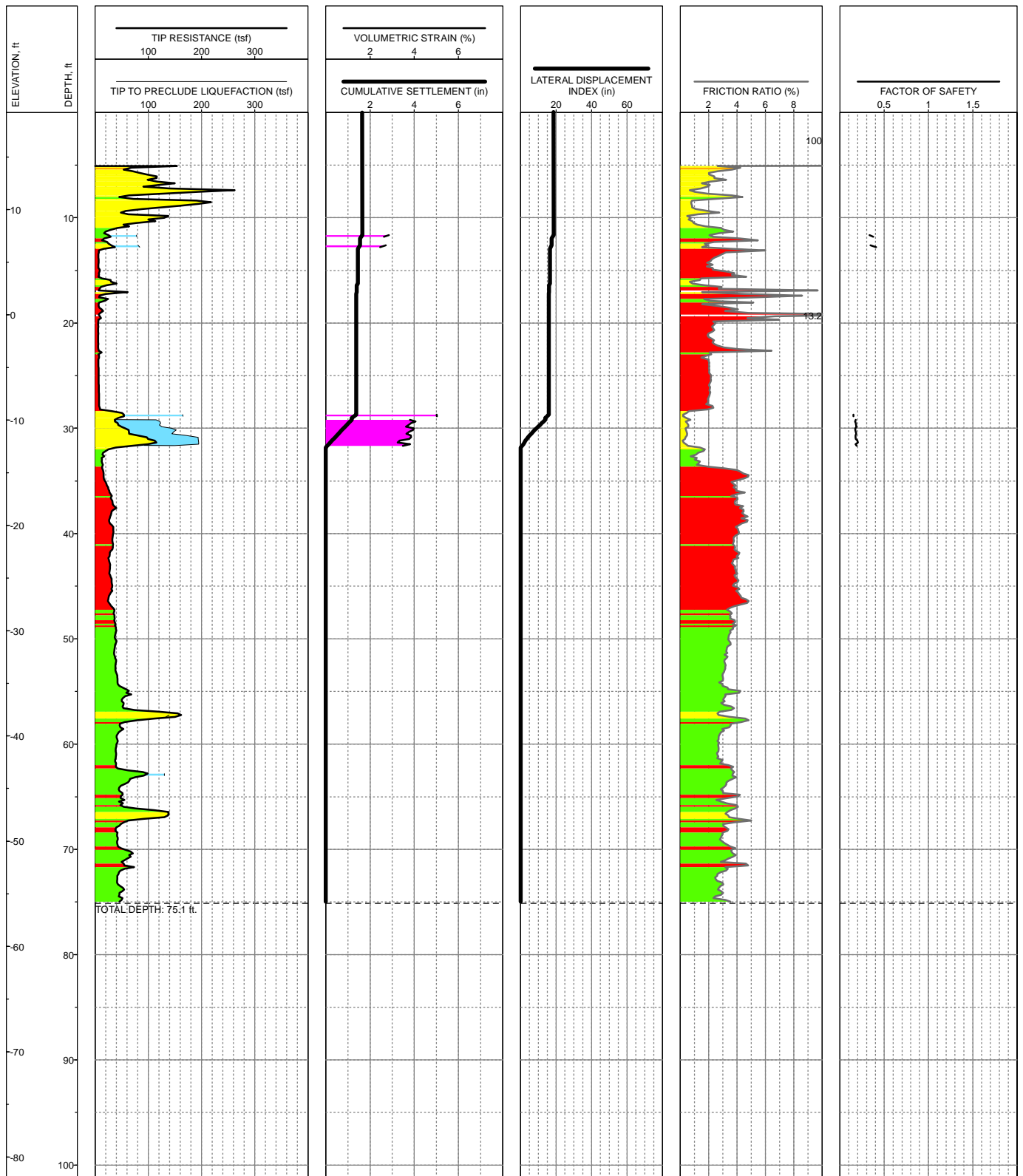


LOCATION: E6,052,570, N2,116,535, NAD83 SP CA Z3 FT
 SURFACE EL: 16.26 ft
 COMPLETION DEPTH: 75.4 ft
 TESTDATE: 3/29/2019

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.59
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-12: LOG OF 2019-CPT-03 – M=7.0, PGA=0.810, B, TL, TR



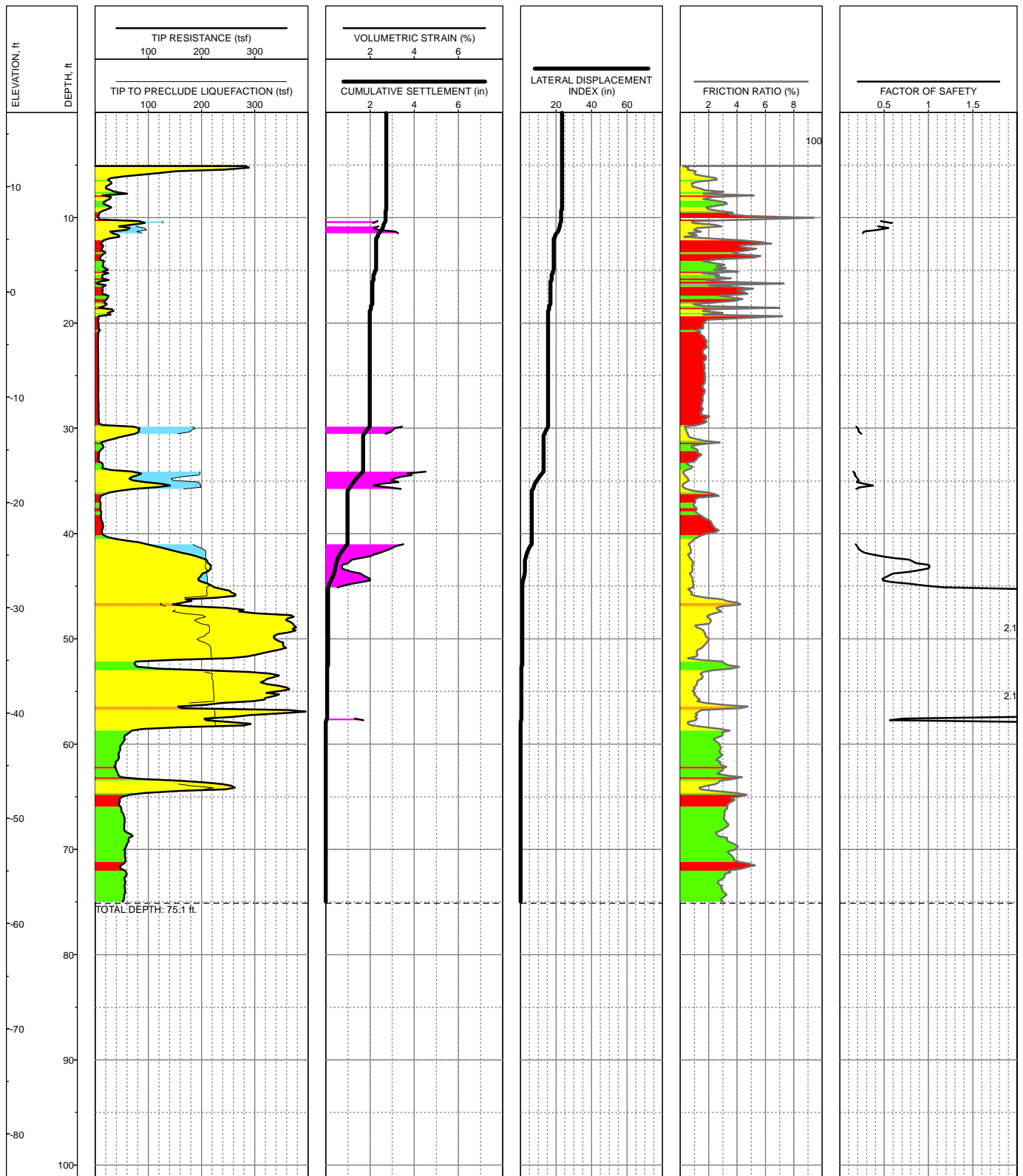


LOCATION: E6,052,490, N2,116,767, NAD83 SP CA Z3 FT
 SURFACE EL: 19.2 ft
 COMPLETION DEPTH: 75.1 ft
 TESTDATE: 3.01.2020

EXPLORATION METHOD: CPT
 PERFORMED BY: GREGG DRILLING
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.80
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-13: LOG OF 2020-CPT-04 – M=7.0, PGA=0.810, B, TL, TR



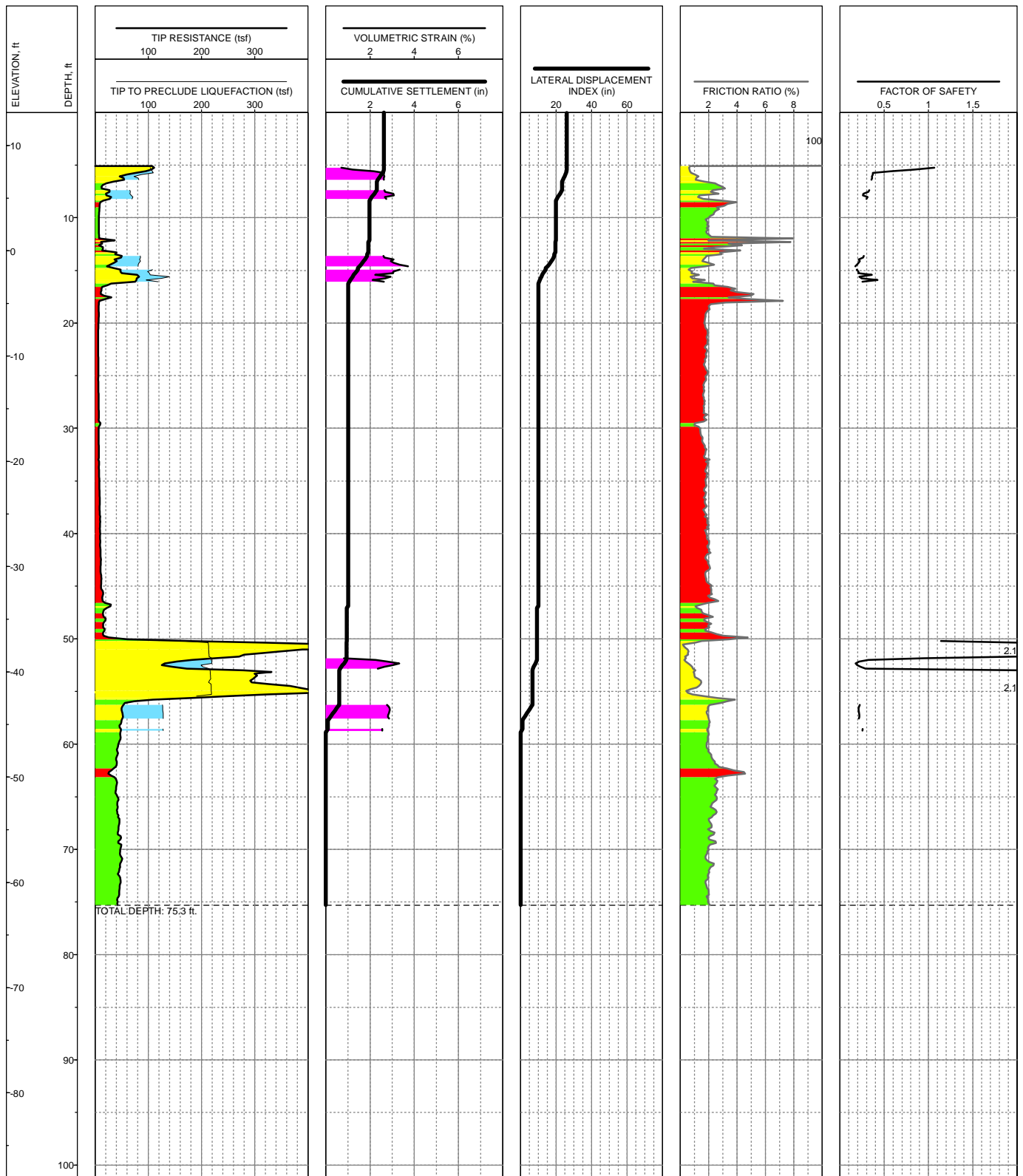


LOCATION: E6,052,557, N2,116,734, NAD83 SP CA Z3 FT
 SURFACE EL: 17.1 ft
 COMPLETION DEPTH: 75.1 ft
 TESTDATE: 3.01.2020

EXPLORATION METHOD: CPT
 PERFORMED BY: GREGG DRILLING
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.80
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-14: LOG OF 2020-CPT-05 – M=7.0, PGA=0.810, B, TL, TR

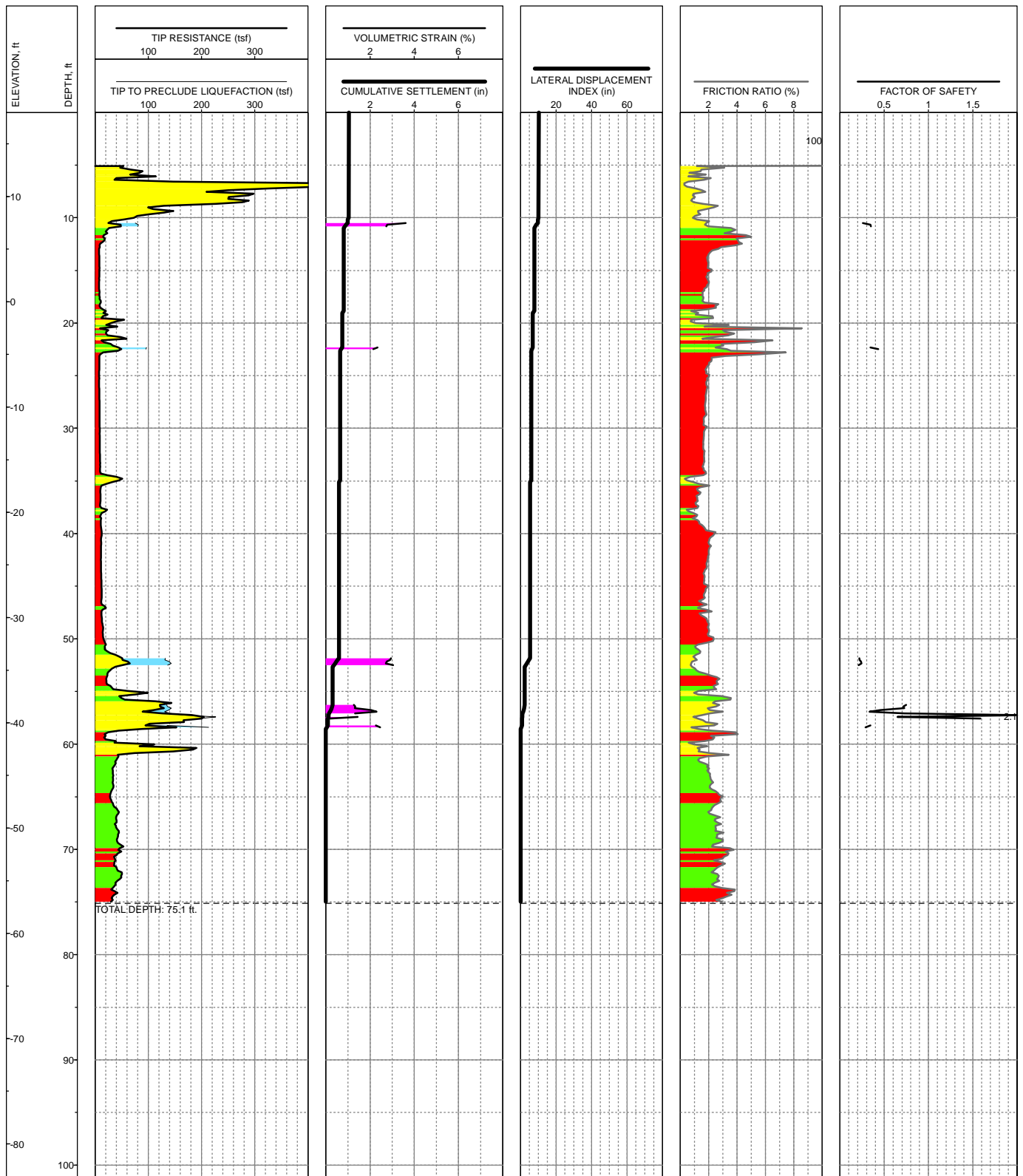




LOCATION: E6,052,632, N2,116,632, NAD83 SP CA Z3 FT
 SURFACE EL: 13.1 ft
 COMPLETION DEPTH: 75.3 ft
 TESTDATE: 3.01.2020

EXPLORATION METHOD: CPT
 PERFORMED BY: GREGG DRILLING
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.80
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-15: LOG OF 2020-CPT-06 – M=7.0, PGA=0.810, B, TL, TR

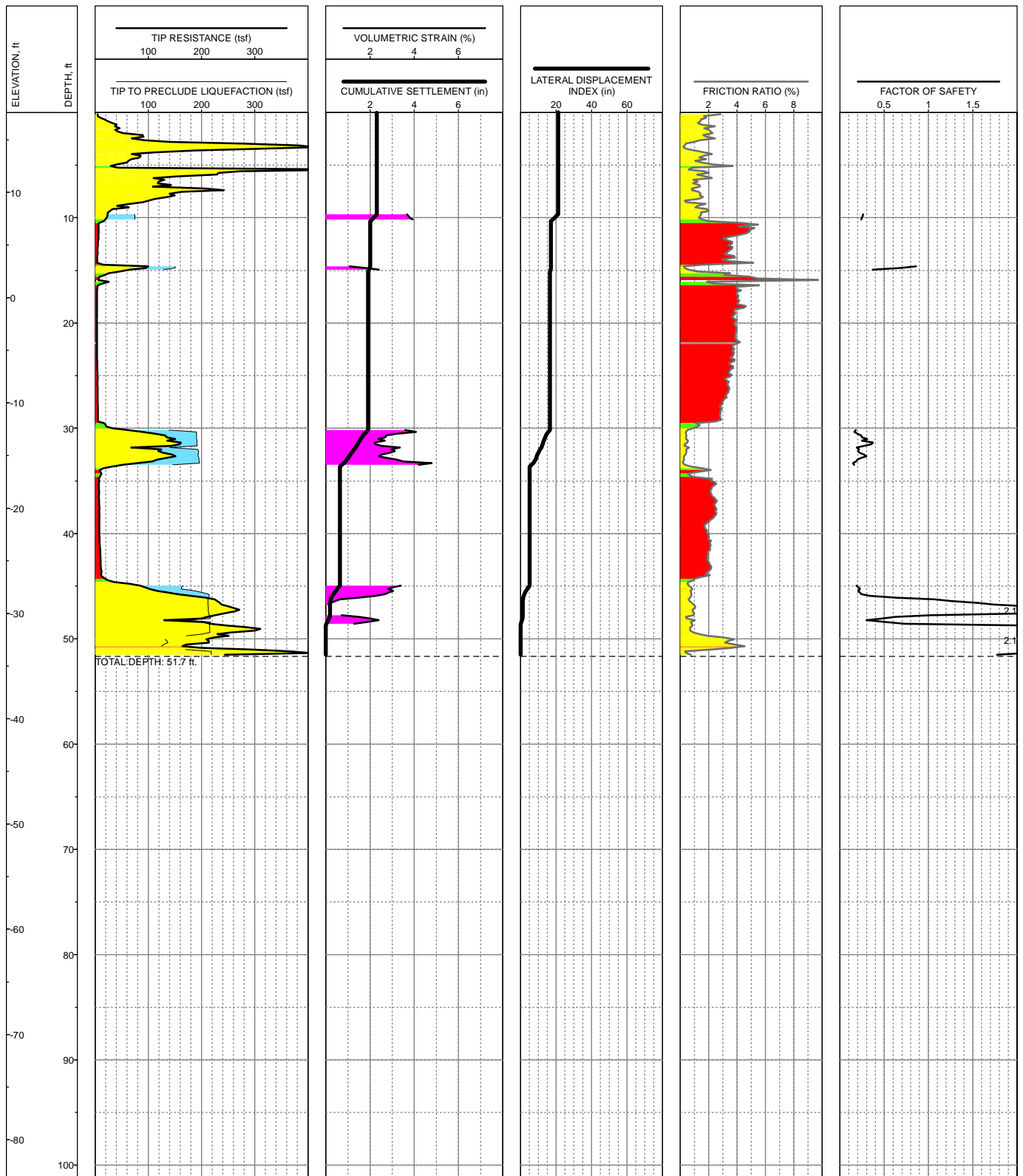


LOCATION: E6,052,572, N2,116,598, NAD83 SP CA Z3 FT
 SURFACE EL: 18.0 ft
 COMPLETION DEPTH: 75.1 ft
 TESTDATE: 3.01.2020

EXPLORATION METHOD: CPT
 PERFORMED BY: GREGG DRILLING
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.80
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-16: LOG OF 2020-CPT-07 – M=7.0, PGA=0.810, B, TL, TR



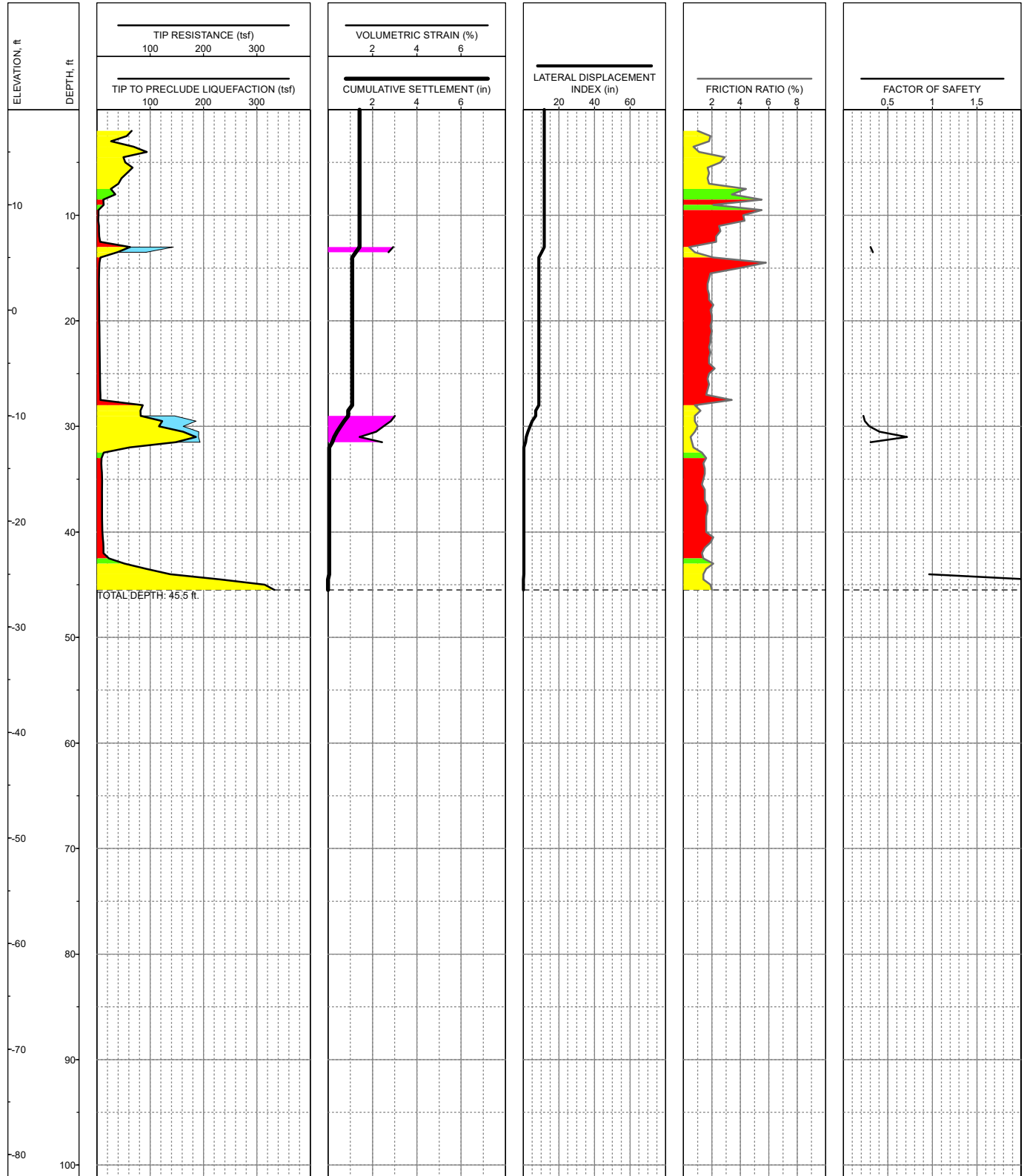


LOCATION: E6,052,485, N2,116,625, NAD83 SP CA Z3 FT
 SURFACE EL: 17.6 ft
 COMPLETION DEPTH: 51.7 ft
 TESTDATE: 2.01.2020

EXPLORATION METHOD: CPT
 PERFORMED BY: GREGG DRILLING
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.80
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-17: LOG OF 2020-CPT-08 – M=7.0, PGA=0.810, B, TL, TR





LOCATION: E6,052,497, N2,116,672, NAD83 SP CA Z3 FT
 SURFACE EL: 19.00 ft
 COMPLETION DEPTH: 45.5 ft
 TESTDATE: 2/26/2002

EXPLORATION METHOD: CPT
 PERFORMED BY: FUGRO
 REVIEWED BY: T. CHEN
 CONE AREA RATIO: 0.59
 LIQUEFACTION ANALYSIS GROUNDWATER EL: 8 ft

PLATE D-18: LOG OF 2002-CPT-2 – M=7.0, PGA=0.810, B, TL, TR



**LIQUEFACTION ANALYSES BASED ON SPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
5/15/19 TC

a_{max} = 0.81 g ASCE 7-16
M_w = 7.0

2002-EB-2
Ground Elevation = 18.2 ft
Depth to Ground Water Table = 10.2 ft = EL 8 ft
γ = 110 pcf
γ_{sat} = 120 pcf
Boring Diameter = 8 inch = 203.2 mm
Rod Length Above Ground = 3 ft = 0.9 m

		Liner								Assumed																					
Elevation	Depth	Depth	N	σ _v	σ _v	σ _v '	σ _v '	C _R	Correction	C _S	C _B	C _E	C _N	N _{1,60}	FC	ΔN	N _{1,60,cs}	r _d	CSR	MSF	K _σ	CRR _{M=7.5,1 atm}	CRR	FS	γ _{lim}	Fα	γ _{max}	ε _v	ΔH (ft)	ΔS (in)	ΔLDI (in)
ft	ft	m	blow/ft	psf	kPa	psf	kPa		Y/N					%			blow/ft										%	ft	in		
-16.3	34.5	10.5	37	4,038.0	193.6	2,521.7	120.9	1.00	Y	1.30	1.15	1	0.94	52	15	3	56	0.85	0.71	1.141	0.95	2.00	2.00	2.0	0.000	-2.044	0.000	0.0	5.0	0.0	0.0
-21.3	39.5	12.0	32	4,638.0	222.3	2,809.7	134.7	1.00	Y	1.30	1.15	1	0.90	43	15	3	47	0.83	0.71	1.141	0.92	2.00	2.00	2.0	0.002	-1.310	0.000	0.0	5.0	0.0	0.0
-26.3	44.5	13.6	32	5,238.0	251.1	3,097.7	148.5	1.00	Y	1.30	1.15	1	0.87	42	15	3	45	0.80	0.71	1.141	0.89	2.00	2.00	2.0	0.002	-1.195	0.000	0.0	5.0	0.0	0.0
-31.3	49.5	15.1	37	5,838.0	279.9	3,385.7	162.3	1.00	Y	1.30	1.15	1	0.86	48	15	3	51	0.77	0.69	1.141	0.86	2.00	1.96	2.0	0.000	-1.659	0.000	0.0	5.0	0.0	0.0
Total																											0.0	0.0	0.0	0.0	

PLATE D-21: BORING 2002-EB-2



Supplement E

Dynamic Densification Analyses



DYNAMIC DENSIFICATION ANALYSES BASED ON CPT DATA LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA

04.72190021
2/20/2020 TC
a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2019-CPT-01
Ground Elevation = 18.0 ft
Depth to Ground Water Table = 10.0 ft = EL 8 ft
γ = 110 pcf
γ_{sat} = 120 pcf
Atmospheric pressure = 2,116.2 psf
Cone Area Ratio = 0.59

Depth	q _c	f _s	Pore Pressure	q _c	qt	f _s	Pore Pressure	σ _v	u	σ _v '	rd	τ _{ave}	Fr	n	Q _{tn}	lc	G0	p	a	b	R	γ	Kc	Q _{tn,cs}	N1(60),cs	Nc	ε _{vol(15)}	ε _{vol}	Δs
ft	tsf	tsf	tsf	psf	psf	psf	psf	psf	psf	psf		psf					psf												in
Hand Auger from 0 to 6 feet																													
6.04	9.75	0.42	0.46	19,501.4	19,874.7	843.0	910.4	664.4	0.0	664.4	0.99	10.7	4.4	1.04	10.3	3.1	2.92E+05	442.9	0.1	16,357.3	3.68E-05	0.0040	7.7	79.2	28.2	10.8	0.0027	0.0023	0.001
6.10	9.46	0.44	0.43	18,925.0	19,279.6	880.0	864.8	671.0	0.0	671.0	0.99	10.8	4.7	1.02	11.1	3.0	3.06E+05	447.3	0.1	16,260.6	3.53E-05	0.0039	7.2	79.8	27.7	10.8	0.0026	0.0023	0.002
6.17	9.42	0.47	0.38	18,839.8	19,154.4	937.8	767.2	678.7	0.0	678.7	0.99	10.9	5.1	1.02	11.5	3.0	3.16E+05	452.5	0.1	16,149.6	3.46E-05	0.0038	7.0	80.7	27.7	10.8	0.0025	0.0022	0.002
6.23	9.55	0.48	0.35	19,098.6	19,382.2	956.6	691.8	685.3	0.0	685.3	0.99	11.1	5.1	1.03	11.5	3.0	3.26E+05	456.9	0.1	16,056.1	3.39E-05	0.0037	7.3	83.6	29.1	10.8	0.0023	0.0020	0.002
6.30	9.52	0.47	0.31	19,045.8	19,302.7	941.8	626.6	693.0	0.0	693.0	0.99	11.2	5.1	1.05	11.0	3.1	3.30E+05	462.0	0.1	15,948.8	3.39E-05	0.0037	8.0	87.3	31.5	10.8	0.0021	0.0018	0.001
6.36	9.27	0.47	0.30	18,537.4	18,786.4	939.2	607.2	699.6	0.0	699.6	0.99	11.3	5.2	1.06	10.6	3.1	3.32E+05	466.4	0.1	15,858.4	3.40E-05	0.0037	8.5	89.7	33.3	10.8	0.0020	0.0017	0.001
6.43	8.88	0.45	0.34	17,767.2	18,047.6	905.6	684.0	707.3	0.0	707.3	0.99	11.4	5.2	1.07	10.5	3.2	3.36E+05	471.5	0.1	15,754.6	3.39E-05	0.0037	8.7	90.5	33.9	10.8	0.0020	0.0017	0.001
6.49	8.62	0.42	0.36	17,241.4	17,539.5	845.2	727.0	713.9	0.0	713.9	0.98	11.5	5.0	1.05	10.9	3.1	3.43E+05	475.9	0.1	15,667.0	3.35E-05	0.0036	8.1	89.0	32.5	10.8	0.0020	0.0018	0.001
6.56	8.41	0.37	0.38	16,825.4	17,141.0	741.2	769.8	721.6	0.0	721.6	0.98	11.6	4.5	1.04	11.3	3.1	3.45E+05	481.1	0.1	15,566.5	3.37E-05	0.0036	7.6	86.0	30.5	10.8	0.0022	0.0019	0.002
6.63	8.31	0.32	0.44	16,610.0	16,966.9	640.2	870.6	729.3	0.0	729.3	0.98	11.7	3.9	1.03	11.1	3.1	3.39E+05	486.2	0.1	15,467.7	3.46E-05	0.0038	7.4	82.6	29.0	10.8	0.0024	0.0021	0.002
6.69	8.30	0.30	0.46	16,595.0	16,975.6	602.2	928.2	735.9	0.0	735.9	0.98	11.9	3.7	1.03	11.0	3.0	3.33E+05	490.6	0.1	15,384.3	3.56E-05	0.0039	7.2	79.2	27.5	10.8	0.0026	0.0023	0.002
6.76	8.52	0.30	0.51	17,030.0	17,446.6	590.2	1,016.2	743.6	0.0	743.6	0.98	12.0	3.5	1.02	10.9	3.0	3.34E+05	495.7	0.1	15,288.5	3.59E-05	0.0039	7.1	78.2	27.0	10.8	0.0027	0.0023	0.002
6.82	8.63	0.29	0.54	17,265.2	17,704.1	586.0	1,070.4	750.2	0.0	750.2	0.98	12.1	3.5	1.04	11.2	3.1	3.57E+05	500.1	0.1	15,207.7	3.39E-05	0.0037	7.7	85.7	30.5	10.8	0.0022	0.0019	0.001
6.89	9.00	0.31	0.52	17,995.2	18,422.9	625.8	1,043.2	757.9	0.0	757.9	0.98	12.2	3.5	0.99	13.5	2.9	3.88E+05	505.3	0.1	15,114.8	3.14E-05	0.0034	6.2	83.5	27.4	10.8	0.0023	0.0020	0.002
6.95	9.41	0.33	0.50	18,828.8	19,237.3	657.6	996.4	764.5	0.0	764.5	0.98	12.3	3.6	0.92	18.9	2.8	4.67E+05	509.7	0.1	15,036.3	2.63E-05	0.0028	4.5	84.9	25.0	10.8	0.0021	0.0018	0.001
7.02	9.84	0.35	0.49	19,684.4	20,085.9	700.2	979.2	772.2	0.0	772.2	0.98	12.4	3.6	0.87	24.1	2.6	5.38E+05	514.8	0.1	14,946.2	2.31E-05	0.0024	3.6	86.1	23.7	10.8	0.0020	0.0017	0.001
7.08	9.97	0.38	0.49	19,941.8	20,340.8	754.2	973.2	778.8	0.0	778.8	0.98	12.5	3.9	0.83	29.3	2.5	5.98E+05	519.2	0.1	14,870.1	2.10E-05	0.0022	2.9	85.8	22.4	10.8	0.0019	0.0016	0.001
7.15	9.80	0.40	0.54	19,603.8	20,048.1	795.2	1,083.6	786.5	0.0	786.5	0.98	12.7	4.1	0.83	30.7	2.5	6.20E+05	524.3	0.1	14,782.6	2.04E-05	0.0021	2.8	86.6	22.4	10.8	0.0019	0.0016	0.001
7.22	9.61	0.39	0.57	19,224.2	19,694.9	781.4	1,148.0	794.2	0.0	794.2	0.98	12.8	4.1	0.87	26.3	2.6	5.88E+05	529.5	0.1	14,696.4	2.17E-05	0.0023	3.4	90.0	24.6	10.8	0.0018	0.0015	0.001
7.28	9.48	0.38	0.60	18,960.6	19,455.5	760.4	1,207.0	800.8	0.0	800.8	0.98	12.9	4.1	0.91	22.2	2.7	5.55E+05	533.9	0.1	14,623.6	2.32E-05	0.0024	4.2	93.8	27.2	10.8	0.0017	0.0015	0.001
7.35	9.39	0.38	0.62	18,787.6	19,295.8	757.4	1,239.6	808.5	0.0	808.5	0.98	13.0	4.1	0.88	25.1	2.6	5.87E+05	539.0	0.1	14,539.9	2.21E-05	0.0023	3.6	91.2	25.3	10.8	0.0017	0.0015	0.001
7.41	9.18	0.35	0.67	18,367.0	18,917.1	694.8	1,341.6	815.1	0.0	815.1	0.98	13.1	3.8	0.85	27.6	2.6	6.13E+05	543.4	0.1	14,469.1	2.14E-05	0.0022	3.2	89.0	23.9	10.8	0.0018	0.0016	0.001
7.48	9.16	0.37	0.67	18,319.6	18,872.0	733.2	1,347.2	822.8	0.0	822.8	0.98	13.2	4.1	0.80	34.3	2.4	6.77E+05	548.5	0.1	14,387.7	1.95E-05	0.0020	2.5	85.8	21.5	10.8	0.0019	0.0016	0.001
7.54	9.10	0.37	0.68	18,192.6	18,747.2	745.4	1,352.8	829.4	0.0	829.4	0.98	13.3	4.2	0.76	41.2	2.3	7.48E+05	552.9	0.1	14,318.9	1.78E-05	0.0018	2.1	86.6	20.8	10.8	0.0018	0.0015	0.001
7.61	9.06	0.37	0.69	18,114.4	18,683.1	746.8	1,387.0	837.1	0.0	837.1	0.98	13.5	4.2	0.75	48.6	2.3	8.70E+05	558.1	0.1	14,239.7	1.55E-05	0.0016	2.0	98.1	23.3	10.8	0.0013	0.0011	0.001
7.68	7.03	0.37	0.74	14,052.6	14,655.6	747.0	1,470.8	844.8	0.0	844.8	0.98	13.6	5.4	0.69	61.3	2.1	9.37E+05	563.2	0.1	14,161.7	1.45E-05	0.0015	1.5	94.2	20.7	10.8	0.0014	0.0012	0.001
7.74	9.04	0.35	0.88	18,086.8	18,808.2	708.6	1,759.4	851.4	0.0	851.4	0.98	13.7	3.9	0.71	53.7	2.2	8.78E+05	567.6	0.1	14,095.8	1.56E-05	0.0016	1.7	90.7	20.5	10.8	0.0016	0.0013	0.001
7.81	8.81	0.33	0.99	17,621.8	18,430.4	650.2	1,972.2	859.1	0.0	859.1	0.98	13.8	3.7	0.76	43.2	2.3	7.95E+05	572.7	0.1	14,019.8	1.74E-05	0.0018	2.1	88.7	21.1	10.8	0.0017	0.0014	0.001
7.87	9.11	0.32	1.11	18,228.8	19,137.1	641.6	2,215.4	865.7	0.0	865.7	0.98	13.9	3.5	0.76	41.7	2.3	7.81E+05	577.1	0.1	13,955.6	1.78E-05	0.0018	2.1	87.4	21.0	10.8	0.0017	0.0015	0.001
7.94	9.41	0.33	1.15	18,812.2	19,751.1	652.6	2,290.0	873.4	0.0	873.4	0.98	14.0	3.5	0.80	41.5	2.4	8.50E+05	582.3	0.1	13,881.6	1.65E-05	0.0017	2.5	101.8	25.4	10.8	0.0013	0.0011	0.001
8.00	9.84	0.33	1.12	19,677.4	20,599.2	651.4	2,248.4	880.0	0.0	880.0	0.98	14.1	3.3	0.80	40.1	2.4	8.36E+05	586.7	0.1	13,819.1	1.69E-05	0.0017	2.5	100.5	25.2	10.8	0.0013	0.0011	0.001
8.07	11.12	0.35	0.83	22,230.0	22,913.6	690.0	1,667.2	887.7	0.0	887.7	0.98	14.3	3.1	0.83	35.7	2.5	7.98E+05	591.8	0.1	13,747.0	1.79E-05	0.0018	2.8	101.1	26.2	10.8	0.0013	0.0012	0.001
8.13	10.85	0.33	0.86	21,707.4	22,413.5	659.0	1,722.2	894.3	0.0	894.3	0.98	14.4	3.1	0.90	26.4	2.7	7.10E+05	596.2	0.1	13,686.1	2.02E-05	0.0021	4.0	106.4	30.4	10.8	0.0013	0.0011	0.001
8.20	10.28	0.32	0.92	20,555.0	21,306.1	637.4	1,832.0	902.0	0.0	902.0	0.98	14.5	3.1	0.90	25.9	2.7	6.93E+05	601.3	0.1	13,615.9	2.09E-05	0.0022	3.9	101.7	28.8	10.8	0.0014	0.0012	0.001
8.27	9.44	0.32	0.91	18,871.4	19,614.2	641.4	1,811.6	909.7	0.0	909.7	0.98	14.6	3.4	0.90	25.4	2.7	6.82E+05	606.5	0.1	13,546.6	2.14E-05	0.0022	3.9	99.2	28.1	10.8	0.0015	0.0013	0.001
8.33	8.27	0.31	0.98	16,536.4	17,341.1	629.6	1,962.8	916.3	0.0	916.3	0.98	14.7	3.8	0.83	31.8	2.5	7.34E+05	610.9	0.1	13,488.0	2.00E-05	0.0021	2.9	91.3	23.7	10.8	0.0017	0.0015	0.001
8.40	7.56	0.31	1.07	15,126.0	16,002.1	610.8	2,136.8	924.0	0.0	924.0	0.98	14.8	4.1	0.77	34.3	2.4	6.89E+05	616.0	0.1	13,420.4	2.15E-05	0.0022	2.2	75.0	18.2	10.8	0.0025	0.0022	0.002
8.46	7.26	0.29	1.09	14,522.8	15,419.1	586.6	2,186.0	930.6	0.0	930.6	0.98	14.9	4.0	0.76	36.4	2.3	7.08E+05	620.4	0.1	13,363.2	2.11E-05	0.0022	2.0	74.3					

Depth	q _c	f _s	Pore Pressure	q _c	q _t	f _s	Pore Pressure	σ _v	u	σ _v '	rd	τ _{ave}	Fr	n	Q _{tn}	lc	G ₀	p	a	b	R	γ	K _c	Q _{tn,cs}	N _{1(60),cs}	N _c	ε _{vol(15)}	ε _{vol}	Δs	
ft	tsf	tsf	tsf	psf	psf	psf	psf	psf	psf	psf		psf					psf													in
9.71	34.78	0.14	0.39	69,551.4	69,869.4	279.6	775.6	1,068.1	0.0	1,068.1	0.98	17.1	0.4	0.71	45.1	2.2	8.41E+05	712.1	0.1	12,302.7	2.03E-05	0.0021	1.6	73.3	16.4	10.8	0.0027	0.0023	0.002	
9.77	36.08	0.15	0.32	72,156.2	72,422.3	291.2	649.0	1,074.7	0.0	1,074.7	0.98	17.2	0.4	0.70	45.9	2.2	8.37E+05	716.5	0.1	12,257.3	2.05E-05	0.0021	1.6	72.0	15.9	10.8	0.0028	0.0024	0.002	
9.84	37.82	0.16	0.24	75,636.2	75,829.7	328.0	472.0	1,082.4	0.0	1,082.4	0.98	17.3	0.4	0.71	40.9	2.2	7.81E+05	721.6	0.1	12,205.0	2.22E-05	0.0023	1.7	67.9	15.3	10.8	0.0032	0.0027	0.002	
9.91	38.66	0.18	0.17	77,325.4	77,461.7	362.8	332.4	1,090.1	0.0	1,090.1	0.98	17.4	0.5	0.75	34.9	2.3	7.35E+05	726.7	0.1	12,153.2	2.37E-05	0.0025	1.9	66.9	15.7	10.8	0.0033	0.0029	0.002	
9.97	39.27	0.20	0.13	78,543.6	78,649.9	391.0	259.2	1,096.7	0.0	1,096.7	0.98	17.5	0.5	0.77	30.5	2.4	6.90E+05	731.1	0.1	12,109.2	2.54E-05	0.0026	2.1	65.3	15.7	10.8	0.0035	0.0031	0.000	
Total Estimated Settlement																										2 × ΣΔs	0.2			

**DYNAMIC DENSIFICATION ANALYSES BASED ON CPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
2/20/2020 TC
a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2019-CPT-02
Ground Elevation = 14.1 ft
Depth to Ground =
Water Table = 6.1 ft = EL 8 ft
γ = 110 pcf
γ_{sat} = 120 pcf
Atmospheric pressure = 2,116.2 psf
Cone Area Ratio = 0.59

Depth	q _c	f _s	Pore Pressure	q _c	q _t	f _s	Pore Pressure	σ _v	u	σ _v '	rd	τ _{ave}	Fr	n	Q _{tn}	lc	G ₀	p	a	b	R	γ	K _c	Q _{tn,cs}	N1(60),cs	N _c	ε _{vol(15)}	ε _{vol}	Δs
ft	tsf	tsf	tsf	psf	psf	psf	psf	psf	psf	psf		psf					psf												in

Hand Auger from 0 to 6 feet - Ground Water Table is at 5 feet below ground surface

Total Estimated Settlement 2 x ΣΔs **0.0**

**DYNAMIC DENSIFICATION ANALYSES BASED ON CPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
2/20/2020 TC
a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2019-CPT-03
Ground Elevation = 16.3 ft
Depth to Ground = EL 8 ft
Water Table = 8.3 ft
γ = 110 pcf
γ_{sat} = 120 pcf
Atmospheric pressure = 2,116.2 psf
Cone Area Ratio = 0.59

Depth	q _c	f _s	Pore Pressure	q _c	qt	f _s	Pore Pressure	σ _v	u	σ _v '	rd	τ _{ave}	Fr	n	Q _{tn}	lc	G0	p	a	b	R	γ	Kc	Q _{tn,cs}	N1(60),cs	Nc	ε _{vol(15)}	ε _{vol}	Δs		
ft	tsf	tsf	tsf	psf	psf	psf	psf	psf	psf	psf	psf	psf					psf													in	
Hand Auger from 0 to 5 feet																															
5.84	15.47	0.73	0.22	30,930.0	31,112.3	1,450.2	444.6	642.4	0.0	642.4	0.99	10.4	4.8	0.88	41.0	2.7	7.92E+05	428.3	0.1	16,691.1	1.31E-05	0.0013	3.7	150.9	42.0	10.8	0.0006	0.0005	0.000		
5.90	15.85	0.74	0.23	31,702.8	31,892.9	1,485.6	463.6	649.0	0.0	649.0	0.99	10.5	4.8	0.88	41.5	2.7	8.07E+05	432.7	0.1	16,589.1	1.30E-05	0.0013	3.7	151.8	42.1	10.8	0.0005	0.0005	0.000		
5.97	14.51	0.75	0.02	29,012.8	29,025.9	1,507.2	32.0	656.7	0.0	656.7	0.99	10.6	5.3	0.90	38.3	2.7	7.90E+05	437.8	0.1	16,472.1	1.34E-05	0.0014	4.1	155.9	44.6	10.8	0.0005	0.0005	0.000		
6.04	13.42	0.78	0.07	26,840.4	26,895.8	1,563.0	135.2	664.4	0.0	664.4	0.99	10.7	6.0	0.92	36.0	2.8	7.83E+05	442.9	0.1	16,357.3	1.37E-05	0.0014	4.5	161.6	47.6	10.8	0.0005	0.0004	0.000		
6.10	11.61	0.79	-0.09	23,226.8	23,151.6	1,578.4	-183.4	671.0	0.0	671.0	0.99	10.8	7.0	0.95	31.7	2.9	7.51E+05	447.3	0.1	16,260.6	1.44E-05	0.0015	5.3	167.0	51.8	10.8	0.0005	0.0004	0.000		
6.17	11.34	0.79	-0.06	22,676.8	22,626.9	1,578.6	-121.8	678.7	0.0	678.7	0.99	10.9	7.2	0.96	30.9	2.9	7.48E+05	452.5	0.1	16,149.6	1.46E-05	0.0015	5.4	167.0	52.2	10.8	0.0005	0.0004	0.000		
6.23	12.02	0.77	0.07	24,038.4	24,093.8	1,542.0	135.0	685.3	0.0	685.3	0.99	11.1	6.6	0.94	32.1	2.8	7.59E+05	456.9	0.1	16,056.1	1.46E-05	0.0015	5.1	162.1	49.6	10.8	0.0005	0.0004	0.000		
6.30	11.37	0.75	0.12	22,735.2	22,833.3	1,492.8	239.2	693.0	0.0	693.0	0.99	11.2	6.7	0.95	30.3	2.9	7.40E+05	462.0	0.1	15,948.8	1.51E-05	0.0016	5.3	159.9	49.6	10.8	0.0005	0.0005	0.000		
6.36	11.13	0.72	0.16	22,255.2	22,383.7	1,439.4	313.4	699.6	0.0	699.6	0.99	11.3	6.6	0.96	29.5	2.9	7.28E+05	466.4	0.1	15,858.4	1.55E-05	0.0016	5.3	156.4	48.6	10.8	0.0006	0.0005	0.000		
6.43	10.99	0.70	0.25	21,980.6	22,184.3	1,404.4	496.8	707.3	0.0	707.3	0.99	11.4	6.5	0.96	28.9	2.9	7.23E+05	471.5	0.1	15,754.6	1.58E-05	0.0016	5.3	153.8	47.8	10.8	0.0006	0.0005	0.000		
6.49	11.04	0.71	0.22	22,079.2	22,261.2	1,415.8	444.0	713.9	0.0	713.9	0.98	11.5	6.6	0.96	28.8	2.9	7.28E+05	475.9	0.1	15,667.0	1.58E-05	0.0016	5.3	153.9	47.9	10.8	0.0006	0.0005	0.000		
6.56	11.04	0.69	0.31	22,075.2	22,328.8	1,381.6	618.6	721.6	0.0	721.6	0.98	11.6	6.4	0.96	28.5	2.9	7.25E+05	481.1	0.1	15,566.5	1.60E-05	0.0017	5.3	151.0	46.9	10.8	0.0006	0.0005	0.000		
6.63	11.19	0.68	0.39	22,380.0	22,696.5	1,360.0	772.0	729.3	0.0	729.3	0.98	11.7	6.2	0.95	28.6	2.8	7.27E+05	486.2	0.1	15,467.7	1.62E-05	0.0017	5.2	148.5	45.8	10.8	0.0006	0.0005	0.000		
6.69	11.25	0.67	0.37	22,498.4	22,804.8	1,339.4	747.4	735.9	0.0	735.9	0.98	11.9	6.1	0.95	28.5	2.8	7.26E+05	490.6	0.1	15,384.3	1.63E-05	0.0017	5.2	146.6	45.1	10.8	0.0006	0.0005	0.000		
6.76	11.10	0.66	0.41	22,193.6	22,530.6	1,329.4	822.0	743.6	0.0	743.6	0.98	12.0	6.1	0.95	27.9	2.8	7.24E+05	495.7	0.1	15,288.5	1.65E-05	0.0017	5.2	145.7	45.0	10.8	0.0006	0.0006	0.000		
6.82	10.83	0.67	0.26	21,660.8	21,873.0	1,340.0	517.6	750.2	0.0	750.2	0.98	12.1	6.3	0.96	27.1	2.9	7.21E+05	500.1	0.1	15,207.7	1.68E-05	0.0017	5.4	146.6	45.9	10.8	0.0006	0.0006	0.000		
6.89	10.68	0.67	0.42	21,354.6	21,698.4	1,331.0	838.6	757.9	0.0	757.9	0.98	12.2	6.4	0.96	26.6	2.9	7.20E+05	505.3	0.1	15,114.8	1.70E-05	0.0018	5.5	145.7	45.7	10.8	0.0006	0.0006	0.000		
6.95	10.50	0.65	0.23	20,997.2	21,187.0	1,303.0	463.0	764.5	0.0	764.5	0.98	12.3	6.4	0.97	25.9	2.9	7.11E+05	509.7	0.1	15,036.3	1.73E-05	0.0018	5.6	144.0	45.5	10.8	0.0007	0.0006	0.000		
7.02	10.46	0.64	0.19	20,912.6	21,065.8	1,289.0	373.6	772.2	0.0	772.2	0.98	12.4	6.4	0.97	25.5	2.9	7.10E+05	514.8	0.1	14,946.2	1.75E-05	0.0018	5.6	142.7	45.2	10.8	0.0007	0.0006	0.000		
7.08	10.29	0.65	0.27	20,582.0	20,803.4	1,295.8	540.0	778.8	0.0	778.8	0.98	12.5	6.5	0.97	25.0	2.9	7.10E+05	519.2	0.1	14,870.1	1.77E-05	0.0018	5.7	142.9	45.5	10.8	0.0007	0.0006	0.000		
7.15	10.30	0.63	0.21	20,606.4	20,781.2	1,263.2	426.4	786.5	0.0	786.5	0.98	12.7	6.3	0.97	24.7	2.9	7.06E+05	524.3	0.1	14,782.6	1.79E-05	0.0019	5.7	140.3	44.6	10.8	0.0007	0.0006	0.001		
7.22	10.52	0.63	0.22	21,042.0	21,221.9	1,267.2	438.8	794.2	0.0	794.2	0.98	12.8	6.2	0.97	25.0	2.9	7.13E+05	529.5	0.1	14,696.4	1.79E-05	0.0019	5.6	139.6	44.2	10.8	0.0007	0.0006	0.000		
7.28	10.42	0.63	0.43	20,842.4	21,192.7	1,256.4	854.4	800.8	0.0	800.8	0.98	12.9	6.2	0.97	24.7	2.9	7.13E+05	533.9	0.1	14,623.6	1.81E-05	0.0019	5.6	138.5	43.8	10.8	0.0007	0.0006	0.000		
7.35	10.32	0.62	0.32	20,631.6	20,895.5	1,245.8	643.6	808.5	0.0	808.5	0.98	13.0	6.2	0.97	24.2	2.9	7.10E+05	539.0	0.1	14,539.9	1.83E-05	0.0019	5.7	137.6	43.8	10.8	0.0007	0.0006	0.000		
7.41	9.85	0.62	0.41	19,705.8	20,040.3	1,235.0	815.8	815.1	0.0	815.1	0.98	13.1	6.4	0.98	23.2	2.9	7.00E+05	543.4	0.1	14,469.1	1.87E-05	0.0019	5.9	137.4	44.3	10.8	0.0007	0.0006	0.001		
7.48	9.65	0.62	0.32	19,300.0	19,566.4	1,239.2	649.8	822.8	0.0	822.8	0.98	13.2	6.6	0.99	22.6	2.9	6.98E+05	548.5	0.1	14,387.7	1.89E-05	0.0020	6.1	137.6	44.9	10.8	0.0007	0.0006	0.001		
7.54	9.76	0.60	0.41	19,514.4	19,853.3	1,203.6	826.6	829.4	0.0	829.4	0.98	13.3	6.3	0.98	22.6	2.9	6.96E+05	552.9	0.1	14,318.9	1.91E-05	0.0020	6.0	134.7	43.5	10.8	0.0008	0.0007	0.001		
7.61	9.86	0.61	0.16	19,728.8	19,856.1	1,226.4	310.4	837.1	0.0	837.1	0.98	13.5	6.4	0.99	22.5	2.9	7.03E+05	558.1	0.1	14,239.7	1.91E-05	0.0020	6.0	135.6	44.0	10.8	0.0008	0.0007	0.001		
7.68	9.97	0.65	0.49	19,943.2	20,348.0	1,308.0	987.2	844.8	0.0	844.8	0.98	13.6	6.7	0.99	22.9	2.9	7.26E+05	563.2	0.1	14,161.7	1.87E-05	0.0019	6.1	139.5	45.5	10.8	0.0007	0.0006	0.000		
7.74	10.54	0.71	0.48	21,086.4	21,477.3	1,411.0	953.4	851.4	0.0	851.4	0.98	13.7	6.8	0.99	23.9	2.9	7.60E+05	567.6	0.1	14,095.8	1.80E-05	0.0019	6.0	144.0	46.7	10.8	0.0007	0.0006	0.000		
7.81	11.13	0.74	0.43	22,251.4	22,603.4	1,482.4	858.6	859.1	0.0	859.1	0.98	13.8	6.8	0.98	24.9	2.9	7.88E+05	572.7	0.1	14,019.8	1.75E-05	0.0018	5.9	146.5	47.1	10.8	0.0006	0.0006	0.000		
7.87	12.28	0.76	0.5	24,550.6	24,924.2	1,519.6	911.2	865.7	0.0	865.7	0.98	13.9	6.3	0.96	26.9	2.9	8.21E+05	577.1	0.1	13,955.6	1.69E-05	0.0017	5.4	145.9	45.7	10.8	0.0006	0.0006	0.000		
7.94	13.90	0.77	0.57	27,809.2	28,278.5	1,545.2	1,144.6	873.4	0.0	873.4	0.98	14.0	5.6	0.94	29.7	2.8	8.61E+05	582.3	0.1	13,881.6	1.63E-05	0.0017	4.8	143.7	43.4	10.8	0.0007	0.0006	0.000		
8.00	15.32	0.81	0.78	30,635.0	31,271.2	1,628.8	1,551.8	880.0	0.0	880.0	0.98	14.1	5.4	0.92	32.3	2.8	9.07E+05	586.7	0.1	13,819.1	1.56E-05	0.0016	4.5	145.1	42.8	10.8	0.0006	0.0006	0.000		
Total Estimated Settlement																													2 x ΣΔs		
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Depth	q _c	f _s	Pore Pressure	q _c	q _t	f _s	Pore Pressure	σ _v	u	σ _v '	rd	τ _{ave}	Fr	n	Q _{tn}	lc	G0	p	a	b	R	γ	Kc	Q _{tn,cs}	N1(60),cs	Nc	ε _{vol(15)}	ε _{vol}	Δs		
ft	tsf	tsf	tsf	psf	psf	psf	psf	psf	psf	psf		psf					psf													in	
Hand Auger from 0 to 5 feet																															
5.09	153.74	4.04	0.10	307,472.0	307,511.9	8,084.0	199.7	559.4	0.0	559.4	0.99	9.0	2.6	1.04	513.9	3.1	2.92E+05	372.9	0.1	18,136.1	3.68E-05	0.0041	7.7	79.2	28.2	10.8	0.0027	0.0023	0.001		
5.25	68.61	2.91	0.18	137,216.0	137,287.9	5,812.0	359.6	577.4	0.0	577.4	0.99	9.3	4.3	1.02	11.1	3.0	3.06E+05	385.0	0.1	17,793.9	3.53E-05	0.0039	7.2	79.8	27.7	10.8	0.0026	0.0023	0.002		
5.41	53.82	1.96	0.62	107,634.0	107,883.0	3,922.0	1,245.0	595.5	0.0	595.5	0.99	9.6	3.7	1.02	11.5	3.0	3.16E+05	397.0	0.1	17,468.3	3.46E-05	0.0038	7.0	80.7	27.7	10.8	0.0025	0.0022	0.002		
5.58	70.64	1.86	0.40	141,284.0	141,442.5	3,722.0	792.3	613.5	0.0	613.5	0.99	9.9	2.6	1.03	11.5	3.0	3.26E+05	409.0	0.1	17,158.2	3.39E-05	0.0037	7.3	83.6	29.1	10.8	0.0023	0.0020	0.002		
5.74	83.60	1.68	1.31	167,190.0	167,715.9	3,368.0	2,629.7	631.6	0.0	631.6	0.99	10.2	2.0	1.05	11.0	3.1	3.30E+05	421.0	0.1	16,862.4	3.39E-05	0.0037	8.0	87.3	31.5	10.8	0.0021	0.0018	0.001		
5.91	97.58	1.98	1.93	195,156.0	195,926.9	3,954.0	3,854.7	649.6	0.0	649.6	0.99	10.5	2.0	1.06	10.6	3.1	3.32E+05	433.1	0.1	16,579.8	3.40E-05	0.0037	8.5	89.7	33.3	10.8	0.0020	0.0017	0.001		
6.07	116.10	2.78	1.01	232,204.0	232,606.1	5,554.0	2,010.7	667.7	0.0	667.7	0.99	10.8	2.4	1.07	10.5	3.2	3.36E+05	445.1	0.1	16,309.4	3.39E-05	0.0037	8.7	90.5	33.9	10.8	0.0020	0.0017	0.001		
6.23	115.46	2.77	1.46	230,924.0	231,509.9	5,548.0	2,929.4	685.7	0.0	685.7	0.99	11.1	2.4	1.05	10.9	3.1	3.43E+05	457.1	0.1	16,050.6	3.35E-05	0.0036	8.1	89.0	32.5	10.8	0.0020	0.0018	0.001		
6.40	98.72	3.19	1.73	197,442.0	198,133.1	6,378.0	3,455.3	703.7	0.0	703.7	0.99	11.3	3.2	1.04	11.3	3.1	3.45E+05	469.2	0.1	15,802.3	3.37E-05	0.0036	7.6	86.0	30.5	10.8	0.0022	0.0019	0.002		
6.56	116.88	2.48	1.43	233,766.0	234,336.6	4,956.0	2,852.8	721.8	0.0	721.8	0.98	11.6	2.1	1.03	11.1	3.1	3.39E+05	481.2	0.1	15,564.1	3.46E-05	0.0038	7.4	82.6	29.0	10.8	0.0024	0.0021	0.002		
6.73	149.89	2.29	1.27	299,782.0	300,288.6	4,570.0	2,533.2	739.8	0.0	739.8	0.98	11.9	1.5	1.03	11.0	3.0	3.33E+05	493.2	0.1	15,335.2	3.56E-05	0.0039	7.2	79.2	27.5	10.8	0.0026	0.0023	0.002		
6.89	119.92	2.50	0.81	239,838.0	240,162.9	5,004.0	1,624.5	757.9	0.0	757.9	0.98	12.2	2.1	1.02	10.9	3.0	3.34E+05	505.2	0.1	15,115.1	3.59E-05	0.0039	7.1	78.2	27.0	10.8	0.0027	0.0023	0.002		
7.05	90.70	1.74	0.68	181,396.0	181,667.0	3,484.0	1,354.9	775.9	0.0	775.9	0.98	12.5	1.9	1.04	11.2	3.1	3.57E+05	517.3	0.1	14,903.2	3.39E-05	0.0037	7.7	85.7	30.5	10.8	0.0022	0.0019	0.001		
7.22	140.06	2.02	1.87	280,116.0	280,865.7	4,042.0	3,748.3	794.0	0.0	794.0	0.98	12.8	1.4	0.99	13.5	2.9	3.88E+05	529.3	0.1	14,699.0	3.14E-05	0.0034	6.2	83.5	27.4	10.8	0.0023	0.0020	0.002		
7.38	262.07	1.75	1.52	524,132.0	524,739.2	3,492.0	3,036.0	812.0	0.0	812.0	0.98	13.1	0.7	0.92	18.9	2.8	4.67E+05	541.3	0.1	14,502.2	2.63E-05	0.0028	4.5	84.9	25.0	10.8	0.0021	0.0018	0.001		
7.55	194.71	1.99	0.83	389,422.0	389,753.5	3,988.0	1,657.7	830.1	0.0	830.1	0.98	13.3	1.0	0.87	24.1	2.6	5.38E+05	553.4	0.1	14,312.2	2.31E-05	0.0024	3.6	86.1	23.7	10.8	0.0020	0.0017	0.001		
7.71	127.33	2.48	0.57	254,656.0	254,883.7	4,968.0	1,138.5	848.1	0.0	848.1	0.98	13.6	2.0	0.83	29.3	2.5	5.98E+05	565.4	0.1	14,128.7	2.10E-05	0.0022	2.9	85.8	22.4	10.8	0.0019	0.0016	0.001		
7.87	63.85	2.33	0.48	127,690.0	127,883.1	4,664.0	965.4	866.1	0.0	866.1	0.98	13.9	3.7	0.83	30.7	2.5	6.20E+05	577.4	0.1	13,951.3	2.04E-05	0.0021	2.8	86.6	22.4	10.8	0.0019	0.0016	0.001		
8.04	45.35	1.99	1.57	90,698.0	91,327.2	3,978.0	3,145.8	884.2	0.0	884.2	0.98	14.2	4.4	0.87	26.3	2.6	5.88E+05	589.5	0.1	13,779.8	2.17E-05	0.0023	3.4	90.0	24.6	10.8	0.0018	0.0015	0.001		
8.20	72.17	1.74	5.35	144,348.0	146,487.1	3,476.0	10,695.6	902.2	0.0	902.2	0.98	14.5	2.4	0.91	22.2	2.7	5.55E+05	601.5	0.1	13,613.8	2.32E-05	0.0024	4.2	93.8	27.2	10.8	0.0017	0.0015	0.001		
8.37	190.78	1.58	3.87	381,566.0	383,112.6	3,168.0	7,732.9	920.3	0.0	920.3	0.98	14.8	0.8	0.88	25.1	2.6	5.87E+05	613.5	0.1	13,453.0	2.21E-05	0.0023	3.6	91.2	25.3	10.8	0.0017	0.0015	0.001		
8.53	217.78	1.66	1.97	435,552.0	436,338.3	3,318.0	3,931.3	938.3	0.0	938.3	0.98	15.0	0.8	0.85	27.6	2.6	6.13E+05	625.5	0.1	13,297.1	2.14E-05	0.0022	3.2	89.0	23.9	10.8	0.0018	0.0016	0.001		
8.69	194.85	1.52	1.17	389,700.0	390,168.0	3,048.0	2,340.1	956.4	0.0	956.4	0.98	15.3	0.8	0.80	34.3	2.4	6.77E+05	637.6	0.1	13,146.0	1.95E-05	0.0020	2.5	85.8	21.5	10.8	0.0019	0.0016	0.001		
8.86	159.11	1.32	0.76	318,224.0	318,528.2	2,634.0	1,521.2	974.4	0.0	974.4	0.98	15.6	0.8	0.76	41.2	2.3	7.48E+05	649.6	0.1	12,999.4	1.78E-05	0.0018	2.1	86.6	20.8	10.8	0.0018	0.0015	0.001		
9.02	123.48	1.03	0.51	246,968.0	247,171.7	2,052.0	1,018.7	992.5	0.0	992.5	0.98	15.9	0.8	0.75	48.6	2.3	8.70E+05	661.6	0.1	12,857.1	1.55E-05	0.0016	2.0	98.1	23.3	10.8	0.0013	0.0011	0.001		
9.19	88.89	0.99	0.37	177,774.0	177,923.8	1,970.0	748.9	1,010.5	0.0	1,010.5	0.98	16.2	1.1	0.69	61.3	2.1	9.37E+05	673.7	0.1	12,718.8	1.45E-05	0.0015	1.5	94.2	20.7	10.8	0.0014	0.0012	0.001		
9.35	57.52	1.12	0.11	115,044.0	115,087.3	2,248.0	216.4	1,028.5	0.0	1,028.5	0.98	16.5	2.0	0.71	53.7	2.2	8.78E+05	685.7	0.1	12,584.5	1.56E-05	0.0016	1.7	90.7	20.5	10.8	0.0016	0.0013	0.001		
9.51	48.55	1.34	0.11	97,106.0	97,148.6	2,674.0	213.1	1,046.6	0.0	1,046.6	0.98	16.7	2.8	0.76	43.2	2.3	7.95E+05	697.7	0.1	12,453.8	1.74E-05	0.0018	2.1	88.7	21.1	10.8	0.0017	0.0014	0.001		
9.68	62.20	0.78	0.45	124,404.0	124,582.4	1,558.0	892.1	1,064.6	0.0	1,064.6	0.98	17.0	1.3	0.76	41.7	2.3	7.81E+05	709.8	0.1	12,326.8	1.78E-05	0.0018	2.1	87.4	21.0	10.8	0.0017	0.0015	0.001		
9.84	137.80	0.66	0.94	275,604.0	275,979.5	1,310.0	1,877.5	1,082.7	0.0	1,082.7	0.98	17.3	0.5	0.80	41.5	2.4	8.50E+05	721.8	0.1	12,203.1	1.65E-05	0.0017	2.5	101.8	25.4	10.8	0.0013	0.0011	0.001		
10.01	129.81	0.97	0.29	259,614.0	259,731.8	1,942.0	589.2	1,100.7	0.0	1,100.7	0.98	17.6	0.8	0.80	40.1	2.4	8.36E+05	733.8	0.1	12,082.7	1.69E-05	0.0017	2.5	100.5	25.2	10.8	0.0013	0.0011	0.001		
10.17	100.17	0.59	0.00	200,338.0	200,336.0	1,180.0	-9.9	1,118.8	0.0	1,118.8	0.98	17.9	0.6	0.83	35.7	2.5	7.98E+05	745.8	0.1	11,965.3	1.79E-05	0.0018	2.8	101.1	26.2	10.8	0.0013	0.0012	0.001		
10.33	113.29	0.97	0.13	226,578.0	226,630.6	1,940.0	262.9	1,136.8	0.0	1,136.8	0.98	18.2	0.9	0.90	26.4	2.7	7.10E+05	757.9	0.1	11,851.0	2.02E-05	0.0021	4.0	106.4	30.4	10.8	0.0013	0.0011	0.001		
10.50	76.72	0.73	0.12	153,430.0	153,477.9	1,450.0	239.6	1,154.9	0.0	1,154.9	0.98	18.4	1.0	0.90	25.9	2.7	6.93E+05	769.9	0.1	11,739.6	2.09E-05	0.0022	3.9	101.7	28.8	10.8	0.0014	0.0012	0.001		
10.66	53.37	0.64	-0.05	106,742.0	106,722.7	1,286.0	-96.5	1,172.9	0.0	1,172.9	0.98	18.7	1.2	0.90	25.4	2.7	6.82E+05	781.9	0.1	11,630.9	2.14E-05	0.0022	3.9	99.2	28.1	10.8	0.0015	0.0013	0.001		
10.83	64.01	1.14	-0.17	128,024.0	127,956.8	2,278.0	-336.2	1,190.9	0.0	1,190.9	0.97	19.0	1.8	0.83	31.8	2.5	7.34E+05	794.0	0.1	11,524.8	2.00E-05	0.0021	2.9	91.3	23.7	10.8	0.0017	0.0015	0.001		
10.99	41.70	1.20	-0.02	83,400.0	83,391.3	2,406.0	-43.3	1,209.0	0.0	1,209.0	0.97	19.3	2.9	0.77	34.3	2.4	6.89E+05	806.0	0.1	11,421.3	2.15E-05	0.0022	2.2	75.0	18.2	10.8	0.0025	0.0022	0.002		

**DYNAMIC DENSIFICATION ANALYSES BASED ON CPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
2/20/2020 TC
a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2020-CPT-05
Ground Elevation = 17.1 ft
Water Table Depth from ground surface = 9.1 ft = EL 8 ft
γ = 110 pcf
γ_{sat} = 120 pcf
Atmospheric pressure = 2,116.2 psf
Cone Area Ratio = 0.8

Depth	q _c	f _s	Pore Pressure	q _c	qt	f _s	Pore Pressure	σ _v	u	σ _v '	rd	τ _{ave}	Fr	n	Q _{tn}	lc	G0	p	a	b	R	γ	Kc	Q _{tn,cs}	N1(60),cs	Nc	ε _{vol(15)}	ε _{vol}	Δs	
ft	tsf	tsf	tsf	psf	psf	psf	psf	psf	psf	psf		psf					psf													in
Hand Auger from 0 to 5 feet																														
5.09	282.09	0.50	0.20	564,188.0	564,269.2	1,000.0	406.1	559.4	0.0	559.4	0.99	9.0	0.2	1.04	10.3	3.1	2.92E+05	372.9	0.1	18,136.1	3.68E-05	0.0040	7.7	79.2	28.2	10.8	0.0027	0.0023	0.001	
5.25	289.53	1.63	2.63	579,064.0	580,116.6	3,266.0	5,262.9	577.4	0.0	577.4	0.99	9.3	0.6	1.02	11.1	3.0	3.06E+05	385.0	0.1	17,793.9	3.53E-05	0.0039	7.2	79.8	27.7	10.8	0.0026	0.0023	0.002	
5.41	243.79	1.24	1.54	487,584.0	488,199.2	2,484.0	3,075.8	595.5	0.0	595.5	0.99	9.6	0.5	1.02	11.5	3.0	3.16E+05	397.0	0.1	17,468.3	3.46E-05	0.0038	7.0	80.7	27.7	10.8	0.0025	0.0022	0.002	
5.58	152.12	1.67	0.24	304,240.0	304,335.9	3,330.0	479.4	613.5	0.0	613.5	0.99	9.9	1.1	1.03	11.5	3.0	3.26E+05	409.0	0.1	17,158.2	3.39E-05	0.0037	7.3	83.6	29.1	10.8	0.0023	0.0020	0.002	
5.74	122.82	1.23	0.39	245,632.0	245,788.4	2,452.0	782.2	631.6	0.0	631.6	0.99	10.2	1.0	1.05	11.0	3.1	3.30E+05	421.0	0.1	16,862.4	3.39E-05	0.0037	8.0	87.3	31.5	10.8	0.0021	0.0018	0.001	
5.91	90.84	0.96	0.71	181,674.0	181,959.6	1,920.0	1,428.0	649.6	0.0	649.6	0.99	10.5	1.1	1.06	10.6	3.1	3.32E+05	433.1	0.1	16,579.8	3.40E-05	0.0037	8.5	89.7	33.3	10.8	0.0020	0.0017	0.001	
6.07	53.54	0.96	0.40	107,078.0	107,237.8	1,916.0	798.9	667.7	0.0	667.7	0.99	10.8	1.8	1.07	10.5	3.2	3.36E+05	445.1	0.1	16,309.4	3.39E-05	0.0037	8.7	90.5	33.9	10.8	0.0020	0.0017	0.001	
6.23	29.72	0.75	0.23	59,444.0	59,537.2	1,494.0	466.0	685.7	0.0	685.7	0.99	11.1	2.5	1.05	10.9	3.1	3.43E+05	457.1	0.1	16,050.6	3.35E-05	0.0036	8.1	89.0	32.5	10.8	0.0020	0.0018	0.001	
6.40	24.07	0.62	0.12	48,134.0	48,183.9	1,240.0	249.7	703.7	0.0	703.7	0.99	11.3	2.6	1.04	11.3	3.1	3.45E+05	469.2	0.1	15,802.3	3.37E-05	0.0036	7.6	86.0	30.5	10.8	0.0022	0.0019	0.002	
6.56	29.50	0.39	0.09	58,998.0	59,033.3	774.0	176.4	721.8	0.0	721.8	0.98	11.6	1.3	1.03	11.1	3.1	3.39E+05	481.2	0.1	15,564.1	3.46E-05	0.0038	7.4	82.6	29.0	10.8	0.0024	0.0021	0.002	
6.73	31.14	0.25	0.07	62,284.0	62,311.3	500.0	136.5	739.8	0.0	739.8	0.98	11.9	0.8	1.03	11.0	3.0	3.33E+05	493.2	0.1	15,335.2	3.56E-05	0.0039	7.2	79.2	27.5	10.8	0.0026	0.0023	0.002	
6.89	25.82	0.22	0.03	51,644.0	51,658.0	432.0	69.8	757.9	0.0	757.9	0.98	12.2	0.8	1.02	10.9	3.0	3.34E+05	505.2	0.1	15,115.1	3.59E-05	0.0039	7.1	78.2	27.0	10.8	0.0027	0.0023	0.002	
7.05	20.50	0.18	0.01	41,004.0	41,008.7	352.0	23.3	775.9	0.0	775.9	0.98	12.5	0.9	1.04	11.2	3.1	3.57E+05	517.3	0.1	14,903.2	3.39E-05	0.0037	7.7	85.7	30.5	10.8	0.0022	0.0019	0.001	
7.22	20.36	0.29	0.04	40,726.0	40,742.6	576.0	83.2	794.0	0.0	794.0	0.98	12.8	1.4	0.99	13.5	2.9	3.88E+05	529.3	0.1	14,699.0	3.14E-05	0.0034	6.2	83.5	27.4	10.8	0.0023	0.0020	0.002	
7.38	29.86	0.51	0.06	59,722.0	59,744.6	1,016.0	113.2	812.0	0.0	812.0	0.98	13.1	1.7	0.92	18.9	2.8	4.67E+05	541.3	0.1	14,502.2	2.63E-05	0.0028	4.5	84.9	25.0	10.8	0.0021	0.0018	0.001	
7.55	36.38	1.11	0.01	72,760.0	72,766.0	2,220.0	30.0	830.1	0.0	830.1	0.98	13.3	3.1	0.87	24.1	2.6	5.38E+05	553.4	0.1	14,312.2	2.31E-05	0.0024	3.6	86.1	23.7	10.8	0.0020	0.0017	0.001	
7.71	60.59	0.99	-0.01	121,172.0	121,168.7	1,986.0	-16.7	848.1	0.0	848.1	0.98	13.6	1.7	0.83	29.3	2.5	5.98E+05	565.4	0.1	14,128.7	2.10E-05	0.0022	2.9	85.8	22.4	10.8	0.0019	0.0016	0.001	
7.87	13.98	0.73	-0.02	27,966.0	27,956.7	1,450.0	-46.7	866.1	0.0	866.1	0.98	13.9	5.4	0.83	30.7	2.5	6.20E+05	577.4	0.1	13,951.3	2.04E-05	0.0021	2.8	86.6	22.4	10.8	0.0019	0.0016	0.001	
8.04	30.17	0.69	0.09	60,336.0	60,373.9	1,374.0	189.6	884.2	0.0	884.2	0.98	14.2	2.3	0.87	26.3	2.6	5.88E+05	589.5	0.1	13,779.8	2.17E-05	0.0023	3.4	90.0	24.6	10.8	0.0018	0.0015	0.001	
8.20	27.35	0.44	0.01	54,708.0	54,713.3	886.0	26.6	902.2	0.0	902.2	0.98	14.5	1.6	0.91	22.2	2.7	5.55E+05	601.5	0.1	13,613.8	2.32E-05	0.0024	4.2	93.8	27.2	10.8	0.0017	0.0015	0.001	
8.37	20.98	0.51	0.04	41,950.0	41,966.0	1,018.0	79.9	920.3	0.0	920.3	0.98	14.8	2.5	0.88	25.1	2.6	5.87E+05	613.5	0.1	13,453.0	2.21E-05	0.0023	3.6	91.2	25.3	10.8	0.0017	0.0015	0.001	
8.53	15.91	0.50	0.07	31,812.0	31,838.6	1,006.0	133.1	938.3	0.0	938.3	0.98	15.0	3.3	0.85	27.6	2.6	6.13E+05	625.5	0.1	13,297.1	2.14E-05	0.0022	3.2	89.0	23.9	10.8	0.0018	0.0016	0.001	
8.69	15.74	0.52	0.26	31,476.0	31,578.5	1,040.0	512.6	956.4	0.0	956.4	0.98	15.3	3.4	0.80	34.3	2.4	6.77E+05	637.6	0.1	13,146.0	1.95E-05	0.0020	2.5	85.8	21.5	10.8	0.0019	0.0016	0.001	
8.86	24.32	0.63	0.25	48,636.0	48,735.2	1,250.0	496.1	974.4	0.0	974.4	0.98	15.6	2.6	0.76	41.2	2.3	7.48E+05	649.6	0.1	12,999.4	1.78E-05	0.0018	2.1	86.6	20.8	10.8	0.0018	0.0015	0.001	
9.02	30.67	0.56	0.04	61,338.0	61,355.3	1,110.0	86.5	992.5	0.0	992.5	0.98	15.9	1.8	0.75	48.6	2.3	8.70E+05	661.6	0.1	12,857.1	1.55E-05	0.0016	2.0	98.1	23.3	10.8	0.0013	0.0011	0.000	
Total Estimated Settlement																												2 x ΣΔs	0.1	

**DYNAMIC DENSIFICATION ANALYSES BASED ON CPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
2/20/2020 TC
a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2020-CPT-06
Ground Elevation = 13.1 ft
Water Table Depth from ground surface = 5.1 ft = EL 8 ft
γ = 110 pcf
γ_{sat} = 120 pcf
Atmospheric pressure = 2,116.2 psf
Cone Area Ratio = 0.8

Depth	q _c	f _s	Pore Pressure	q _c	q _t	f _s	Pore Pressure	σ _v	u	σ _v '	rd	τ _{ave}	Fr	n	Q _{tn}	lc	G0	p	a	b	R	γ	Kc	Q _{tn,cs}	N1(60),cs	Nc	ε _{vol(15)}	ε _{vol}	Δs		
ft	tsf	tsf	tsf	psf	psf	psf	psf	psf	psf	psf		psf					psf												in		
Hand Auger from 0 to 5 feet																															
5.09	107.30	0.75	0.41	214,600.0	214,765.1	1,506.0	825.6	559.4	0.0	559.4	0.99	9.0	0.7	1.04	10.3	3.1	2.92E+05	372.9	0.1	18,136.1	3.68E-05	0.0040	7.7	79.2	28.2	10.8	0.0027	0.0023	0.001		
5.25	110.92	0.68	0.36	221,842.0	221,985.1	1,352.0	715.7	578.9	9.3	569.6	0.99	9.4	0.6	1.02	11.1	3.0	3.06E+05	385.9	0.1	17,766.3	3.53E-05	0.0039	7.2	79.8	27.7	10.8	0.0026	0.0023	0.000		
																									Total Estimated Settlement		2 x ΣΔs		0.1		

**DYNAMIC DENSIFICATION ANALYSES BASED ON CPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
2/20/2020 TC
a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2020-CPT-07
Ground Elevation = 18.0 ft
Water Table Depth from ground surface = EL 8 ft
γ = 110 pcf
γ_{sat} = 120 pcf
Atmospheric pressure = 2,116.2 psf
Cone Area Ratio = 0.8

Depth	q _c	f _s	Pore Pressure	q _c	q _t	f _s	Pore Pressure	σ _v	u	σ _v '	rd	τ _{ave}	Fr	n	Q _{tn}	lc	G0	p	a	b	R	γ	Kc	Q _{tn,cs}	N1(60),cs	Nc	ε _{vol(15)}	ε _{vol}	Δs		
ft	tsf	tsf	tsf	psf	psf	psf	psf	psf	psf	psf		psf					psf												in		
Hand Auger from 0 to 5 feet																															
5.09	53.37	0.62	0.23	106,742.0	106,832.5	1,246.0	452.7	559.4	0.0	559.4	0.99	9.0	1.2	1.04	10.3	3.1	2.92E+05	372.9	0.1	18,136.1	3.68E-05	0.0040	7.7	79.2	28.2	10.8	0.0027	0.0023	0.001		
5.25	47.10	1.46	-0.12	94,208.0	94,158.7	2,924.0	-246.4	577.4	0.0	577.4	0.99	9.3	3.1	1.02	11.1	3.0	3.06E+05	385.0	0.1	17,793.9	3.53E-05	0.0039	7.2	79.8	27.7	10.8	0.0026	0.0023	0.002		
5.41	67.27	1.00	-0.14	134,542.0	134,484.7	1,996.0	-286.3	595.5	0.0	595.5	0.99	9.6	1.5	1.02	11.5	3.0	3.16E+05	397.0	0.1	17,468.3	3.46E-05	0.0038	7.0	80.7	27.7	10.8	0.0025	0.0022	0.002		
5.58	89.19	1.27	0.03	178,388.0	178,400.0	2,544.0	59.9	613.5	0.0	613.5	0.99	9.9	1.4	1.03	11.5	3.0	3.26E+05	409.0	0.1	17,158.2	3.39E-05	0.0037	7.3	83.6	29.1	10.8	0.0023	0.0020	0.002		
5.74	83.04	0.52	0.04	166,076.0	166,094.0	1,040.0	89.9	631.6	0.0	631.6	0.99	10.2	0.6	1.05	11.0	3.1	3.30E+05	421.0	0.1	16,862.4	3.39E-05	0.0037	8.0	87.3	31.5	10.8	0.0021	0.0018	0.001		
5.91	65.68	1.18	0.23	131,368.0	131,461.9	2,364.0	469.3	649.6	0.0	649.6	0.99	10.5	1.8	1.06	10.6	3.1	3.32E+05	433.1	0.1	16,579.8	3.40E-05	0.0037	8.5	89.7	33.3	10.8	0.0020	0.0017	0.001		
6.07	114.29	0.65	0.34	228,584.0	228,721.8	1,290.0	689.0	667.7	0.0	667.7	0.99	10.8	0.6	1.07	10.5	3.2	3.36E+05	445.1	0.1	16,309.4	3.39E-05	0.0037	8.7	90.5	33.9	10.8	0.0020	0.0017	0.001		
6.23	39.92	0.86	-0.07	79,834.0	79,806.0	1,716.0	-139.8	685.7	0.0	685.7	0.99	11.1	2.2	1.05	10.9	3.1	3.43E+05	457.1	0.1	16,050.6	3.35E-05	0.0036	8.1	89.0	32.5	10.8	0.0020	0.0018	0.001		
6.40	36.27	0.61	-0.06	72,536.0	72,513.4	1,218.0	-113.2	703.7	0.0	703.7	0.99	11.3	1.7	1.04	11.3	3.1	3.45E+05	469.2	0.1	15,802.3	3.37E-05	0.0036	7.6	86.0	30.5	10.8	0.0022	0.0019	0.002		
6.56	146.91	0.82	0.03	293,822.0	293,834.0	1,648.0	59.9	721.8	0.0	721.8	0.98	11.6	0.6	1.03	11.1	3.1	3.39E+05	481.2	0.1	15,564.1	3.46E-05	0.0038	7.4	82.6	29.0	10.8	0.0024	0.0021	0.002		
6.73	446.81	1.28	1.50	893,610.0	894,209.2	2,554.0	2,995.9	739.8	0.0	739.8	0.98	11.9	0.3	1.03	11.0	3.0	3.33E+05	493.2	0.1	15,335.2	3.56E-05	0.0039	7.2	79.2	27.5	10.8	0.0026	0.0023	0.002		
6.89	471.79	1.31	1.08	943,582.0	944,012.1	2,622.0	2,150.5	757.9	0.0	757.9	0.98	12.2	0.3	1.02	10.9	3.0	3.34E+05	505.2	0.1	15,115.1	3.59E-05	0.0039	7.1	78.2	27.0	10.8	0.0027	0.0023	0.002		
7.05	419.87	1.99	0.33	839,736.0	839,869.8	3,970.0	669.2	775.9	0.0	775.9	0.98	12.5	0.5	1.04	11.2	3.1	3.57E+05	517.3	0.1	14,903.2	3.39E-05	0.0037	7.7	85.7	30.5	10.8	0.0022	0.0019	0.001		
7.22	326.25	3.58	0.40	652,492.0	652,651.1	7,166.0	795.6	794.0	0.0	794.0	0.98	12.8	1.1	0.99	13.5	2.9	3.88E+05	529.3	0.1	14,699.0	3.14E-05	0.0034	6.2	83.5	27.4	10.8	0.0023	0.0020	0.002		
7.38	251.04	3.79	1.33	502,070.0	502,600.6	7,586.0	2,653.1	812.0	0.0	812.0	0.98	13.1	1.5	0.92	18.9	2.8	4.67E+05	541.3	0.1	14,502.2	2.63E-05	0.0028	4.5	84.9	25.0	10.8	0.0021	0.0018	0.001		
7.55	209.17	3.69	4.16	418,336.0	419,999.7	7,374.0	8,318.7	830.1	0.0	830.1	0.98	13.3	1.8	0.87	24.1	2.6	5.38E+05	553.4	0.1	14,312.2	2.31E-05	0.0024	3.6	86.1	23.7	10.8	0.0020	0.0017	0.001		
7.71	297.86	2.80	2.87	595,720.0	596,867.8	5,598.0	5,739.0	848.1	0.0	848.1	0.98	13.6	0.9	0.83	29.3	2.5	5.98E+05	565.4	0.1	14,128.7	2.10E-05	0.0022	2.9	85.8	22.4	10.8	0.0019	0.0016	0.001		
7.87	288.31	2.54	0.72	576,612.0	576,899.6	5,070.0	1,438.1	866.1	0.0	866.1	0.98	13.9	0.9	0.83	30.7	2.5	6.20E+05	577.4	0.1	13,951.3	2.04E-05	0.0021	2.8	86.6	22.4	10.8	0.0019	0.0016	0.001		
8.04	250.90	2.60	0.33	501,792.0	501,923.2	5,202.0	655.8	884.2	0.0	884.2	0.98	14.2	1.0	0.87	26.3	2.6	5.88E+05	589.5	0.1	13,779.8	2.17E-05	0.0023	3.4	90.0	24.6	10.8	0.0018	0.0015	0.001		
8.20	250.34	2.14	0.65	500,678.0	500,937.0	4,272.0	1,294.8	902.2	0.0	902.2	0.98	14.5	0.9	0.91	22.2	2.7	5.55E+05	601.5	0.1	13,613.8	2.32E-05	0.0024	4.2	93.8	27.2	10.8	0.0017	0.0015	0.001		
8.37	288.84	2.20	0.81	577,670.0	577,992.2	4,392.0	1,611.2	920.3	0.0	920.3	0.98	14.8	0.8	0.88	25.1	2.6	5.87E+05	613.5	0.1	13,453.0	2.21E-05	0.0023	3.6	91.2	25.3	10.8	0.0017	0.0015	0.001		
8.53	276.66	2.62	1.37	553,326.0	553,873.3	5,240.0	2,736.3	938.3	0.0	938.3	0.98	15.0	0.9	0.85	27.6	2.6	6.13E+05	625.5	0.1	13,297.1	2.14E-05	0.0022	3.2	89.0	23.9	10.8	0.0018	0.0016	0.001		
8.69	226.36	3.69	1.37	452,710.0	453,257.3	7,374.0	2,736.3	956.4	0.0	956.4	0.98	15.3	1.6	0.80	34.3	2.4	6.77E+05	637.6	0.1	13,146.0	1.95E-05	0.0020	2.5	85.8	21.5	10.8	0.0019	0.0016	0.001		
8.86	129.14	3.43	1.27	258,278.0	258,786.0	6,862.0	2,539.9	974.4	0.0	974.4	0.98	15.6	2.7	0.76	41.2	2.3	7.48E+05	649.6	0.1	12,999.4	1.78E-05	0.0018	2.1	86.6	20.8	10.8	0.0018	0.0015	0.001		
9.02	99.58	2.34	3.16	199,168.0	200,431.6	4,682.0	6,318.1	992.5	0.0	992.5	0.98	15.9	2.3	0.75	48.6	2.3	8.70E+05	661.6	0.1	12,857.1	1.55E-05	0.0016	2.0	98.1	23.3	10.8	0.0013	0.0011	0.001		
9.19	108.75	1.99	2.91	217,498.0	218,661.8	3,976.0	5,818.8	1,010.5	0.0	1,010.5	0.98	16.2	1.8	0.69	61.3	2.1	9.37E+05	673.7	0.1	12,718.8	1.45E-05	0.0015	1.5	94.2	20.7	10.8	0.0014	0.0012	0.001		
9.35	146.97	1.83	0.69	293,934.0	294,210.3	3,668.0	1,381.5	1,028.5	0.0	1,028.5	0.98	16.5	1.3	0.71	53.7	2.2	8.78E+05	685.7	0.1	12,584.5	1.56E-05	0.0016	1.7	90.7	20.5	10.8	0.0016	0.0013	0.001		
9.51	129.36	1.65	0.05	258,724.0	258,744.6	3,292.0	103.2	1,046.6	0.0	1,046.6	0.98	16.7	1.3	0.76	43.2	2.3	7.95E+05	697.7	0.1	12,453.8	1.74E-05	0.0018	2.1	88.7	21.1	10.8	0.0017	0.0014	0.001		
9.68	101.79	1.44	-0.02	203,570.0	203,562.0	2,870.0	-40.0	1,064.6	0.0	1,064.6	0.98	17.0	1.4	0.76	41.7	2.3	7.81E+05	709.8	0.1	12,326.8	1.78E-05	0.0018	2.1	87.4	21.0	10.8	0.0017	0.0015	0.001		
9.84	79.03	0.81	-0.02	158,054.0	158,047.3	1,624.0	-33.3	1,082.7	0.0	1,082.7	0.98	17.3	1.0	0.80	41.5	2.4	8.50E+05	721.8	0.1	12,203.1	1.65E-05	0.0017	2.5	101.8	25.4	10.8	0.0013	0.0011	0.001		
10.01	73.01	0.65	-0.06	146,020.0	145,994.0	1,300.0	-129.9	1,100.8	0.4	1,100.4	0.98	17.6	0.9	0.80	40.1	2.4	8.36E+05	733.9	0.1	12,082.2	1.69E-05	0.0017	2.5	100.5	25.2	10.8	0.0013	0.0011	0.000		
Total Estimated Settlement																										2 x ΣΔs	0.1				

**DYNAMIC DENSIFICATION ANALYSES BASED ON CPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
2/20/2020 TC
a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2020-CPT-08
Ground Elevation = 17.6 ft
Water Table Depth from ground surface = 9.6 ft = EL 8 ft
γ = 110 pcf
γ_{sat} = 120 pcf
Atmospheric pressure = 2,116.2 psf
Cone Area Ratio = 0.8

Depth	q _c	f _s	Pore Pressure	q _c	q _t	f _s	Pore Pressure	σ _v	u	σ _v '	rd	τ _{ave}	Fr	n	Q _{tn}	lc	G0	p	a	b	R	γ	Kc	Q _{tn,cs}	N1(60),cs	Nc	ε _{vol(15)}	ε _{vol}	Δs	
ft	tsf	tsf	tsf	psf	psf	psf	psf	psf	psf	psf	psf	psf					psf													in
0.16	4.98	0.14	0.18	9,950.0	10,023.5	282.0	367.5	18.0	0.0	18.0	1.00	0.3	2.8	0.00	4.2	0.0	0.00E+00	12.0	0.1	142,350.9	0.00E+00	0.0000	0.0	0.0	0.0	10.8	0.0000	0.0000	0.000	
0.33	4.98	0.08	0.18	9,950.0	10,022.4	166.0	362.2	36.1	0.0	36.1	1.00	0.6	1.7	1.02	4.2	3.0	3.06E+05	24.1	0.1	93,916.5	3.53E-05	0.0039	7.2	79.8	27.7	10.8	0.0026	0.0023	0.002	
0.49	10.37	0.19	0.07	20,746.0	20,773.0	376.0	135.1	54.1	0.0	54.1	1.00	0.9	1.8	1.02	4.2	3.0	3.16E+05	36.1	0.1	73,635.5	3.46E-05	0.0038	7.0	80.7	27.7	10.8	0.0025	0.0022	0.002	
0.66	17.67	0.26	0.13	35,330.0	35,381.9	518.0	259.5	72.2	0.0	72.2	1.00	1.2	1.5	1.03	4.2	3.0	3.26E+05	48.1	0.1	61,961.8	3.39E-05	0.0037	7.3	83.6	29.1	10.8	0.0023	0.0020	0.002	
0.82	23.43	0.33	0.19	46,862.0	46,937.7	660.0	378.4	90.2	0.0	90.2	1.00	1.5	1.4	1.05	4.2	3.1	3.30E+05	60.1	0.1	54,197.4	3.39E-05	0.0037	8.0	87.3	31.5	10.8	0.0021	0.0018	0.001	
0.98	31.88	0.39	0.23	63,764.0	63,854.8	786.0	454.0	108.3	0.0	108.3	1.00	1.8	1.2	1.06	0.0	3.1	3.32E+05	72.2	0.1	48,581.3	3.40E-05	0.0037	8.5	89.7	33.3	10.8	0.0020	0.0017	0.001	
1.15	40.45	0.61	0.23	80,892.0	80,983.9	1,210.0	459.5	126.3	0.0	126.3	1.00	2.1	1.5	1.07	4.2	3.2	3.36E+05	84.2	0.1	44,289.6	3.39E-05	0.0037	8.7	90.5	33.9	10.8	0.0020	0.0017	0.001	
1.31	37.48	0.91	0.23	74,958.0	75,048.8	1,822.0	454.0	144.4	0.0	144.4	1.00	2.4	1.4	1.05	4.2	3.1	3.43E+05	96.2	0.1	40,879.6	3.35E-05	0.0036	8.1	89.0	32.5	10.8	0.0020	0.0018	0.001	
1.48	46.21	0.78	0.21	92,424.0	92,506.2	1,550.0	410.8	162.4	0.0	162.4	1.00	2.6	1.7	1.04	4.2	3.1	3.45E+05	108.3	0.1	38,090.3	3.37E-05	0.0036	7.6	86.0	30.5	10.8	0.0022	0.0019	0.002	
1.64	37.68	0.76	0.16	75,354.0	75,418.9	1,520.0	324.3	180.4	0.0	180.4	1.00	2.9	2.0	1.03	4.2	3.1	3.39E+05	120.3	0.1	35,756.9	3.46E-05	0.0038	7.4	82.6	29.0	10.8	0.0024	0.0021	0.002	
1.80	42.45	0.91	0.17	84,906.0	84,973.0	1,812.0	335.1	198.5	0.0	198.5	1.00	3.2	2.1	1.03	4.2	3.0	3.33E+05	132.3	0.1	33,769.5	3.56E-05	0.0039	7.2	79.2	27.5	10.8	0.0026	0.0023	0.002	
1.97	52.94	1.21	0.20	105,878.0	105,959.1	2,414.0	405.4	216.5	0.0	216.5	1.00	3.5	2.3	1.02	4.2	3.0	3.34E+05	144.4	0.1	32,051.7	3.59E-05	0.0039	7.1	78.2	27.0	10.8	0.0027	0.0023	0.002	
2.13	89.12	1.44	0.29	178,236.0	178,351.7	2,872.0	578.4	234.6	0.0	234.6	1.00	3.8	1.6	1.04	4.2	3.1	3.57E+05	156.4	0.1	30,548.8	3.39E-05	0.0037	7.7	85.7	30.5	10.8	0.0022	0.0019	0.001	
2.30	91.29	1.70	0.25	182,588.0	182,687.4	3,392.0	497.2	252.6	0.0	252.6	0.99	4.1	1.9	0.99	4.2	2.9	3.88E+05	168.4	0.1	29,220.2	3.14E-05	0.0034	6.2	83.5	27.4	10.8	0.0023	0.0020	0.002	
2.46	68.85	1.69	0.29	137,704.0	137,818.6	3,370.0	573.0	270.7	0.0	270.7	0.99	4.4	2.5	0.92	4.2	2.8	4.67E+05	180.4	0.1	28,035.3	2.63E-05	0.0028	4.5	84.9	25.0	10.8	0.0021	0.0018	0.001	
2.62	93.24	1.29	0.26	186,488.0	186,594.0	2,582.0	529.8	288.7	0.0	288.7	0.99	4.7	1.4	0.87	4.2	2.6	5.38E+05	192.5	0.1	26,970.4	2.31E-05	0.0024	3.6	86.1	23.7	10.8	0.0020	0.0017	0.001	
2.79	139.51	1.36	0.31	279,026.0	279,149.2	2,720.0	616.2	306.8	0.0	306.8	0.99	5.0	1.0	0.83	4.2	2.5	5.98E+05	204.5	0.1	26,007.0	2.10E-05	0.0022	2.9	85.8	22.4	10.8	0.0019	0.0016	0.001	
2.95	275.86	1.11	0.26	551,722.0	551,828.0	2,224.0	529.8	324.8	0.0	324.8	0.99	5.3	0.4	0.83	4.2	2.5	6.20E+05	216.5	0.1	25,130.2	2.04E-05	0.0021	2.8	86.6	22.4	10.8	0.0019	0.0016	0.001	
3.12	383.61	1.15	0.21	767,210.0	767,293.3	2,302.0	416.3	342.8	0.0	342.8	0.99	5.6	0.3	0.87	4.2	2.6	5.88E+05	228.6	0.1	24,328.1	2.17E-05	0.0023	3.4	90.0	24.6	10.8	0.0018	0.0015	0.001	
3.28	412.77	0.90	0.24	825,546.0	825,641.1	1,796.0	475.6	360.9	0.0	360.9	0.99	5.9	0.2	0.91	4.2	2.7	5.55E+05	240.6	0.1	23,590.8	2.32E-05	0.0024	4.2	93.8	27.2	10.8	0.0017	0.0015	0.001	
3.44	310.65	1.26	0.27	621,308.0	621,416.1	2,514.0	540.4	378.9	0.0	378.9	0.99	6.2	0.4	0.88	4.2	2.6	5.87E+05	252.6	0.1	22,910.2	2.21E-05	0.0023	3.6	91.2	25.3	10.8	0.0017	0.0015	0.001	
3.61	190.87	1.91	0.22	381,738.0	381,827.7	3,822.0	448.6	397.0	0.0	397.0	0.99	6.4	1.0	0.85	4.2	2.6	6.13E+05	264.7	0.1	22,279.6	2.14E-05	0.0022	3.2	89.0	23.9	10.8	0.0018	0.0016	0.001	
3.77	112.69	1.90	0.17	225,380.0	225,447.0	3,802.0	335.1	415.0	0.0	415.0	0.99	6.7	1.7	0.80	4.2	2.4	6.77E+05	276.7	0.1	21,693.2	1.95E-05	0.0020	2.5	85.8	21.5	10.8	0.0019	0.0016	0.001	
3.94	68.77	1.54	0.29	137,534.0	137,649.7	3,082.0	578.4	433.1	0.0	433.1	0.99	7.0	2.2	0.76	4.2	2.3	7.48E+05	288.7	0.1	21,146.3	1.78E-05	0.0018	2.1	86.6	20.8	10.8	0.0018	0.0015	0.001	
4.10	85.98	1.44	0.38	171,960.0	172,113.5	2,878.0	767.5	451.1	0.0	451.1	0.99	7.3	1.7	0.75	4.2	2.3	8.70E+05	300.7	0.1	20,634.6	1.55E-05	0.0016	2.0	98.1	23.3	10.8	0.0013	0.0011	0.001	
4.27	83.55	1.12	0.31	167,100.0	167,224.3	2,230.0	621.6	469.2	0.0	469.2	0.99	7.6	1.3	0.69	4.2	2.1	9.37E+05	312.8	0.1	20,154.7	1.45E-05	0.0015	1.5	94.2	20.7	10.8	0.0014	0.0012	0.001	
4.43	67.81	1.23	0.28	135,612.0	135,722.3	2,454.0	551.4	487.2	0.0	487.2	0.99	7.9	1.8	0.71	4.2	2.2	8.78E+05	324.8	0.1	19,703.4	1.56E-05	0.0016	1.7	90.7	20.5	10.8	0.0016	0.0013	0.001	
4.59	62.66	0.66	0.24	125,324.0	125,419.1	1,310.0	475.6	505.2	0.0	505.2	0.99	8.2	1.0	0.76	4.2	2.3	7.95E+05	338.8	0.1	19,278.1	1.74E-05	0.0018	2.1	88.7	21.1	10.8	0.0017	0.0014	0.001	
4.76	60.03	0.90	0.22	120,066.0	120,153.6	1,804.0	437.9	523.3	0.0	523.3	0.99	8.5	1.5	0.76	4.2	2.3	7.81E+05	348.9	0.1	18,876.5	1.78E-05	0.0018	2.1	87.4	21.0	10.8	0.0017	0.0015	0.001	
4.92	40.67	0.91	0.10	81,344.0	81,384.0	1,824.0	200.0	541.3	0.0	541.3	0.99	8.8	2.3	0.80	4.2	2.4	8.50E+05	360.9	0.1	18,496.4	1.65E-05	0.0017	2.5	101.8	25.4	10.8	0.0013	0.0011	0.001	
5.09	29.48	1.09	0.12	58,960.0	59,007.6	2,186.0	237.9	559.4	0.0	559.4	0.99	9.0	3.7	0.80	4.2	2.4	8.36E+05	372.9	0.1	18,136.1	1.69E-05	0.0017	2.5	100.5	25.2	10.8	0.0013	0.0011	0.001	
5.25	43.10	0.35	0.14	86,206.0	86,263.3	708.0	286.6	577.4	0.0	577.4	0.99	9.3	0.8	0.83	4.2	2.5	7.98E+05	385.0	0.1	17,793.9	1.79E-05	0.0018	2.8	101.1	26.2	10.8	0.0013	0.0012	0.001	
5.41	516.36	3.05	0.21	#####	#####	6,094.0	427.0	595.5	0.0	595.5	0.99	9.6	0.6	0.90	4.2	2.7	7.10E+05	397.0	0.1	17,468.3	2.02E-05	0.0021	4.0	106.4	30.4	10.8	0.0013	0.0011	0.001	
5.58	273.35	4.62	0.16	546,690.0	546,756.0	9,234.0	329.8	613.5	0.0	613.5	0.99	9.9	1.7	0.90	4.2	2.7	6.93E+05	409.0	0.1	17,158.2	2.09E-05	0.0022	3.9	101.7	28.8	10.8	0.0014	0.0012	0.001	
5.74	231.85	4.67	-0.17	463,706.0	463,636.8	9,336.0	-345.9	631.6	0.0	631.6	0.99	10.2	2.0	0.90	4.2	2.7	6.82E+05	421.0	0.1	16,862.4	2.14E-05	0.0022	3.9	99.2	28.1	10.8	0.0015	0.0013	0.001	
5.91	228.94	2.71	0.02	457,884.0	457,893.7	5,422.0	48.7	649.6	0.0	649.6	0.99	10.5	1.2	0.83	4.2	2.5	7.34E+05	433.1	0.1	16,579.8	2.00E-05	0.0021	2.9	91.3	23.7	10.8	0.0017	0.0015	0.001	
6.07	152.74	2.72	0.11	305,482.0	305,524.2	5,440.0	210.8	667.7	0.0	667.7	0.99	10.8	1.8	0.77	4.2	2.4	6.89E+05	445.1	0.1	16,309.4	2.15E-05	0.0022	2.2	75.0	18.2	10.8	0.0025	0.0022	0.002	
6.23	109.64	2.46	0.04	219,276.0	219,293.3	4,914.0	86.5	685.7	0.0	685.7	0.99	11.1	2.2	0.76	4.2	2.3	7.08E+05	457.1	0.1	16,050.6	2.11E-05	0.0022	2.0	74.3	17.7	10.8	0.0025			

**DYNAMIC DENSIFICATION ANALYSES BASED ON SPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
2/20/20 TC

a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2002-B-1
Ground Elevation = 19.8 ft
Depth to Ground Water Table = 11.8 ft = EL 8 ft
 γ = 110 pcf
 γ_{sat} = 120 pcf
Boring Diameter = 8 inch = 203.2 mm
Rod Length Above Ground = 3 ft = 0.9 m
 $\epsilon_{C,N}/\epsilon_{C,N=15}$ = 0.925
 ϕ = 35 degree

Elevation	Depth	Depth	ΔH (ft)	N	σ_v	σ_v	σ_v'	σ_v'	Liner					$N_{1,60}$	σ_m'	σ_m'	$K_{2(max)}$	G_{max}	r_d	$r_{eff} \cdot G_{eff}/G_{max}$	Sand	r_{eff}	r_{eff}	$\epsilon_{C,N=15}$	$\epsilon_{C,N}$	ΔS (in)	
									C_R	Correction	C_S	C_B	C_E														C_N
17.8	2	0.6	2.5	12	220.0	10.5	220.0	10.5	0.75	N	1.00	1.15	1	1.70	18	135.9	0.07	52.0	6.1E+05	1.00	1.9E-04	Y	0.00035	0.035	0.036	0.03	0.01
15.8	4	1.2	2.0	13	440.0	21.1	440.0	21.1	0.75	Y	1.13	1.15	1	1.70	22	271.8	0.14	55.6	9.2E+05	1.00	2.5E-04	Y	0.00036	0.036	0.030	0.03	0.01
13.8	6	1.8	2.5	13	660.0	31.6	660.0	31.6	0.80	N	1.00	1.15	1	1.70	20	407.6	0.20	54.6	1.1E+06	0.99	3.1E-04	Y	0.00500	0.500	0.500	0.46	0.14
10.3	9.5	2.9	2.5	31	1,045.0	50.1	1,045.0	50.1	0.85	N	1.00	1.15	1	1.28	39	645.4	0.32	67.8	1.7E+06	0.98	3.1E-04	Y	0.00250	0.250	0.075	0.07	0.02
																								Total			0.2
																								Multi-directional Shaking Total			0.4

**DYNAMIC DENSIFICATION ANALYSES BASED ON SPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
2/20/20 TC

a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2002-B-2
Ground Elevation = 18.2 ft
Depth to Ground Water Table = 10.2 ft = EL 8 ft
 γ = 110 pcf
 γ_{sat} = 120 pcf
Boring Diameter = 8 inch = 203.2 mm
Rod Length Above Ground = 3 ft = 0.9 m
 $\epsilon_{C,N}/\epsilon_{C,N=15}$ = 0.925
 ϕ = 35 degree

Elevation	Depth	Depth	ΔH (ft)	N	σ_v	σ_v	σ_v'	σ_v'	Liner						$N_{1,60}$	σ_m'	σ_m'	$K_{2(max)}$	G_{max}	r_d	$r_{eff}^*G_{eff}/G_{max}$	Sand	r_{eff}	r_{eff}	$\epsilon_{C,N=15}$	$\epsilon_{C,N}$	ΔS (in)																			
									C_R	Correction	C_S	C_B	C_E	C_N														psf	tsf	psf	%	%	%	in												
16.2	2	0.6	1.0	9	220.0	10.5	220.0	10.5	0.75	N	1.00	1.15	1	1.70	13	135.9	0.07	47.3	5.5E+05	1.00	2.1E-04	Y	0.010	1.0	1.3	1.2	0.14																			
14.2	4	1.2	5.0	23	440.0	21.1	440.0	21.1	0.75	Y	1.23	1.15	1	1.70	41	271.8	0.14	69.2	1.1E+06	1.00	2.0E-04	Y	0.002	0.2	0.1	0.1	0.03																			
12.2	6	1.8	1.0	6	660.0	31.6	660.0	31.6	0.80	N	1.00	1.15	1	1.70	9	407.6	0.20	42.2	8.5E+05	0.99	4.0E-04	Y	0.010	1.0	1.0	0.9	0.11																			
																							Total	0.3		Multi-directional Shaking Total		0.6																		

**DYNAMIC DENSIFICATION ANALYSES BASED ON SPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
2/20/20 TC

a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2002-B-3
Ground Elevation = 19.2 ft
Depth to Groumd Water Table = 11.2 ft = EL 8 ft
 γ = 110 pcf
 γ_{sat} = 120 pcf
Boring Diameter = 8 inch = 203.2 mm
Rod Length Above Ground = 3 ft = 0.9 m
 $\epsilon_{C,N}/\epsilon_{C,N=15}$ = 0.925
 ϕ = 35 degree

Elevation		Depth		ΔH (ft)	N	σ_v	σ_v	σ_v'	σ_v'	Liner		C_B	C_E	C_N	$N_{1,60}$	σ_m'	σ_m'	$K_{2(max)}$	G_{max}	r_d	$r_{eff} \cdot G_{eff}/G_{max}$	Sand	r_{eff}	r_{eff}	$\epsilon_{C,N=15}$	$\epsilon_{C,N}$	ΔS (in)
ft	ft	m	ft	blow/ft	psf	kPa	psf	kPa	C_R	Correction	C_S					psf	tsf		psf		Y/N	%	%	%	%	in	
14.7	4.5	1.4	5.0	21	495.0	23.7	495.0	23.7	0.75	N	1.00	1.15	1	1.70	31	305.7	0.15	62.7	1.1E+06	0.99	2.4E-04	Y	0.003	0.3	0.2	0.1	0.09
Total																									0.1		
Multi-directional Shaking Total																									0.2		

**DYNAMIC DENSIFICATION ANALYSES BASED ON SPT DATA
LANEY COLLEGE LIBRARY LEARNING RESOURCE CENTER, OAKLAND, CALIFORNIA**

04.72190021
2/20/20 TC

a_{max} = 0.81 g ASCE 7-16
Mw = 7.0

2020-B-01
Ground Elevation = 17.5 ft
Depth to Ground Water Table = 9.5 ft = EL 8 ft
 γ = 110 pcf
 γ_{sat} = 120 pcf
Boring Diameter = 4 inch = 101.6 mm
Rod Length Above Ground = 3 ft = 0.9 m
 $\epsilon_{c,N}/\epsilon_{c,N=15}$ = 0.925
 ϕ = 35 degree
Energy Ratio = 84%

Elevation	Depth	Depth	ΔH (ft)	N	σ_v	σ_v	σ_v'	σ_v'	Liner				N _{1,60}	σ_m'	σ_m'	K _{2(max)}	G _{max}	r _d	r _{eff} *G _{eff} /G _{max}	Sand	r _{eff}	r _{eff}	$\epsilon_{c,N=15}$	$\epsilon_{c,N}$	ΔS (in)																							
									C _R	Correction	C _S	C _B														C _E	C _N	psf	tsf	psf	Y/N	%	%	%	in													
13.5	4.0	1.2	6.5	19	440.0	21.1	440.0	21.1	0.75	N	1.00	1	1.4	1.70	34	271.8	0.14	64.7	1.1E+06	1.00	2.2E-04	Y	0.0025	0.250	0.100	0.09	0.07																					
9.5	8.0	2.4	3.0	4	880.0	42.2	880.0	42.2	0.80	Y	1.10	1	1.4	1.70	8	543.5	0.27	40.6	9.5E+05	0.98	4.8E-04	N	-	-	-	-	-																					
																							Total																							0.1		
																							Multi-directional Shaking Total																									0.1

Supplement F

Slope Stability Analyses

Title: Laney College Library Learning Resource Center
 File Name: Section A-A'.gsz
 Description: Case 1 - Static Long Term
 Horz Seismic Coef.: 0
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Tau/Sigma Ratio	Minimum Strength (psf)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1		
Light Green	Highly Liquefiable Sand	Mohr-Coulomb	110	0	33	1		
Grey	Young Bay Mud	S=f(overburden)	90			1	0.35	350
Light Blue	Sand and Clay	Mohr-Coulomb	130	0	40	1		

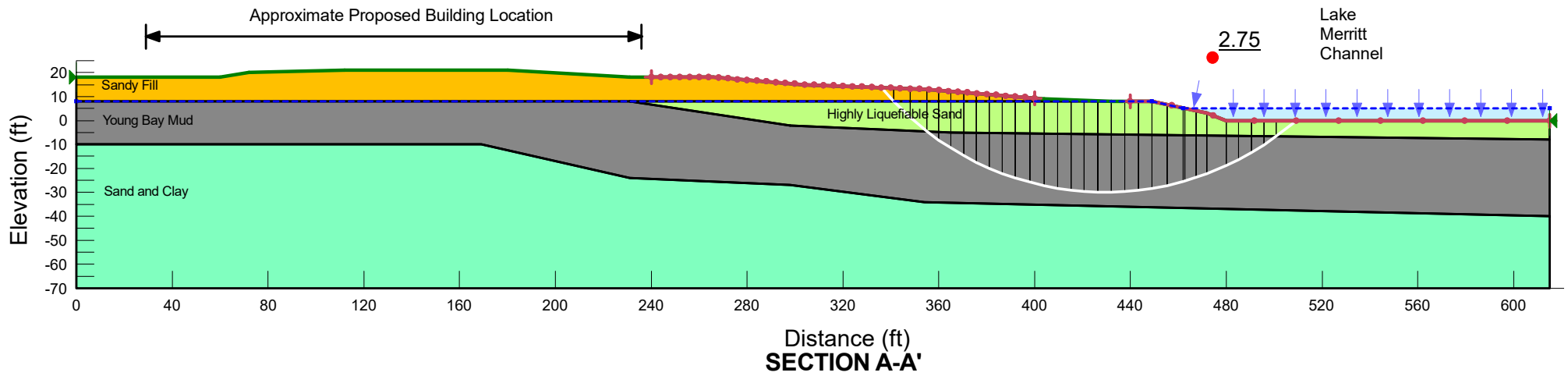


PLATE F-1

Title: Laney College Library Learning Resource Center
 File Name: Section A-A'.gsz
 Description: Case 2 - Pseudo-Static Yield Acceleration
 Horz Seismic Coef.: 0.12
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Tau/Sigma Ratio	Minimum Strength (psf)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1		
Light Green	Highly Liquefiable Sand	Mohr-Coulomb	110	0	33	1		
Grey	Young Bay Mud	S=f(overburden)	90			1	0.35	350
Light Blue	Sand and Clay	Mohr-Coulomb	130	0	40	1		

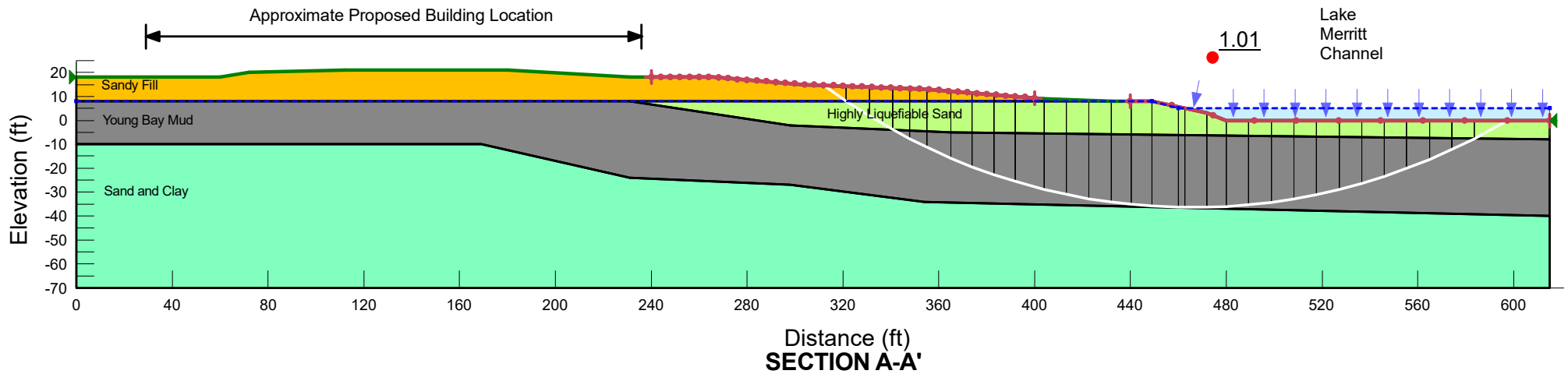


PLATE F-2

Title: Laney College Library Learning Resource Center
 File Name: Section A-A'.gsz
 Description: Case 3 - Pseudo-Static k = 0.15g; Fixed Slip Surface at Edge of Building
 Horz Seismic Coef.: 0.15
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Tau/Sigma Ratio	Minimum Strength (psf)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1		
Light Green	Highly Liquefiable Sand	Mohr-Coulomb	110	0	33	1		
Grey	Young Bay Mud	S=f(overburden)	90			1	0.35	350
Light Blue	Sand and Clay	Mohr-Coulomb	130	0	40	1		

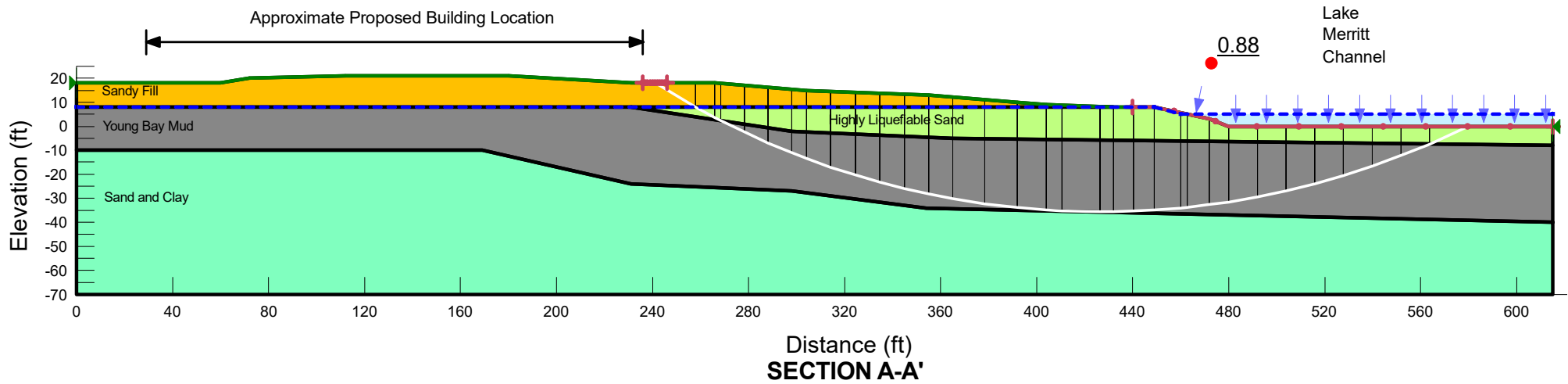


PLATE F-3

Title: Laney College Library Learning Resource Center
 File Name: Section A-A'.gsz
 Description: Case 4 - Post-Liquefaction
 Horz Seismic Coef.: 0
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Tau/Sigma Ratio	Minimum Strength (psf)	C-Datum (psf)	C-Rate of Change ((lbs/ft ²)/ft)	C-Maximum (psf)	Datum (Elevation) (ft)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1						
Grey	Young Bay Mud	S=f(overburden)	90			1	0.35	350				
Light Green	Sand and Clay	Mohr-Coulomb	130	0	40	1						
Cyan	Post-Liquefaction Sand	S=f(datum)	110			1			100	20	500	8

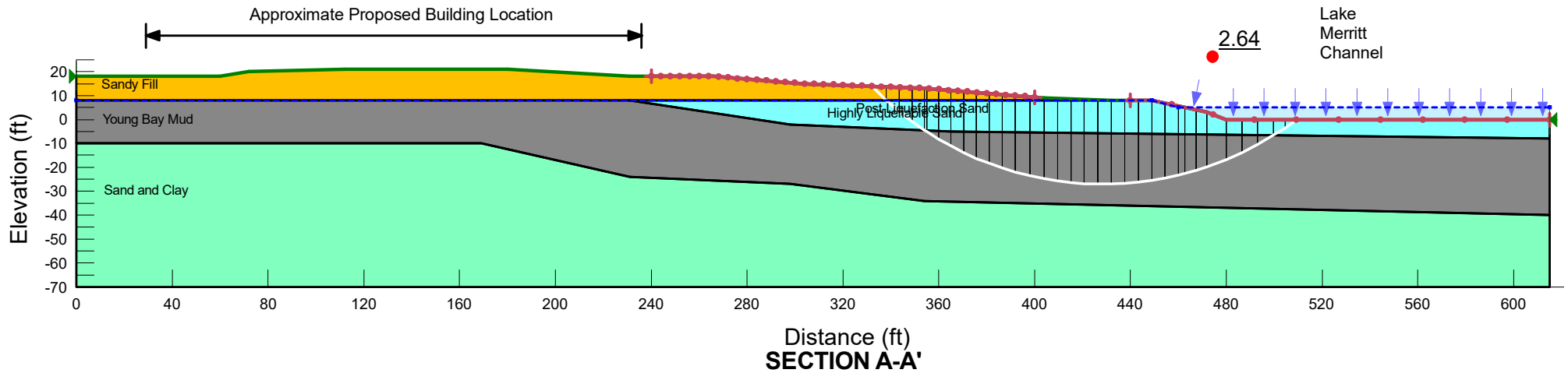


PLATE F-4

Title: Laney College Library Learning Resource Center
 File Name: Section D-D'.gsz
 Description: Case 1 - Static Long Term
 Horz Seismic Coef.: 0
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Tau/Sigma Ratio	Minimum Strength (psf)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1		
Grey	Young Bay Mud	S=f(overburden)	90			1	0.35	350
Light Green	Sand and Clay	Mohr-Coulomb	130	0	40	1		
Light Blue	Highly Liquefiable Sand	Mohr-Coulomb	110	0	33	1		

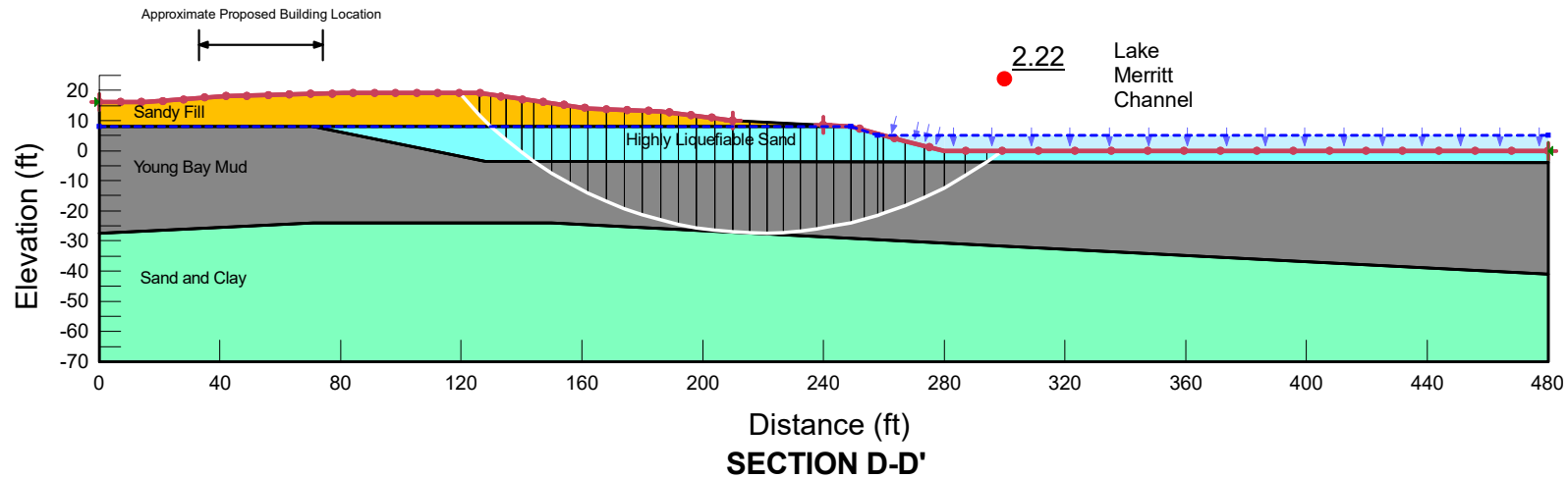


PLATE F-5

Title: Laney College Library Learning Resource Center
 File Name: Section D-D'.gsz
 Description: Case 2 - Pseudo-Static Yield Acceleration
 Horz Seismic Coef.: 0.12
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Tau/Sigma Ratio	Minimum Strength (psf)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1		
Grey	Young Bay Mud	S=f(overburden)	90			1	0.35	350
Light Green	Sand and Clay	Mohr-Coulomb	130	0	40	1		
Light Blue	Highly Liquefiable Sand	Mohr-Coulomb	110	0	33	1		

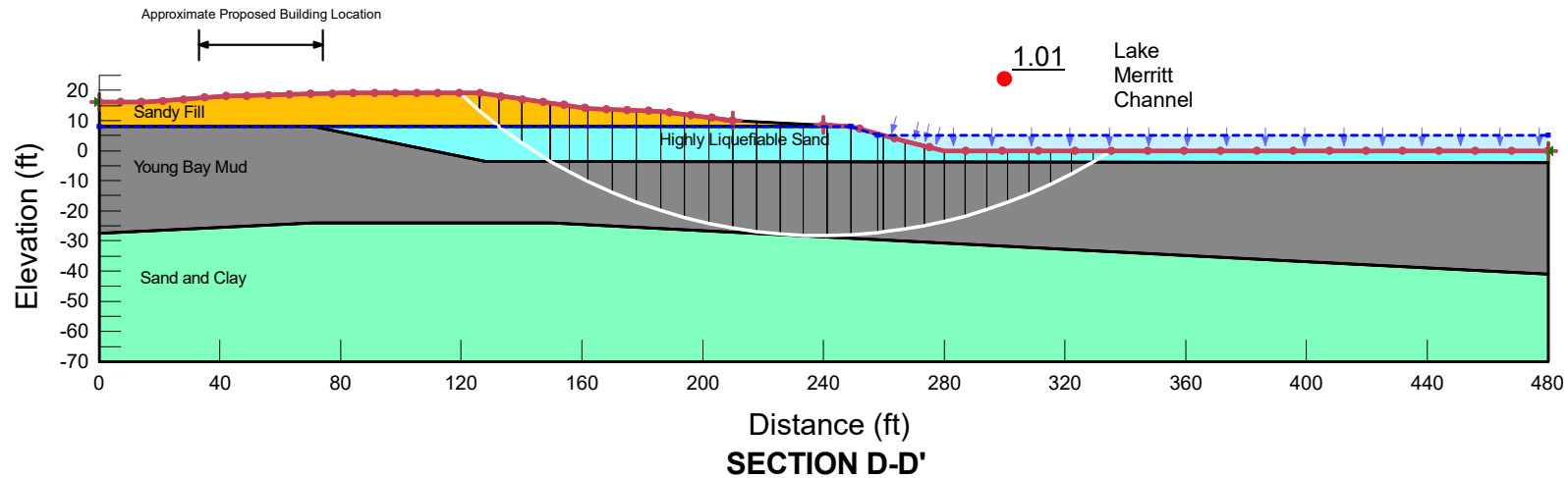


PLATE F-6

Title: Laney College Library Learning Resource Center
 File Name: Section D-D'.gsz
 Description: Case 3 - Pseudo-Static k = 0.15g; Fixed Slip Surface at Edge of Building
 Horz Seismic Coef.: 0.15
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Tau/Sigma Ratio	Minimum Strength (psf)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1		
Grey	Young Bay Mud	S=f(overburden)	90			1	0.35	350
Light Green	Sand and Clay	Mohr-Coulomb	130	0	40	1		
Light Blue	Highly Liquefiable Sand	Mohr-Coulomb	110	0	33	1		

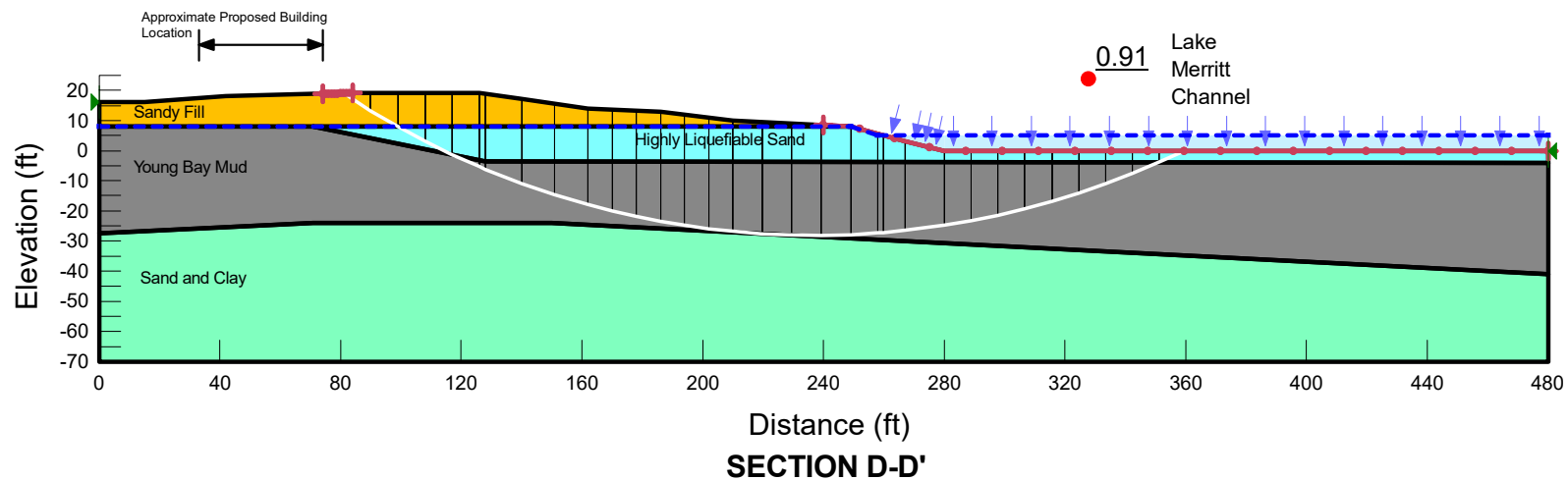


PLATE F-7

Title: Laney College Library Learning Resource Center
 File Name: Section D-D'.gsz
 Description: Case 4 - Post-Liquefaction
 Horz Seismic Coef.: 0
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	C-Datum (psf)	C-Rate of Change ((lbs/ft ²)/ft)	C-Maximum (psf)	Datum (Elevation) (ft)	Tau/Sigma Ratio	Minimum Strength (psf)
Orange	Sandy Fill	Mohr-Coulomb	120	0	35	1						
Light Green	Post-Liquefaction Sand	S=f(datum)	110			1	100	20	500	8		
Grey	Young Bay Mud	S=f(overburden)	90			1					0.35	350
Light Blue	Sand and Clay	Mohr-Coulomb	130	0	40	1						

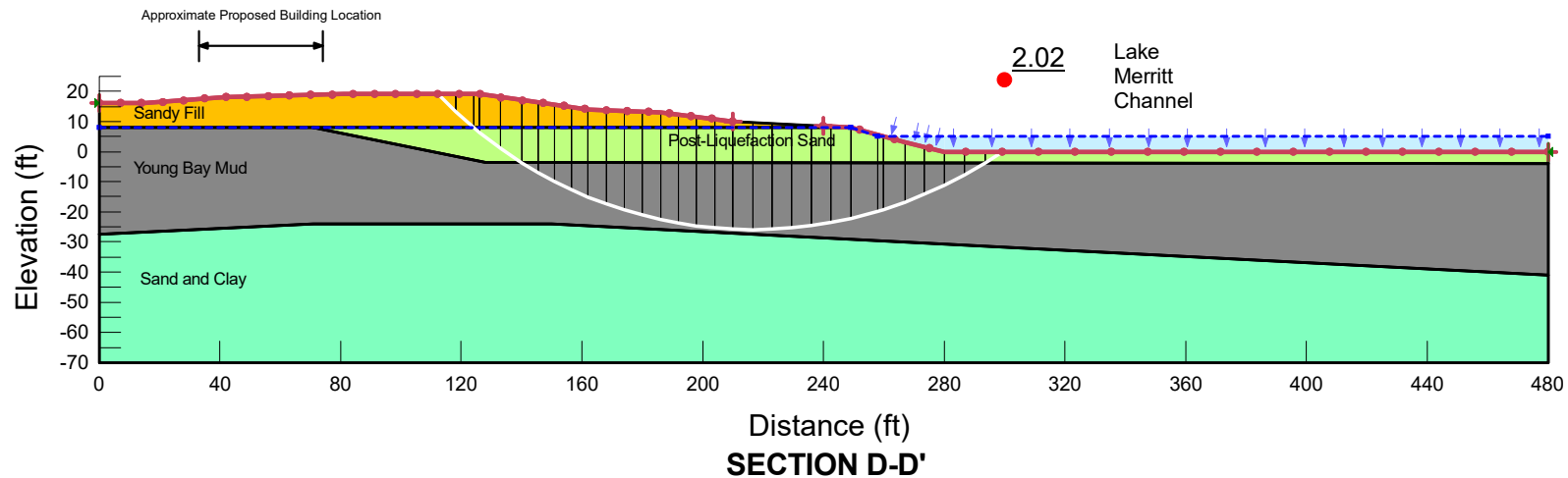


PLATE F-8

Title: Laney College Library Learning Resource Center
 File Name: Section E-E'.gsz
 Description: Case 1 - Static Long Term
 Horz Seismic Coef.: 0
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Tau/Sigma Ratio	Minimum Strength (psf)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1		
Grey	Young Bay Mud	S=f(overburden)	90			1	0.35	350
Light Green	Sand and Clay	Mohr-Coulomb	130	0	40	1		
Light Blue	Highly Liquefiable Sand	Mohr-Coulomb	110	0	33	1		

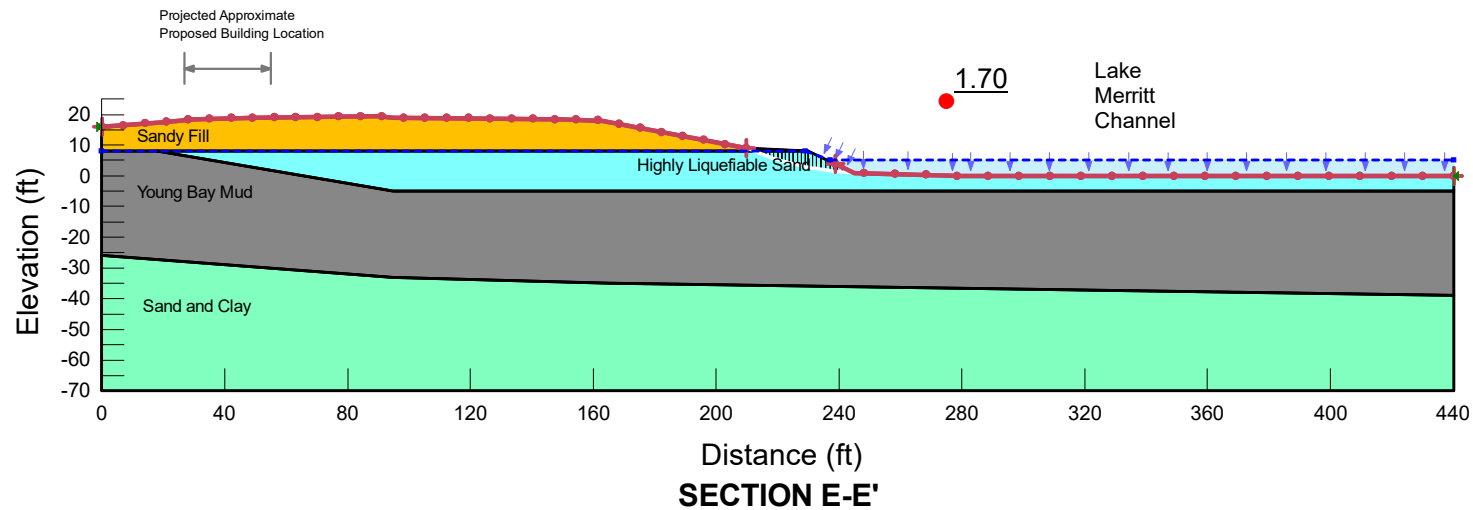


PLATE F-9

Title: Laney College Library Learning Resource Center
 File Name: Section E-E'.gsz
 Description: Case 2 - Pseudo-Static Yield Acceleration
 Horz Seismic Coef.: 0.11
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Tau/Sigma Ratio	Minimum Strength (psf)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1		
Grey	Young Bay Mud	S=f(overburden)	90			1	0.35	350
Light Green	Sand and Clay	Mohr-Coulomb	130	0	40	1		
Light Blue	Highly Liquefiable Sand	Mohr-Coulomb	110	0	33	1		

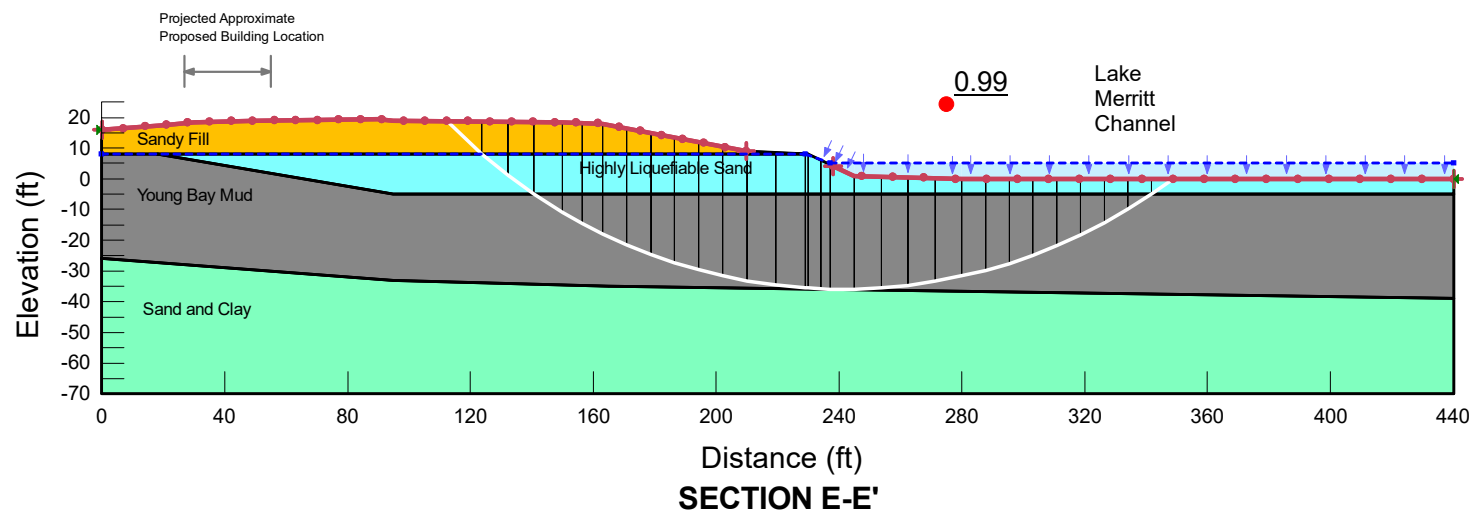


PLATE F-10

Title: Laney College Library Learning Resource Center
 File Name: Section E-E'.gsz
 Description: Case 3 - Pseudo-Static $k = 0.15g$; Fixed Slip Surface at Edge of Building
 Horz Seismic Coef.: 0.15
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Tau/Sigma Ratio	Minimum Strength (psf)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1		
Grey	Young Bay Mud	S=f(overburden)	90			1	0.35	350
Light Green	Sand and Clay	Mohr-Coulomb	130	0	40	1		
Cyan	Highly Liquefiable Sand	Mohr-Coulomb	110	0	33	1		

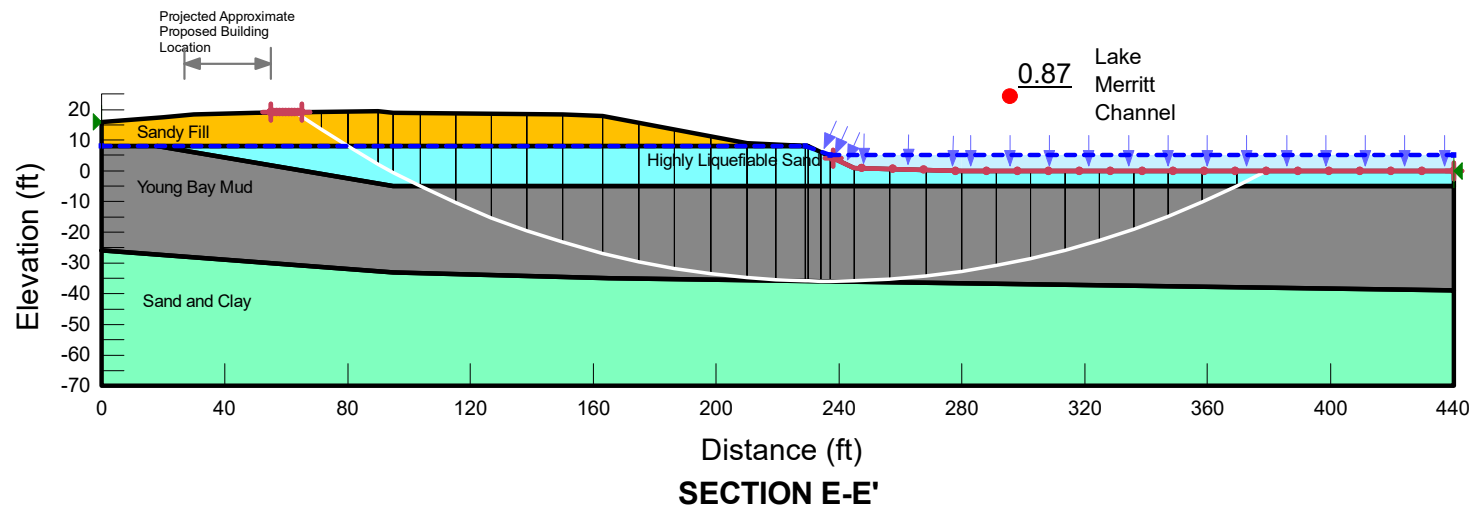


PLATE F-11

Title: Laney College Library Learning Resource Center
 File Name: Section E-E'.gsz
 Description: Case 4 - Post-Liquefaction
 Horz Seismic Coef.: 0
 Method: Spencer

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	C-Datum (psf)	C-Rate of Change ((lbs/ft ²)/ft)	C-Maximum (psf)	Datum (Elevation) (ft)	Tau/Sigma Ratio	Minimum Strength (psf)
Yellow	Sandy Fill	Mohr-Coulomb	120	0	35	1						
Light Green	Post-Liquefaction Sand	S=f(datum)	110			1	100	20	500	8		
Grey	Young Bay Mud	S=f(overburden)	90			1					0.35	350
Light Blue	Sand and Clay	Mohr-Coulomb	130	0	40	1						

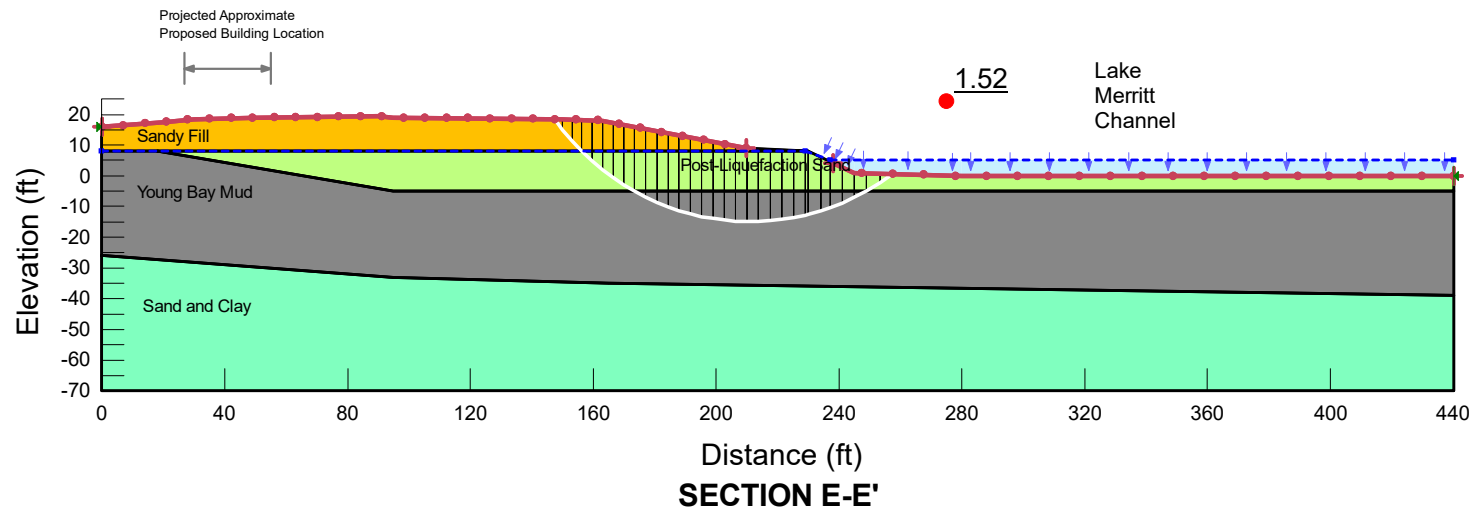


PLATE F-12

Supplement G

Site-Specific Ground

Motion Analyses

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G.1 Introduction

This appendix summarizes a site-specific seismic hazard assessment and site response analyses conducted to estimate the severity of ground motions that may affect the project site for specific design levels of hazard. The seismic hazard assessment was conducted using the seismic source model adopted by the United States Geological Survey (USGS) to develop the 2014 National Seismic Hazard Map Project (NSHMP) (Petersen et al., 2014), and the NGA West 2 Ground Motion Models (Bozorgnia et al., 2014).

A liquefaction triggering hazard assessment indicated that the soils at the site are potentially liquefiable. Therefore, according to ASCE 7-16, the site is classified as Site Class F, and site response analyses are required to calculate the design ground motions at the ground surface. These site response analyses were performed using the commercial finite-difference program FLAC (Itasca, 2016) and evaluated the effect of nonlinear dynamic response of the soft and liquefiable soils at the site on the surface ground motions. The design ground motion parameters were calculated following the site-specific ground motion procedures defined in Chapter 21 of ASCE 7-16 (ASCE, 2016; 2018) as required by the 2019 California Building Code (CBC) (CBC, 2019).

G.2 Subsurface Conditions for the Seismic Hazard Assessment

Subsurface conditions at the project site generally consist of approximately 10 feet (ft) of sandy fill overlaying approximately 20 to 30 ft of soft Young Bay Mud (YBM) overlaying denser sands and stiffer clays (e.g., see **Plates 7 and 9** of the main text). Liquefiable sand seams on the order of 5 ft in thickness exist within the YBM (these sands are referred to as YBM Sand herein). Bedrock at the project site is expected to exist at depths greater than approximately 500 ft (Rodgers and Figuers, 1991). Idealization of subsurface conditions for the seismic hazard assessment was based primarily on data from geotechnical borings (including standard penetration test [SPT] and laboratory test data) and cone penetration test (CPT) soundings performed at the project site. Locations of the project explorations and interpreted cross sections are shown on **Plate 3** of the main text.

Free-field site response analyses were performed for a one-dimensional soil column extending from the ground surface to the base of the YBM. The denser sands and stiffer clays underlying the YBM are considered competent (Site Class D), and consequently their effect on seismic wave propagation at the site is captured reasonably well by the ground motion models used in the seismic hazard assessment.

G.2.1 Shear Wave Velocity

The time-weighted average shear wave velocity (V_s) in the top 100 ft (30 meters [m]) (V_{s30}) is an important input parameter to include the local site conditions in the seismic hazard assessment.

Similarly, characterization of the small-strain stiffness, G (where $G = \rho V_s^2$ and ρ is density) is important for site response analysis. In-situ V_s measurements were conducted by Gregg Drilling and Testing for the seismic CPT-07 located between the building footprint and the Lake Merritt Channel (2020-CPT-07 on **Plate 3** of the main text; data presented in **Appendix A**). These measurements are shown on **Figure G.2-1** alongside V_s values calculated from empirical correlations between V_s and CPT data using the same CPT sounding. Two CPT-based shear wave velocity correlations are shown on **Figure G.2-1**; the Mayne and Rix (1995) correlation for clays is shown within the YBM and the Andrus et al. (2007) correlation is shown for all other strata. The correlations are consistent with the seismic measurements for this CPT sounding in the YBM and competent clays and sands underlying the YBM. Strata demarcations for CPT-07 consistent with the interpreted cross sections (e.g., **Plate 8** of the main text) are also shown on this figure. **Figure G.2-2** shows correlated V_s values for all project CPT soundings, where Mayne and Rix (1995) is shown for YBM and Andrus et al. (2007) is shown for all other strata. This range of data approximately represents the variability of V_s across the site. The relatively small range of correlated V_s values in YBM across all CPT soundings is similar to the range of measured values for CPT-07. Idealized shear wave velocities within the YBM and competent sands and clays underlying the YBM are shown on **Figure G.2-3**. Measured and correlated V_s values for CPT-07 are also shown on this figure. Extrapolation of shear wave velocities in the competent soils underlying the YBM was based on review of data from (1) local Fugro projects and (2) near the former Cypress Structure (Rogers and Figuers, 1991). A V_{s30} from the base of the YBM of approximately 860 ft/s (260 m/s), corresponding to Site Class D per ASCE 7-16, was computed using the idealization shown on **Figure G.2-3** and was used for the seismic hazard assessment to develop input ground motions for the site response analyses. V_{s30} from the ground surface was estimated to be approximately 560 ft/s (170 m/s), corresponding to Site Class E per ASCE 7-16; however, Site Class F was assigned because of the presence of potentially liquefiable YBM Sand seams. The Site Class F classification requires that a site response analysis in accordance with ASCE 7-16 Section 21.1 be performed.

G.2.2 Young Bay Mud Undrained Shear Strength

The undrained shear strength (s_u) of YBM was evaluated based on CPT and laboratory test data. YBM undrained shear strengths from (1) unconsolidated undrained (UU) triaxial compression tests, (2) unconfined compression (UC) tests, and (3) CPT measurements (i.e., $s_u = q_{t,net}/N_{kt}$ where $q_{t,net}$ is the net total cone resistance and the cone factor $N_{kt} = 20$) are shown on **Figure G.2-4**. The CPT data are shown as a hexagonally binned two-dimensional histogram (hexbin). The laboratory test data are biased low (i.e., they fall near the lower bound of the CPT data) likely because of sample disturbance effects. The idealized YBM undrained shear strength used for the site response analyses (i.e., for calibration of the modulus reduction and damping factor [MRDF] constitutive model as described in **Section G.6.1**) is also shown on **Figure G.2-4**.

Note that these are static strengths which were empirically adjusted for rate effects for the site response analyses as described in **Section G.6.1**.

G.2.3 Penetration Resistance for Sand-Like Soils (Fill and YBM Sand)

Penetration resistances in the fill and YBM Sand are summarized on **Figure G.2-5** which plots $(N_1)_{60cs}$ (i.e., equivalent clean sand blow counts corrected to 60% energy ratio and an effective overburden of one atmosphere) versus elevation. Hexbin profiles of correlated $(N_1)_{60cs}$ values from CPT data (per the procedures described by Boulanger and Idriss [2014]) are in good agreement with SPT measurements (shown with triangular markers on **Figure G.2-5**). Blow counts in the saturated YBM Sand are mostly between 9 and 16, whereas blow counts in the fill range from roughly 10 to greater than 30.

G.2.4 Idealized Profiles for One-Dimensional Site Response Analyses

Figure G.2-6 shows three idealized soil profiles used for the site response analyses. These profiles reasonably represent the expected stratigraphic variation beneath the building footprint (note that deeper YBM was encountered closer to the Lake Merritt Channel, outside of the building footprint, e.g., 2020-CPT-06 on **Plate 7**). The three idealized profiles are described below.

- **Profile P1** (deep YBM) consists of 10 ft of fill overlaying 31 ft of YBM.
- **Profile P2** (deep YBM with liquefiable sand) consists of 10 ft of fill overlaying 31 ft of YBM with a 5-foot-thick liquefiable YBM Sand layer within the YBM from depths of 25 to 30 ft.
- **Profile P3** (shallow YBM) consists 10 ft of fill overlaying 18 ft of YBM.

G.3 Probabilistic Seismic Hazard Analysis

A site-specific seismic hazard assessment was conducted for a V_{s30} of 860 ft/s (260 m/s) corresponding to the base of the YBM, to calculate the input design ground motions for the site response analyses.

G.3.1 Project Location

A Probabilistic Seismic Hazard Analysis (PSHA) was conducted for one representative location of the project site. The geographical coordinates of the location used for the seismic hazard analyses are tabulated in **Table G.1**.

Table G.1: Representative Project Location Coordinates used in the PSHA

Latitude	Longitude
37.7948°N	122.2624°W

G.3.2 Methodology

PSHA Framework

The methodology for a PSHA includes the following components:

1. Seismic Source Model. This includes defining the location, style, and rates of earthquake occurrence in the model area. The characterization includes developing values for the following seismic source parameters:
 - i. Source location and geometry. All major active faults and seismotectonic provinces are defined within the model area. This includes the geographical extent at the surface as well as the orientation and depth of the source zones.
 - ii. Source type (e.g., shallow crustal area source zones, fault sources, subduction zones, etc.) and style of faulting (e.g., normal, strike-slip, reverse, etc.).
 - iii. Magnitude potential (i.e., range of earthquake sizes possible on each source) and magnitude distribution (i.e., characterized using a magnitude probability density function).
 - iv. Earthquake magnitude recurrence, which is a characterization of the annual rate at which earthquakes of a specified magnitude or greater occur in each source.
2. Ground Motion Model. Characterization of ground motion attenuation characteristics of each source are based on the geologic and tectonic environment. These characteristics are described by a series of ground motion models, or GMM (also known as “attenuation relationships,” “attenuation models,” or “ground motion prediction equations”).
3. Probabilistic Seismic Hazard Analysis. A PSHA uses inputs from the seismic source model and GMMs selected for the specific environment, to estimate the ground motion hazard at the site. The hazard is expressed in terms of the annual frequency of exceeding a given spectral acceleration at the project site (i.e., annual hazard curves). This information also can be shown in the form of uniform hazard response spectra (UHRS), which correspond to spectral acceleration having the same probability of exceedance across all structural periods. The UHRS are typically used by different design codes to define the design response spectra.

PSHA Calculation

Computation of the seismic hazard involves the combination of uncertainties in earthquake size, location, frequency, and resulting ground motions. The estimated annual rate at which the ground motion, A , will exceed a particular value, a , is computed by (Cornell, 1968):

$$\lambda[A > a] = \sum_{i=1}^{N_{source}} N(M_{min}) \iint P[A > a | m, r] f_M(m) f_R(r) dm dr$$

Equation 1

where N_{source} is the total number of seismic sources; $N(M_{min})$ is the annual rate of earthquake with magnitude greater than or equal to M_{min} ; $P[A > a|m, r]$ is the probability of the ground motion, A , exceeding the threshold value, a , given the earthquake magnitude and distance from the seismic source; and $f_M(m)$ and $f_R(r)$ are probability density functions describing magnitude and distance.

The computation of this integral is carried out numerically. By assuming that earthquake occurrence can be modeled as a Poisson process, the probability of exceedance in a specified exposure period (typically corresponding to the useful life of a project) may be estimated as follows:

$$P[A > a, t] = 1 - e^{-[\lambda(a)t]}$$

Equation 2

where $P[A > a, t]$ is the conditional probability of the spectral acceleration (A) exceeding a specified acceleration (a) during a time interval (t) given that an earthquake will occur, and $\lambda(a)$ is the mean annual rate of exceedance of the specified acceleration level.

Seismic Source Model

The PSHA was conducted using the seismic source model adopted by the USGS to develop the 2014 NSHMP (Petersen et al., 2014) for California which corresponds to the Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3). The details of this seismic source model can be found in Field et al. (2013).

Empirical Ground Motion Models

The attenuation of seismic waves from a seismic source were modeled using empirical ground motion models (GMM's). These empirical GMM's should model the type of rupture mechanism as well as the regional geology to properly estimate site-specific strong ground motion parameters. Four of the Next Generation Attenuation (NGA) West 2 GMM's (Bozorgnia et al., 2014) were used. These four NGA West 2 GMM are: Abrahamson et al. (2014), Boore et al. (2014), Campbell and Bozorgnia (2014), and Chiou and Youngs (2014). The four NGA West 2 GMM's were equally weighted, following the weighting scheme used in the development of the 2014 USGS NSHMP (Petersen et al., 2014).

Implementation

The PSHA was performed using the USGS computer code *nshmp-haz*, which has been used by the USGS to develop the US national seismic hazard maps.

G.3.3 Results from the PSHA

Figure G.3-1 shows the mean annual seismic hazard curves for selected spectral periods ranging from 0.01 to 10 seconds for a V_{s30} of 260 m/sec. A spectral period of 0.01 seconds is used to represent the peak ground acceleration (PGA). These hazard curves represent the total mean hazard from combining all seismic sources and ground motion models. This figure also indicates the annual frequency of exceedance corresponding to a return period of 2,475 years.

Table G.2 tabulates the mean magnitude, distance, and epsilon calculated from the seismic hazard deaggregation for PGA and S_a (spectral acceleration) at 1 second for a return period of 2,475 years. Epsilon is the number of standard deviations that the estimated ground motion amplitude deviates from the estimated median ground motion amplitude. Thus, an epsilon of 1 indicates that the probabilistic value of the ground motion corresponds to a median plus one-standard-deviation value.

Table G.2: Mean Seismic Hazard Deaggregation for a Return Period of 2,475 years and V_{s30} of 260 m/sec

	PGA	S_a at 1 sec.
Mean Magnitude (Mw)	7.00	7.27
Mean Distance (km)	9.2	10.0
Mean Epsilon	1.8	1.7

Figure G.3-2 presents the 5 percent-damped mean horizontal UHRS for a return period of 2,475 years and a V_{s30} of 260 m/sec. Table G.3 tabulates the mean horizontal UHRS for periods ranging from 0.01 (i.e., PGA) to 10 seconds for a return period of 2,475 years.

Table G.3: Mean Horizontal UHRS for Return Period of 2,475 Years and a Vs30 of 260 m/sec, 5% Damping

Period (sec)	Horizontal Spectral Acceleration (g)
0.01 (PGA)	0.933
0.03	0.957
0.05	1.07
0.075	1.32
0.1	1.55
0.15	1.83
0.2	2.05
0.25	2.23
0.3	2.36
0.4	2.42
0.5	2.35
0.75	1.96
1	1.65
1.5	1.19
2	0.924
3	0.606
4	0.429
5	0.320
7.5	0.177
10	0.110

G.4 Design Response Spectra at Base of YBM

According to ASCE 7-16, for Site Class D sites with S1 (mapped 5% damped spectral response acceleration parameter at a period of 1 second) greater than or equal to 0.2 g, the design response spectrum and design acceleration parameters should be developed following the site-specific ground motion procedures defined in Section 21.2 of ASCE 7-16. The S1 for the project site was calculated as 0.660 g using the USGS web service (<https://earthquake.usgs.gov/ws/designmaps/asce7-16.html>). Therefore, the design ground motions for the site should be calculated using the site-specific procedures from ASCE 7-16.

ASCE 7-16 defines a site-specific Risk-Targeted Maximum Considered Earthquake (MCE_R) as the lesser of probabilistic (MCE_R) and deterministic (MCE_R) ground motions. The probabilistic MCE_R ground motion is calculated as the ground motion in the direction of maximum horizontal

response that is expected to achieve 1 percent probability of collapse within a 50-year period. The deterministic MCE_R ground motion is defined as the 84th percentile ground motion in the direction of maximum horizontal response of the largest acceleration from deterministic seismic hazard analysis (DSHA) of the characteristic earthquakes on all known active faults within the project region. Additionally, ASCE 7-16 specifies a lower limit to the deterministic MCE_R ground motion. The site-specific MCE_R should not be less than 150 percent of the site-specific design response spectrum. The site-specific design response spectrum is calculated as $2/3$ of the site-specific MCE_R . The site-specific design response spectrum should be greater than or equal to 80 percent of the spectral acceleration as determined by using the general response spectrum of Section 11.4.6 of ASCE 7-16, using modified F_a and F_v values provided in Section 21.3 of ASCE 7-16.

The PSHA results described in the previous section were used to calculate the probabilistic MCE_R spectrum. As specified in ASCE 7-16, to obtain ground motions with a uniform 1 percent probability of collapse within a 50-year period, the UHRS for a return period of 2,475 was scaled by a risk coefficient, C_R . The C_R values were calculated using Method 1 described in Chapter 21 of ASCE 7-16. The mapped risk coefficients at spectral periods of 0.2 and 1.0 sec, C_{RS} and C_{R1} , respectively, were determined using the USGS web service (<https://earthquake.usgs.gov/ws/designmaps/asce7-16.html>). The value of these risk coefficients C_{RS} and C_{R1} are 0.921 and 0.906, respectively. The ground motions in the direction of maximum horizontal response were calculated by applying the scaling factors recommended in ASCE 7-16. **Figure G.4-1** shows the UHRS for a return period of 2,475 years along with the probabilistic MCE_R response spectrum.

The deterministic MCE_R spectrum was calculated by performing a DSHA in EZ-FRISK™ (Fugro, 2019) using the same seismic sources and GMM's used in the PSHA. The UCERF3 source model includes magnitude frequency distributions (MFD's) which relate frequency of occurrence to earthquake magnitude; however, these MFD's include multi-fault ruptures scenarios with large magnitudes but with low probability of occurrence. Therefore, following the current USGS approach to calculate deterministic ground motions from the UCERF3 source model, to estimate the characteristic magnitude for the seismic sources, we used the empirical relationships proposed by Wells and Coppersmith (1994) that relates rupture geometry to earthquake magnitude. The ground motions in the direction of maximum horizontal response were calculated by applying the scaling factors recommended in ASCE 7-16. **Figure G.4-1** illustrates the calculation of the deterministic MCE_R response spectrum. The deterministic MCE_R response spectrum was calculated as the maximum of the 84th DSHA response spectrum and the lower limit specified by ASCE 7-16 Supplement 1 calculated for a Site Class D.

Figure G.4-2 presents the development of the site-specific MCE_R and design response spectra for the base of the YBM. In this case, the deterministic MCE_R spectrum is lower than the probabilistic MCE_R spectrum for all spectral periods. The site-specific MCE_R spectrum is the

maximum of: 1) the minimum of the probabilistic and deterministic MCE_R , and 2) 150 percent of the design response spectrum. Following ASCE 7-16, the design response spectrum was calculated as the maximum of 2/3 of the site-specific MCE_R and the lower limit specified by ASCE 7-16 (80 percent of the general spectrum for Site Class D, using modified F_a and F_v values provided in Section 21.3 of ASCE 7-16). The transition period from constant velocity to constant displacement, T_L , required to calculate the lower limit, was estimated as 8 seconds using the USGS web service (<https://earthquake.usgs.gov/ws/designmaps/asce7-16.html>).

Table G.4 tabulates the spectral ordinates of the recommended site-specific MCE_R and design response spectra per ASCE 7-16 for the base of the YBM.

Table G.4: MCE_R and Design Response Spectra per ASCE 7-16 for a Vs30 of 260 m/sec (base of YBM), 5% Damping

Period (sec)	Horizontal Spectral Acceleration (g)									
	UHRS for Return Period of 2,475 Years	Risk Coefficients	Max. Direction Scaling Factors	Probabilistic MCE _R	84th Deterministic Spectrum	Deterministic Lower Limit	Deterministic MCE _R	Site- Specific MCE _R	80% General Response Spectrum	Design Response Spectrum
0.01 (PGA)	0.933	0.921	1.10	0.945	0.711	0.555	0.782	0.782	0.400	0.521
0.03	0.957	0.921	1.10	0.970	0.717	0.559	0.789	0.789	0.459	0.526
0.05	1.07	0.921	1.10	1.08	0.783	0.611	0.861	0.861	0.518	0.574
0.075	1.32	0.921	1.10	1.34	0.928	0.724	1.02	1.02	0.591	0.680
0.1	1.55	0.921	1.10	1.57	1.07	0.831	1.17	1.17	0.664	0.781
0.15	1.83	0.921	1.10	1.86	1.29	1.01	1.42	1.42	0.811	0.946
0.190	2.01	0.921	1.10	2.04	1.42	1.11	1.56	1.56	0.927	1.04
0.2	2.05	0.921	1.10	2.08	1.45	1.13	1.60	1.60	0.927	1.06
0.25	2.23	0.919	1.13	2.32	1.57	1.26	1.77	1.77	0.927	1.18
0.3	2.36	0.917	1.15	2.49	1.66	1.36	1.91	1.91	0.927	1.28
0.4	2.42	0.915	1.19	2.62	1.75	1.48	2.08	2.08	0.927	1.39
0.5	2.35	0.912	1.21	2.61	1.74	1.50	2.11	2.11	0.927	1.41
0.75	1.96	0.909	1.26	2.25	1.50	1.34	1.89	1.89	0.927	1.26
0.949	1.70	0.906	1.29	2.00	1.33	1.22	1.73	1.73	0.927	1.15
1	1.65	0.906	1.30	1.95	1.30	1.20	1.69	1.69	0.880	1.13
1.5	1.19	0.906	1.35	1.46	0.983	0.942	1.33	1.33	0.587	0.885
2	0.924	0.906	1.39	1.16	0.783	0.770	1.09	1.09	0.440	0.724
3	0.606	0.906	1.44	0.789	0.538	0.548	0.773	0.773	0.293	0.515
4	0.429	0.906	1.47	0.572	0.383	0.400	0.564	0.564	0.220	0.376
5	0.320	0.906	1.50	0.435	0.283	0.301	0.425	0.425	0.176	0.283
7.5	0.177	0.906	1.50	0.240	0.140	0.149	0.210	0.210	0.117	0.140
8	0.159	0.906	1.50	0.216	0.124	0.131	0.185	0.185	0.110	0.124
10	0.110	0.906	1.50	0.150	0.0801	0.0852	0.120	0.120	0.0704	0.0801

G.5 Ground Motion Acceleration Time Histories for Input to Site Response Analyses

G.5.1 Selection of Seed Ground Motions

Following Section 21.1.1 of ASCE 7-16, five pairs of orthogonal recorded horizontal seed ground motion (GM's) acceleration time histories were selected and scaled to comply with the site-specific MCE_R response spectrum at the base of the YBM developed in the previous section.

During the selection of seed GM's, we considered the following criteria:

- The selected GM's were recorded from seismic events that are comparable with events that control the MCE_R scenario from the seismic deaggregation.
- The shape of the GM's acceleration response spectra.
- The lowest usable frequency of the selected GM's.
- Other criteria including strong motion duration, Arias Intensity, faulting mechanism, and shear wave velocity at the site where the GM's were recorded.

Table G.5 lists the properties of the selected seed GM's.

Table G.5: Selected Seed Ground Motions

No.	Record Sequence Number (RSN)	Earthquake Name	Recording Station	Moment Magnitude (Mw)	Faulting Mechanism	Vs30 of Recording Station (m/s)	Rupture/ Closest Distance (km)	Minimum Usable Frequency (Hz)	Average Scaling Factor
1	729	1987 Superstition Hills-02	Imperial Valley Wildlife Liquefaction Array	6.54	Strike slip	179	24	0.1	4.1
2	1545	199 Chi-Chi_ Taiwan	TCU120	7.62	Reverse Oblique	459	7.4	0.0375	4.1
3	6952	2010 Darfield_ New Zealand	Papanui High School	7	Strike slip	263	19	0.0625	4.0
4	806	1989 Loma Prieta	Sunnyvale - Colton Ave.	6.93	Reverse Oblique	268	24	0.1	4.4
5	1176	1999 Kocaeli_ Turkey	Yarimca	7.51	Strike slip	297	5	0.0875	3.3

G.5.2 Scaling of Seed Ground Motions

Figure G.5-1 shows a comparison between the response spectra of the two components (H1, H2) for each of the linearly scaled ground motions (thin colored lines), the mean response spectra of the five scaled motions (thick red line) and the target MCE_R at the base of the YBM (thick black line). On average, the mean of the scaled acceleration response spectra shows good agreement with the target response spectrum.

The scale factor for each of the seed ground motions was selected such that the average of their spectral accelerations within the period range from 0.05 seconds to 5 seconds matches, on average, the spectral accelerations of the target MCE_R response spectrum within the same period range. The average scaling factor for the response spectra of the two components of the seed ground motions is listed in **Table G.5** above.

G.6 One-Dimensional Site Response Analyses

According to ASCE 7-16, for sites classified as Site Class F, the design response spectrum and design acceleration parameters should be developed following the site-specific ground motion procedures defined in Chapter 21 of ASCE 716. Specifically, site response analyses shall be performed in accordance with ASCE 7-16 Section 21.1. The approach, analyses, and results for one-dimensional free-field site response analyses are presented herein.

G.6.1 Approach

One-Dimensional Site Response Modelling in FLAC

One-dimensional site response analyses were performed using the commercial finite difference program FLAC (Fast Analysis of Continua) (Itasca, 2016). One-dimensional site response was modeled with a single column of 2.5-foot square zones. Analyses were performed for the three idealized profiles shown on **Figure G.2-6**. The water table was modeled at the base of the fill for all profiles. Analyses were performed using the user defined constitutive models MRDF (modulus reduction and damping factor hysteretic model, Hashash et al., 2010) and PM4Sand (Boulanger and Ziotopoulou, 2017). MRDF was used to model the fill and YBM, and PM4Sand was used to model the liquefiable, saturated YBM Sand in profile P2. Analyses were performed for each of the 10 scaled ground motion time histories (5 ground motion records, 2 components) developed in the previous section.

For dynamic simulation, a quiet (absorbing) boundary was used at the base of the model and the lateral boundaries were attached (i.e., at a given elevation the left and right nodes displace together). A single elastic zone was included at the base of the model with properties representative of the competent soils underlying the YBM (i.e., V_{s30} of 860 ft/s). Outcrop ground motions were input at the base of the model (at the quiet boundary) as shear stress time histories. Shear stress time histories were computed from outcrop acceleration time histories by

integrating to obtain velocity and multiplying by twice the competent soil density times the competent soil V_s per the compliant base procedure proposed by Mejia and Dawson (2006).

Constitutive Calibration and Input Parameters

The bases for constitutive model calibration and input parameters are summarized in **Table G.6**. YBM shear wave velocity was modeled using the idealization shown on **Figure G.2-3**. Shear wave velocity in the fill and YBM Sand was modeled based on correlation to SPT blow count. Representative $(N_1)_{60cs}$ values of 17 and 12 were used to model the fill and YBM Sand, respectively. These $(N_1)_{60cs}$ values correspond to $V_{s1} = 586$ ft/s in the fill (i.e., V_s ranges from about 300 to 500 ft/s in the fill) and $V_{s1} = 544$ ft/s in the YBM Sand (i.e., V_s of about 550 ft/s in the YBM Sand).

Target empirical shear modulus reduction (G/G_{max}) and material damping relationships are summarized in **Table G.6**. In general, the degree to which the target relationships are represented by the calibrated models depends on the model (i.e., MRDF vs. PM4Sand) and the calibration procedure. For MRDF, fitting parameters can be selected to produce near exact matches with target shear modulus reduction and damping curves, however, such calibrations may underpredict or overpredict shear strength depending on the small-strain stiffness (G). For site response analyses, the relative importance of matching these behaviors (i.e., empirical G/G_{max} and shear strength) depends on the strain-level of interest and is problem dependent. Soft clays at the project site are expected to develop large shear strains for the MCE_R level of shaking, hence MRDF was calibrated to honor the idealized undrained shear strength profile shown on **Figure G.2-4**; a dynamic multiplier of 1.4 was applied to these idealized strengths to account for strain-rate effects. This was done following the procedure described by Hashash et al. (2010) where G/G_{max} values for shear strains greater than 0.1% are adjusted to achieve the desired shear strength. For PM4Sand primary input parameters were correlated to $(N_1)_{60cs}$ as described by Boulanger and Ziotopoulou (2017); all secondary input parameters used default values. Boulanger and Ziotopoulou (2017) demonstrate reasonable consistency with the EPRI (1993) modulus reduction and damping curves for a range of $(N_1)_{60cs}$ and effective overburden pressures.

Lastly, the PM4Sand contraction rate parameter was calibrated based on $(N_1)_{60cs}$ and the Idriss and Boulanger (2008) SPT-based liquefaction triggering correlation.

Table G.6: Constitutive Model Calibration Basis

Strata	Constitutive Model	Shear wave velocity, V_s	Basis for MRDF Strength	G/G_{max} and Damping Ratio Curve Source(s)
Fill	MRDF	$V_{s1} = 85[(N_1)_{60} + 2.5]^{0.25}$ m/s (Boulanger and Ziotopoulou, 2017)	Bolton (1986) strength-dilatancy relationship for plane strain ($\phi'_{cv} = 33^\circ$)	EPRI (1993)
YBM	MRDF	$V_s = 310$ ft/s at 10 ft depth Increasing at 5 ft/s/ft (Figure G.2-3)	Figure G.2-4 with 1.4 dynamic multiplier	Fugro (2007, 2020)
YBM Sand	PM4Sand	$V_{s1} = 85[(N_1)_{60} + 2.5]^{0.25}$ m/s (Boulanger and Ziotopoulou, 2017)	N/A	EPRI (1993)

Verification of Modelling Approach

To verify the FLAC modeling approach (i.e., the numerical platform, application of earthquake loading, MRDF constitutive model implementation, etc.), a subset of analyses was performed using both FLAC and DEEPSOIL (Hashash et al., 2017). Comparisons between FLAC and DEEPSOIL were made for profile P1 for two levels of shaking (the MCE_R and a smaller level of shaking with $PGA \approx 0.45$ g). Comparisons of results obtained from the two analysis platforms showed near identical surface response spectra, stress-strain responses, and profiles of maximum shear strain, PGA, and maximum shear stress. The FLAC modelling approach was adopted for all other analyses (including modelling of liquefiable YBM Sand in profile P2), as described in the preceding sections.

G.6.2 Results

Baseline Analyses

Results for one-dimensional site response analyses for profile P1, P2, and P3 are shown on **Figure G.6-1** and **Figure G.6-2**. Profiles of absolute maximum shear strain and PGA are shown on **Figure G.6-1**. The thin lines are for individual ground motions and the thick lines are mean responses per profile. Overall, large shear strains develop in the YBM at the MCE_R level of shaking. Surface response spectra and amplification ratios are shown on **Figure G.6-2**. The amplification ratios were calculated as the ratio of the response spectra at the surface to the input response spectrum. The thin lines show responses for each ground motion time history and the thick lines show mean responses per idealized profile. Overall, there is little variation in the mean surface spectra for the three profiles analyzed. The shorter period (higher frequency) mean responses exhibit significant deamplification, whereas periods greater than approximately three seconds exhibit amplified responses. Yielding in the YBM deamplifies higher frequencies and effectively base isolates the soil column, hence there is little difference in the surface

response spectra for the three idealized profiles. For smaller levels of shaking, clear differences in the response of the three profiles is expected.

Figure G.6-3 shows the idealized amplification ratios developed based on the average amplification ratios from the site response analyses. The idealized amplification ratios consider variability on the soil stratigraphy and variability on ground motion time histories. However, sensitivity analyses conducted showed similar amplification ratios by considering variability in soil properties (YBM shear wave velocity and undrained shear strength).

Parametric Analyses

Parametric analyses were performed for profile P1 to evaluate the effect of lower bound YBM shear wave velocities and a range of YBM undrained shear strength idealizations on the site response. Overall, these parameter variations had little effect on the surface spectrum (for the same reasons discussed above). An upper bound undrained shear strength profile caused the most significant change to the surface spectrum, slightly increasing the amplification for periods between about 1.5 to 4 seconds while decreasing the amplification for periods greater than approximately 4 seconds. Even with an upper bound undrained shear strength, large shear strains developed throughout the YBM (mean absolute maximum shear strains were on the order of 10 to 20 percent).

G.7 Design Response Spectra at the Ground Surface

Figure G.7-1 presents the development of the site-specific MCE_R and design response spectra for the ground surface. The MCE_R response spectrum from the site response analyses is calculated as the site-specific MCE_R at the base of the YBM (input to the site response analyses) multiplied by the idealized amplification ratios presented on **Figure G.6-3**. The site-specific MCE_R spectrum is the maximum of: 1) MCE_R response spectrum from the site response analyses, and 2) 150 percent of the design response spectrum. Following ASCE 7-16, the design response spectrum was calculated as the maximum of $2/3$ of the site-specific MCE_R and the lower limit specified by ASCE 7-16 (80 percent of the general spectrum for Site Class E, using modified F_a and F_v values provided in Section 21.3 of ASCE 7-16). The transition period from constant velocity to constant displacement, T_L , required to calculate the lower limit, was estimated as 8 seconds using the USGS web service (<https://earthquake.usgs.gov/ws/designmaps/asce7-16.html>).

Table G.7 tabulates the spectral ordinates of the recommended site-specific MCE_R and design response spectra per ASCE 7-16 for the ground surface. The corresponding design acceleration parameters S_{MS} , S_{M1} , S_{DS} , and S_{D1} are tabulated in **Table G.8**.

Table G.7: MCE_R and Design Response Spectra per ASCE 7-16 at the Ground Surface, 5% Damping

Period (sec)	Horizontal Spectral Acceleration (g)		
	Site-Specific MCE _R	80% General Response Spectrum	Design Response Spectrum
0.01 (PGA)	0.584	0.389	0.389
0.03	0.639	0.426	0.426
0.05	0.694	0.463	0.463
0.075	0.763	0.508	0.508
0.1	0.831	0.554	0.554
0.15	0.969	0.646	0.646
0.2	1.11	0.738	0.738
0.25	1.24	0.829	0.829
0.3	1.38	0.921	0.921
0.304	1.39	0.927	0.927
0.4	1.39	0.927	0.927
0.5	1.39	0.927	0.927
0.75	1.39	0.927	0.927
1	1.39	0.927	0.927
1.5	1.39	0.927	0.927
1.52	1.39	0.927	0.927
2	1.06	0.704	0.704
3	0.827	0.469	0.551
4	0.733	0.352	0.489
5	0.561	0.282	0.374
7.5	0.282	0.188	0.188
8	0.264	0.176	0.176
10	0.169	0.113	0.113

Table G.8: Design Acceleration Parameters per ASCE 7-16 at the Ground Surface, 5% Damping

Parameter	Value
S _{MS}	1.39 g
S _{M1}	2.93 g
S _{DS}	0.927 g
S _{D1}	1.96 g

G.8 References

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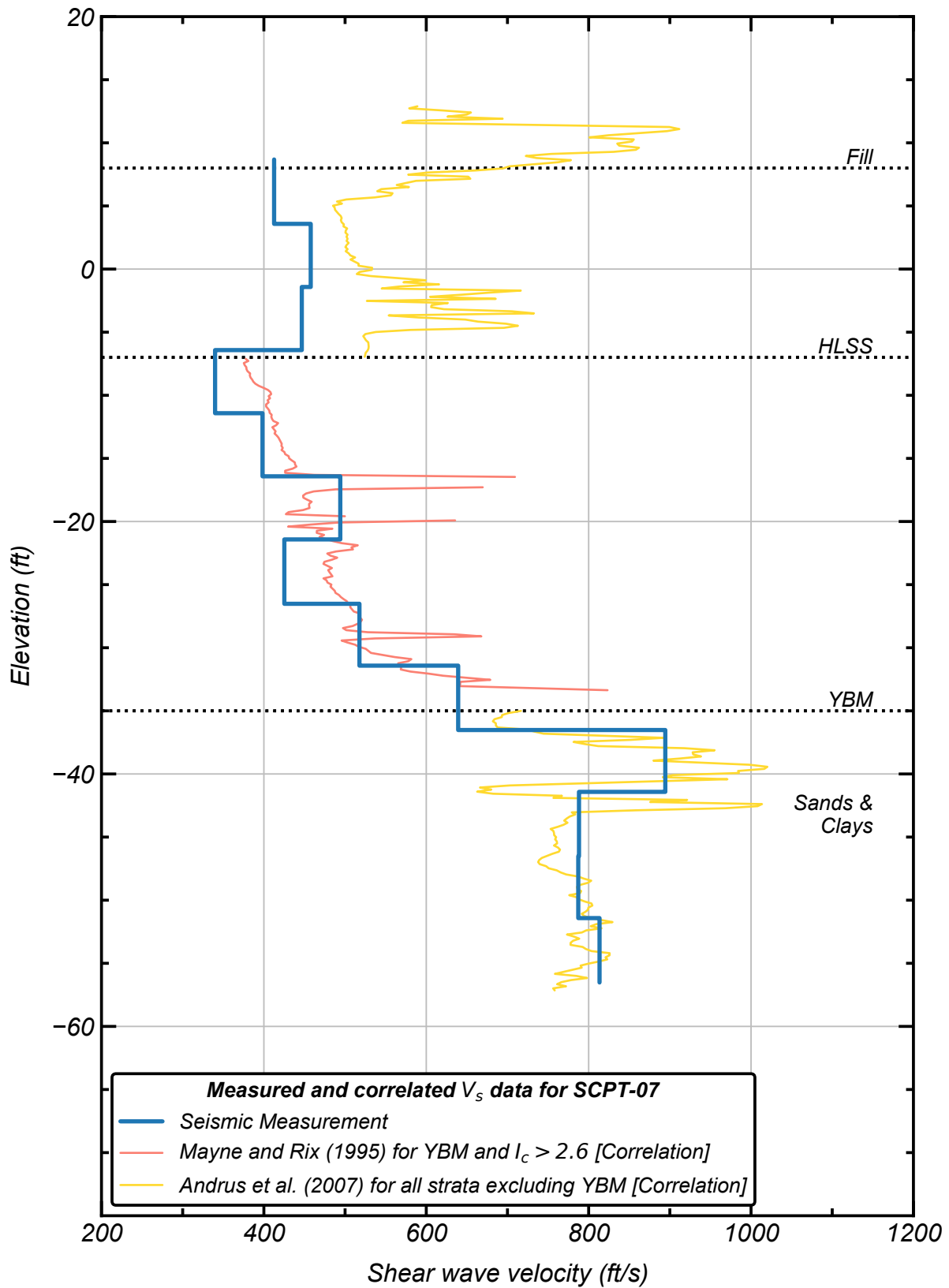
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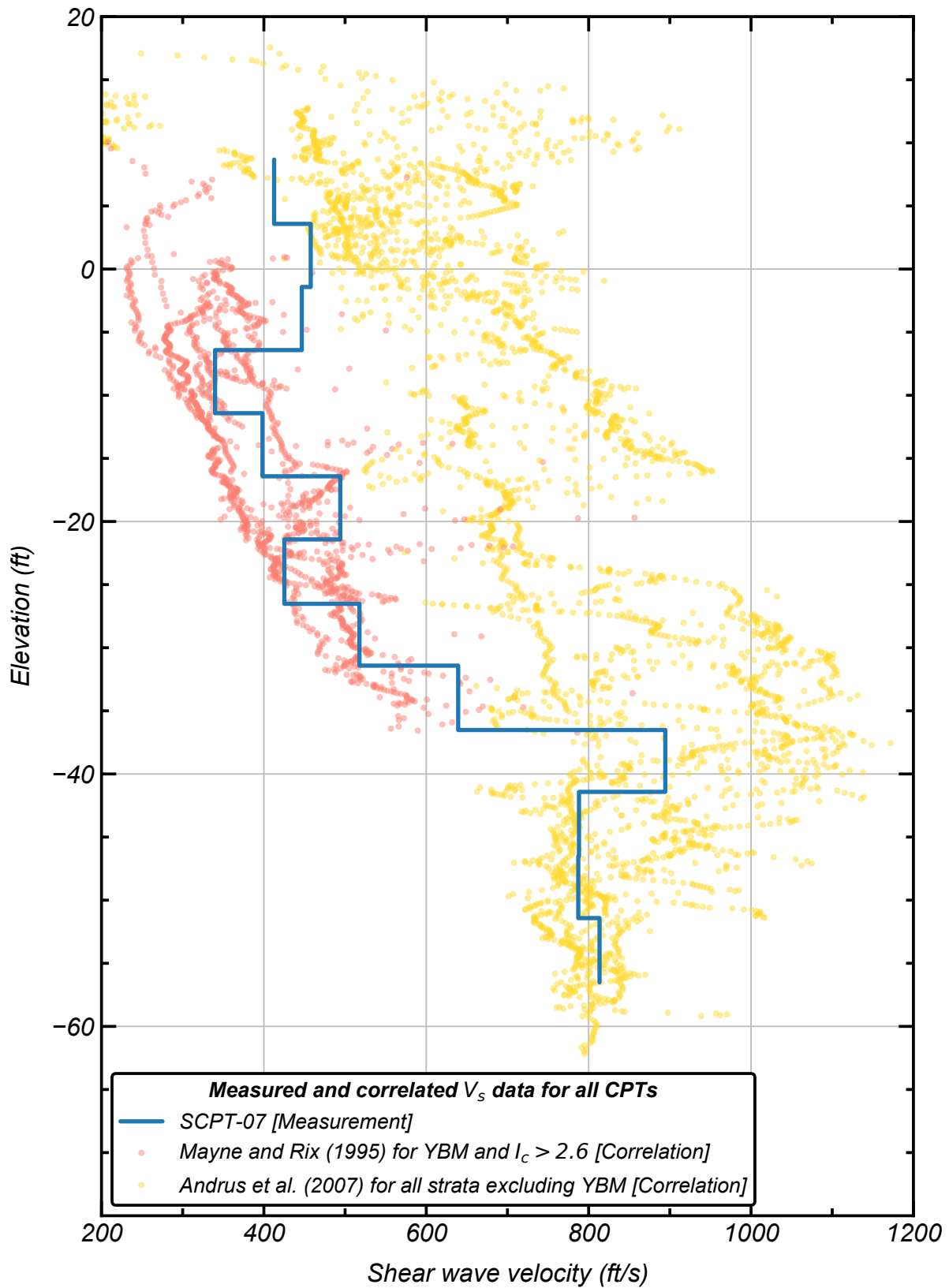
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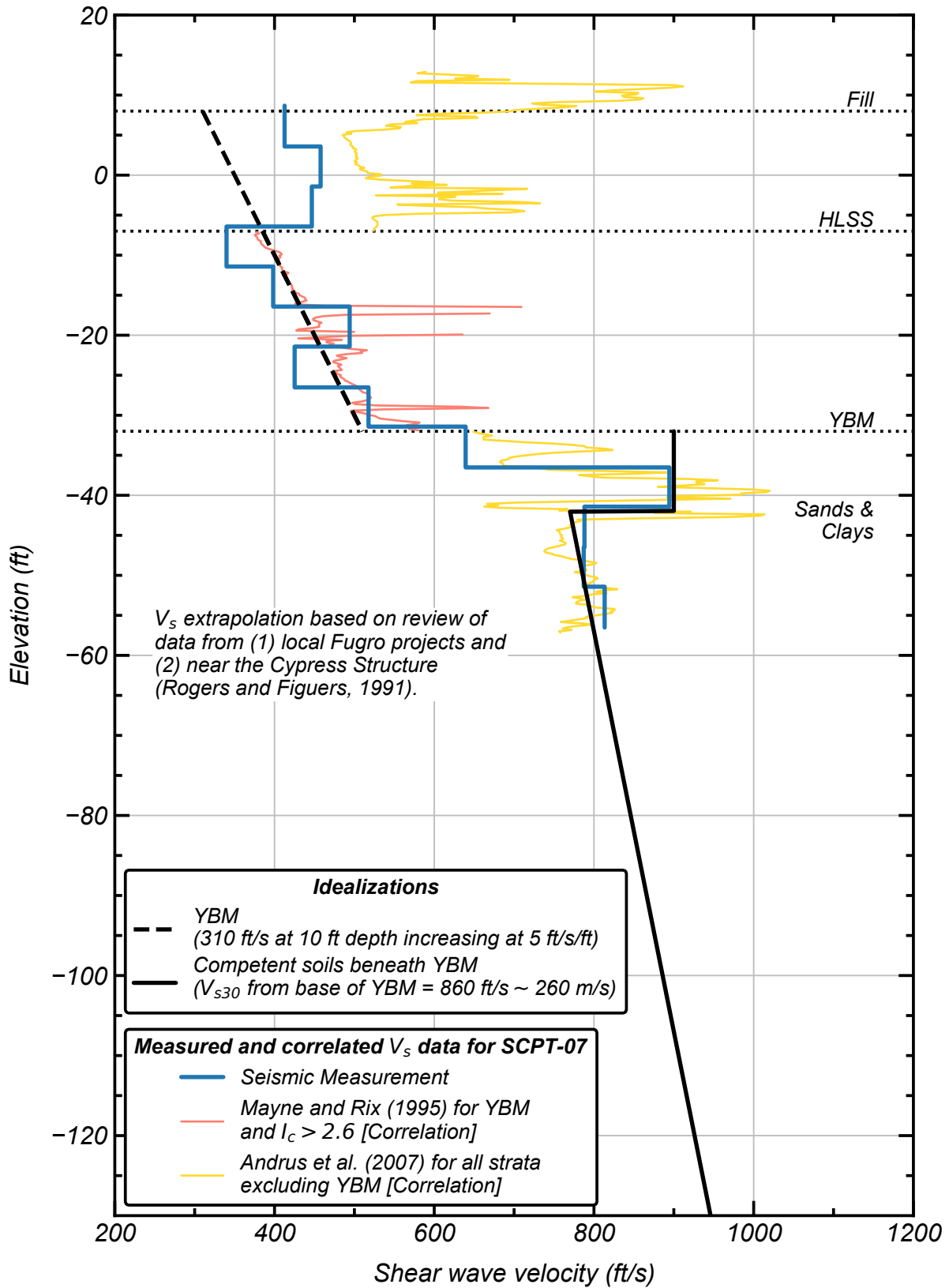
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Figure G.2-1: Measured and Correlated V_s Data for SCPT-07



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Figure G.2-2: Measured and Correlated V_s Data for All CPTs



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Figure G.2-3: Shear Wave Velocity Idealizations

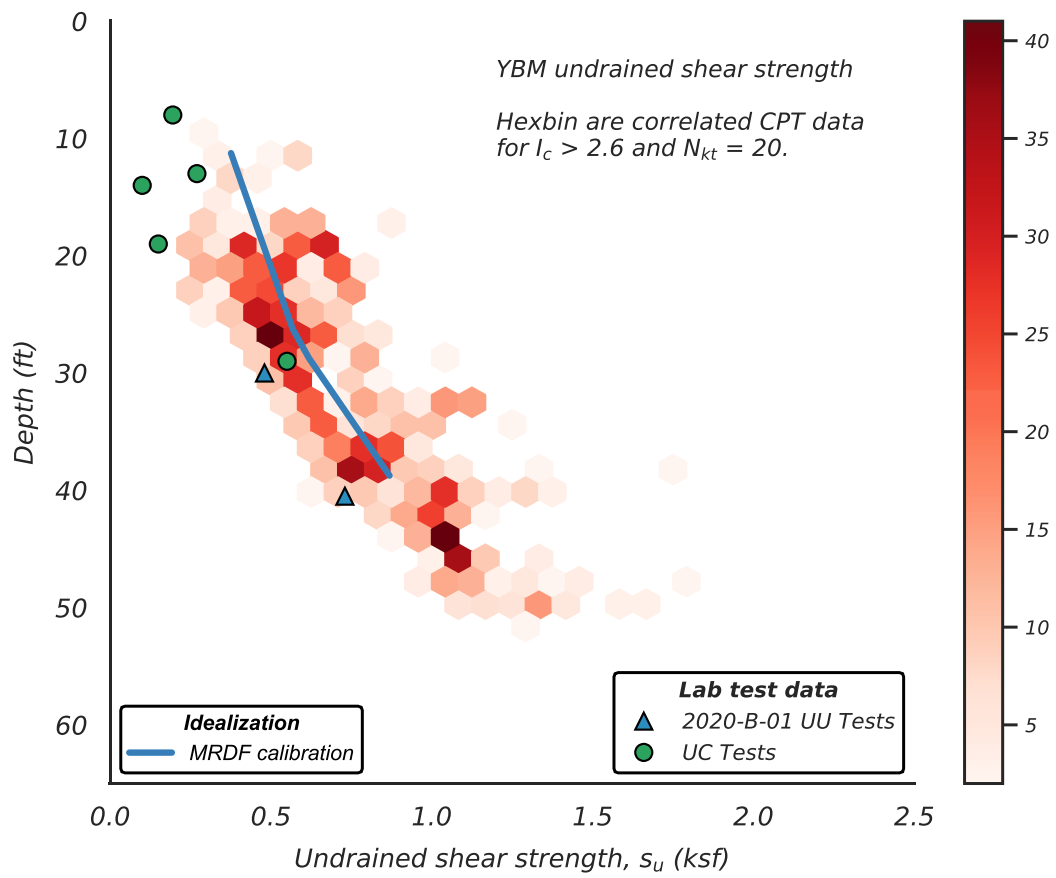


Figure G.2-4: YBM Undrained Shear Strength

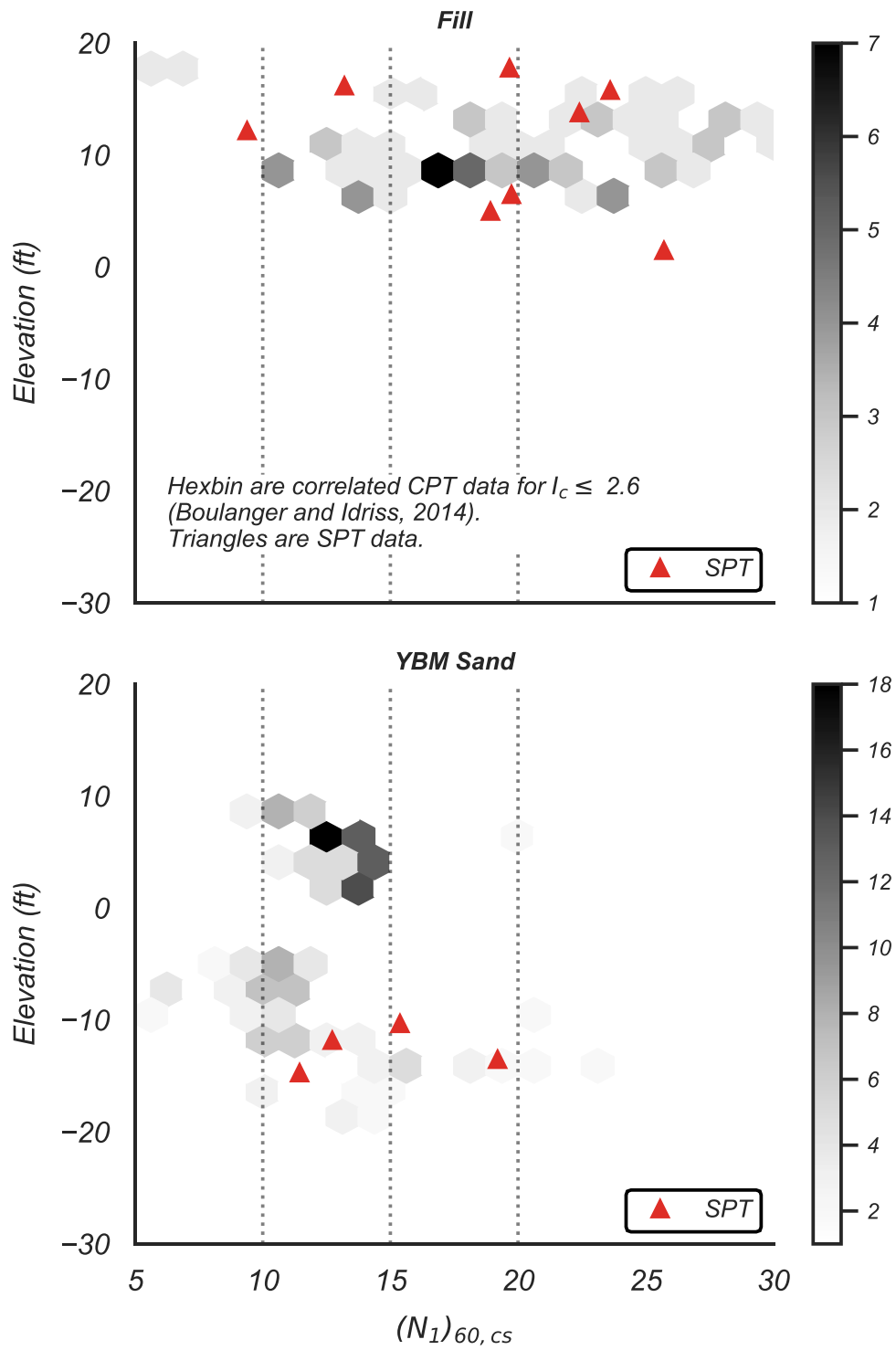


Figure G.2-5: Penetration Resistance (N160cs) vs. Elevation for Fill and YBM Sand

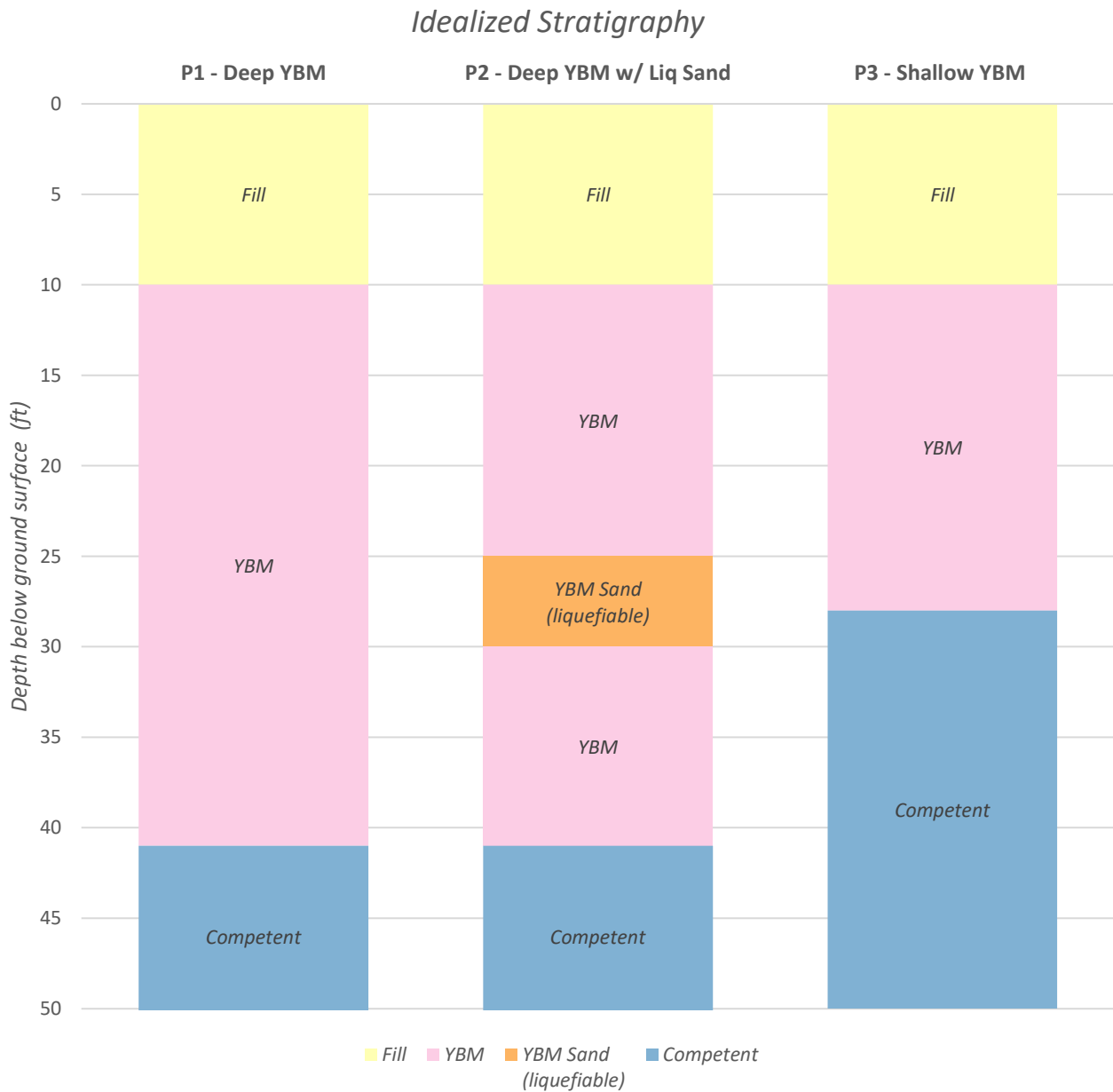


Figure G.2-6: Idealized Stratigraphy for 1D Site Response Analyses

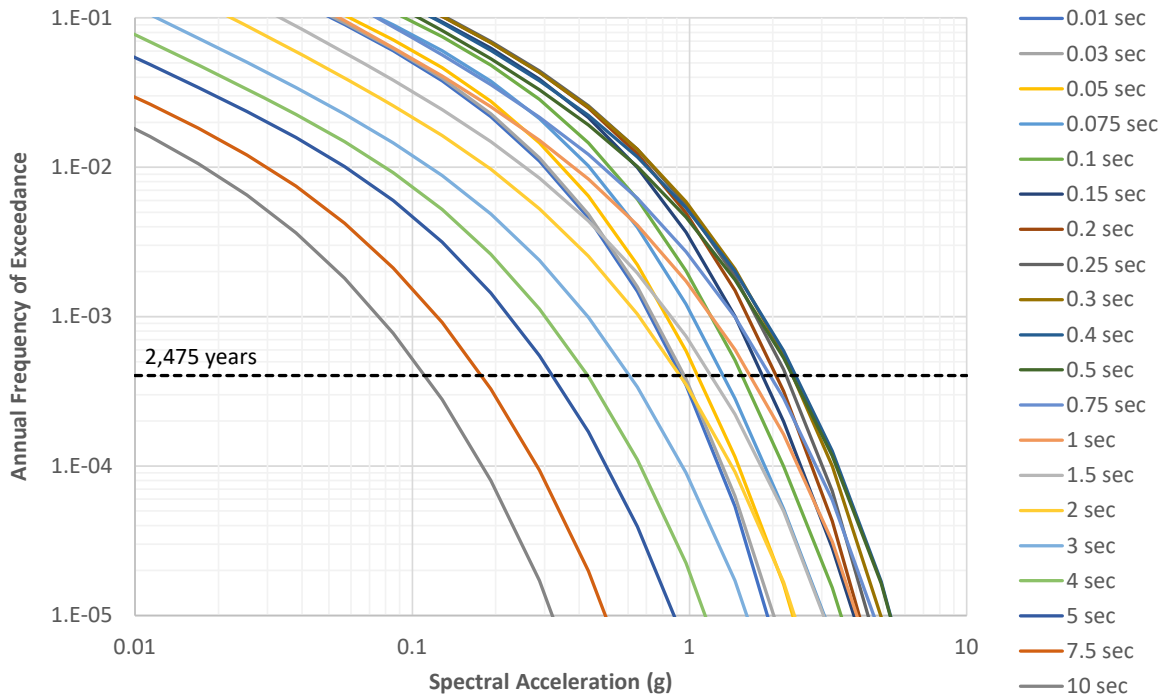


Figure G.3-1: Mean Annual Seismic Hazard Curves for Vs30 of 260 m/s (Base of YBM)

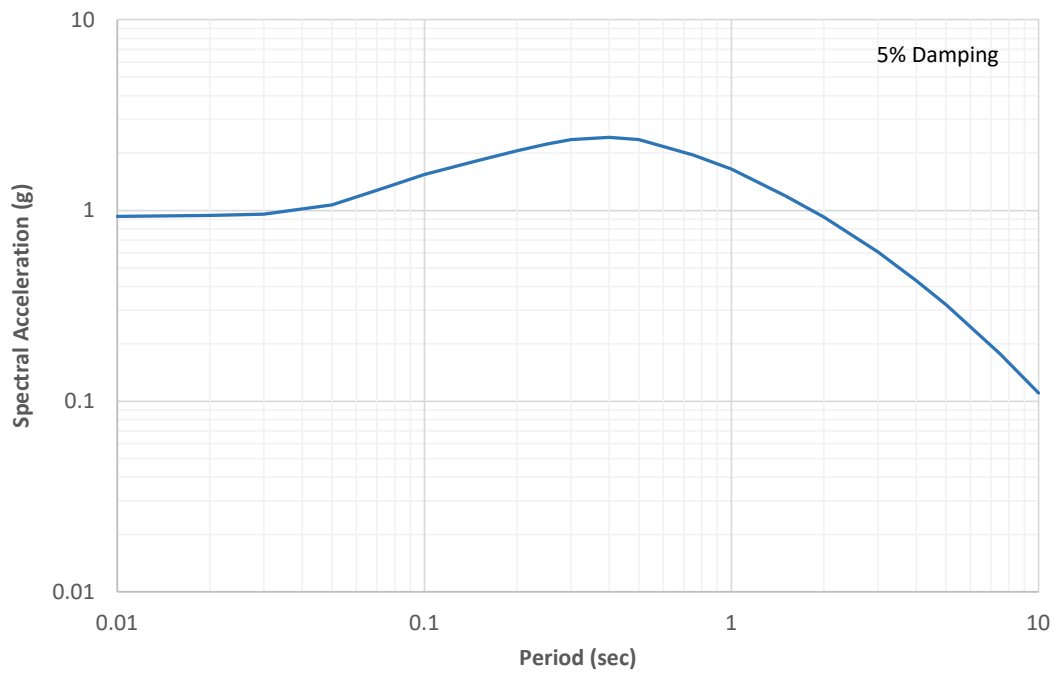


Figure G.3-2: Mean Horizontal Uniform Hazard Response Spectrum for a Return Period of 2,475 Years and Vs30 of 260 m/s (Base of YBM)

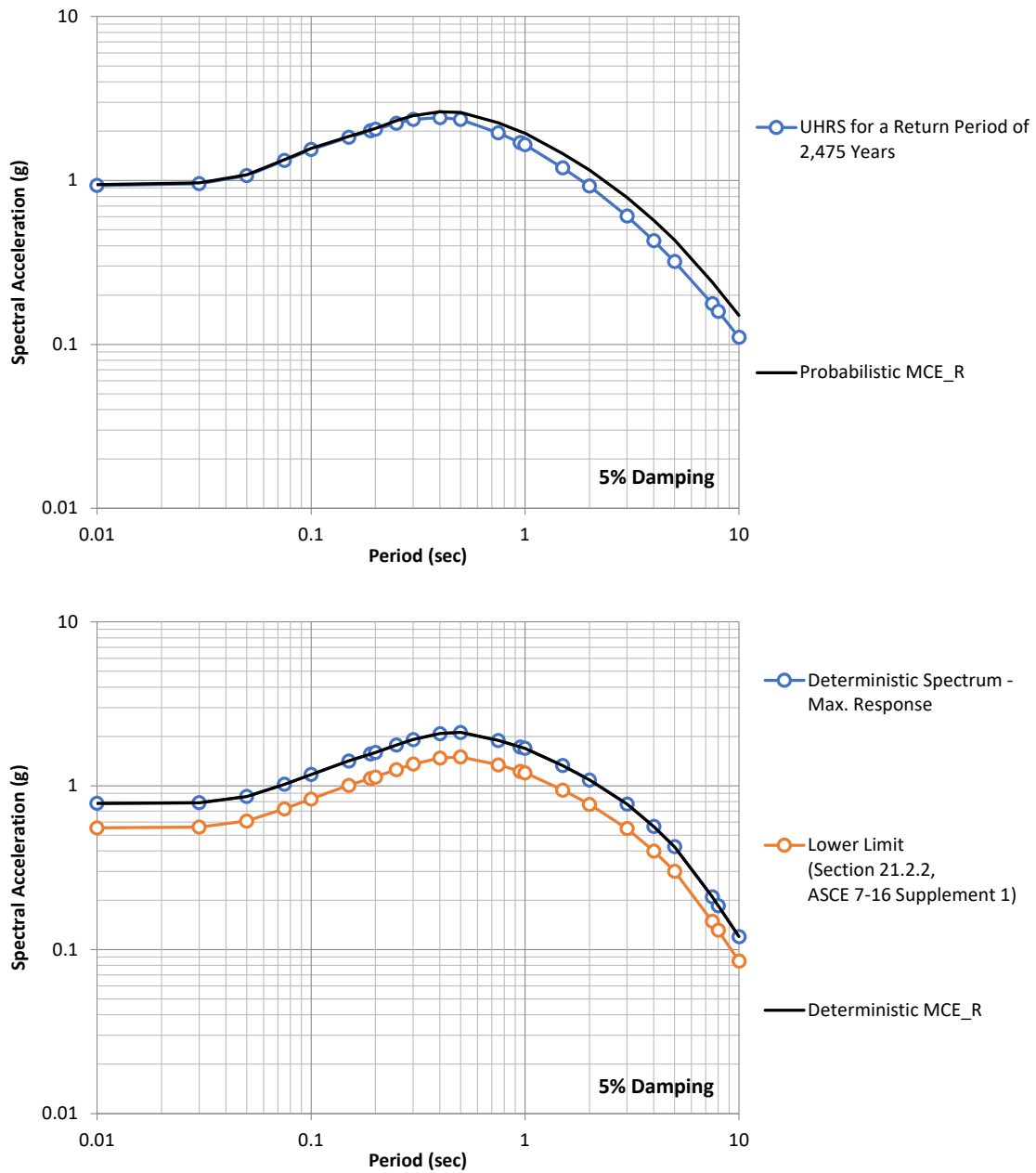


Figure G.4-1: Calculation of the Probabilistic and Deterministic Horizontal MCE_R Response Spectra per ASCE 7-16 for Vs30 of 260 m/s (Base of YBM)

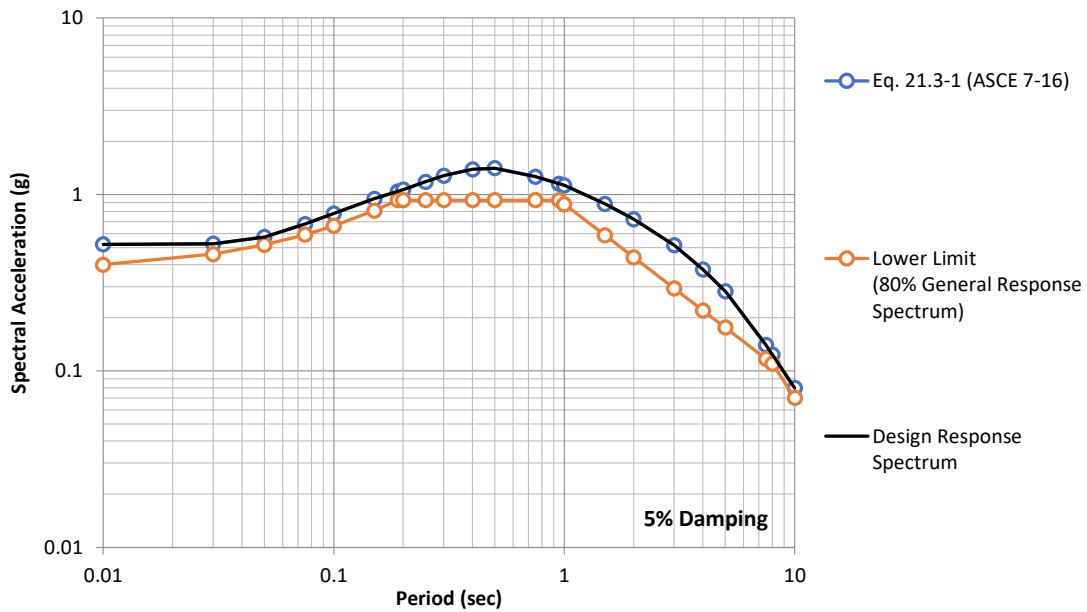
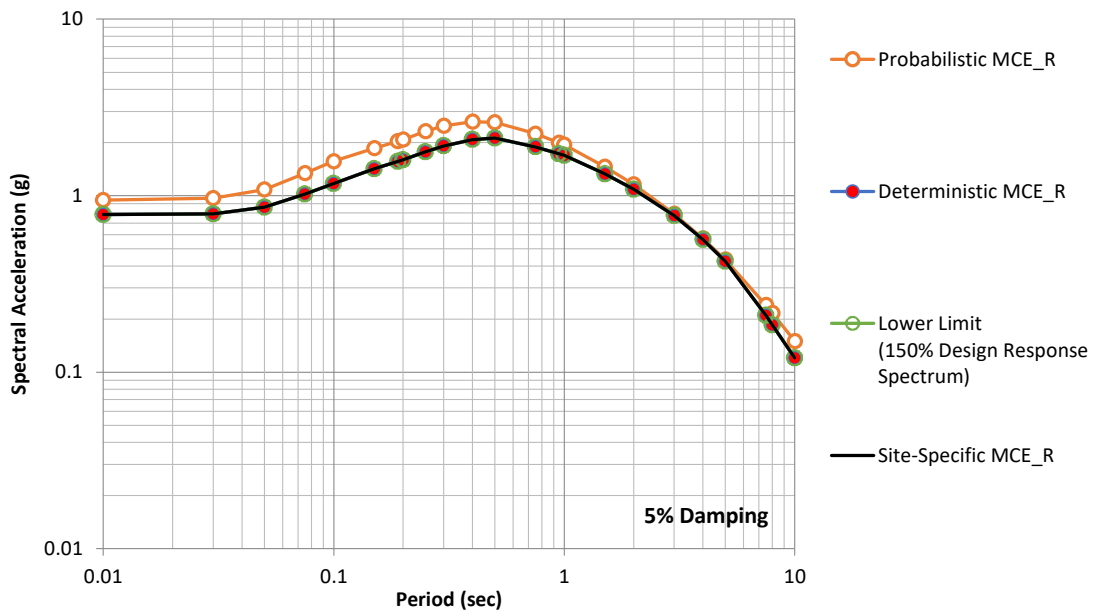


Figure G.4-2: Calculation of the Site-Specific Horizontal MCE_R and Design Response Spectra per ASCE 7-16 for Vs30 of 260 m/s (Base of YBM)

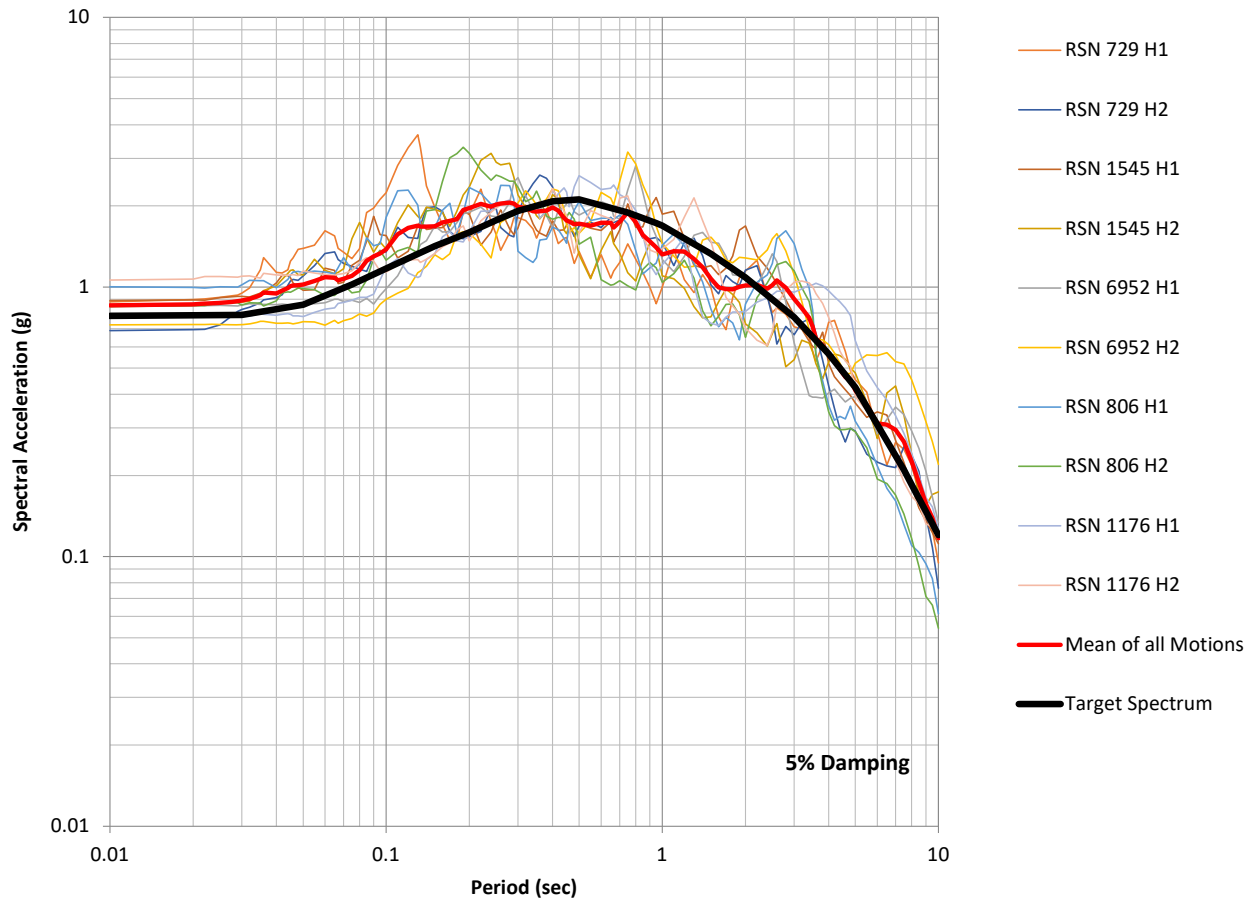
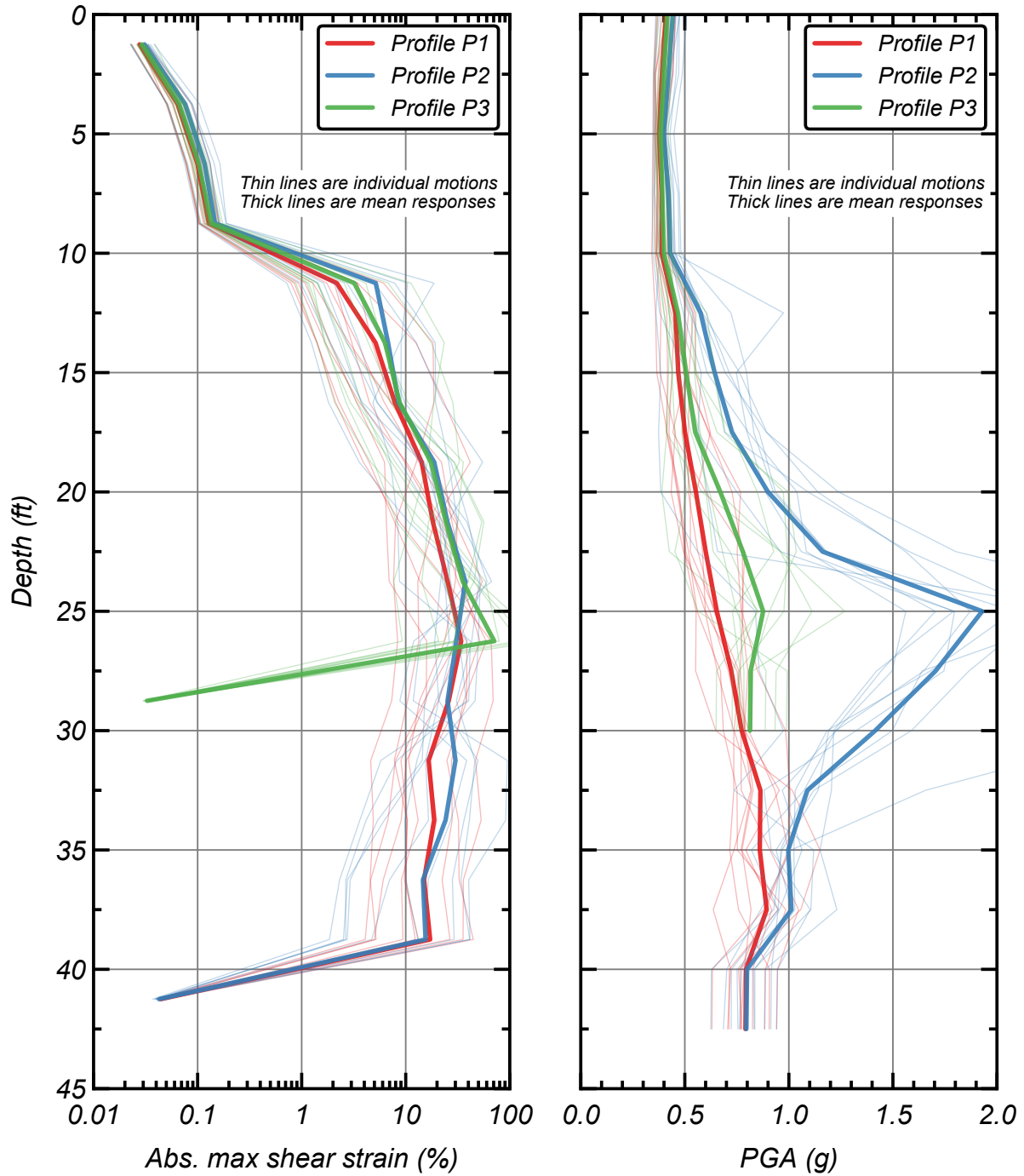
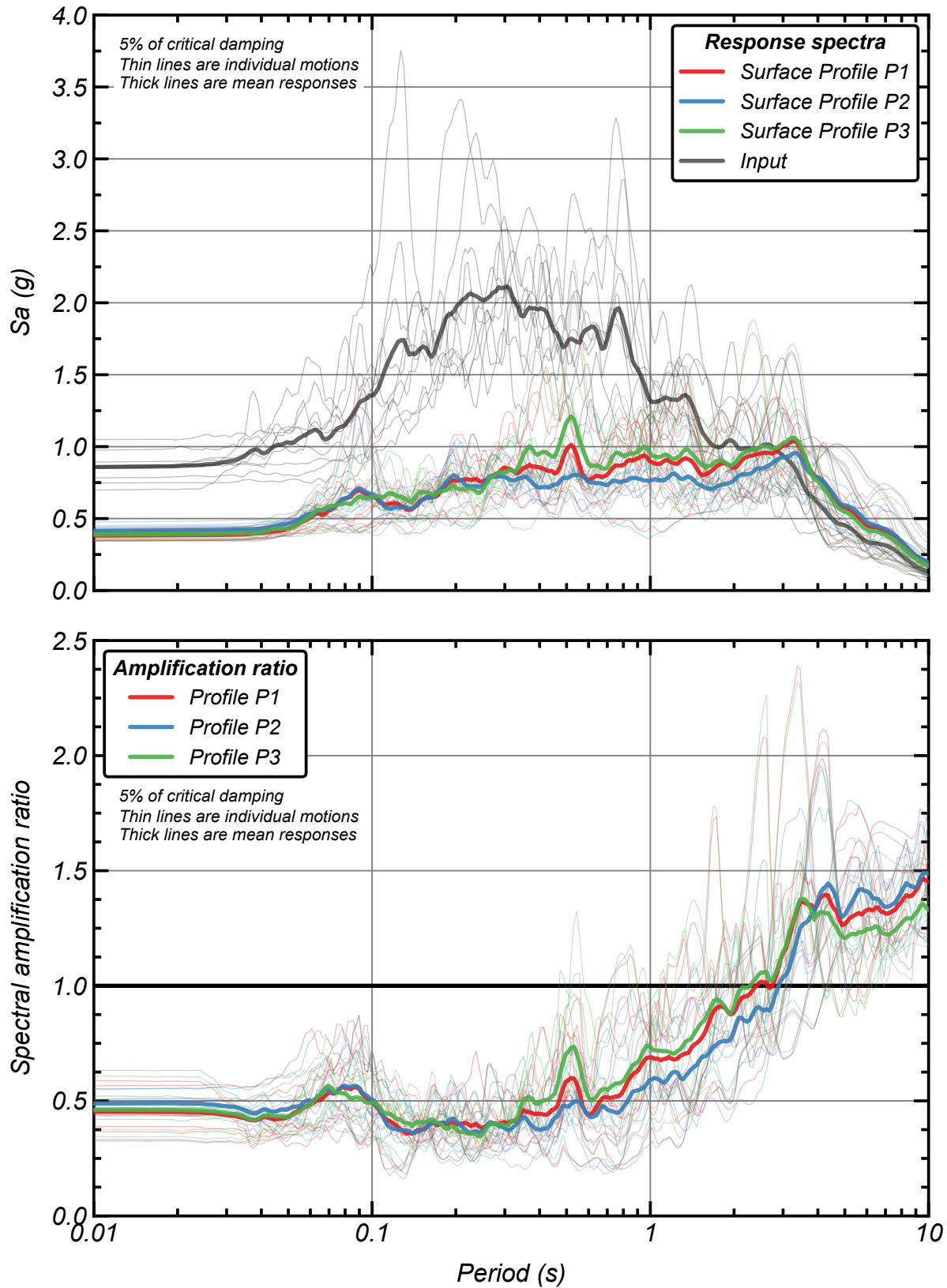


Figure G.5-1: Comparison of Target Response Spectrum (MCE_R), Mean of Scaled Response Spectra and Individual Scaled Ground Motions Response Spectra



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Figure G.6-1: Profiles of Absolute Maximum Shear Strain and PGA from 1D Site Response Analyses



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Figure G.6-2: Surface Response Spectra and Amplification Ratios from 1D Site Response Analyses

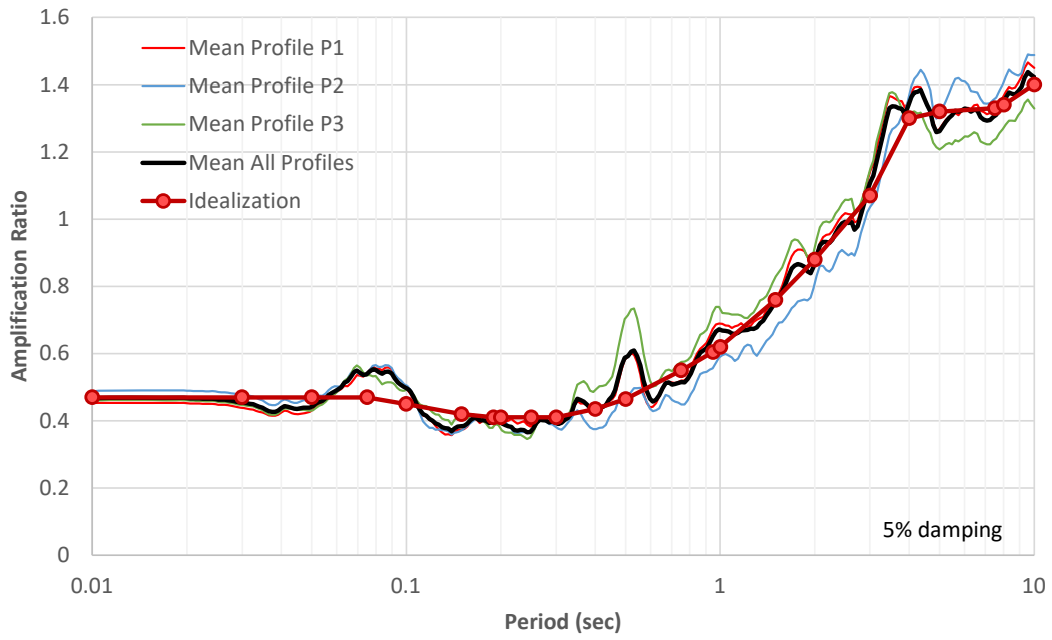


Figure G.6-3: Idealized Amplification Ratios

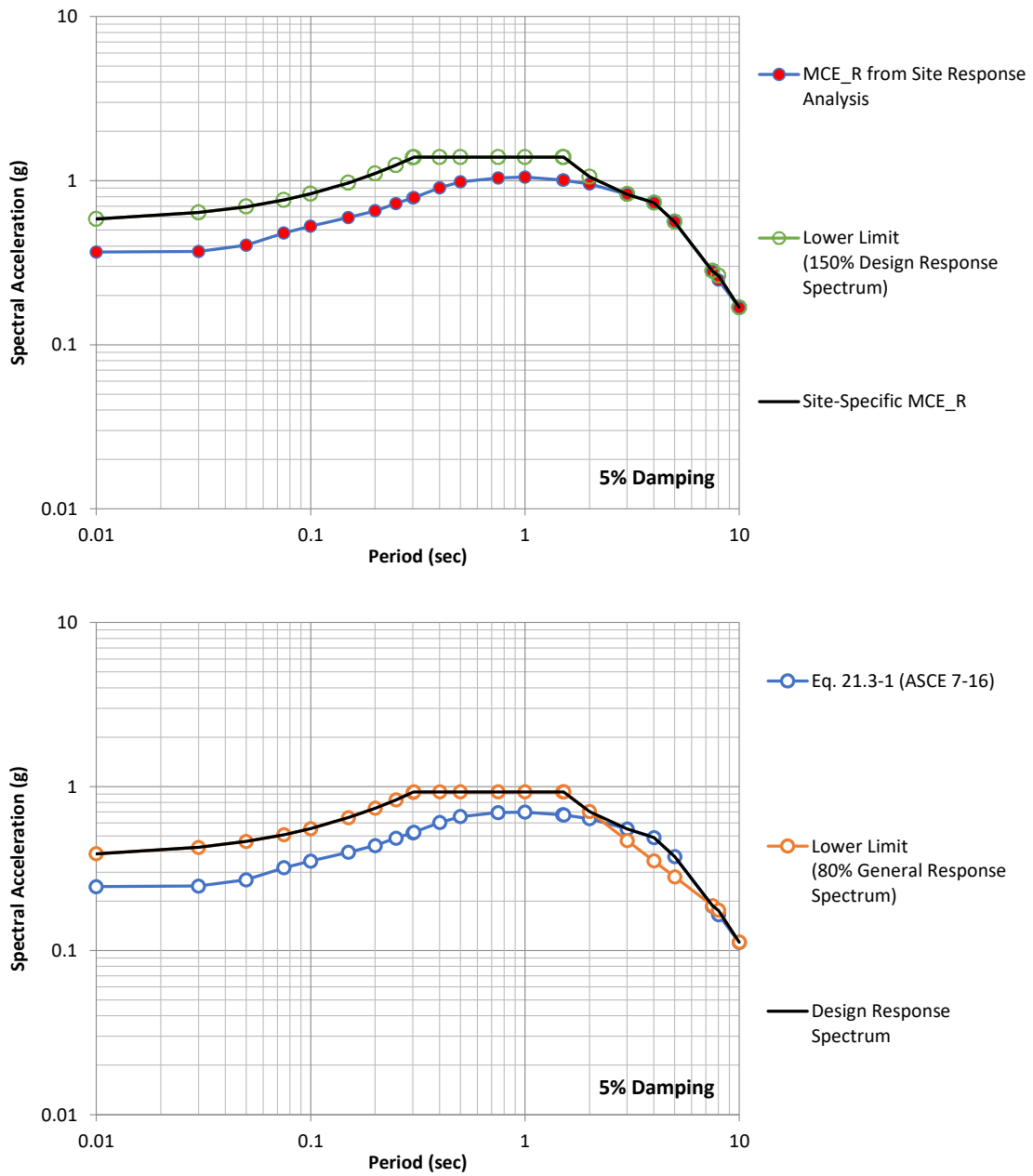


Figure G.7-1: Calculation of the Site-Specific Horizontal MCE_R and Design Response Spectra per ASCE 7-16 for the Ground Surface

Supplement H

LPILE Analyses

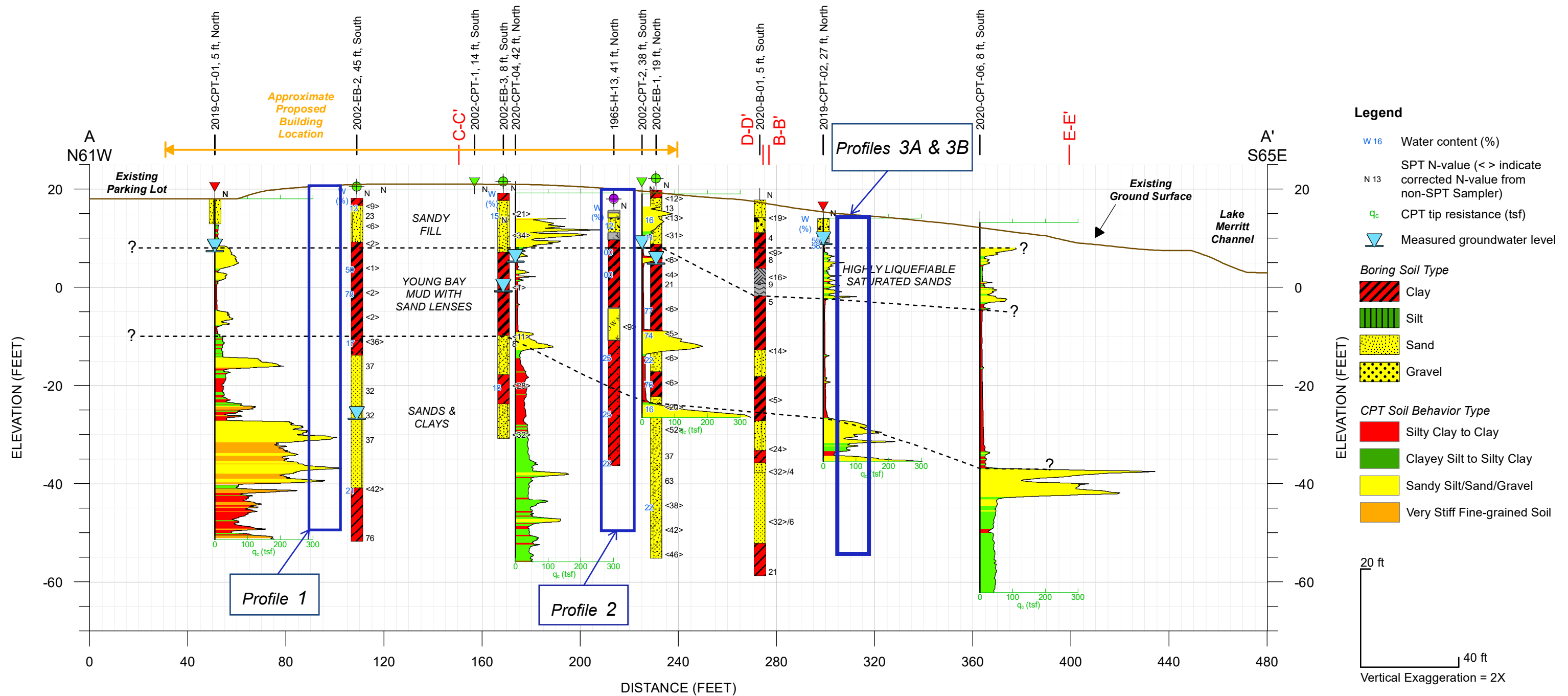


PLATE G-1: Profiles Along Cross Section A-A'



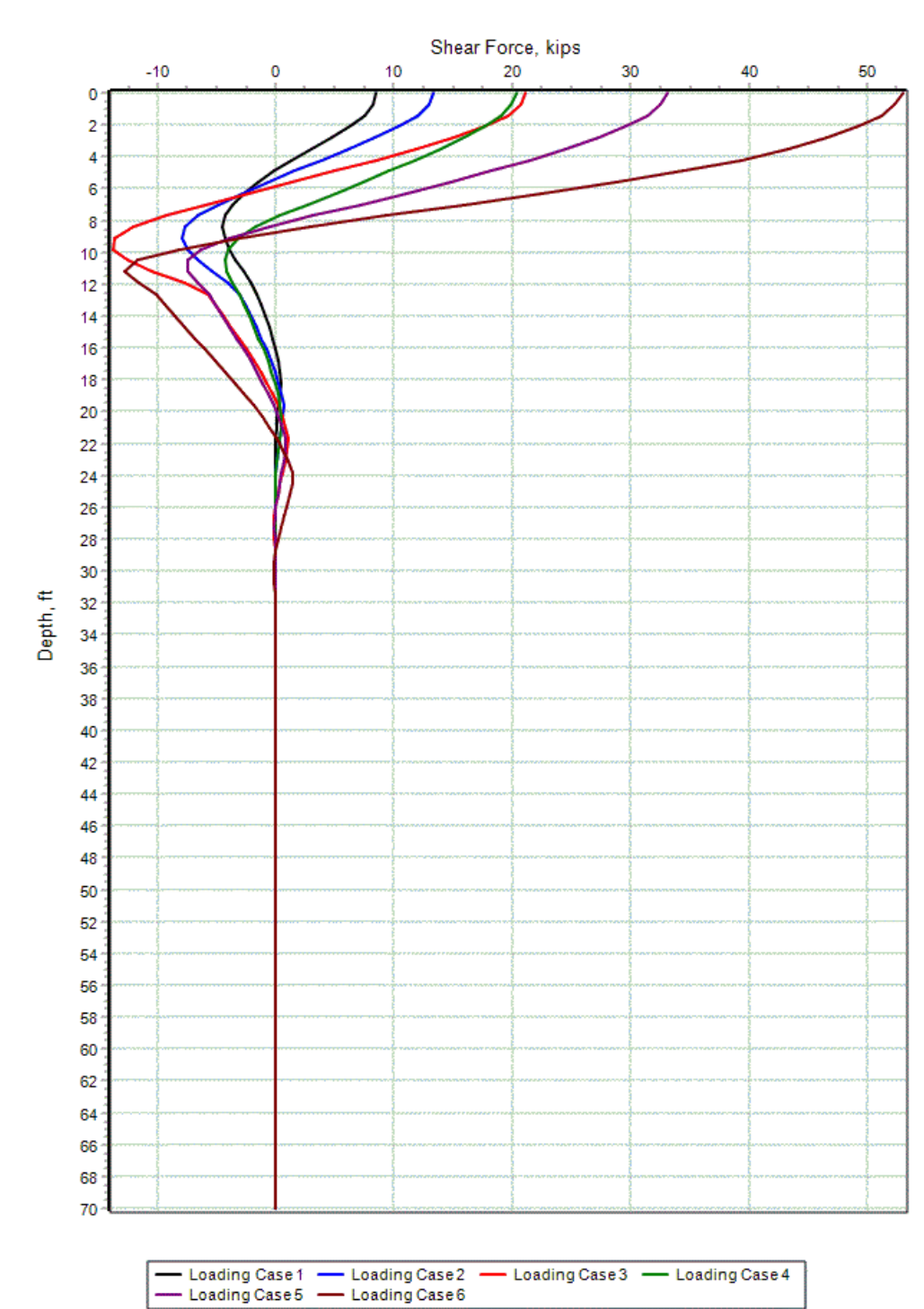
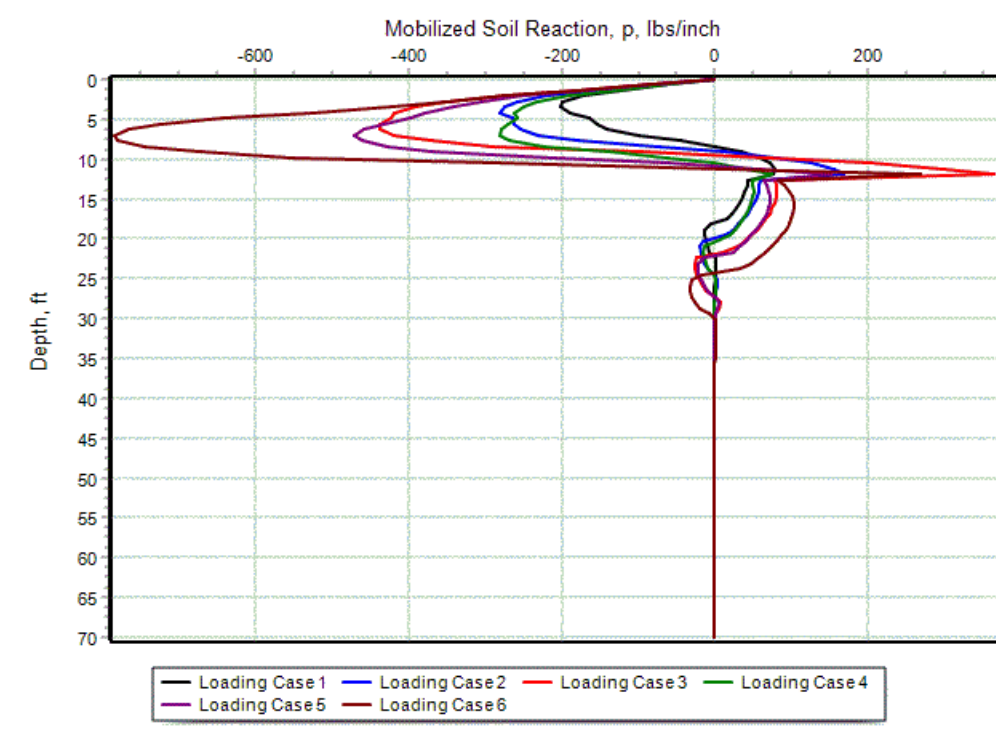
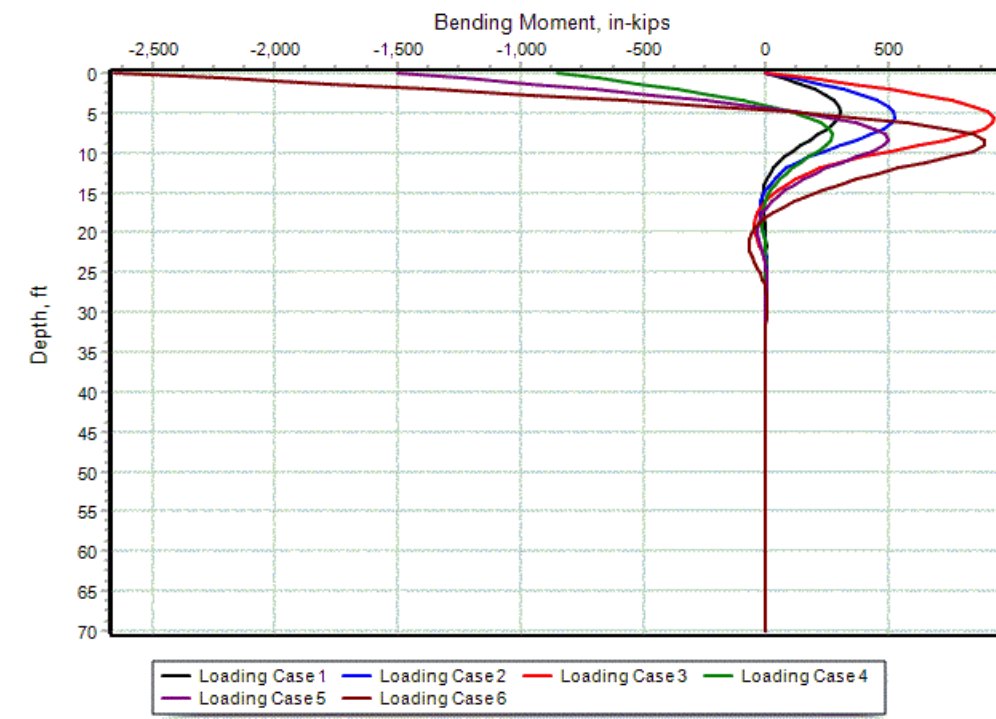
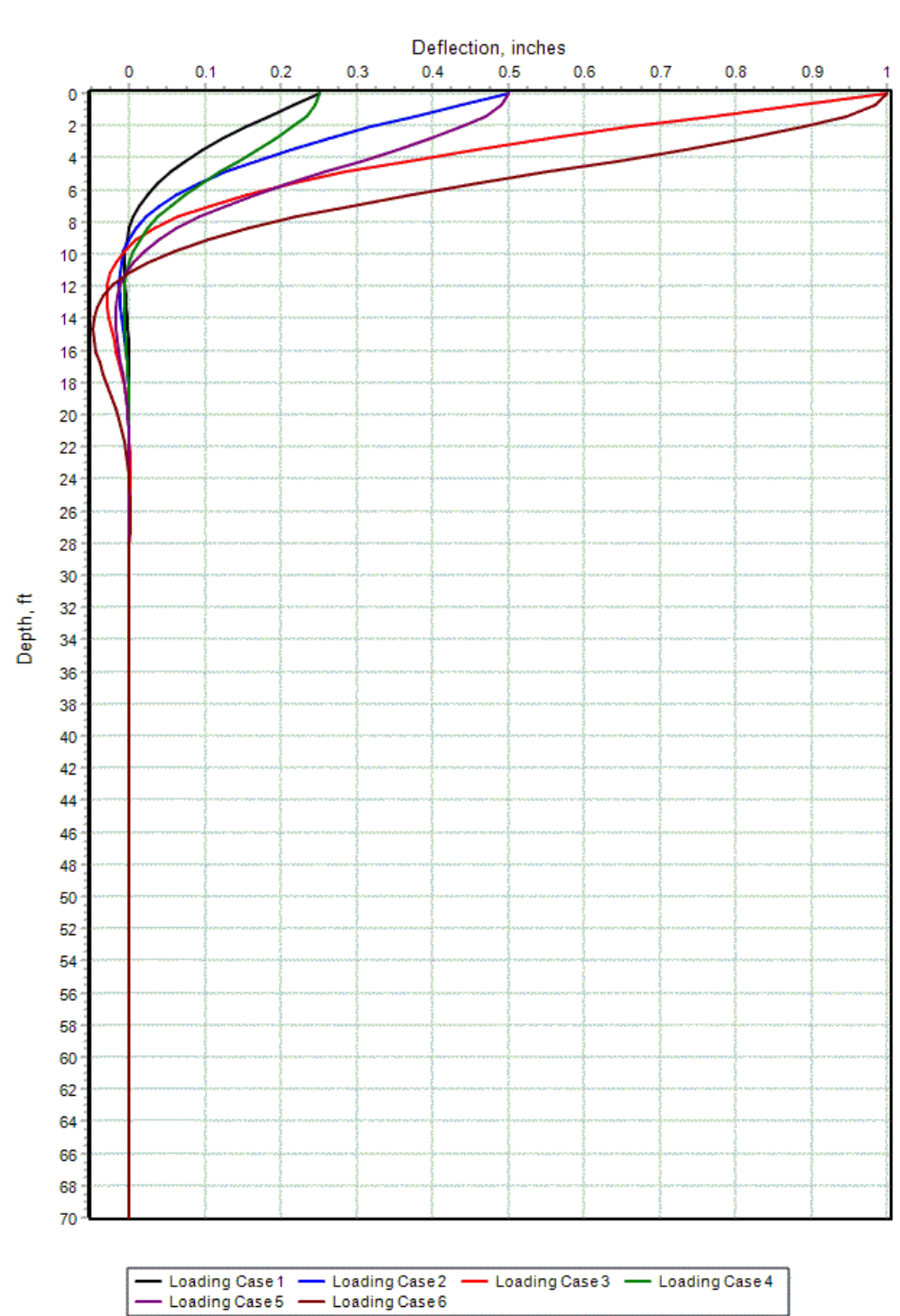


PLATE G-2: LPILE Results for Profile 1



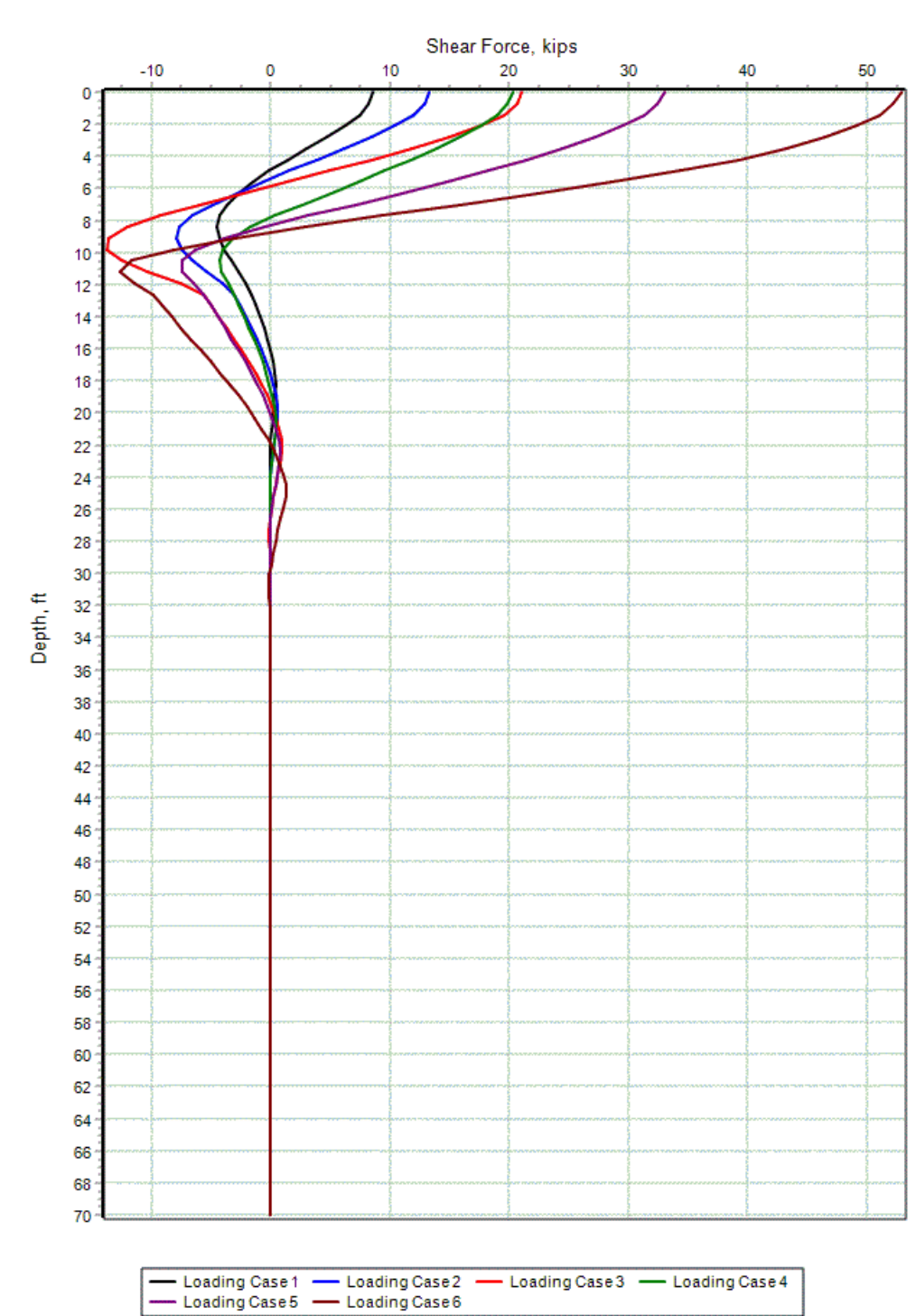
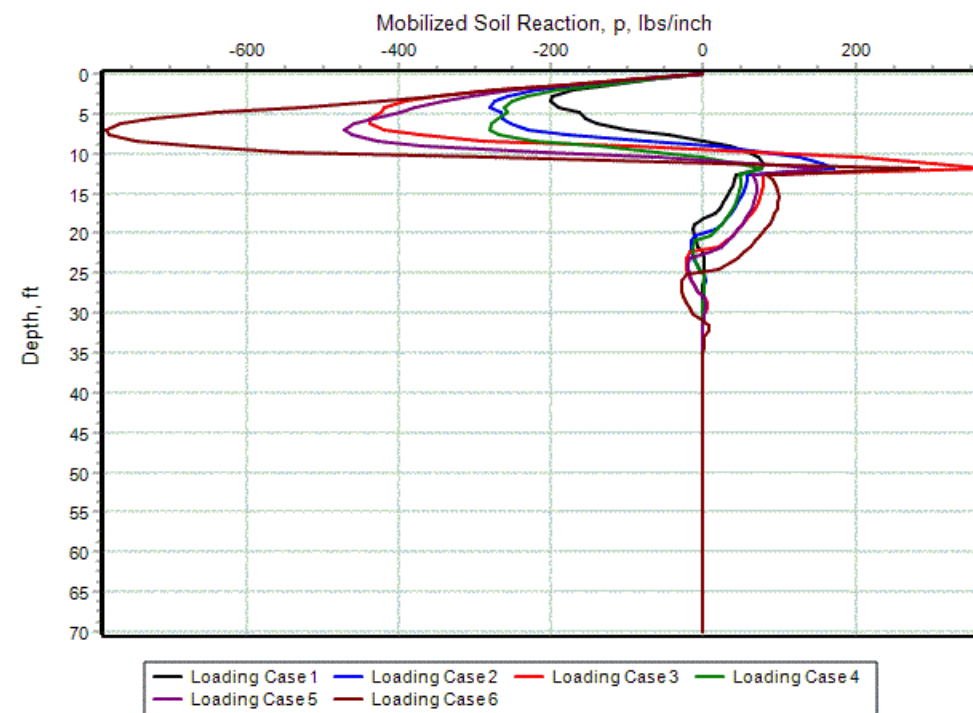
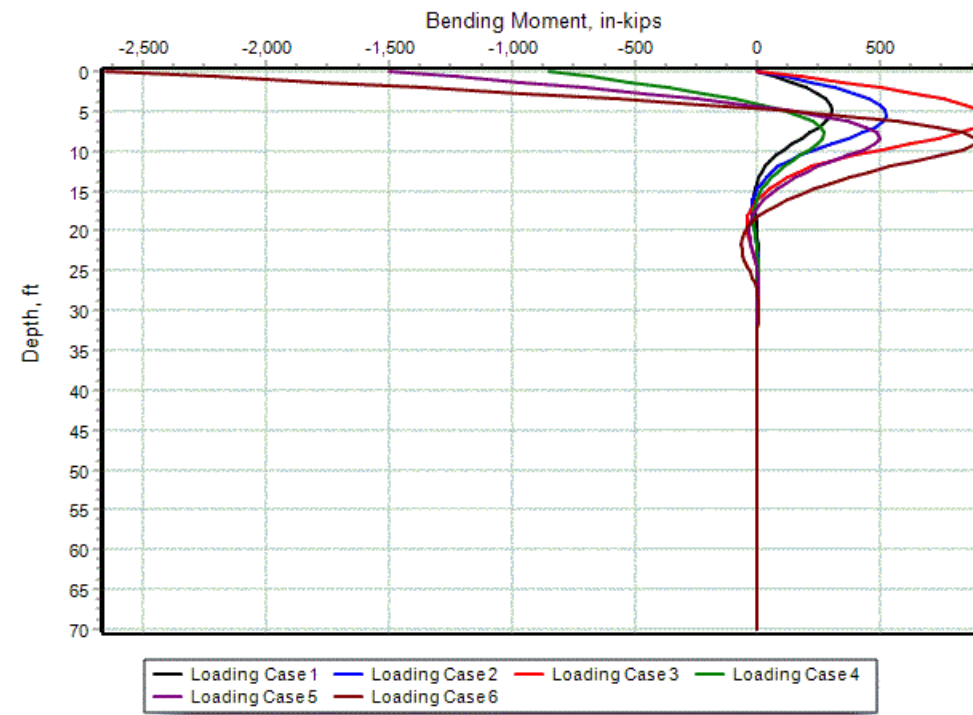
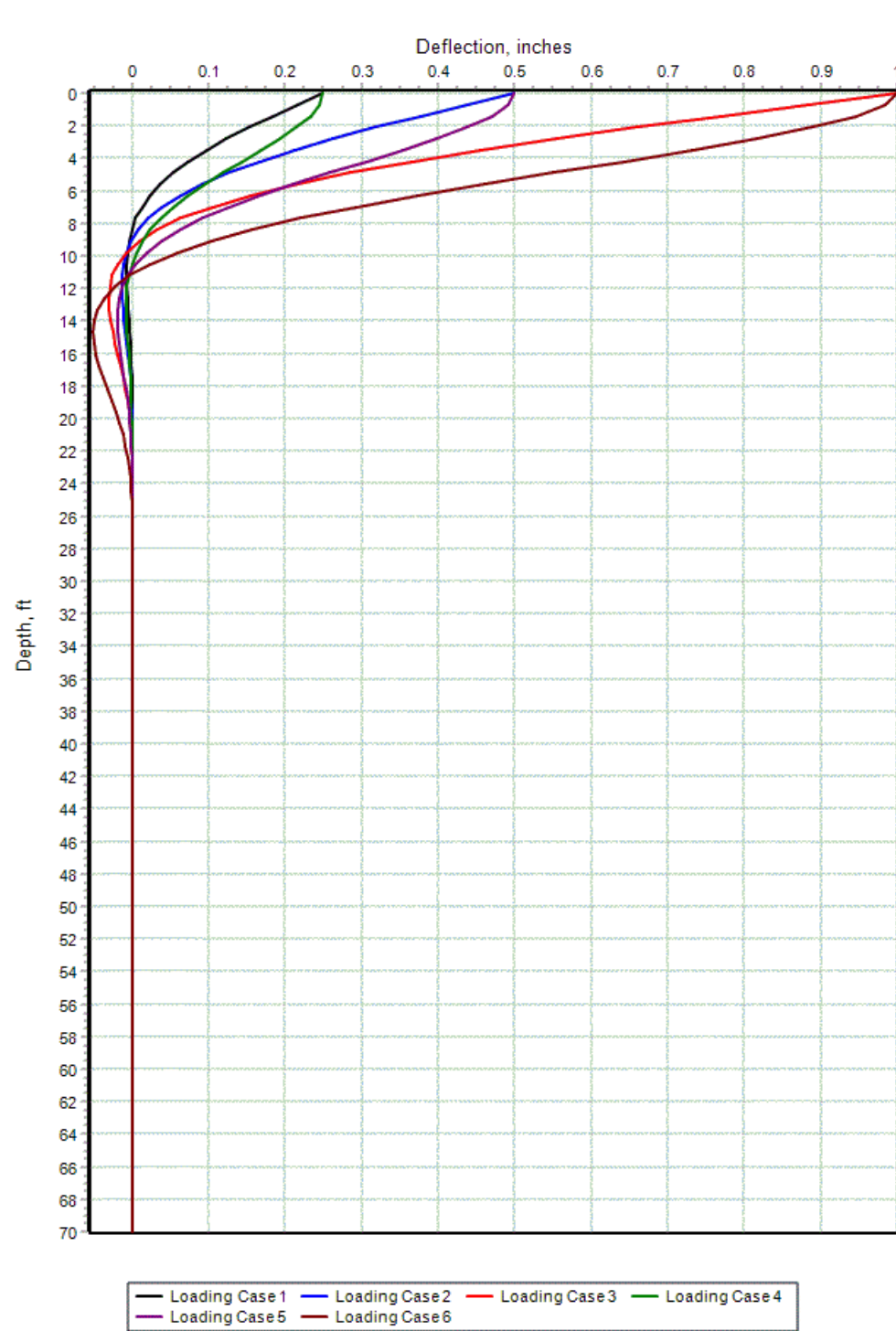


PLATE G-3: LPILE Results for Profile 2

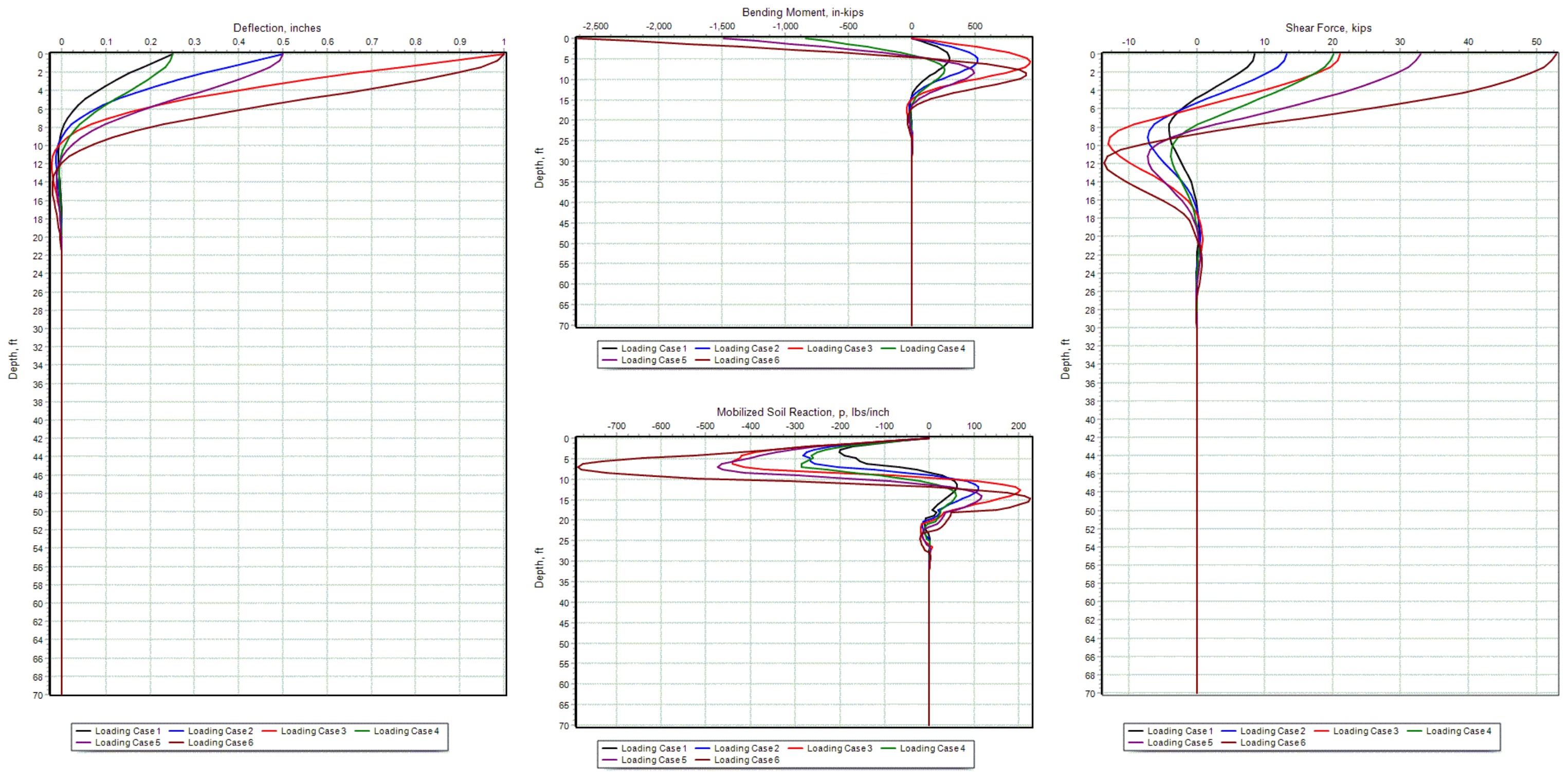


PLATE G-4: LPILE Results for Profile 3A

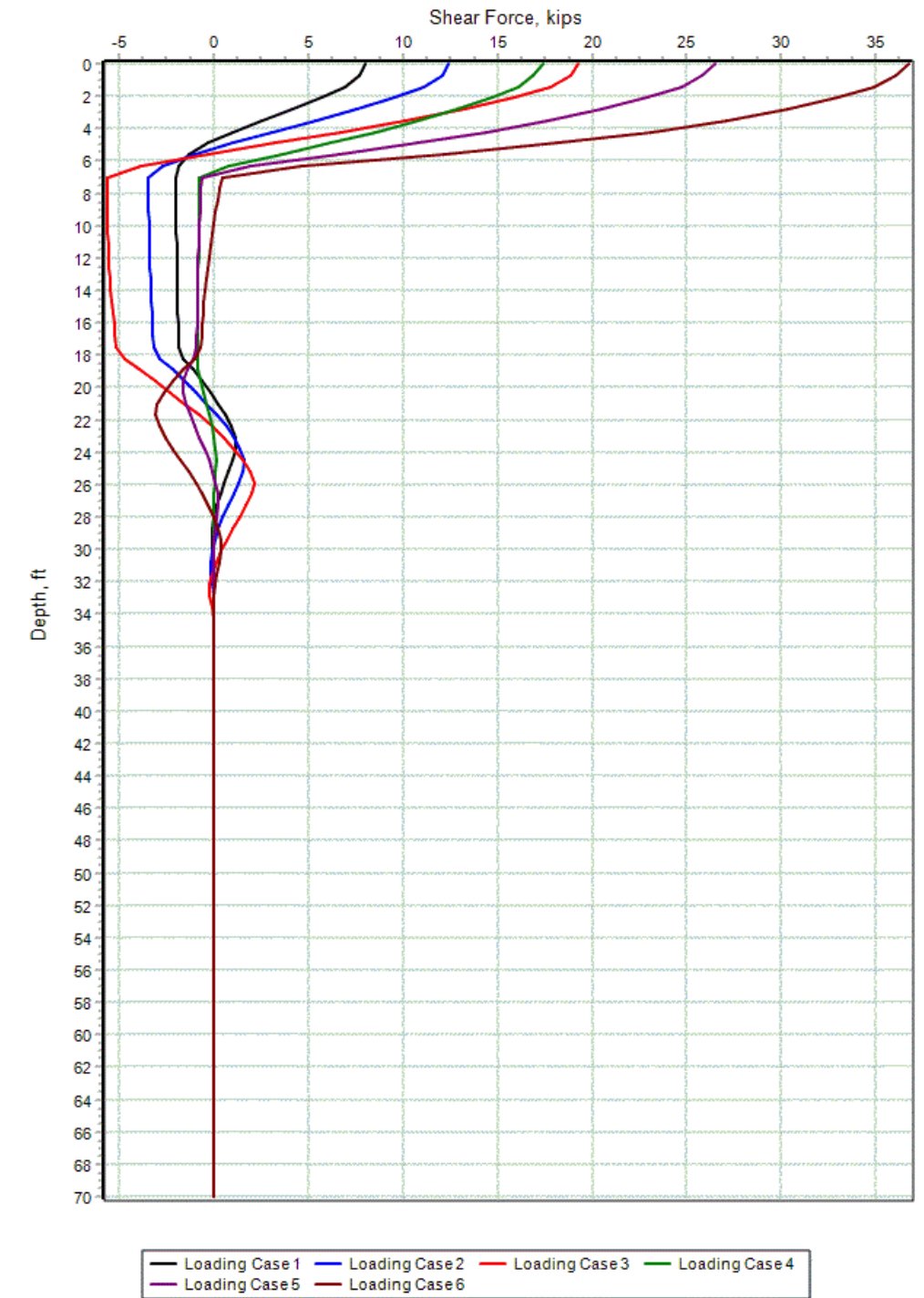
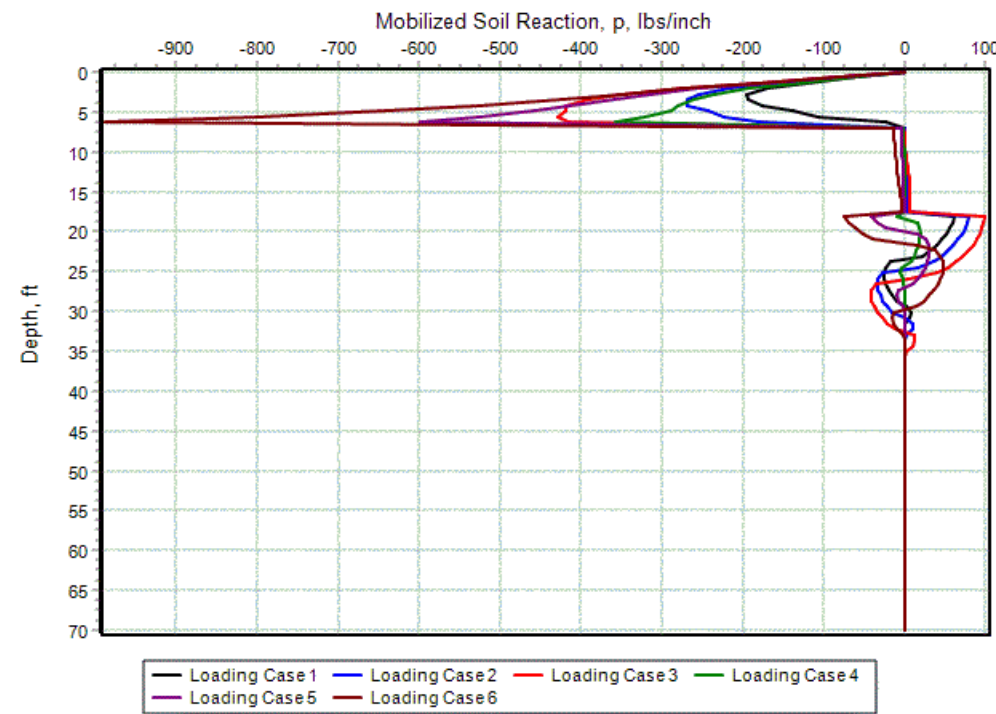
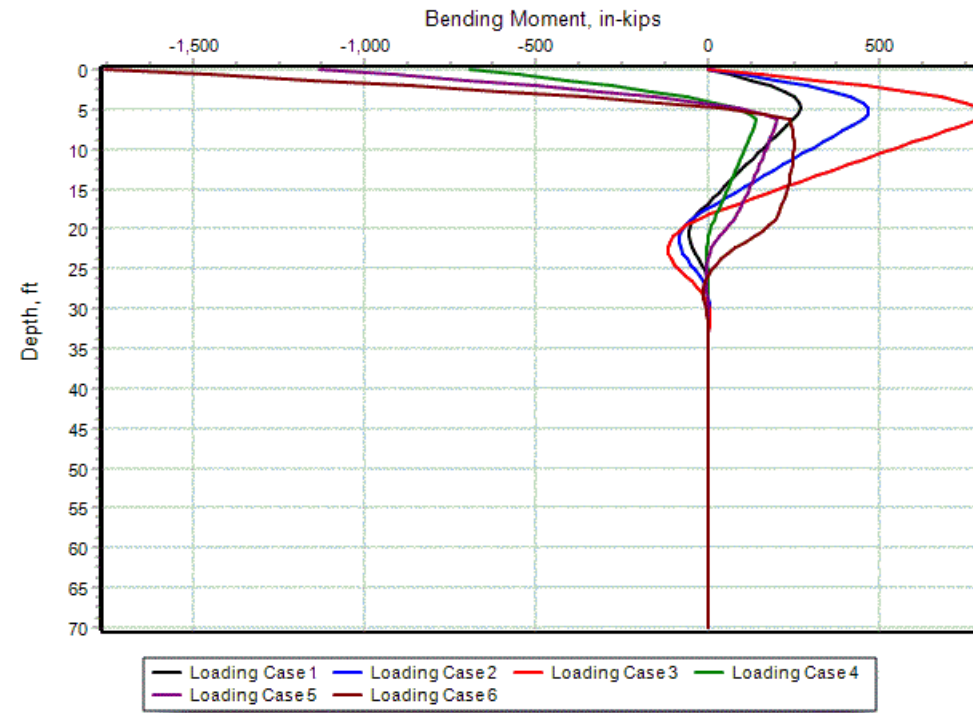
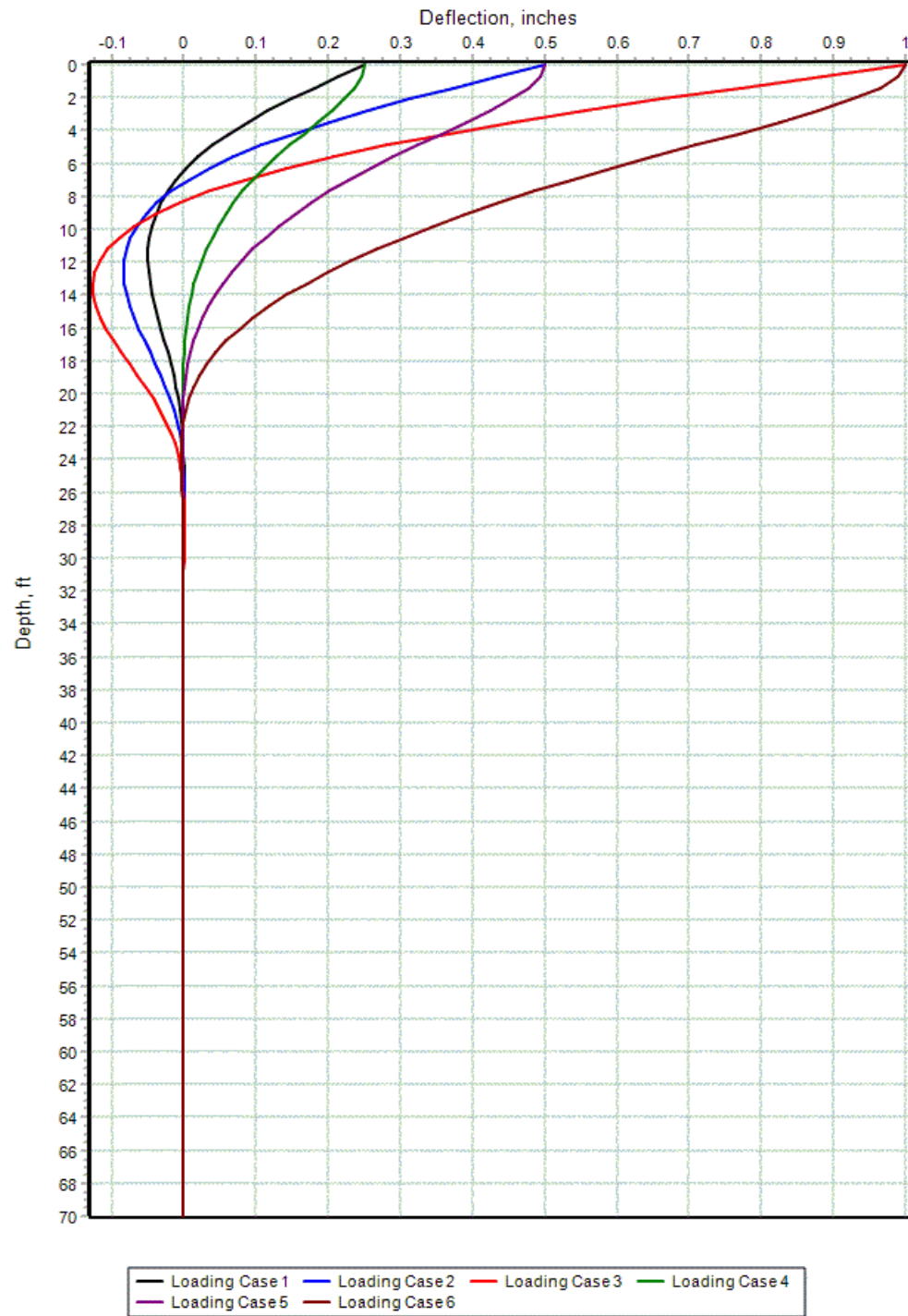


PLATE G-5: LPILE Results for Profile 3B

Supplement I

DMM Design and

Recommendations Report

I.1 Introduction

Liquefaction and seismic slope stability analyses performed during project geotechnical investigation and geologic hazards evaluation, indicated potential for significant lateral spreading (up to several feet) and liquefaction-induced settlements (generally 1 to 4 inches and up to about 6 inches closer to the Lake Merritt Channel). The loose to medium dense sand layers of various thicknesses located both above and within the Young Bay Mud layer have a high potential for liquefying when subjected to an MCE (Maximum Considered Earthquake) event. These sand layers were encountered within depths of about 30 to 40 feet (above elevation -15 feet). The seismic slope stability at the planned building location is affected by both liquefaction and the presence of relatively soft Young Bay Mud (YBM). For further description of the seismic slope stability and liquefaction hazards refer to the project geotechnical report (Fugro, 2020).

It has been decided that the foundation soil will be improved using Deep Mixing Method (DMM) columns and grids under the entire footprint of the Laney College Library & Learning Resource Center (LLRC) building, which will be supported by shallow foundations (e.g., footings, and structural slab, and grade beams). This Addendum presents our methodology for the DMM design, provide DMM specifications, and to provide geotechnical design parameters for the design of the LLRC structure and its foundation system.

I.2 Proposed Structure

The location of the LLRC building is shown on **Plate 1**. The proposed new structure will be constructed at approximately the existing grades without basements. The footprint of the LLRC building is approximately 23,750 square feet. This building will be supported by shallow spread footings with interior structural first floor slabs and grade beams.

I.3 Subsurface Conditions

The subsurface soils below the site generally consist of predominately medium dense sandy fills that extend to depths of about 8 to 25 feet (Elevations of about +8 feet to -5 feet). Clayey fills of about 2 to 4 feet thick were also encountered in some areas. These fills are heterogenous and locally contain various amounts of concrete, brick, and wood debris. Most of these fills appear to be derived from the historical filling of the natural Lake Merritt outlet channel between 1860s and 1940s, and the later development of the Laney College campus in 1960s. Most likely these fills were not compacted to current acceptable geotechnical engineering standards.

Below the surficial fill layer, very soft to soft, high moisture content, and low shear strength Young Bay Mud was encountered to a depth of about 30 feet (Elevation of about -10 feet) at the northwest side of the proposed building location and about 50 feet (Elevation of about -30 feet) at the southeast side of the proposed building location. Some thin loose to medium dense sand lenses about 2 to 6 feet thick were also encountered within the Young Bay Mud layer. About 15-

feet of loose to medium dense sands were also encountered between the surficial fill and the Young Bay Mud layers at the east edge of the building, extending towards the channel. These sands could be either historical fills placed in the natural Lake Merritt outlet channel or natural sand deposits that existed within the channel.

I.4 DMM Ground Improvement

I.4.1 Purpose

Several alternatives were considered for mitigating the lateral spread hazard at the planned building site, including installation of a retaining wall and the deep mixing method (DMM) beneath the building footprint. Considering the high seismic demand, presence of shallow liquefiable soils and soft Young Bay Mud, proximity to the Lake Merritt Channel, and constraints from the PG&E easement on the north side of the planned building, it is our experience and opinion that continuous grids of deep mixed shear walls are the most suitable, robust, and cost-effective technique to mitigate the lateral spread hazard at the planned building site. The grids of deep mixed shear walls will provide support for shallow foundation systems for seismic loading and transfer bearing loads deeper to the medium dense to very dense sands and stiff to hard clays, reducing total and differential building settlements. In addition, we recommend using structural slabs to span between DMM deep mixed shear walls, assuming that the untreated soils within the grid walls may still develop post-liquefaction reconsolidation settlements below slabs. The deep mixed shear walls will also affect the composite ground response to horizontal ground motions. This section presents a brief overview of the deep mixing method (DMM), our design approach, DMM design properties, and results of our evaluation process, including results of seismic stability analyses. Seismic design parameters incorporating the composite response of the deep mixed zone are presented in **Section I.5**, herein.

I.4.2 Description of the Deep Mixing Method

The deep mixing method (DMM) is a soil improvement technique used to treat soils in place without excavation or dewatering. A rig that is typically equipped with multi-shaft mixing augers (containing auger flights and mixing paddles) is used to inject a cementitious grout and blend it with the in-situ soils. When the design depth is reached, the augers are withdrawn while mixing on the way to the surface, leaving in-place a stabilized soil mass that is stronger, less permeable, and has improved engineering properties. A multi-shaft mixing rig creates interconnected soil mixed elements formed by partially overlapping columns. The elements can be arranged to form walls, grids, and blocks of deep mixed soil-cement. There are various diameters of multi-shaft mixing augers and they typically range from 3 to 5 feet.

While there are other methods of creating deep mixed grids, such as by Cutter Soil Mixing (CSM) or Trench Cutting and Remixing (TRD), we believe multi-shaft auger systems will be most efficient for creating the deep mixed grids, and there are several contractors locally who have

such systems. We do not recommend using single shaft soil mixing equipment for creating deep mixed shear walls and grids because, in our experience, uniform mixing is more difficult to control when using single shaft soil mixing equipment.

The body of literature (case histories, numerical simulations, and physical model tests) on the effectiveness of DMM grids for mitigating liquefaction effects demonstrates that grid configurations are more effective than columns, with benefits including reduced ground settlements and lateral spread displacements, reduced earthquake-induced shear stress and strain within untreated soils bounded by the grid walls, containment of liquefied soils within the grid walls if liquefaction occurs, and reduced migration of excess pore pressure between unimproved and improved zones (Namikawa et al., 2007; Siddharthan & Porbaha, 2008; Nguyen et al., 2013; Yamashita et al., 2015; Tsukuni & Uchida, 2015 and 2017; Boulanger et al, 2018; Boulanger & Shao, 2021). The effectiveness of DMM grids to mitigate liquefaction-induced displacements depends on a variety of factors, including the treatment geometry and area replacement ratio (A_r) and deep mixed ground strength and stiffness. The area replacement ratio is defined as the ratio of the surface area of treated soil-cement to the total surface area within a given treatment zone. As area replacement ratio increases, the composite shear strength of the deep mixed zone increases, and earthquake-induced shear stresses decrease.

I.4.3 Design Approach

Design of the DMM ground improvement generally follows the approach described by the FHWA guidelines (Bruce et al., 2013) and involves the following steps:

1. Establish trial geometry (area replacement ratio, column diameter, and shear wall spacing) and deep mixed ground properties,
2. Evaluate global slope stability (static, seismic, and post-seismic),
3. Evaluate other potential external modes of failure of the deep mixed zone (overturning and bearing)
4. Evaluate internal stability of the deep mixed zone (racking failure, crushing of deep mixed shear walls at the outside toe),
5. Evaluate static and seismic settlements,
6. Repeat steps 1-5 until performance is satisfactory,
7. Evaluate deep mixed column bearing capacity for support of structural loads, and
8. Refine layout and add additional deep mixed columns to reduce floor free span distance, where appropriate, to reduce floor slab costs.

The following sections describe the evaluation process for the key steps (1 through 5) listed above.

I.4.4 DMM Design Properties

DMM design properties and geometries were initially selected based on rule of thumb and review of relevant case histories and published design guidelines and technical papers on the subject. Following the design approach presented above, DMM properties and geometries were iteratively adjusted to achieve acceptable performance. The final DMM properties used for design are summarized in the **Table I.4.1**.

Table I.4.1: DMM Design Properties

Parameter	Design Value
Unconfined Compressive Strength ($q_{dm,spec}$)	125 psi
Shear Strength (s_{dm})	74 psi (curing time = 365 days) (40% of unconfined compressive strength)
Young's Modulus (secant modulus at 50% mobilized strength; E_{50})	37,500 psi (300 times unconfined compressive strength)
Shear Modulus Ratio ($G_r = G_{dm}/G_{soil}$)	5-20
*dm = deep mixed	

I.4.4.1 Area Replacement Ratio

An area replacement ratio (A_r) of 50 percent was selected for design to limit lateral spread displacement to an acceptable magnitude. The basis for tolerable lateral spread displacement and our evaluation of seismic slope displacement are presented in the following section. An area replacement ratio of 50 percent with conventional DMM strengths will also provide adequate support for all footings and moment frame grade beams. In addition, case histories indicate good performance against soil liquefaction hazards with A_r greater than approximately 20 percent.

For example, the 14-story International Hotel in Kobe Japan used an A_r of about 20 percent. During the Kobe earthquake, this structure performed very well despite having the ground surrounding the building liquefy, laterally spread several meters, and settle significantly. DMM grids of about 34 feet deep and with an A_r of about 30 percent were reportedly used for several two-story new school buildings at Jordan High School in Long Beach, California (completed in 2017) to reduce liquefaction-induced settlements and support the buildings on shallow foundation systems. A design 28-days DMM unconfined compressive strength of 150 psi was used at the Jordan High School project.

The West Dowling Road Overcrossing in Anchorage Alaska was built in 2014 with deep mixed shear walls and columns supporting the approach abutment footings in part to mitigate earthquake-induced lateral deformations within shallow soft peat and liquefiable silt layers (Boulanger & Shao, 2021). The deep mixed walls and columns were spaced to produce area

replacement ratios of approximately 90 percent beneath the footings (shear walls with overlapping columns) and 50 percent in the area surrounding the footings (shear walls only). The bridge performed well in the 2018 Anchorage earthquake ($M = 7.1$ and PGA at the overcrossing estimated to be 0.35 to 0.45) with deformations kept to acceptable levels.

We have used the deep mixing ground improvement method and our latest experience was the Agnews Campus project located in San Jose, California. The project included sixteen one- to three-story building on an approximately 55-acre site. For that project, estimated liquefaction-induced ground surface settlements exceeded the project settlement design criteria for buildings and structures that were supported on shallow foundations without ground improvement. DMM grids of about 40 feet deep with an A_r of 40% and unconfined compressive strength of 250 psi was used for the ground DMM design.

Based on available literature, case histories, and the analyses presented in the following sections, we judge that a minimum A_r of 40 to 50 percent is reasonable for support of the planned Laney College LLRC building. The design calculations presented in the following sections are based on $A_r = 50\%$.

I.4.5 Global Slope Stability Analyses

I.4.5.1 Seismic Slope Displacement

The methodology and results of seismic slope displacement evaluations for the DMM ground improvement are presented in this section. Based on results of the stability analysis and variable Young Bay Mud (YBM) thickness encountered at the site, we performed 10 additional CPTs on November 17, 18, and 22, 2022 to better define the bottom elevation of the YBM layer. The new cross sections are shown on **Plates 2a through 2f**, herein. The updated cross sections together with results of stability analysis were used to develop the DMM depths and the zonation shown on **Plate 1**.

I.4.5.1.1 Methodology

Simplified Seismic Slope Displacement Procedures

Seismic slope displacement was evaluated for an idealized section representative of cross section A-A' [**Plate 1**; the interpretive cross section is presented in the LLRC Geotechnical Report (Fugro, 2020)] using the simplified procedures developed by Bray and Macedo (2019) and Rathje and Antonakos (2011). In general, these procedures are based on regression of Newmark sliding block type analyses performed for a wide range of slope conditions (i.e., slope height, soil stiffness, and yield acceleration) and substantial databases of ground motions. The two models used herein differ with respect to:

1. Their representation of the dynamic response of the sliding block,

2. The ground motion databases available at the time of their development, and
3. Their parameterization of the ground motion for regression (for building their predictive models).

The Bray and Macedo (2019) procedure is based on fully coupled stick-slip sliding block analyses and the NGA-West2 ground motion database (>6,000 ground motion recordings were used to develop their predictive model). Their coupled model simultaneously captures the nonlinear dynamic response of the sliding mass and its effect on sliding episodes. The Rathje and Antonakos (2011) procedure is based on decoupled analyses, where calculations for the dynamic response of the sliding block and plastic slip (i.e., sliding) are performed independently. Their predictive model is based on an earlier version of the NGA strong ground motion database (>2,000 ground motion recordings were used to develop their predictive model). Coupled analyses are more rigorous and considered superior, although any sliding block type analysis represents potential slope deformations with a very simplistic failure mechanism, and results should be interpreted as an index of slope performance. While both models use earthquake magnitude as a proxy for shaking duration, they employ different parameterization of the seismic demand. The Bray and Macedo (2019) model uses the spectral acceleration (at the base of the sliding mass) at a degraded period equal to 1.3 times the initial period of the sliding mass to represent the seismic demand. The Rathje and Antonakos (2011) model used herein uses the PGA at the base of the sliding mass to represent the seismic demand. Both models require the initial fundamental period of the potential sliding mass (T_s) and the slope's yield coefficient (k_y).

The initial fundamental period of the potential sliding mass (T_s) was estimated based on the approximate height of the potential sliding mass observed in the pseudostatic limit equilibrium analyses, the range of in-situ shear wave velocities previously idealized for site response analysis (Supplement G of LLRC Geotech Report), shear modulus ratios ($G_r = G_{dm} / G_{soil}$) ranging from 5 to 20, an area replacement ratio of 50 percent, and the model for shear wave velocity ratio for periodic grid inclusions proposed by Nguyen et al. (2013). The resulting estimates of T_s ranged from approximately 0.17 to 0.28 seconds.

Seismic slope displacements were estimated for a design-level ground motion based on the geometric mean and without risk coefficients (e.g., $PGA_M / 1.5$) [CGS Note 48 (CGS, 2019)]. Acceleration response spectra for the MCE_R [tabulated in Table G.4 of the LLRC Geotech Report (Fugro, 2020)], MCE_G , and the design-level ground motion used for seismic slope displacement analyses are shown in **Plate 3** for $V_{s30} = 260$ m/s (i.e., at the base of the YBM). The range of spectral accelerations used for the Bray and Macedo (2019) seismic slope displacement model (corresponding to the estimated range of degraded period of the sliding mass) is annotated on this plate. An earthquake magnitude of 7.6 was used in these analyses based on the maximum considered earthquake associated with the Hayward Fault.

Displacements were estimated using the Bray and Macedo (2019) procedure for both ordinary ground motions and near-fault pulse ground motions. The results presented in the following section were weighted by the expected proportion of pulse motions, which was estimated to be approximately 0.4 based on the Hayden et al. (2014) model. A peak ground velocity (PGV) of 105 cm/s was used for the pulse ground motion predictive model based on the correlation developed by Watson-Lamprey and Abrahamson (2006), which was found to be in good agreement with the 1,000-year PGV computed using the beta web API for the 2018 USGS national seismic hazard maps.

Pseudostatic Slope Stability Analyses and Estimation of Yield Coefficient

The yield coefficient (i.e., the horizontal seismic coefficient that results in a pseudostatic factor of safety of unity) was evaluated by pseudostatic limit equilibrium analyses performed with the commercial software program SLOPE/W (GeoStudio 2019 version 10.0.0.18569; GEOSLOPE, 2019) and the idealized stratigraphy presented in **Table I.4.2**. Circular and non-circular slip surfaces were evaluated using the Morgenstern-Price limit equilibrium method (which satisfies equilibrium of both forces and moments). The design of the DMM ground improvement was iteratively adjusted until pseudostatic stability analyses produced yield coefficient values corresponding to tolerable seismic displacements.

The deep mixing treatment zone was represented with composite properties assuming no shear resistance from native soil between the deep mixed grids. The shear strength of the deep mixed ground was computed as $s_{dm} = \frac{1}{2}(f_r \times f_c \times q_{dm,spec})$ where $q_{dm,spec}$ is the specified unconfined compressive strength of the deep mixed ground ($q_{dm,spec} = 125$ psi), f_c is a factor accounting for curing time ($f_c = 1.48$ for the 365 day curing time assumed for seismic load cases), and f_r is a factor accounting for differences between unconfined peak and confined large-strain strengths taken as 0.8 (Bruce et al., 2013). The composite shear strength of the treatment zone was then estimated as $s_{dm,grid} = f_v \times A_r \times s_{dm} \approx 5,000$ psf where f_v is a factor that accounts for the greater variability that typically exists in the strength of deep mixed ground compared to the variability that exists in the strength of clay deposits [f_v was estimated to be 0.95 per the FHWA guidelines (Bruce et al., 2013)], A_r is the area replacement ratio ($A_r = 0.5$), and s_{dm} is the shear strength of the deep mixed ground defined above.

The Young Bay Mud (YBM) was modelled with an undrained shear strength ratio of 0.22 to approximate cyclic softening behaviours. This softened strength ratio was based on an average peak, static strength ratio of 0.28 and an undrained shear strength reduction factor of 0.8 (i.e., $0.8 \times 0.28 = 0.22$) based on the cyclic strength (i.e., cyclic resistance ratio, CRR) for $M=7.5$ suggested by Idriss and Boulanger (2008) for plastic silts and clays, and Fugro's past experience characterizing and modelling YBM.

The liquefiable sands were modelled with residual strength of liquefied soil estimated using the Kramer and Wang (2015) model which depends on energy and effective overburden corrected SPT blow count, $(N_1)_{60}$ and in-situ vertical effective stress. Baseline analyses were performed for $(N_1)_{60} = 15$. Sensitivity analyses were also performed for $(N_1)_{60} = 10$.

Table I.4.2: Soil Properties Used in Pseudostatic Slope Stability Analyses

Material	Unit Weight (pcf)	Material Shear Strength	
		Cohesion c' (psf)	Friction Angle ϕ' (degree)
Sandy Fill	120	0	35
Young Bay Mud with Sand Lenses	90	0.22 x Effective Overburden Stress (psf)	0
Interbedded Clays and Sands	130	0	40
Highly Liquefiable Sands	110	Kramer and Wang (2015) $(N_1)_{60}=15$	0
DMM Composite	120	5,000	0

I.4.5.1.2 Results

Results of the pseudostatic slope stability analyses and simplified seismic slope displacement estimates are presented herein. **Plates 4a through 4c** show factors of safety and corresponding slip surfaces from pseudostatic stability analyses with a horizontal seismic coefficient (k_h) of 0.35 for block, circular, and optimized circular slip surfaces. The block slip surface (passing through the DMM grid) and the optimized circular slip surface (passing beneath the grid) both have factors of safety of approximately 1.0 (i.e., $k_y = 0.35$). The circular slip surface (not optimized) exhibits a factor of safety of 1.1 for $k_h = 0.35$ (i.e., $k_y < 0.35$). The deep mixed zone is deeper on the east side of the building (Zones A2 and B in **Plate 1**) extending approximately 55 feet deep (Elev. -35 feet; 12 to 22 feet below YBM). This deeper section is approximately 55 feet wide in the slope stability model. Based on the results of the stability analyses the deeper portion of the DMM is extended further back along the north side of the building so that there is at least a 55-foot-wide deep buttress for slip surfaces oblique to the building orientation (e.g., Cross Section F-F', **Plate 2f**). Additionally, based on the additional CPTs performed in November 2022 the DMM depth was extended in Zone A2 to ensure bearing into the competent sands and clays beneath the YBM. A smaller maximum center-to-center grid spacing is specified for Zone B (**Plate 4**). The deep mixed zone on the western side of the building is shorter (Zone A1 in **Plate 1**), keyed 3-5 feet into the competent sands and clay under the YBM, generally extending to a depth of about 33 feet below ground surface (Elev. -15 feet). Sensitivity analyses with residual strength of liquefied soils based on Kramer and Wang (2015) for $(N_1)_{60} = 10$ had a small effect on the results because only small fractions of the slip surfaces were affected.

The range of estimated seismic displacements for the DMM ground improvement is shown in **Plate 5**. The range is based on: (1) the range of k_y values computed for circular and non-circular slip surfaces and several parameter sensitivity analyses, (2) reasonable ranges of average shear wave velocity of the potential sliding mass, and (3) both the Bray and Macedo (2019) and Rathje and Antonakos (2011) predictive models. Estimated median seismic displacements range from negligible to approximately 13 cm, with the Bray and Macedo (2019) model producing larger displacement estimates for all cases. The $T_s = 0.17$ and 0.21 seconds analysis cases likely better represent the deep mixed zone in these analyses ($Gr \approx 20$ and 10 , respectively). The $T_s = 0.28$ seconds case was included as a reasonable sensitivity analysis where the degraded period of the sliding mass corresponds to the peak spectral acceleration (i.e., $Sa(1.3T_s) = 1.2$ g). The differences between the two predictive models are partly attributed to differences in how they model the dynamic response of the sliding mass, with the Bray and Macedo (2019) coupled model considered superior. The approximate performance of the existing slope (i.e., without DMM ground improvement) is also annotated on **Plate 5** for reference. Large seismic displacements were estimated for the existing slope for $k_y \approx 0.1$, which corresponds to a range of performance where displacement estimates are very sensitive to small changes in yield acceleration. Conversely, the DMM ground improvement performance falls on a much flatter part of the displacement vs. k_y curves.

Two seismic displacement thresholds are indicated on **Plate 5**. The 15-cm (6-inch) threshold is commonly accepted for screening-level evaluations of earthquake-induced landslide hazard (e.g., SP-117A, 2008). The 15-cm threshold likely distinguishes small to moderate displacements from larger displacements (Blake et al., 2002), and sliding block displacement estimates less than approximately 15 centimetres are unlikely to correspond to serious landslide movement or damage (SP-117A, 2007). The 10-cm (4-inch) threshold corresponds to the ASCE 7-16 upper limit for lateral spreading horizontal ground displacement for shallow foundations for buildings in Risk Category IV (Table 12.13-2 of ASCE 7-16). Therefore, we designed the DMM ground improvement to limit average lateral spread displacement to approximately 10 cm. This corresponds to a yield acceleration of approximately 0.35 (**Plate 4**) which was computed for the best estimate pseudostatic stability analyses previously presented on **Plates 4a and 4c**.

I.4.5.1.3 Conclusions

Seismic slope displacement estimates based on two methods and incorporating uncertainty in the initial fundamental period of the sliding mass were on average less than 10 cm and are considered tolerable given the ASCE 7-16 upper limit for lateral spreading horizontal ground displacement for shallow foundations (10 cm for buildings in Risk Category IV). Therefore, the design of the DMM ground improvement presented herein is judged to be acceptable with respect to global seismic stability.

The deeper treatment zone modelled on the east side of the building in the two-dimensional pseudostatic stability analyses will need to also wrap around the north side of the building to limit lateral displacement for slip surfaces oblique to the building's principal orientation and to protect the north side of the building against potential soil loss. This configuration is shown in plan on **Plate 1** and provides a similar width of deeper treatment (to what was modelled for Section A-A') for potential slip surfaces on cross sections oblique to the building orientation. The deeper ground improvement extends along the north side of the LLRC building to the eastern limit of the Building E.

The final depth of the DMM grid should be determined based on the results and interpretation of additional CPTs that we recommend be performed prior to construction. The DMM depths presented in this section (and used for the stability analyses) are minimum depths that may need to be exceeded based on interpretation of the additional CPTs.

I.4.5.2 Post-Seismic Global Stability

Post-seismic stability analyses demonstrated factors of safety greater than five. Post-seismic global stability was evaluated using the same properties shown in **Table I.4.2**, except the YBM was modelled with an undrained shear strength ratio of 0.17 (i.e., a strength reduction factor of 0.6 to represent cyclically softened strength for a static loading rate). Analyses were performed for both the original slope geometry and for a case where the channel side soils (east of the building) are assumed to have displaced towards the channel more than the building, exposing a free face of deep mixed ground approximately 20 feet tall. In both cases the DMM ground improvement is acceptable from a post-seismic global stability perspective.

I.4.6 Additional Stability Checks

Additional stability checks were performed following FHWA guidelines (Bruce et al., 2013) and including seismic loads. Overall, the design of the DMM ground improvement was controlled by global seismic slope displacements given the favourable aspect ratio and relatively high area replacement ratio needed. External stability was checked for combined overturning and bearing. Internal stability was checked for crushing of the deep mixed shear walls at the outside toe, racking failure (shearing on vertical planes in the deep mixed shear walls), and extrusion of soil between the deep mixed shear walls.

To simplify these checks, we conservatively modelled the shallower treatment zone on the west end of the building and the deeper treatment zone on the east end of the building as separate blocks of soil-cement. Seismic activate earth pressures were estimated using the same limit-equilibrium models used for the pseudostatic analyses and with $k_h = 0.35$ (following the GLE approach described by Anderson et al., 2008). A horizontal inertial load of the deep mixed ground was also included as the weight of the deep mixed ground (W) times the horizontal seismic coefficient (k_h). Additionally, no passive resistance from the channel side of the deep mixed

ground was conservatively assumed. Factors of safety for all additional stability checks were more than 1.3 [the minimum value for static load cases recommended by Bruce et al. (2013)].

I.4.7 DMM Treatment Zone Settlements

Post-liquefaction reconsolidation settlement within the building footprint was estimated to range between approximately 1 and 4 inches based on the local borings and CPTs. Note that the largest settlement (approximately 6 inches) was estimated for CPT-03 which was performed to the southeast of the building. The potential for the DMM to reduce cyclic shear stresses and limit post-liquefaction reconsolidation settlement was evaluated for shear modulus ratios ($G_r = G_{dm} / G_{soil}$) ranging from 5 to 20 and the design area replacement ratio of 50%. The shear stress reduction factor ($R_d = CSR_i / CSR_u$, where CSR_i and CSR_u are cyclic stress ratio for the improved and unimproved cases, respectively) was estimated using the relationship proposed by Nguyen et al. (2013) for periodic grid arrangement of shear walls. CPT-based post-liquefaction reconsolidation settlement analyses for R_d values ranging from 0.5 ($A_r = 50\%$ and $G_r = 5$) to 0.17 ($A_r = 50\%$ and $G_r = 20$) resulted in negligible ($R_d = 0.5$) to substantial ($R_d = 0.17$) reduction in estimated settlements. A R_d value of 0.3 ($A_r = 50\%$ and $G_r = 10$) provides a reasonable estimate of the settlement hazard that accounts for reduced seismic shear stresses in the native soil and resulted in reconsolidation settlements within the building footprint on the order of 1 to 2 inches for the MCE.

We judge that by using DMM to mitigate liquefaction effects, post-liquefaction reconsolidation settlements of 1 to 2 inches can develop between DMM grids beneath the floor slabs. Therefore, we recommend using structural slabs to span between deep mixed shear walls.

In addition, we estimate static settlement of buildings and structures supported on the deep mixed ground will depend on footing layout and service load and will be less than about 3/4 inch.

Underground pipelines (gas lines, sanitary sewers, water services, etc.) should be properly designed considering differential settlements of about 4 inches associated with post-liquefaction reconsolidation between DMM supported structure and unimproved areas adjacent to the building. Additional consideration should be given to the impacts of differential seismic slope movements (lateral and vertical) between the improved and unimproved areas.

I.5 Seismic Design Parameters

Due to the ground improvement, the combination of the DMM grids and the existing soil will create a stiffer composite medium which has a higher shear wave velocity compared to the native soft YBM and sandy fill material. We estimate that the shear wave velocity of the top 100 feet of soil (V_{s30}) will increase to 270 m/s due to the ground improvement. The corresponding composite average shear wave velocity profile was estimated based on the idealized shear wave

velocity profiles previously developed for site response analyses [Supplement G of LLRC Geotech Report (Fugro, 2023)] and considering shear modulus ratios, G_r , ranging from 5 to 30 (based on deep mixed soil-cement E_{50} values between 300 and 600 times the specified unconfined compressive strength, as recommended by Boulanger and Shao, 2021). Overall, for the resulting range of estimated V_{s30} values the short period spectral accelerations (that control short period spectral acceleration parameters, S_{DS} and S_{MS}) increase with increasing V_{s30} . Given that the estimated building period is 0.45 seconds, we selected a representative V_{s30} based on a reasonably conservative average G_r value of 20, which for $A_r = 50\%$ corresponds with a ratio of $V_{s,av} / V_s$ of approximately 2.5 per the relationship developed by Nguyen et al. (2013) for periodic grid inclusions (where $V_{s,av}$ is the average shear wave velocity in the treatment zone and V_s is the soil's shear wave velocity) The idealized V_s profiles previously developed for site response produce V_{s30} values of approximately 270 m/s when multiplied by 2.5 over the thickness of fill and YBM.

A site-specific Probabilistic Seismic Hazard Analysis (PSHA) was performed for the new V_{s30} to estimate the severity of ground motions that may affect the project site for specific design levels of hazard. The design ground motion parameters were calculated following the site-specific ground motion procedures defined in Chapter 21 of ASCE 7-16 (ASCE, 2016) as required by the California Building Code (CBC) (CBSC, 2019).

Table I.5.1 tabulates the spectral ordinates of the recommended site-specific MCER and design response spectra per ASCE 7-16. The corresponding design acceleration parameters S_{MS} , S_{M1} , S_{DS} , and S_{D1} are tabulated in **Table I.5.2**.

Table I.5.1: MCE_R and Design Response Spectra per ASCE 7-16 for a V_{s30} of 270 m/sec, 5% Damping

Period (sec)	UHRs for Return Period of 2,475 Years	Horizontal Spectral Acceleration (g)						Design Response Spectrum
		Probabilistic MCE_R	84th Deterministic Spectrum	Deterministic Lower Limit	Deterministic MCE_R	Site-Specific MCE_R	80% General Response Spectrum	
0.01 (PGA)	0.947	0.959	0.731	0.555	0.804	0.804	0.400	0.536
0.03	0.974	0.987	0.739	0.561	0.812	0.812	0.459	0.542
0.05	1.09	1.11	0.810	0.615	0.891	0.891	0.518	0.594
0.075	1.35	1.37	0.96	0.73	1.06	1.06	0.591	0.704
0.1	1.58	1.60	1.1	0.837	1.21	1.21	0.664	0.807
0.15	1.87	1.90	1.33	1.01	1.47	1.47	0.811	0.978
0.19	2.06	2.09	1.47	1.11	1.61	1.61	0.927	1.08
0.2	2.1	2.13	1.5	1.14	1.65	1.65	0.927	1.1
0.25	2.27	2.36	1.62	1.26	1.83	1.83	0.927	1.22
0.3	2.39	2.52	1.72	1.36	1.97	1.97	0.927	1.32
0.4	2.44	2.64	1.81	1.48	2.14	2.14	0.927	1.43
0.5	2.36	2.62	1.79	1.50	2.17	2.17	0.927	1.45
0.75	1.95	2.24	1.53	1.33	1.93	1.93	0.927	1.29
0.949	1.68	1.97	1.36	1.21	1.75	1.75	0.927	1.17
1	1.63	1.92	1.32	1.19	1.72	1.72	0.88	1.14
1.5	1.16	1.42	0.991	0.924	1.34	1.34	0.587	0.892
2	0.891	1.12	0.785	0.752	1.09	1.09	0.44	0.726
3	0.583	0.759	0.541	0.537	0.778	0.759	0.293	0.506
4	0.413	0.551	0.389	0.396	0.573	0.551	0.22	0.367
5	0.310	0.421	0.290	0.300	0.435	0.421	0.176	0.281
7.5	0.171	0.233	0.145	0.15	0.218	0.218	0.117	0.145
8	0.154	0.21	0.128	0.133	0.192	0.192	0.110	0.128
10	0.107	0.146	0.084	0.087	0.125	0.125	0.070	0.084

Table I.5.2: Design Parameters per ASCE 7-16 at the Ground Surface, 5% Damping

Parameter	Value
S_{MS}	1.95
S_{M1}	2.28
S_{DS}	1.30
S_{D1}	1.52
T_L	8 seconds

Plate 6 shows the mean annual seismic hazard curves for selected spectral periods ranging from 0.01 to 10 seconds for V_{s30} of 270 m/s. A spectral period of 0.01 seconds is used to represent the peak ground acceleration (PGA). These hazard curves represent the total mean hazard from combining all seismic sources and ground motion models. These figures also indicate the annual frequency of exceedance corresponding to a return period of 2,475 years. **Plate 7** presents the 5 percent-damped mean horizontal UHRS (Uniform Hazard Response Spectrum) for a return period of 2,475 years and the representative V_{s30} value of 270 m/sec. The UHRS for a return period of 2,475 years along with probabilistic response MCE_R response spectrum are illustrated in **Plate 8**.

Plate 9 presents the development of the site-specific MCE_R and design response spectra for the site. In this case, the deterministic MCE_R spectrum is lower than the probabilistic MCE_R spectrum for all spectral periods. The site-specific MCE_R spectrum is the maximum of: 1) the minimum of the probabilistic and deterministic MCE_R , and 2) 150 percent of the design response spectrum. Following ASCE 7-16, the recommended design response spectrum for the site was calculated as the maximum of 2/3 of the site-specific MCE_R and the lower limit specified by ASCE 7-16 (80 percent of the general spectrum for Site Class D, using modified F_a and F_v values provided in Section 21.3 of ASCE 7-16). The transition period from constant velocity to constant displacement, T_L , required to calculate the lower limit, was estimated as 8 seconds using the USGS web service (<https://earthquake.usgs.gov/ws/designmaps/asce7-16.html>).

I.6 Foundation System

I.6.1 Spread Footing

We anticipate an area replacement ratio (A_r) of at least 50% will be used in the DMM design. The DMM columns can be constructed in various diameters and selection of the diameter and depth of these columns is project specific. Typically, the overlap of adjacent DMM columns is about 30% of the column diameter. The A_r may vary based on number of DMM columns under the foundation. To achieve the full allowable bearing pressure, DMM should extend laterally beyond

footing bases such that the area replacement ratio under the footing is 100%. Otherwise, the bearing capacity should be multiplied by the actual A_r under the foundation.

The axial capacity of the DMM grids is the minimum of the structural capacity and geotechnical capacity of the grids. For the designed DMM grids, the structural capacity is expected to control. Using a design DMM unconfined compressive strength of 125 psi, and following the FHWA design guidelines (Bruce et al., 2013), the ultimate structural capacity of the DMM columns ($A_r=100\%$) is estimated to be 21,300 pounds per square feet (psf) for long term and seismic loads and 14,400 psf for short term construction loads (after 28 days). According to CBC Section 1605A.1.1, the factor of safety for soil bearing shall not be less than the overstrength factor. Factors of safety for allowable stress design are show in **Table I.6.1** below. For example, if the overstrength factor is 2.5, the factors of safety for Dead Load, Dead plus Live Load, and Total Load cases are 3, 2.5, and 2.5, respectively.

Table I.6.1: Factors of Safety for Axial Loading of Foundations (Allowable Stress Design)

Load Condition	Factor of Safety
Dead Load	maximum (3, overstrength factor)
Dead plus Live Loads	maximum (2, overstrength factor)
Total Loads (including wind or seismic)	maximum (1.5, overstrength factor)

Provided bearing capacities are for shallow foundations supported on DMM with 100% area replacement ratio (A_r). It should be noted that considering the relatively high bearing capacity of the DMM, the A_r under the footing may be decreased depending on the design loads. The allowable bearing pressure is a net value; therefore, the weight of the footing can be neglected for design purposes. For footings supported on DMM with A_r less than 100%, the bearing capacity should be reduced by multiplying by A_r .

Footings should be at least 12 inches wide, and bottom of footings should be founded at least 24 inches below the lowest adjacent finished grade. Estimated static settlement of building supported on the deep mixed ground depends on footing layout and service loads, but should be less than about $\frac{3}{4}$ inch.

Resistance to lateral loads may be provided by friction along the base of foundations and by passive pressures acting on the sides of foundations. An allowable friction coefficient of 0.35 may be multiplied by the dead load to evaluate the allowable frictional resistance along the bottom of foundations. Where the footing is poured neat against subgrade soils, an ultimate passive pressure equal to an equivalent fluid pressure of 500 pounds per cubic foot (pcf) can be used for lateral load resistance against the sides of footings perpendicular to the direction of loading. If the footing is poured against forming, the ultimate passive resistance will be reduced by 30%. The upper 12 inches of soils should be ignored unless they are confined by pavement or slab.

The passive resistance value can be linearly interpolated between at-rest pressure (equivalent to a fluid pressure of 50 pcf) at zero deflection and the ultimate at a deflection of $0.025 \cdot D$, where D is the depth of the footing. The passive pressures against the footings and grade beams along the eastern and northern edge of the treatment Zone B should be ignored in foundation design due to potential for seismic soil displacements adjacent to the building in these areas.

I.6.2 Structural Mat Slab

When used, the structural mat slabs foundations should be supported on properly prepared subgrade that is proof rolled to provide a smooth, unyielding surface for slab support. Where the slab will be located at surface grade, we recommend at least 12 inches of imported, predominantly granular, "non-expansive" engineered fills that meet the requirements presented in the **Section 7.2** of the LLRC Geotechnical Report (Fugro, 2023) be provided below the slab. For slabs that support vehicular loads, the "non-expansive" engineered fill layer should consist of Caltrans Class 2 aggregate base.

For the portion of the slab that are supported on compacted soil, we recommend a modulus of subgrade reaction (k_1 , 1 foot by 1 foot) of 125 pounds per square inch per inch (psi/in) be used for the design of the structural mat slab foundation for the static condition. This value can be modified to k as $125/B$ psi/in, where B is the equivalent foundation width measured in feet. However, for the seismic condition, the slabs should be able to span between the DMM grids due to liquefaction-induced settlements (i.e., subgrade modulus = 0.0).

For the portion of the slab that are supported on 100% area replacement ratio DMM, we recommend a modulus of subgrade reaction (k_1 , 1 foot by 1 foot) of 4,000 psi/in be used for the design of the structural mat slab foundation. This value can be modified to k as $4,000/B$ psi/in, where B is the equivalent foundation width measured in feet. Recommended values of modulus of subgrade reaction for various footing aspect ratios are provided in **Table I.6.2** below. For other aspect ratios, values of modulus of subgrade reaction can be linearly interpolated. Note that if the area replacement ratio is less than 100%, **rigid footing** bearing capacities provided above and **modulus of subgrade reaction** in table below shall be **reduced by multiplying by the area replacement ratio**.

Table I.6.2: Values of Modulus of Subgrade Reaction for Various Rigid Footing Aspect Ratios

Footing Aspect Ratio Length (L) : Width (B)	Modulus of Subgrade Reaction k (psi/inch)
1	4,000/B
1.5	3,300/B
2	2,900/B
3	2,500/B
4	2,300/B
5	2,100/B
10	1,800/B
15	1,700/B

Note: B, equivalent footing width measured in feet

I.7 Conclusions and Recommendations

We recommend that approximately 30- to 55-foot deep DMM ground improvement be used to support shallow foundations of the proposed LLRC building to mitigate seismic hazards. We conclude that the LLRC building supported on DMM that are designed using the recommendations provided below will meet the project settlement criteria and allowable lateral spread displacement for shallow foundations per ASCE 7-16. We estimate total settlements less than ¾ inch (differential settlements up ½ inch over 30 feet or between adjacent structural columns) for DMM supported foundations and less than approximately 4 inches of average lateral spread displacement for the design-level ground motion.

A summary of our key recommendations for DMM follows:

- Ultimate DMM compressive capacities of 21,300 psf and 14,400 psf can be used for design of footings and slabs supported on DMM with 100% A_r for long term/seismic and short-term construction loads (after 28 days), respectively. For footings supported on DMM with A_r less than 100%, the bearing capacity should be reduced by multiplying by A_r .
- The allowable axial capacity should be calculated by dividing the ultimate axial capacities by the factors of safety provided in **Table I.6.1**.
- Lateral resistance of footing bases and slabs supported on DMM can be calculated using an allowable frictional coefficient of 0.35.
- The DMM should be constructed using multi-shaft mixing equipment to create columns that are a minimum of 3 feet and a maximum of 6 feet in diameter.
- The overlapping between any two adjacent DMM columns should be at least 30 percent of the column diameter.

- The bottom of DMM columns should be extended to below elevation -15 feet for Zone A1 and -35 feet for Zones A2 and B.
- The design unconfined compressive strength ($q_{dm,spec}$) is 125 psi .
- The mixed-in-place soil cement grids and blocks should cover a minimum Area Replacement Ratio (A_r) of 50 percent for a specified unconfined compressive strength ($q_{dm,spec}$) of 125 psi.
- Center-to-center spacing of DMM grids should not exceed 4.0d Zones A1 and A2 and 3.2d for Zone B, for min $A_r = 50\%$ ($q_{dm,spec} = 125$ psi), where d is the diameter of the DMM columns.
- DMM within the building footprint should be arranged in an uninterrupted grid that follows the building column lines and underlies all footings and moment frame grade beams.
- The DMM should underlie the entire building footprint and extend laterally to include any attached structures which are deemed to be essential parts of the buildings.
- To achieve the full allowable bearing pressure, DMM should extend laterally beyond footing bases such that the area replacement ratio under the footing is 100%. Otherwise, the bearing capacity should be multiplied by the actual A_r under the foundation.
- Elevator shafts should also be supported by DMM grids.
- Ground floor slabs should be designed to structurally span between DMM walls. Vapor barrier recommendations for floor slabs are provided in Section 7.3.4 of the LLRC Geotechnical Report (Fugro, 2023).
- The top of the DMM elements should extend to the base of the ground floor slab section, the bottom of footings, and the bottom of moment frame grade beams. The bottom of DMM elements should extend at least to the minimum depth shown on **Plate 1**.
- The average unconfined compressive strength of the DMM core specimens should be at least 125 psi at 28 days for a minimum A_r of 50% as determined by ASTM D2166. Ninety percent (90%) of all unconfined compressive strength tests on core samples should exceed the specified unconfined compressive strength.
- Lumps of unimproved soils should not amount to more than 15 percent of the total volume of any core run from continuous full-depth core sample and all of the unrecovered core length should be assumed to be unimproved soil.
- Any individual or aggregation of lumps of unimproved soil should not be larger than 12 inches in greatest dimension.
- Detailed DMM acceptance criteria are provided in performance specifications in **Supplement J, Construction Specifications for Deep Mixing**.
- Before construction, a detailed utility locating report should be provided to the design team.
- The DMM Contractor should control and process all spoils created during the DMM construction and should coordinate with the project grading contractor for the spoils to be reused as fills at the project site. The DMM spoils can be used below all interior slabs-on-grade or structural mat slabs as non-expansive engineered fills provided, they meet the requirements provided in our Geotechnical Report (Fugro, March 31, 2023).

- Design parameters per ASCE 7-16 at the ground surface are tabulated in **Table I.7.1** below:

Table I.7.1: Design Parameters per ASCE 7-16 at the Ground Surface, 5% Damping

Parameter	Value
S_{MS}	1.95
S_{M1}	2.28
S_{DS}	1.30
S_{D1}	1.52
T_L	8 seconds

- DMM modulus of subgrade reaction (k_1 , 1 foot by 1 foot) of 4,000 psi/in can be used for the structural design for portions of the slab that are supported by $A_r = 100\%$ DMM. The modulus of subgrade reaction for compacted soil between DMM grid is 125 psi/in which should be ignored when designing for seismic condition. These values can be modified to $k_{aa} = k_1/B$ psi/in, where B is the equivalent foundation width measured in feet. DMM modulus of subgrade reaction (k) for footings with various aspect ratios are provided in Table 6.1.
- Design requirements for foundations in liquefiable sites specified in **Section 12.13.9** of **ASCE 7-16** should be used for when designing the structural members and foundation system.
- We judge that by using DMM to mitigate liquefaction effects, post-liquefaction reconsolidation settlements of up to 2 inches can develop between DMM grids beneath the floor slabs. Therefore, we recommend using structural slabs to span between deep mixed shear walls.
- We recommend DMM ground improvement be installed by a qualified specialty contractor with demonstrated experience in this type of ground improvement. Construction of uniformly mixed, high strength DMM columns requires proper equipment, trained and experienced personnel, the proper mix design for the soils encountered, careful attention to the construction procedures, continuous monitoring of the installation parameters, and sufficient quality control testing. The DMM contractor should develop construction procedures, mix design, and quality control required to achieve the desired results and meet the project design and specified acceptance criteria. Additional details regarding contractor's responsibility are included in the DMM specifications.
- Fugro should also be retained to provide geotechnical services during DMM contractor selection, construction document and drawing submittal review, and DMM implementation and testing, to observe compliance with the design concepts, specifications, and recommendations presented in this addendum and the project Geotechnical Report (Fugro, , March 31, 2023). Our presence will also allow us to modify design if unanticipated subsurface conditions are encountered.

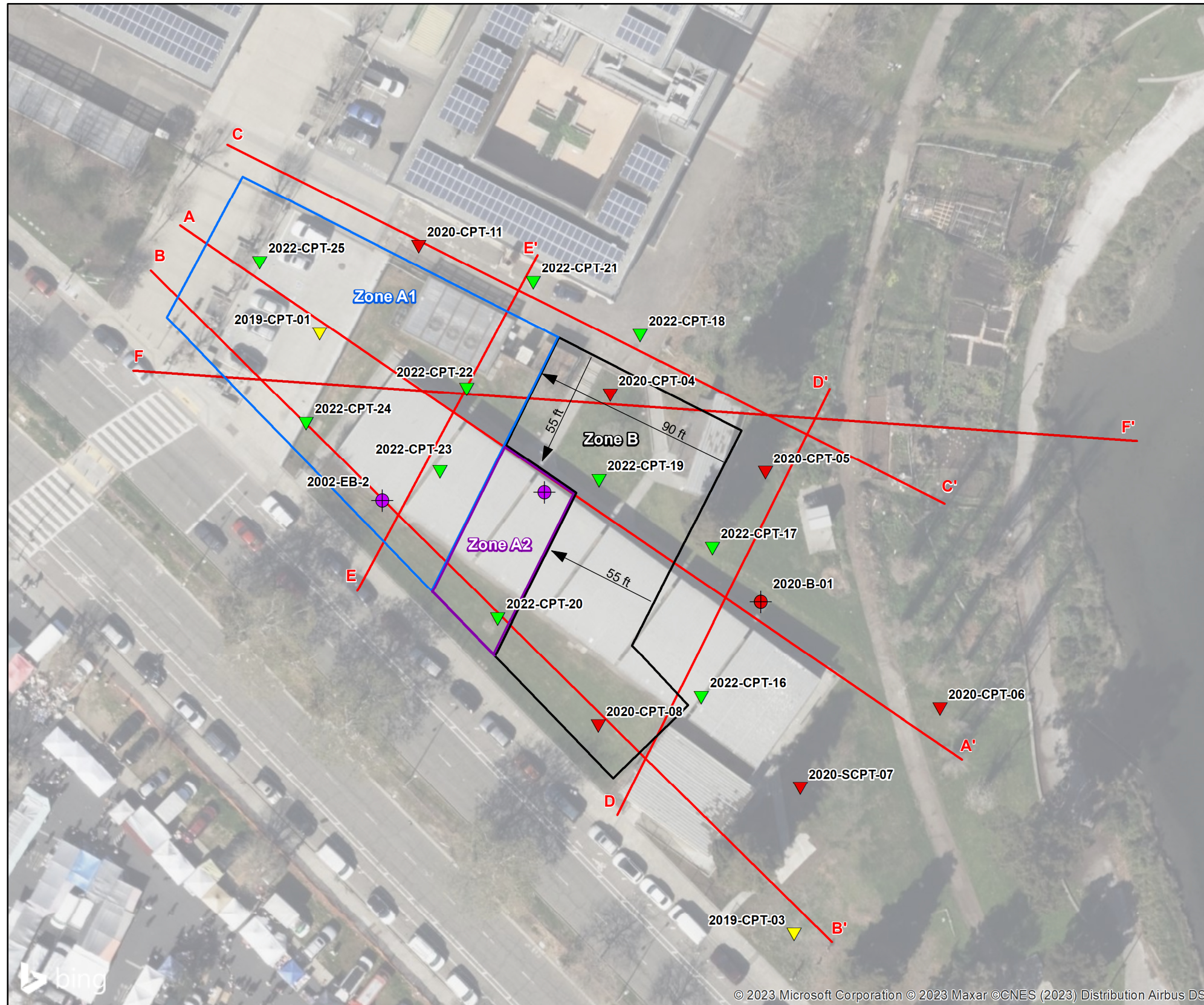
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Legend

- Cross section
- ▼ Cone Penetration Test by Gregg Drilling LLC (October 7, 2022)
- ▼ Cone Penetration Test by Fugro (Oct 2020, Fugro No. 04.00174369)
- ▼ Cone Penetration Test by Fugro (Mar 2019 & Jan 2020, Fugro No.04.72190021)
- ⊕ Exploratory Boring by WCS (Nov 1965, WCS No. S10312)
- ⊕ Exploratory Boring by Fugro (Oct 2020, Fugro No. 04.00174369)
- Zone A1: DMM Columns Tip Elev. = -15 ft
- Zone A2: DMM Columns Tip Elev. = -35 ft
- Zone B: DMM Columns Tip Elev. = -35 ft

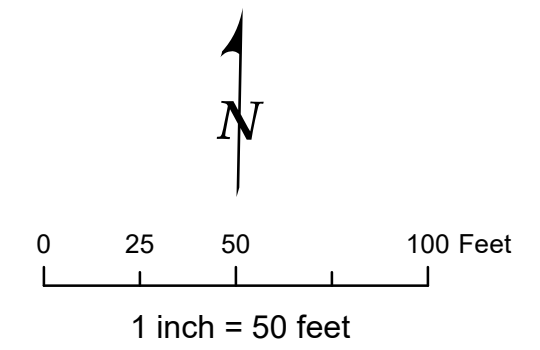


Plate I-1: Ground Improvement Plan

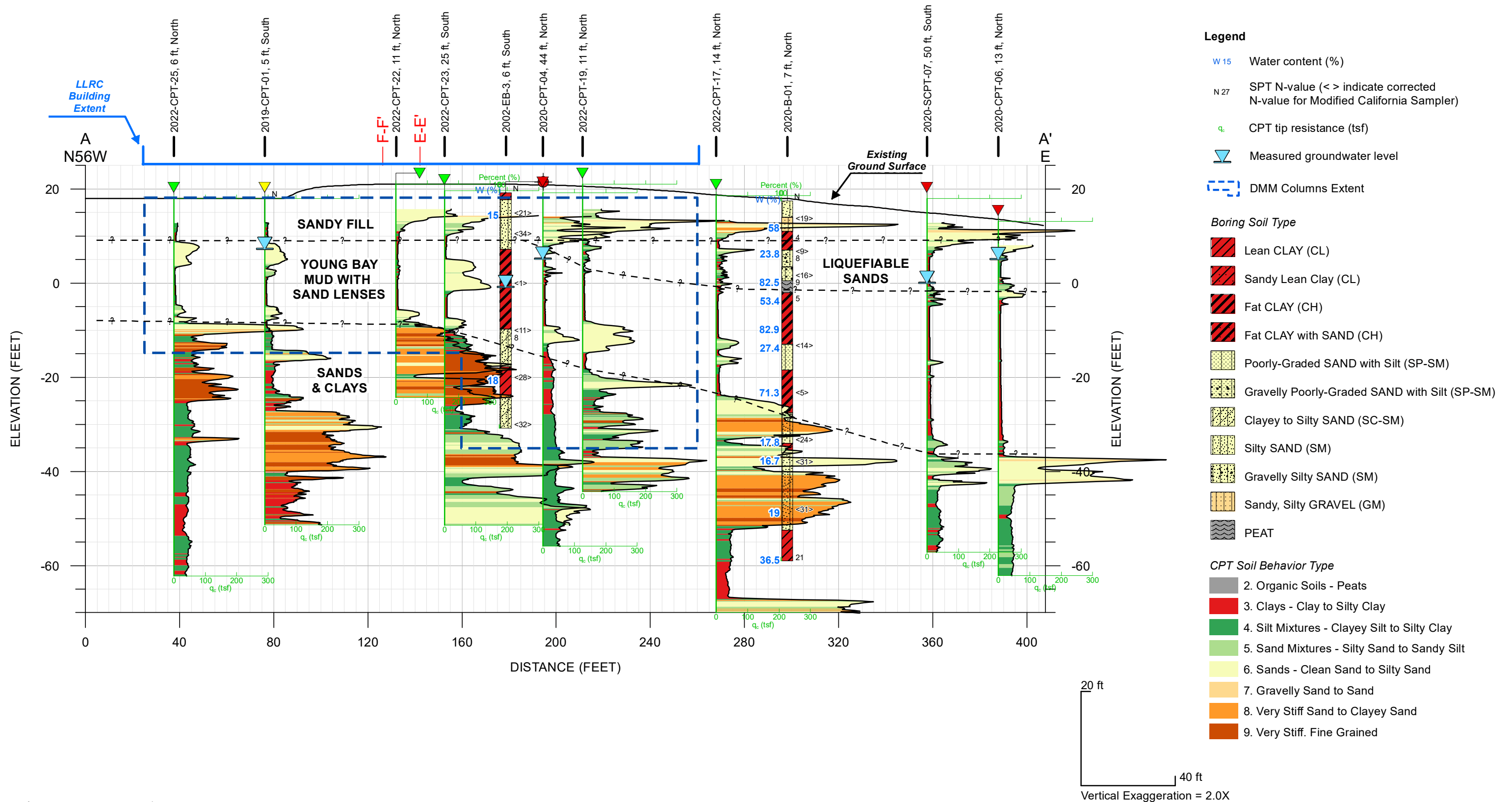


Plate I-2a: Cross Section A-A'

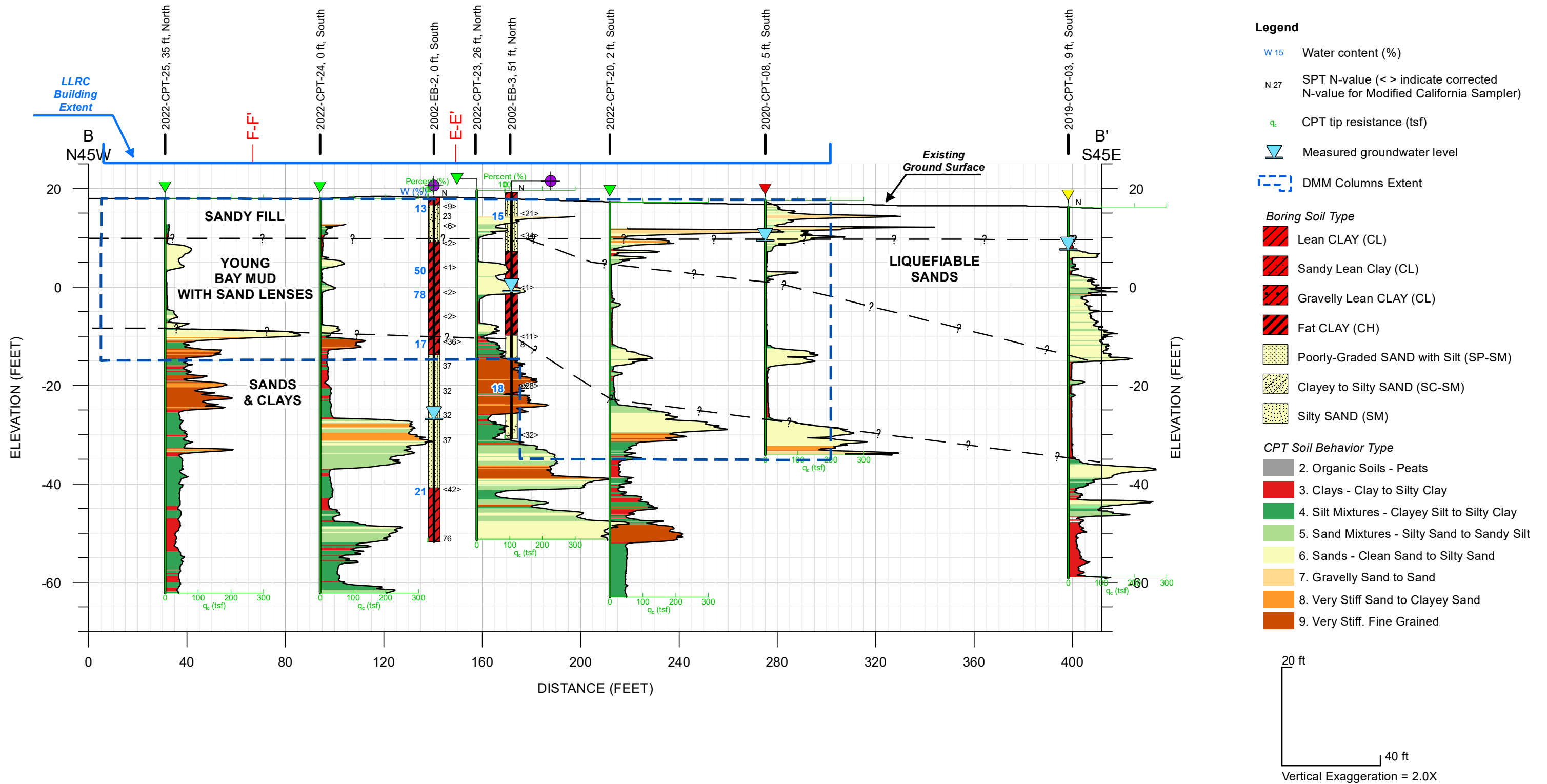


Plate I-2b: Cross Section B-B'

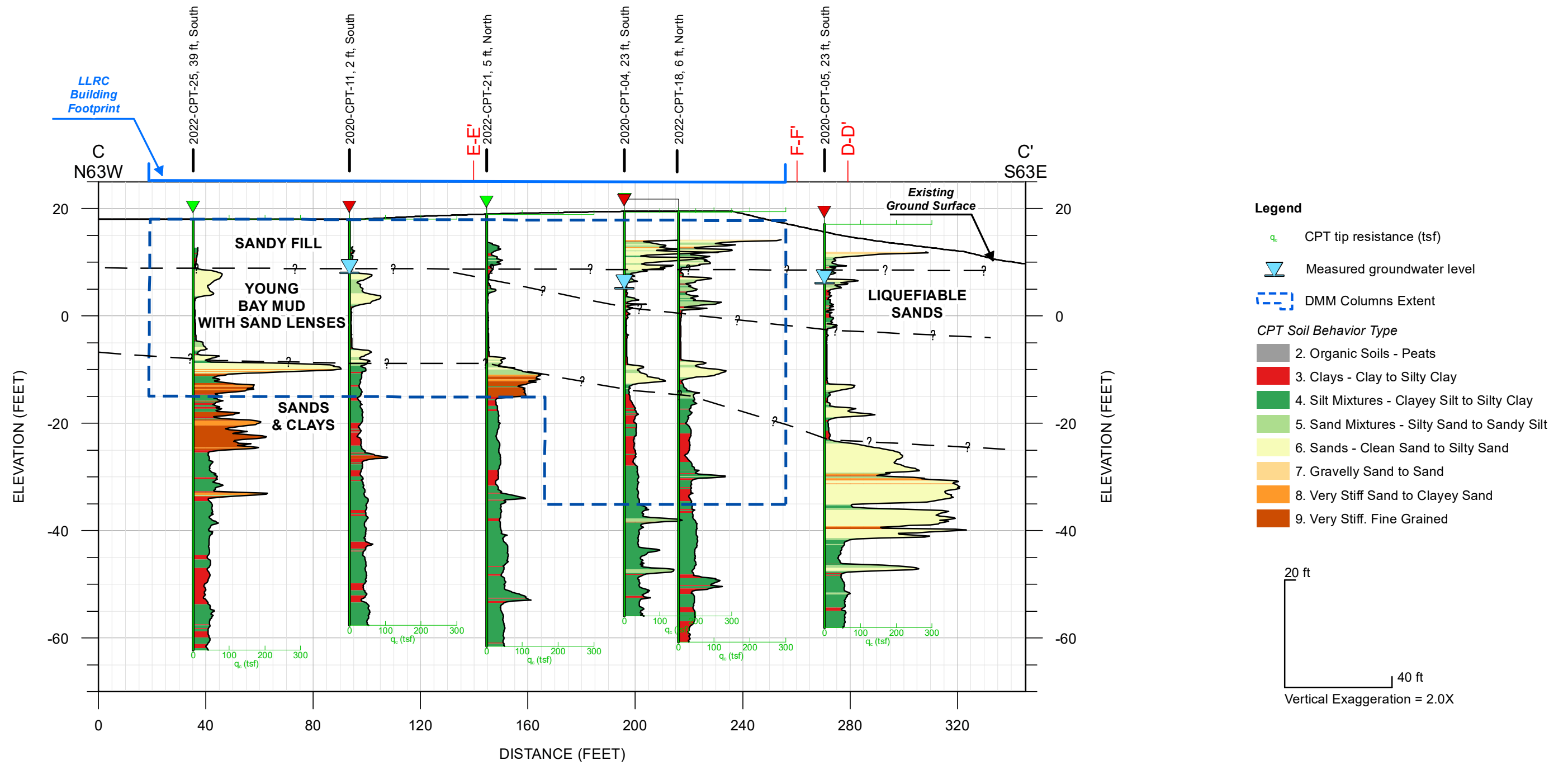
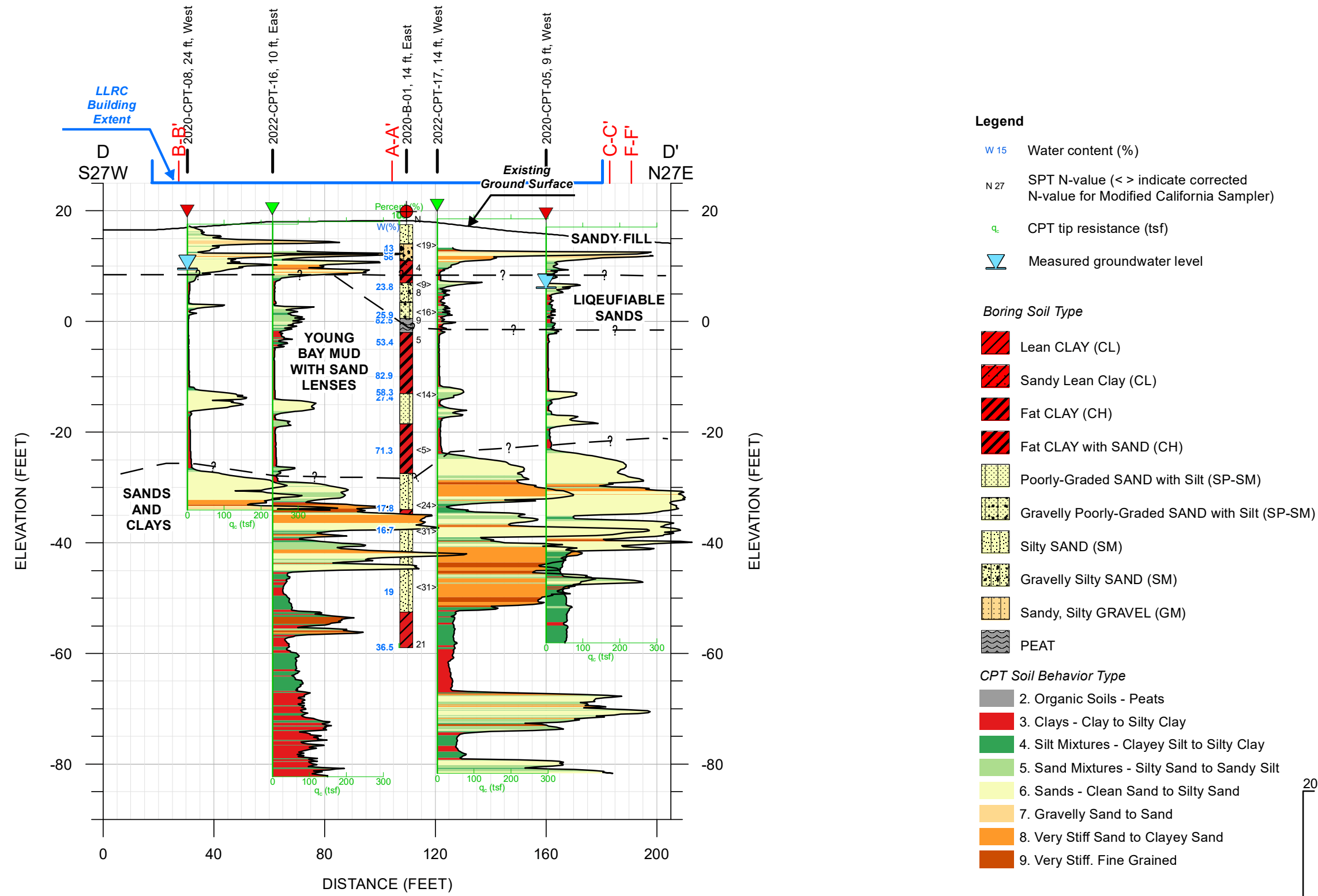


Plate I-2c: Cross Section C-C'



- Legend**
- W 15 Water content (%)
 - N 27 SPT N-value (< > indicate corrected N-value for Modified California Sampler)
 - q_c CPT tip resistance (tsf)
 - Measured groundwater level
- Boring Soil Type**
- Lean CLAY (CL)
 - Sandy Lean Clay (CL)
 - Fat CLAY (CH)
 - Fat CLAY with SAND (CH)
 - Poorly-Graded SAND with Silt (SP-SM)
 - Gravelly Poorly-Graded SAND with Silt (SP-SM)
 - Silty SAND (SM)
 - Gravelly Silty SAND (SM)
 - Sandy, Silty GRAVEL (GM)
 - PEAT
- CPT Soil Behavior Type**
- 2. Organic Soils - Peats
 - 3. Clays - Clay to Silty Clay
 - 4. Silt Mixtures - Clayey Silt to Silty Clay
 - 5. Sand Mixtures - Silty Sand to Sandy Silt
 - 6. Sands - Clean Sand to Silty Sand
 - 7. Gravelly Sand to Sand
 - 8. Very Stiff Sand to Clayey Sand
 - 9. Very Stiff. Fine Grained

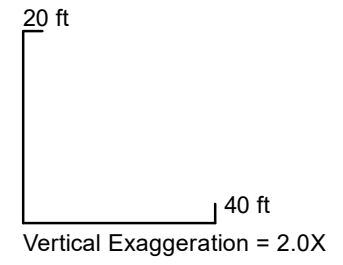


Plate I-2d: Cross Section D-D'



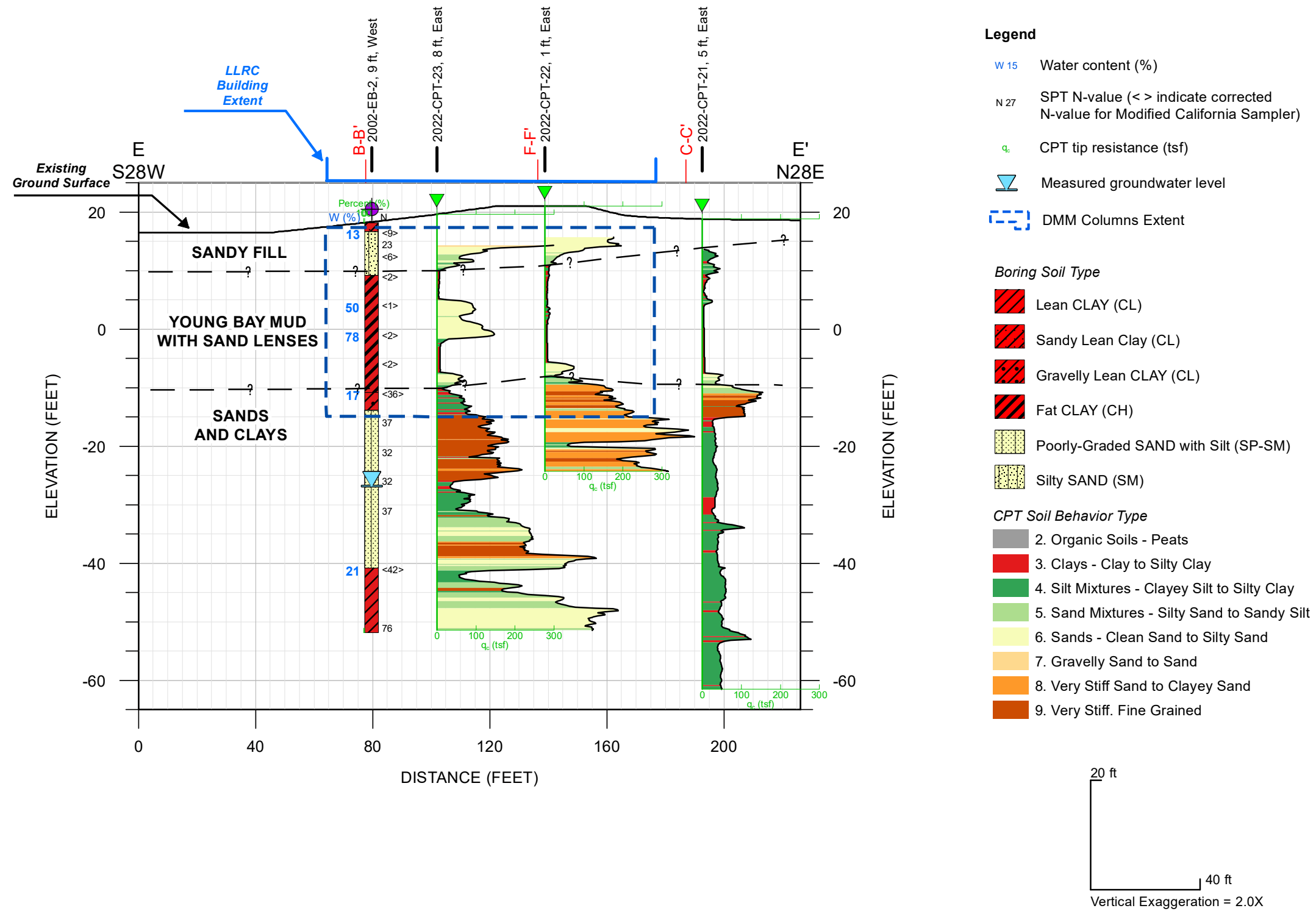
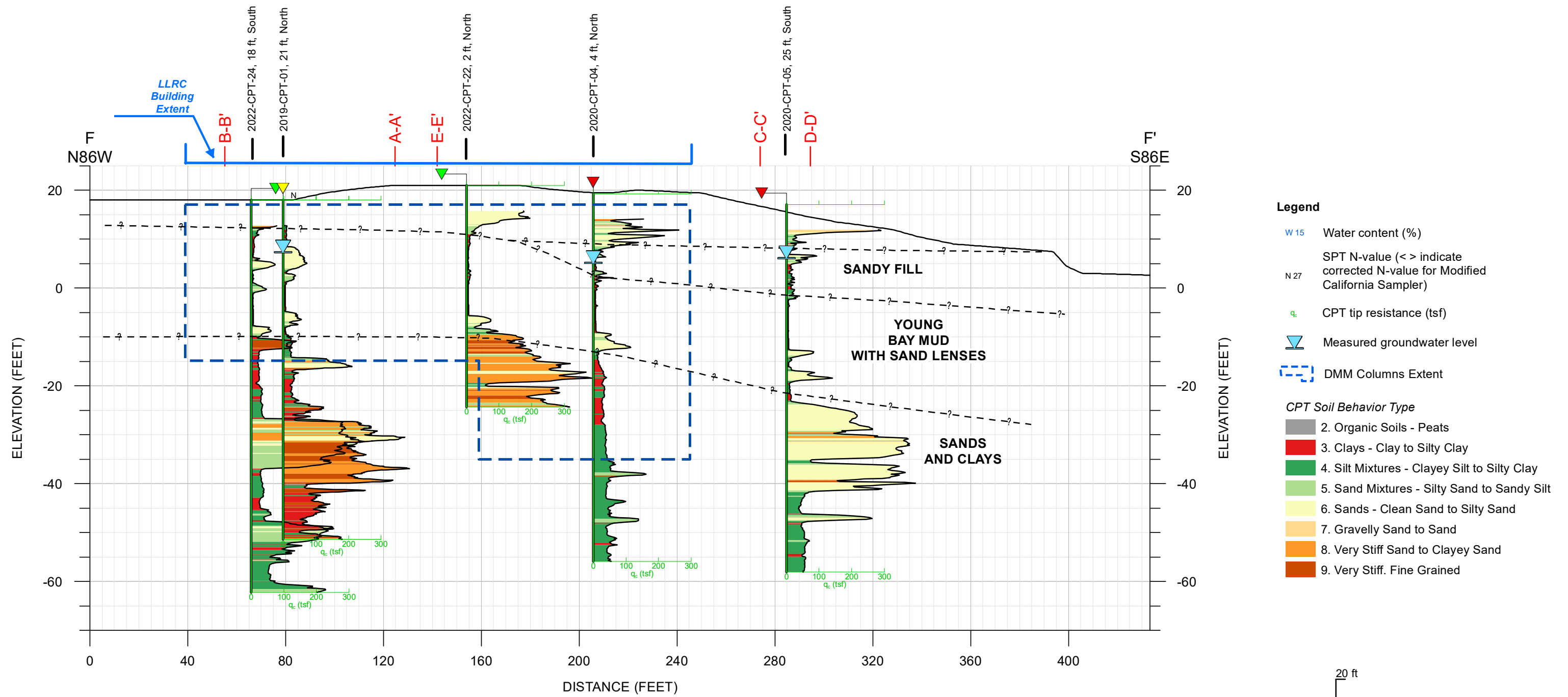


Plate I-2e: Cross Section E-E'



- Legend**
- W 15 Water content (%)
 - N 27 SPT N-value (< > indicate corrected N-value for Modified California Sampler)
 - q_c CPT tip resistance (tsf)
 - Measured groundwater level
 - DMM Columns Extent
- CPT Soil Behavior Type**
- 2. Organic Soils - Peats
 - 3. Clays - Clay to Silty Clay
 - 4. Silt Mixtures - Clayey Silt to Silty Clay
 - 5. Sand Mixtures - Silty Sand to Sandy Silt
 - 6. Sands - Clean Sand to Silty Sand
 - 7. Gravelly Sand to Sand
 - 8. Very Stiff Sand to Clayey Sand
 - 9. Very Stiff. Fine Grained

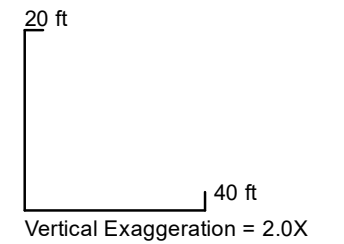


Plate I-2f: Cross Section F-F'

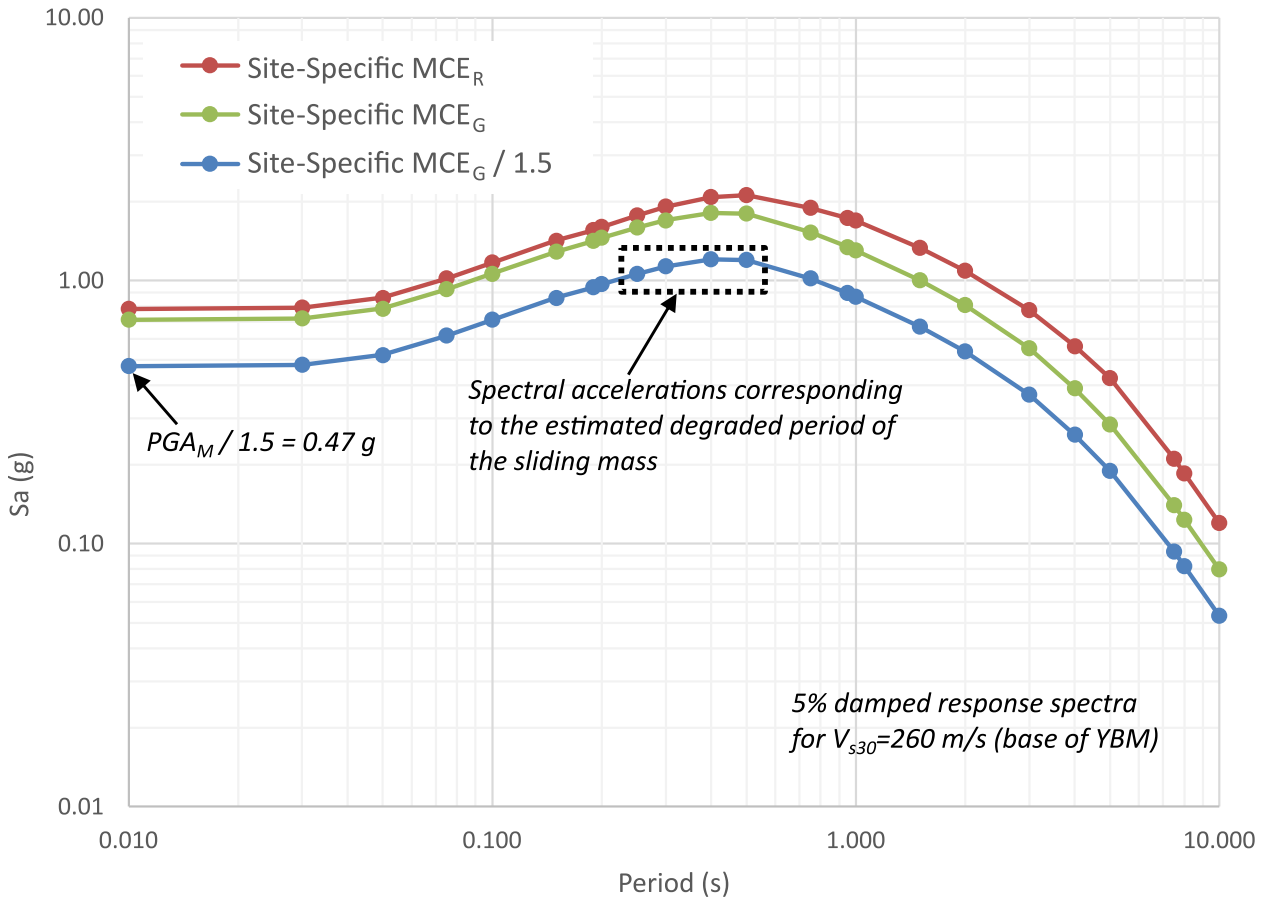


Plate I-3: Acceleration Response Spectra at Base of YBM ($V_{s30} = 260$ m/s)

Title: Laney College Library Learning Resource Center
 File Name: Section F_rev03.gsz
 Name: DSM_I_b_mp
 Horz Seismic Coef.: 0.35
 Method: Morgenstern-Price
 Date: 05/04/2022

Color	Name	Model	Unit Weight (pcf)	Minimum Strength (psf)	Tau/Sigma Ratio	Undrained Shear Strength vs Vertical Effective Stress Function	Cohesion' (psf)	Phi' (°)
■	DSM Composite	Mohr-Coulomb	120				5,000	0
■	Post-Liquefaction Sand (K&W)	SHANSEP	110	0		Kramer and Wang (2015) N160=15		
■	Sand and Clay	Mohr-Coulomb	130				0	40
■	Sandy Fill	Mohr-Coulomb	120				0	35
■	Young Bay Mud (During Earthquake)	SHANSEP	90	200	0.22			

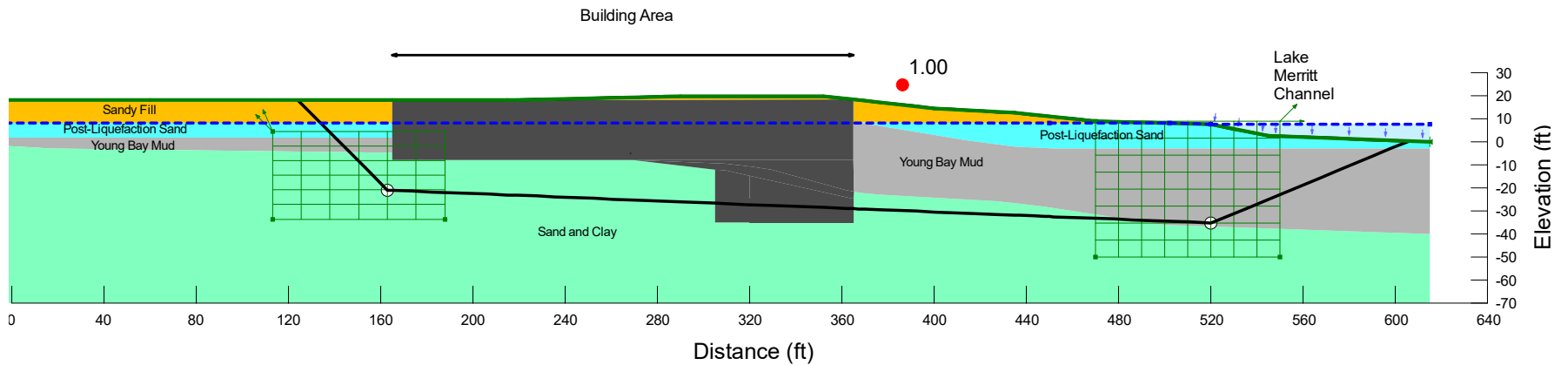


Plate I-4a: Pseudostatic Slope Stability Analysis for DMM Ground Improvement for $k_h = 0.35$ and Block Slip Surface

Title: Laney College Library Learning Resource Center
 File Name: Section F_rev03.gsz
 Name: DSM_I_c_mp
 Horz Seismic Coef.: 0.35
 Method: Morgenstern-Price
 Date: 05/04/2022

Color	Name	Model	Unit Weight (pcf)	Minimum Strength (psf)	Tau/Sigma Ratio	Undrained Shear Strength vs Vertical Effective Stress Function	Cohesion' (psf)	Phi' (°)
■	DSM Composite	Mohr-Coulomb	120				5,000	0
■	Post-Liquefaction Sand (K&W)	SHANSEP	110	0		Kramer and Wang (2015) N160=15		
■	Sand and Clay	Mohr-Coulomb	130				0	40
■	Sandy Fill	Mohr-Coulomb	120				0	35
■	Young Bay Mud (During Earthquake)	SHANSEP	90	200	0.22			

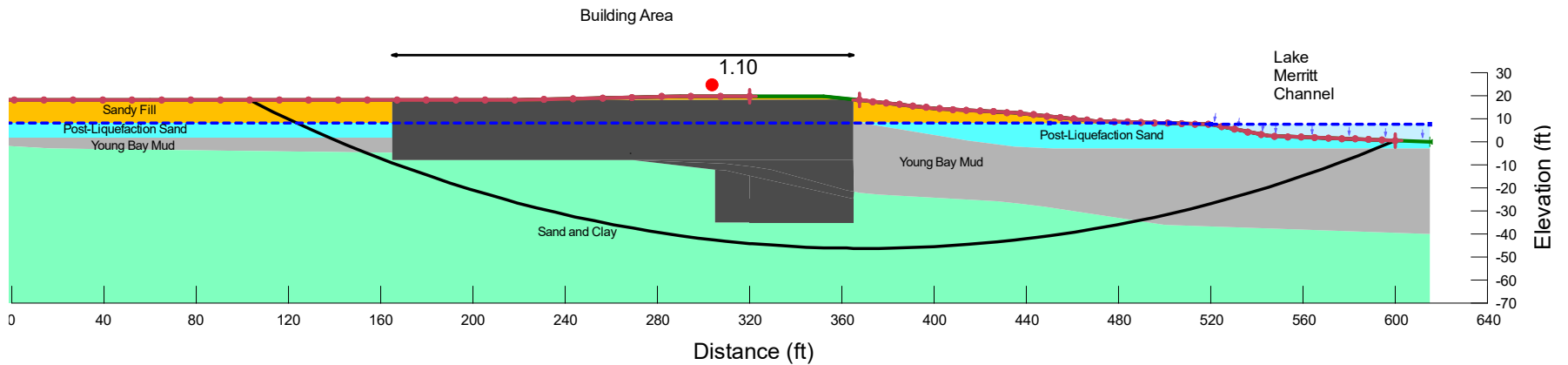


Plate I-4b: Pseudostatic Slope Stability Analysis for DMM Ground Improvement for $k_h = 0.35$ and Circular Slip Surface

Title: Laney College Library Learning Resource Center
 File Name: Section F_rev03.gsz
 Name: DSM_I_c_mp
 Horz Seismic Coef.: 0.35
 Method: Morgenstern-Price
 Date: 05/04/2022

Color	Name	Model	Unit Weight (pcf)	Minimum Strength (psf)	Tau/Sigma Ratio	Undrained Shear Strength vs Vertical Effective Stress Function	Cohesion' (psf)	Phi' (°)
■	DSM Composite	Mohr-Coulomb	120				5,000	0
■	Post-Liquefaction Sand (K&W)	SHANSEP	110	0		Kramer and Wang (2015) N160=15		
■	Sand and Clay	Mohr-Coulomb	130				0	40
■	Sandy Fill	Mohr-Coulomb	120				0	35
■	Young Bay Mud (During Earthquake)	SHANSEP	90	200	0.22			

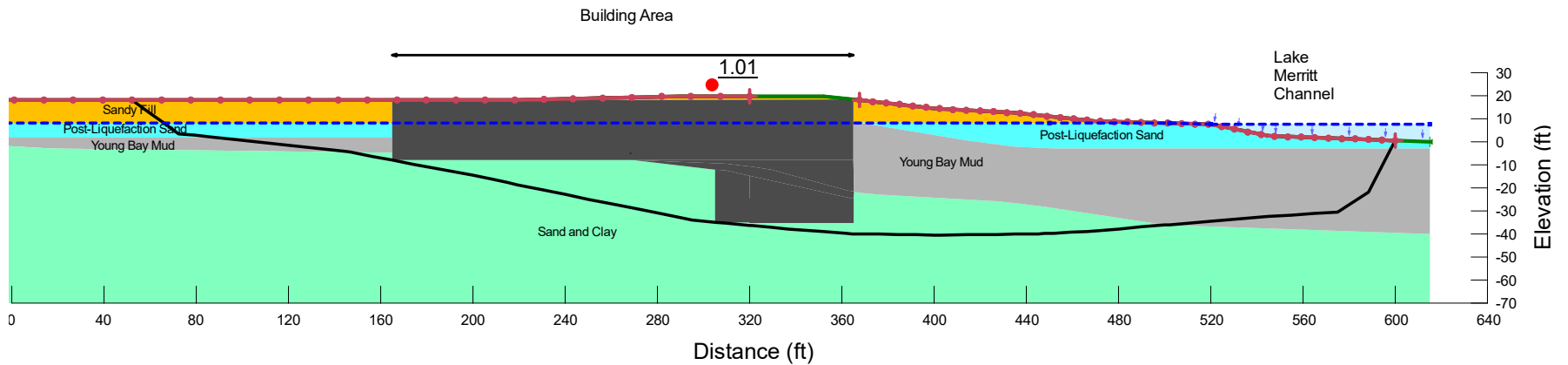


Plate I-4c: Pseudostatic Slope Stability Analysis for DMM Ground Improvement for $k_h = 0.35$ and Optimized Circular Slip Surface

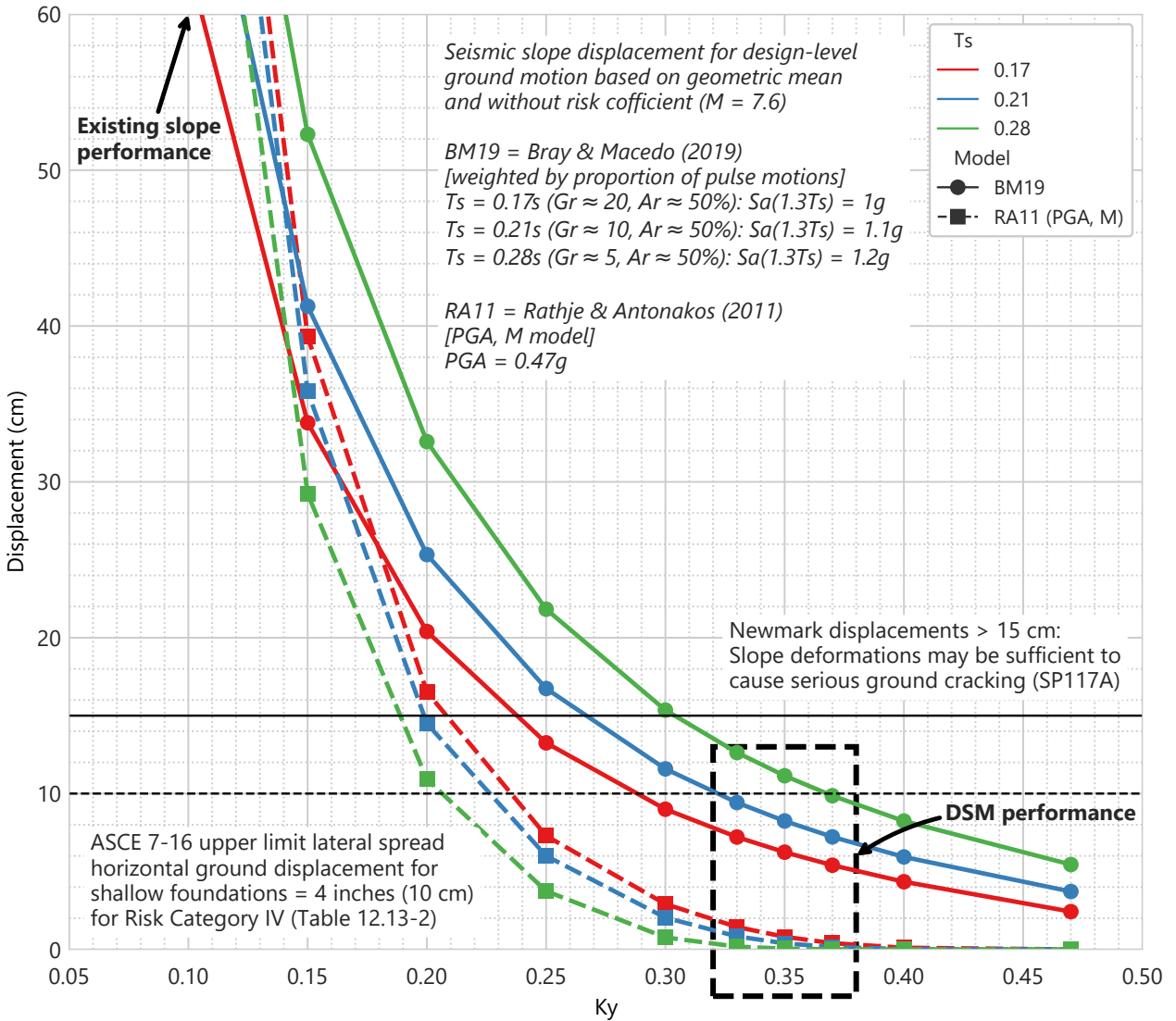


Plate I-5: Seismic Slope Displacement vs. Yield Coefficient

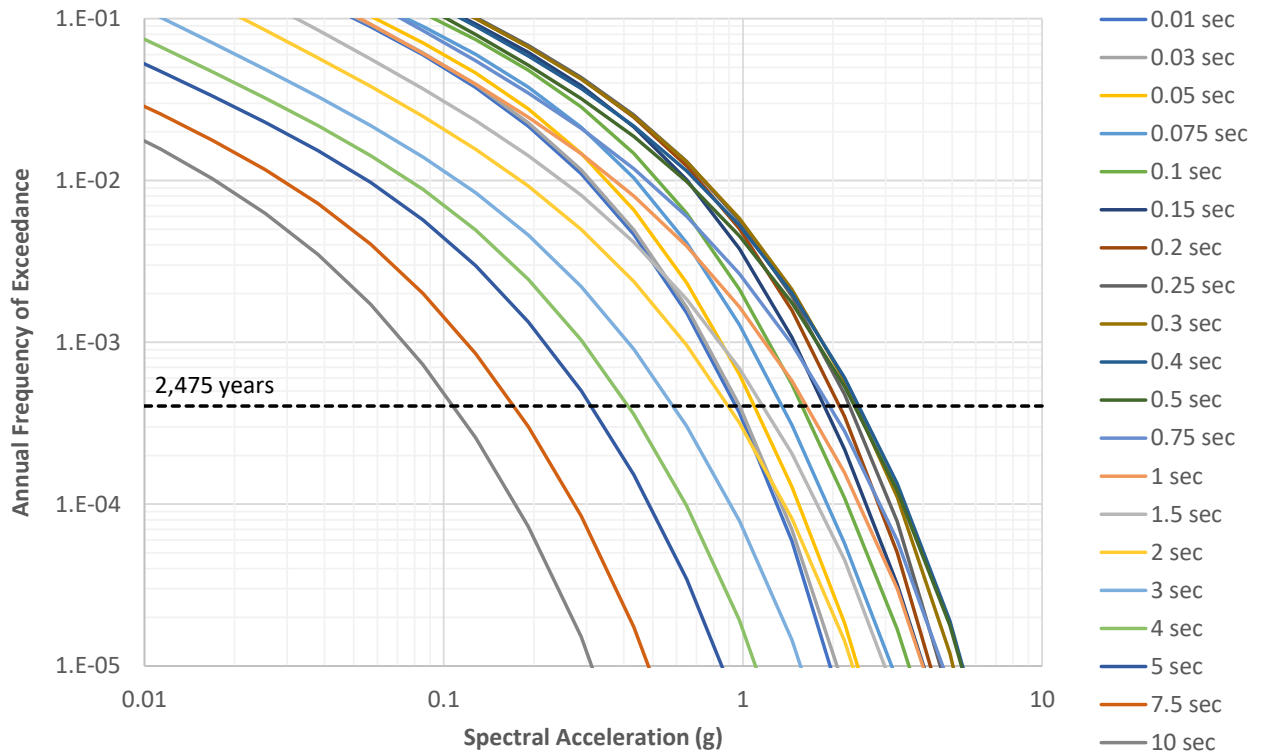


Plate I-6: Mean Annual Seismic Hazard Curves for V_{s30} of 270 m/s

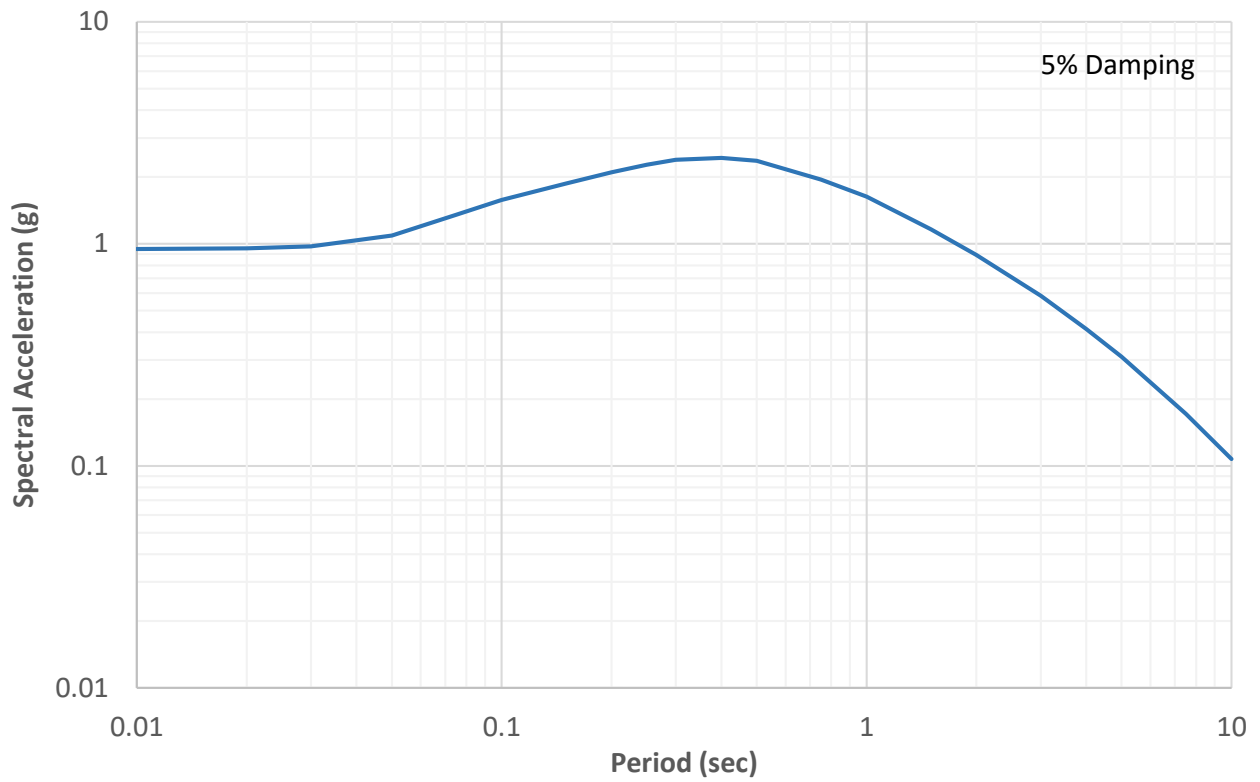


Plate I-7: Mean Horizontal Uniform Hazard Response Spectrum for a Return Period of 2,475 Years and V_{s30} of 270 m/s

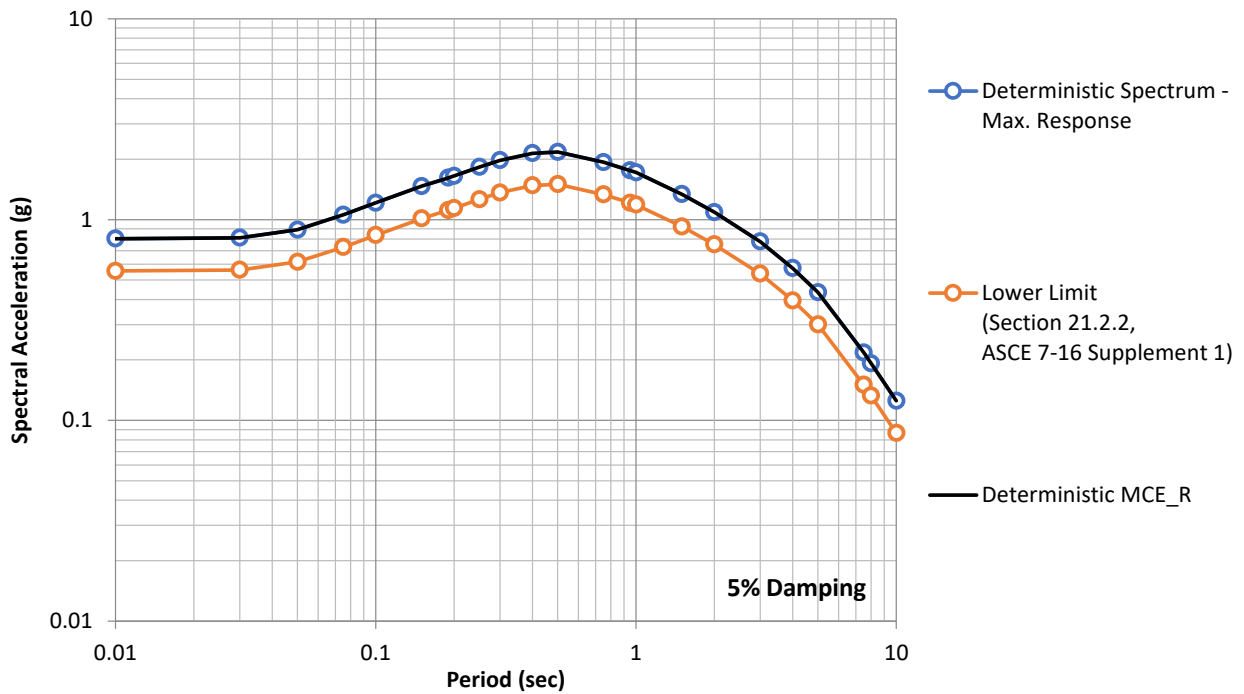
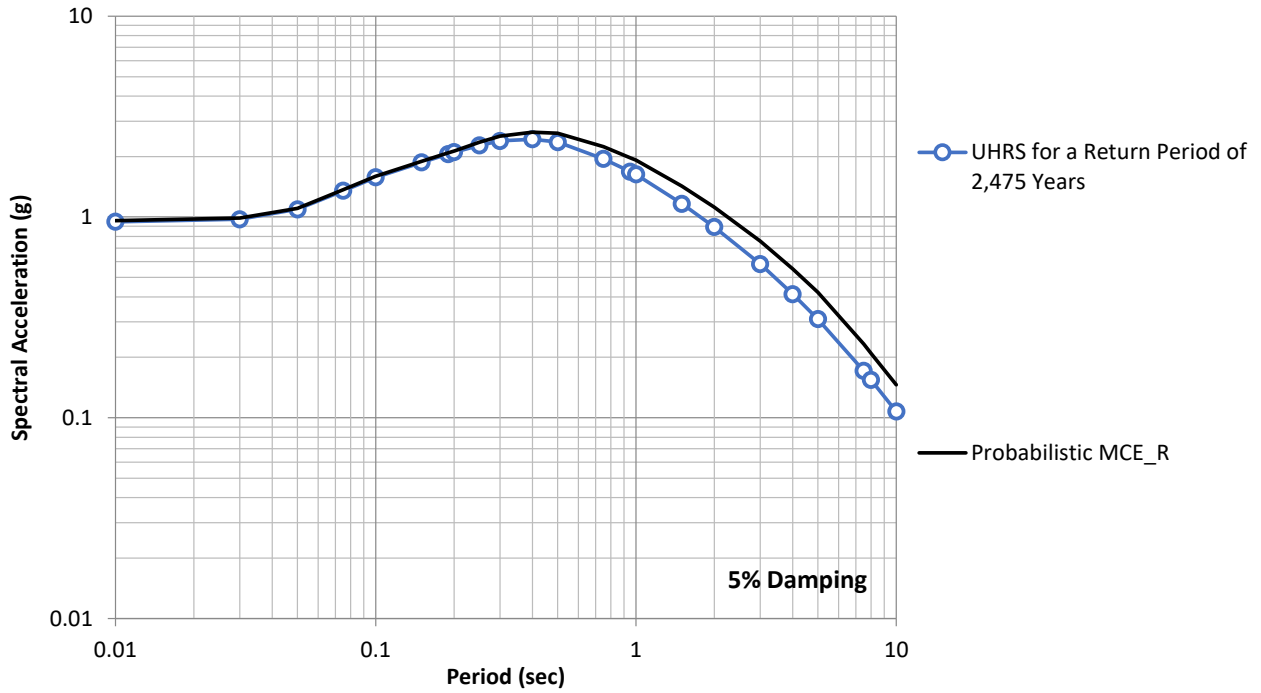


Plate I-8: Calculation of the Probabilistic and Deterministic Horizontal MCE_R Response Spectra per ASCE 7-16 for V_{s30} of 270 m/s

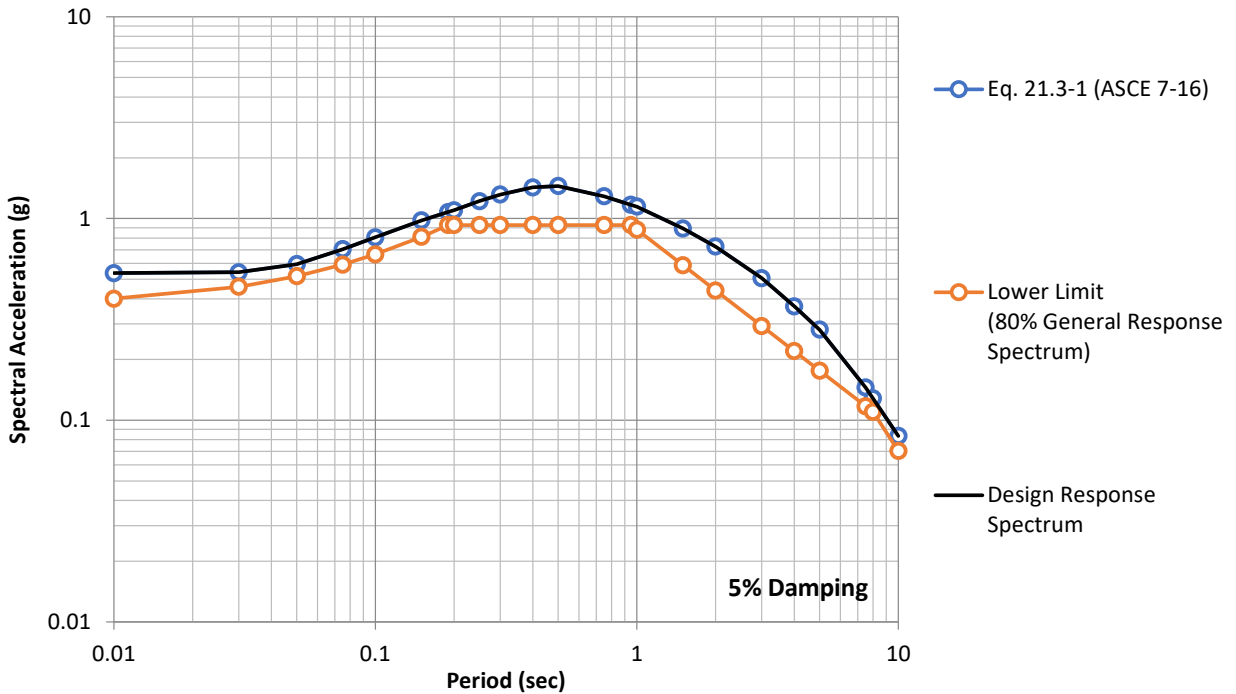
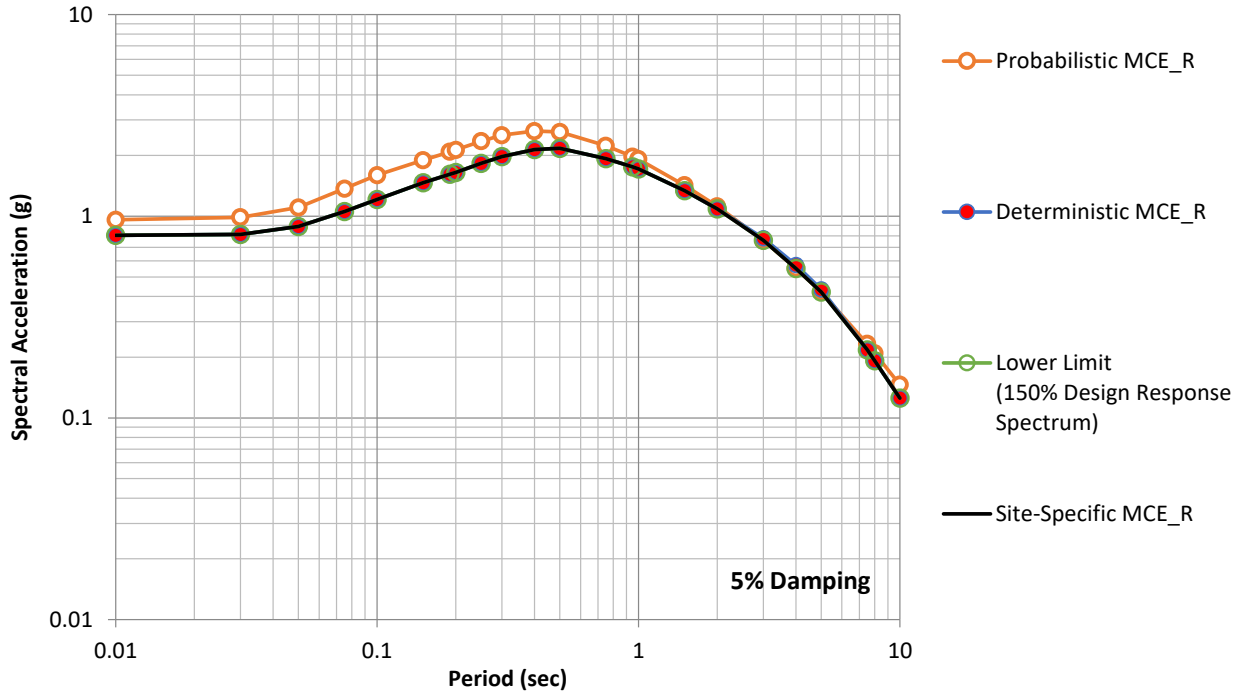


Plate I-9: Calculation of the Site-Specific Horizontal MCE_R and Design Response Spectra per ASCE 7-16 for V_{s30} of 270 m/s

Appendix C

Construction Specification for Deep Mixing

Deep Mixing Method (DMM)

A.1 Part 1 – General

A.1.1 Scope

1. The Deep Mixing Method (DMM) Contractor shall furnish all plant, equipment, labor, and materials required to construct and perform Quality Control of the DMM in accordance with the DMM Design Plans and Specifications.
2. The purpose of DMM ground improvement is to reduce seismically induced slope displacements and settlements to acceptable levels and to provide vertical and lateral support for shallow foundation systems for the Laney College Library & Learning Resource Center (LLRC) building for both static and seismic loadings. The DMM ground improvement consists of continuous underground overlapping deep mixed (DM) columns forming a series of DM walls that are arranged in a grid pattern to form a series of DM walls and blocks. The dimensions and layout of DM grids and blocks are shown on the DMM Design Plans and are described in **Section A.3.2** of this Specification.
3. This specification has been developed as a combination of performance and method specifications. The intent is that the DMM Contractor will select the means and methods for satisfying the acceptance criteria. The DMM Contractor will then demonstrate that the means and methods will satisfy the acceptance criteria using one or more test sections. Once the test section indicates satisfactory results, as determined by the Geotechnical Engineer, the DMM Contractor will follow the means and methods used to satisfy the acceptance criteria for all of the production DMM construction. If the DMM Contractor desires to change the means and methods during the course of production DMM, the changes need to first be approved by the Geotechnical Engineer and CGS. The Geotechnical Engineer may require additional test sections prior to approval of changes in means and methods.
4. The DMM Contractor shall be responsible for performing Quality Control (QC) during DMM construction, which includes QC documentation preparation and submittal, and sample collection, storage, and transportation. Sample testing shall be performed by a DSA approved testing laboratory hired by the Owner to verify that the acceptance criteria are satisfied. The Geotechnical Engineer shall make the determination as to whether the acceptance criteria have been met.
5. Upon completion of DMM installation, an as-built submittal package shall be prepared by the DMM Contractor and the Geotechnical Engineer to document that the installed DMM meets the project performance requirements. The as-built submittal package shall be submitted to CGS for approval. The submittal shall include test section results, daily quality control reports, DMM core and lab test results, as-built DMM record drawings, and any other information needed to document the work.

A.1.2 References

1. American Concrete Institute (ACI)
2. American Society of Testing and Materials (ASTM)
3. American Petroleum Institute (API)

A.1.3 Definitions

1. Area Replacement Ratio (Ar): A ratio of the surface area of soil-cement to the total surface area of ground to be improved within a given Treatment Zone. The total area of each Treatment Zone is measured to the outer tangent lines of the DMM columns along the entire Treatment Zone perimeter.
2. DMM: In situ ground treatment in which soil is blended with cementitious and/or other binder materials to improve strength, permeability, and/or compressibility characteristics (synonym terms include DSM, deep mixing, CDSM, and soil cement mixing).
 - a. The DMM grids and blocks are formed by an arrangement of at least two soil mixing shafts with overlapping augers and blades (paddles), guided by a lead mounted on a crawler base machine.
 - b. The mixing shafts shall be driven by a power source sufficient to provide torque for the wide range of expected drilling conditions, indicated by the available boring and CPT logs and other test data included in the Geotechnical Investigation Report (GIR) and planned future CPT logs prior to construction.
 - c. As the mixing shafts are advanced into the soil, grout is pumped through the hollow stem of the shafts and injected into the soil at the shaft tips. Auger flights and mixing blades on the shafts blend the soil with grout in a pugmill fashion. When the design depth is reached, the mixing shafts are withdrawn while the mixing process is continued.
 - d. The mixing shafts are positioned so as to overlap one another to form continuously mixed overlapping columns. After withdrawal, two (or more) overlapping soil-cement columns remain in the ground.
 - e. The process is then repeated to form grids and blocks of overlapping DMM columns.
3. DMM Design Addendum (DA): DMM Design Addendum No. 1 prepared by Fugro USA Land, Inc. dated June 10, 2022, and subsequent addenda.
4. DMM Elements: DMM columns will be used to create DMM grids and DMM blocks of treated soil referred to as ground improvement. A DMM grid will consist of interconnected DMM walls formed by partially overlapping columns arranged in a grid pattern with a replacement ratio less than 100 percent. A DMM block used to support a building footing will consist of interconnected DMM walls formed by overlapping columns arranged in a parallel pattern with a replacement ratio of 100 percent or less as shown in project plans and drawings. For this project, individual DMM Element refers to the grouping of columns installed simultaneously during single penetration of the DMM rig.
5. DMM Contractor: The firm performing the DMM construction.

6. DMM Layout Plan: The alternate DMM construction layouts designed by the DMM Contractor, which satisfy the requirements of this Specification. The DMM Layout Plans shall be reviewed and approved by the Geotechnical Engineer and Structural Engineer.
7. Cement Dosage: The amount of cement (in terms of dry weight) used to treat a given initial volume of in-situ soil.
8. Cone Penetrometer Test (CPT): A geotechnical exploration tool, as defined in ASTM D 5778.
9. Core Run: The total length reported by the driller as the actual depth penetrated by coring, including both recovered and unrecovered lengths.
10. Geotechnical Investigation Report (GIR): Geotechnical Investigation Report prepared by Fugro USA Land, Inc. dated February 28, 2020, and subsequent addenda. Note the DMM Design Addendum No. 1 (DA) supersedes the GIR.
11. Geotechnical Engineer: The geotechnical engineer of record responsible for the DMM design, who is hired by the Owner.
12. Ground Improvement Area: The plan area contained within a single perimeter shown on the DMM Design Plans that surrounds:
 - a. - All planned soil-cement grids/blocks.
 - b. - Unmixed soil within the grids.
13. Grout: A stable colloidal mixture of water, Portland cement, and admixtures. The purpose of the grout is to assist in loosening the soils for penetration and optimum mixing, and upon setting, to strengthen the in-situ soil.
14. Grout-Soil Ratio: A volumetric ratio of grout to in-situ soil to be mixed.
15. Owner: Peralta Community College District and its representatives.
16. Structural Engineer: The structural engineer of record responsible for designs of structure foundations supported by DMM, who is hired by the Owner.
17. Testing Laboratory: The testing laboratory of record performing construction material testing, which is hired by the Owner and approved by the Geotechnical Engineer. The Testing Laboratory shall be selected from the DSA approved laboratory list.
 - a. Treatment Zone: A spatial zone of soil targeted for ground improvement. The vertical and lateral (horizontal) extents of the Treatment Zones are defined on the DMM Design Plans.

A.1.4 Submittals

1. Evidence of conformance to the referenced standards and requirements shall be submitted by the DMM Contractor to the Geotechnical Engineer for the following, but not limited to, in accordance with the requirements in this Specification.
 - a. Cement: Certificate of compliance for each truck load delivery.
 - b. Admixtures: If used, certificate of compliance for each load or lot of material delivered.
 - c. Preliminary Mix Design: Proposed mix designs including all materials and quantities and documentation of calibration of the grout mixing plant.

- d. Proposed Test Section Program, Sampling Plan, and Laboratory Testing Program, conforming to the requirements described in this Section.
- e. Construction Schedule: Submit a detailed schedule that identifies start dates and duration of each major task in the work. The schedule shall at a minimum include information regarding equipment mobilization, equipment setup, soil-cement mixing test section, production installation, and verification testing.
- f. Site Work Plan: Submit a site plan showing staging area for all on-site equipment, including anticipated sections of the streets which may require blocking of parking spaces or traffic clearances.
- g. DMM Layout Plans: Submit 1"=20' scale drawings showing proposed layout of DMM Elements (including test section(s) and production DMM), including column diameters, column overlap, grid sizes, tip elevations, top elevations, coordinates of the corners, foundations, and proposed column and element numbering scheme prior to site mobilization in hard copy and electronic format using the project coordinate system at least 14 calendar days prior to beginning DMM construction. The DMM Contractor must obtain the Geotechnical Engineer's approval of the proposed column layout prior to beginning DMM construction.
- h. Equipment and Procedures: Submit a detailed description of the equipment and procedures to be used during all DMM work including, but not limited to, construction of DMM test section(s), production DMM work, and collecting samples for laboratory confirmation testing. Procedures shall include methods for locating the DMM Elements in the field and confirming that the columns are plumb. In addition, while it is recognized that the specific responses to field difficulties are dependent on several factors, the DMM Contractor shall submit their anticipated responses to the following possible situations that could occur during construction and testing of the DMM columns including poor core sample recovery or inability to retrieve core samples, and failing production test results (e.g., repair and/or treatment of failed area and modification to approved procedures or mix design).
- i. The DMM Contractor shall also submit the anticipated cement dosages (proportions) to achieve the acceptance criteria outlined under acceptance criteria in **Section A.3.15** of this Specification.
- j. Quality Control Program, as outlined in the Execution Section of this Specification.
- k. Daily Quality Control Reports: Prior to construction, submit a proposed Daily Quality Control Report format for approval by the Geotechnical Engineer. Submit the Daily Quality Control Report at the end of the next working day. The report should be in conformance with quality control in **Section A.3.14** of this Specification.
- l. DMM Test Results: Submit all QC test results as outlined in quality control in **Section A.3.14** of this Specification.

- m. Calibrations: Submit all metering equipment calibration test results including mixing systems, delivery systems, alignment systems, and mixing tool rotational and vertical speed.
 - n. Record Drawing: Submit record drawings prepared by the DMM Contractor indicating the as-built location and elevations of the DMM Elements in terms of project coordinates and vertical datum. The record drawings shall also indicate the above structure foundation designs and locations.
2. Upon completion of DMM installation, the as-built submittal by the DMM Contractor to the Geotechnical Engineer, Structural Engineer, and CGS shall include test section results, daily quality control reports, DMM core and lab test results, DMM record drawings, and any other information needed to document the work.

A.2 Part 2 – Products, Materials, and Equipment

A.2.1 Materials

1. Grout: The material added to the blended in situ soils shall be a water-based Portland cement grout. The purposes of the grout are to assist in loosening the soils for penetration and optimum mixing, and upon setting, to strengthen the in-situ soils. The grout shall be premixed in a mixing plant which combines dry materials and water in predetermined proportions.
2. Cement used in preparing the grout shall conform to ASTM C150 “Standard Specification for Portland Cement Type II”. The cement shall be adequately protected from moisture and contamination while in transit to and in storage at the job site. Reclaimed cement or cement containing lumps or deleterious matter shall not be used.
3. Water: Fresh water, free of deleterious substances that adversely affect the strength and mixing properties of the grout, shall be used to manufacture grout.
4. Admixtures: Admixtures are ingredients in the grout other than Portland cement, and water. Admixtures of softening agents, dispersions, pozzolans, retarders or plugging or bridging agents may be added to the water or the grout to permit efficient use of materials and proper workability of the grout. However, no admixtures shall be used except as approved by the Geotechnical Engineer.

A.2.2 Equipment

The DMM equipment shall meet the following requirements:

1. The mixing tools shall have mixing augers and blades (paddles) configured in such a manner so that they are capable of thoroughly blending the in-situ soils and grout.
 - a. Multi-shaft mixing equipment (machines with at least two soil mixing shafts with overlapping augers and blades) shall be used.

- i. The mixing augers and blades shall be minimum 3 feet and maximum of 6 feet in diameter.
 - ii. Allowable wear to mixing augers and blades will be limited such that equipment produces a column no less than the design diameter listed on the DMM Layout Plans.
 - iii. The overlapping between any two adjacent DMM columns shall be at least 30 percent of the column diameter.
 - b. The power source for driving the mixing shafts shall:
 - i. be sufficient to provide torque for the wide range of expected drilling conditions, indicated by available boring and CPT logs and other test data included in the Geotechnical Investigation Report (GIR) and DMM Design Addendum (DA).
 - ii. be sufficient to maintain the required revolutions per minute (RPM) and penetration rate from a stopped position at the maximum depth required.
2. The DMM rig shall be equipped with electronic sensors built into the leads to determine vertical alignment in two directions: fore-aft and left-right.
 - a. The sensors shall be calibrated at the beginning of the project and the calibration data shall be provided to the Geotechnical Engineer. The calibration shall be repeated at intervals not to exceed three months per rig.
 - b. The output from the sensors shall be routed to a console that is visible to the operator and the Geotechnical Engineer during penetration and reported. The console shall be capable of indicating the alignment angle in each plane.
3. The DMM equipment shall be adequately marked to allow the Geotechnical Engineer to confirm the penetration depth to within 6 inches during construction.
4. The grout shall be premixed in an on-site mixing plant, using a batch process, which combines dry materials and water in predetermined proportions. The mixing plant shall consist of a grout mixer, grout agitator, grout pump, batching scales, and a computer control unit.
 - a. Dry materials shall be stored in silos. The dry materials shall be transported to the project site and blown into the on-site storage tanks using a pneumatic system.
 - b. The air evacuated from the storage tanks during the loading process shall be filtered before being discharged to the atmosphere.
 - c. Automatic batch scales shall be used to accurately determine mix proportions for water and cement during grout preparation.
 - d. The dry admixtures, if used for mixing with water and cement, can be delivered to the mixing plant by calibrated auger. However, the DMM Contractor shall demonstrate that the calibrated auger can deliver the quantity of dry admixture with accuracy equivalent to that measured and delivered by weight.

- e. Calibration of mixing components shall be done at the beginning of the project and repeated at intervals not to exceed three months thereafter and after each move of the batch plant.
5. Positive displacement pumps shall be used to transfer the grout from the mixing plant to the mixing tool head. The grout shall be delivered to each slurry-injecting tool head by an individual positive displacement pump.
6. The DMM rig shall be equipped with sensors to continuously monitor and record the mixing tool penetration/withdrawal speed, mixing tool rotation speed, and injection rate.
 - a. The output from these sensors shall be visible to the Operator and Geotechnical Engineer during penetration and withdrawal.
 - b. The DMM Contractor may propose alternative display/monitoring systems; however, the systems shall first be reviewed and approved by the Geotechnical Engineer prior to use.
 - c. Calibration of this equipment shall be performed at the beginning of the project and the calibration data shall be provided to the Geotechnical Engineer. The calibration shall be repeated at intervals not to exceed three months.

A.2.3 Products

1. DMM: The in-place grout mix together with the soils shall meet all of the acceptance criteria specified in **Section A.3.15** of this Specification, determined according to the quality control, sampling, and testing methods specified in **Section A.3.14** of this Specification.

A.3 Part 3 – Execution

A.3.1 Observation of Work

1. The work covered by these specifications shall be performed under the observation of the Geotechnical Engineer, who shall be retained and paid by the Owner. The Geotechnical Engineer will be present at the site during the conduct of work to observe the work, and to perform field and laboratory tests, as deemed necessary by the Owner. The DMM Contractor shall cooperate with the Geotechnical Engineer in performing the observations and tests. At the completion of their work, the Geotechnical Engineer shall submit a report to the Owner, including a tabulation of all tests performed. The Geotechnical Engineer's costs for observing the construction, testing, and the repair of unsatisfactory work performed by the DMM Contractor shall be billed to the Owner. The Owner shall pay them and then shall deduct the amount from monies due to the DMM Contractor.
2. This work falls under the jurisdiction of the California Division of State Architect (DSA) who will review submittals and may observe portions of the work.

A.3.2 General

1. The soil-mixing shall be constructed by the DMM Contractor to the lines, grades, and cross sections indicated on the DMM Design Plans example layouts or an alternate layout approved by the Geotechnical Engineer, Structural Engineer, and CGS. Revisions to the approved layouts shall be submitted to Geotechnical Engineer of Record (GEOR) for review and approval. DMM ground improvement within a single structure shall be arranged in an uninterrupted grid that follows the structure column lines and underlies all footings and moment frame grade beams, tie beams, and shear walls as shown on the DMM Design Plans.
2. As shown on the DMM Design Plans, the DMM shall underlie the entire structure footprints and extend laterally to include any attached structures which are deemed to be essential parts of the structures.
3. Grading after the site demolition may be required to provide suitable level ground for constructing the DMM. The DMM contractor is responsible for coordinating with the site grading operation to define the Drill-Through Zone.
4. The minimum Area Replacement Ratio (A_r) for DMM grids and blocks and the maximum spacing for DMM grids depends on the specified unconfined compressive strength ($q_{dm,spec}$) as shown in **Table A.1**. Additional DMM Elements may be added within the untreated area to meet or reduce the slab free span distance as instructed by the Geotechnical and Structural Engineer.

Table A.1: Minimum DMM A_r and Maximum DMM Grid Spacing

Specified Unconfined Compression Strength, $q_{dm,spec}$ (psi)	Minimum A_r (%)	Zone B Maximum DMM Center-to- Center Grid Spacing ¹	Zones A1 and A2 Maximum DMM Center-to-Center Grid Spacing ¹
125	50	3.2d	4.0d

¹d = DMM column diameter

5. DMM elements shall extend to at least the elevations indicated on the DMM Design Plans based on the penetration of the shortest mixing shafts.
6. The top of the DMM shall extend to the base of the ground floor slab section, the bottom of footings, the bottom of moment frame grade beams, and the bottom of elevator pits, as indicated in the DMM Design Plans.
7. Any proposed plan and Area Replacement Ratio by the DMM contractor should be approved by the Geotechnical Engineer and CGS.
8. Elevator pits shall be supported entirely by DMM.

9. The DMM columns shall be essentially vertical columns as stated in this Specification, with a minimum diameter of 3 feet and a maximum diameter of 6 feet and shall extend from the top to the bottom of the Treatment Zone indicated on the DMM Design Plans.
10. The overlapping between any two adjacent columns at ground surface shall be a minimum of 30 percent of column diameter.
11. The completed DMM shall be a homogeneous mixture of grout and the in-situ soils. Mixing is to be controlled by shaft rotational speed, drilling speed, and grout injection rate.
12. Monitoring of construction parameters and confirmation testing will be used to verify that the acceptance criteria have been satisfied.
 - a. The DMM Contractor shall establish consistent procedures to be employed during DMM construction to ensure a relatively uniform product is created.
 - b. These procedures are to be defined in the equipment and procedures submittal as defined in **Section A.1.4** of this Specification and subsequently modified, if necessary, based on the results of the pre-production testing or quality control testing.
13. The DMM Contractor may request that the established grout mix/grout-soil ratio design, equipment, installation procedure, or test methods be modified. However, the Geotechnical Engineer may require additional testing, at no additional cost to the Owner, to verify that acceptable results can be achieved.
 - a. The DMM Contractor shall not employ modified grout mix/grout-soil ratio design, equipment, installation procedures, or sampling or testing methods until approved by the Geotechnical Engineer in writing.
 - b. The Geotechnical Engineer, at his sole discretion, may reject any modification proposed by the DMM Contractor.

A.3.3 Construction Site Survey

The location of both active and abandoned buried utilities at the site can have significant impact on the design and construction of deep mixing works. Careful consideration of the presence and location of all utilities is required.

1. Prior to bidding, the contractor should review the available subsurface information and visit the site to assess the site geometry, equipment access conditions, location of existing structures, and above-ground utilities and facilities.
2. The contractor should field locate and verify the locations of all utilities prior to starting work. The contractor should maintain uninterrupted service for those utilities designated to remain in service throughout the work. The contractor should notify the engineer of any utility locations different from those shown in the plans that may require relocation of deep mixed elements or structure design modification. Subject to owner's geotechnical engineer's approval, the contractor should be compensated for additional costs of element relocation and/or structure design modifications resulting from utility locations different from those shown in the plans.

A.3.4 Site Access for Soil Samples

1. After award of the Contract, the DMM Contractor will have the option of accessing the jobsite to collect additional soil samples for use in mix designs with the following requirements:
 - a. Prior to commencing with field work, the DMM Contractor shall obtain all necessary permits for sampling activities, including drilling permits from Alameda County Public Work Agency, if applicable.
 - b. The DMM Contractor shall submit to the Geotechnical Engineer a sampling plan indicating in detail the sampling activities proposed, and the proposed methods for backfilling boreholes or excavations and restoring the site.
 - c. Cement grout backfill for boreholes per Alameda County Public Work Agency is required.
 - d. The soil sampling and testing will be performed by DMM Contractor. The costs of additional soil sampling and testing (if performed) are to be included in the project DMM construction costs.

A.3.5 Test Sections

1. The DMM Contractor shall construct a minimum of one test section on site to demonstrate that the proposed mix design, equipment, and procedures will meet the specified requirements. The location(s) of the test section(s) shall be determined by the DMM Contractor with the approval of the Geotechnical Engineer.
2. Additional test sections may be performed at the DMM Contractor's option to optimize the mix design and procedures.
3. Each test section must extend at least to the deepest DMM design depth as indicated by the DMM Design Plans.
4. The costs of the test section(s) are to be included in the project DMM construction costs.
5. Each test section shall consist of at least two full strokes of the DMM equipment. For example, if the DMM rig uses three augers, then the test section shall consist of 2 strokes times 3 columns equal 6 columns.
6. Test sections shall not be located directly below proposed footings, moment frame grade beams, and elevator pits. However, the test sections may be constructed in place of other production DMM columns, provided it is later demonstrated that the test sections meet all acceptance criteria. If the test sections are found to fail the acceptance criteria, the DMM Contractor shall make necessary repairs or replace the DMM Elements to the written satisfaction of the Geotechnical Engineer and CGS.
7. During the time interval between construction of the test section(s) and the completion of laboratory test results, the DMM Contractor may proceed with production DMM installation at their own risk. Any production DMM found to fail the acceptance criteria must be

repaired at the DMM Contractor's expense, to the written satisfaction of the Geotechnical Engineer and CGS.

8. A minimum of two (2) full-depth cores shall be obtained from each test section, according to the procedures detailed in this Specification.
9. Laboratory tests, as specified in this Specification, shall be performed on a minimum of ten samples per full-depth core or a minimum of one sample per core run, whichever is greater, from each test section, as selected by the Geotechnical Engineer. Additional cores may be performed to retrieve enough test samples.

A.3.6 Horizontal Alignment

1. The DMM Contractor shall accurately stake the location of DMM Elements using a surveyor before beginning installation. The main survey control for a given area shall be established by a California licensed surveyor; layout of individual DMM Elements does not require a licensed surveyor. Horizontal alignment of DMM columns shall conform to the geometric tolerances in the acceptance criteria of this Specification.
2. The DMM Contractor shall provide an adequate method to allow the Geotechnical Engineer to verify the as-built location of the DMM during construction.
3. Movement of the crawler base machine shall provide the preliminary alignment of the augers and the final alignment shall be adjusted by hydraulic manipulation of the leads.
4. One stroke of the machine shall construct a DMM Element consisting of at least two overlapping columns.
5. The DMM shall be advanced stepwise by overlapping the adjacent columns of the previous strokes.
6. Following DMM construction, the DMM Contractor shall submit as-built drawings indicating the location of the DMM elements in terms of project coordinates and elevation datum.
7. The DMM contractor should provide a construction plan at least two (2) weeks prior to the start of construction that includes the plan showing the numbering and location of the DMM columns, tip elevations or depths, and cut-off (top) elevations. The daily work plan should be provided to the Geotechnical Engineer at the beginning of workday and work progress should be checked and confirmed by the Geotechnical Engineer during and at the end of each day. The DMM contractor should provide a summary progress report to the Geotechnical Engineer at the end of each workday.
8. The location of known obstructions or utilities at or near the treatment area should be marked on the project drawings and on the ground before construction begins. Existing obstructions within the treatment zone area should be removed prior to construction. It is not anticipated that drilling obstructions will be encountered within the Treatment Zone during DMM construction unless further site investigation reveals otherwise.
 - a. If an obstruction preventing drilling advancement is encountered, the DMM Contractor shall investigate the location and extent of the obstruction using methods approved by

- the Geotechnical Engineer. The DMM Contractor shall propose remedial measures to clear the obstruction for approval by the Geotechnical Engineer.
- b. While the investigation for an obstruction is underway, the DMM Contractor shall continue to install columns in areas away from the obstruction location. No stand-by delay will be allowed for equipment and operations during the investigation of an obstruction.
 - c. The DMM Contractor will be compensated for removal or clearing of obstructions as a Changed Condition, paid in accordance with the General Conditions.
 - d. The DMM Contractor will not be compensated for removal or clearing of obstructions without prior approval by the Geotechnical Engineer and the Owner.
9. The DMM Contractor will not be compensated for DMM Elements that are located outside of the tolerances specified in the acceptance criteria.

A.3.7 Vertical Alignment

1. The equipment operator shall control vertical alignment of the auger stroke. Verticality shall be monitored with respect to two orthogonal horizontal axes. Vertical alignment of DMM columns shall conform to the geometric tolerances in the acceptance criteria of this Specification.

A.3.8 DMM Depth

1. DMM depths shall extend to the line and grades shown on the DMM Design Plans.
2. The total depth of penetration shall be measured either by observing the length of the mixing shaft inserted below a reference point on the mast, or by subtraction of the exposed length of shaft above the reference point from the total shaft length.
 - a. For each stroke, the elevation of the reference point on the mast must be established within one inch using measurements from a surveyed control point.
 - b. The final depth and bottom elevation of the stroke shall be noted and recorded on the Daily Quality Control Report by the DMM Contractor. The equipment shall be adequately marked to allow the Geotechnical Engineer to confirm the penetration depth during construction.
3. If rigs with varying mixing shaft lengths are used, the shortest shafts shall extend to the minimum DMM depths indicated on the DMM Design Plans.

A.3.9 Grout Preparation

1. Dry material shall be stored in silos and fed to mixers for agitation and shearing. In order to accurately control the mixing ratio of grout, the addition of water and cement shall be determined by weight using the automatic batch scales in the mixing plant.
 - a. The admixtures, if used, for mixing with water and cement, can be delivered to the mixing plant by calibrated auger. However, the DMM Contractor shall prove that the

calibrated auger can deliver the quantity of dry admixture with accuracy equivalent to that measured and delivered by weight.

2. A minimum mixing time of one minute and a maximum holding time of four hours will be enforced for the grout.
 - a. The grout hold time shall be calculated from the beginning of the initial mixing.
3. The specific gravity of the grout shall be determined during the design mix program for double checking grout proportions.
 - a. The specific gravity of the grout shall be checked by the DMM Contractor at least twice per shift per rig using the methods outlined in ASTM D4380.
 - b. The specific gravity of the grout measured in the field should not deviate by more than 3 percent of the calculated specific gravity for the design cement ratio.
 - c. If the specific gravity is lower than that required by the design mix, the DMM Contractor shall add additional cement and remix and retest the grout at no cost or schedule impact to the Owner.
 - d. The specific gravity measurements shall be indicated on the Daily Quality Control Report.

A.3.10 Soil-Grout Mixing

1. Installation of each column shall be continuous without interruption.
 - a. If an interruption of more than one hour occurs, the column shall be remixed (while injecting grout at the design grout ratio) for the entire height of the element at no additional cost to the Owner.
 - b. If an interruption of more than ten minutes occurs, the DMM Contractor shall inject a volume of grout equal to that required for three feet of auger penetration, while maintaining constant auger elevation. Once the specified volume of grout has been injected, auger penetration may continue.
2. The completed CSDM shall be a uniform mixture of cement grout and the in-situ soils.
 - a. Soil and grout shall be mixed together in place by the specially designed overlapping augers or blades on the mixing shafts.
 - b. The grout shall be pumped through the mixing shafts and injected from the tip of the shafts. The shafts shall break up the soil and blend it with cement grout.
 - c. The mixing action of the shafts shall blend, circulate, and knead the soil over the length of the column while mixing it in place with the grout.

A.3.11 Shaft Rotational Speed and Penetration/Withdrawal Rate

1. The mixing shaft rotational speed (measured in RPMs) and penetration/withdrawal rates shall be established before beginning work. It may be adjusted with the approval of the Geotechnical Engineer to achieve adequate mixing.

2. The contractor shall obtain the suitable shaft rotational speed during the installation of test section. The rotational speeds and penetration/ withdrawal rates shall be recorded on the Daily Quality Control Report.
3. The established rotational speeds and penetration/withdrawal rates shall be used during the work. If these parameters are varied more than ten (10) percent from those determined during the test section(s), the Geotechnical Engineer may require additional testing, at no additional cost to the Owner, to verify that the acceptance criteria are met.
4. The DMM Contractor may request that the established mixing parameters be modified during the production DMM installation. To verify acceptable results for the modified parameters, the Geotechnical Engineer may require additional testing at no additional cost to the Owner.

A.3.12 Grout Injection Rate

1. The grout injection rate per no more than three vertical feet of column shall be in accordance with the requirements of the design mix.
 - a. The required mix design and grout-soil ratio shall be determined during the test section(s).
 - b. The grout injection rate shall be constantly monitored and controlled.
 - c. The DMM Contractor shall record the volume of grout injected continuously for each column on the Daily Quality Control Report.
2. If the volume of grout injected per three vertical feet of column is less than the amount required to meet the grout-soil ratio established during the test section, the DMM columns shall be remixed and additional grout injected (at the design grout-soil ratio) to a depth at least 3 feet below the deficient zone or until design depth is met, at no additional cost to the Owner.
3. The DMM Contractor may request that the established grout-soil ratio be modified during the production DMM installation.
 - a. To verify acceptable results for the modified grout-soil ratio, the Geotechnical Engineer may require additional testing or a new test section at no additional cost to the Owner.

A.3.13 Control of Spoils

1. The DMM Contractor shall control and process all spoils created during the DMM construction.
 - a. Prior to stockpiling materials greater than 10 feet in height, stockpile locations and heights shall be submitted for review and approval to Geotechnical Engineer. The DMM Contractor shall consider the locations of and avoid damage to existing utilities, structures, and other improvements, as well as recently constructed DMM Elements when stockpiling material. Lesser stockpile heights may be necessary in some areas.

- b. The spoils shall be processed until they have cured to a sufficient level to allow them to be stockpiled such that they will not reform a cemented mass in the stockpile. The DMM Contractor shall dispose of spoils in accordance with all local laws, codes, and ordinances in a manner acceptable to the Owner or coordinate with the project grading contractor for the spoils be reused as fills at the project site.

A.3.14 Quality Control Program

1. The DMM Quality Control Program shall be the responsibility of the DMM Contractor and shall include, as a minimum, the following components:
 - a. An approved pre-construction test program on soils obtained from the project site, to establish appropriate design parameters such as cement dosage and water content.
 - b. Field monitoring by the DMM Contractor of construction parameters during DMM construction.
 - c. Sample collection including full depth continuous coring, sample storage, and sample transportation to the Testing Laboratory.
 - d. Reporting of the field monitoring and sampling performed by the DMM Contractor.
 - e. Reporting of the core strength testing performed by the Testing Laboratory.
2. Prior to site mobilization, the DMM Contractor shall submit a detailed work plan for the Quality Control Program for review and approval by the Geotechnical Engineer. The work plan shall include, as a minimum:
 - a. A description of all installation, monitoring, sampling, and testing procedures to be implemented. The proposed auger penetration and withdrawal rates shall be proposed by the DMM Contractor at this time.
 - b. Descriptions of all sampling equipment.
 - c. A list of parameters to be monitored.
 - d. Tolerances for the parameters monitored.
 - e. Names of any subcontractors.
3. The DMM Contractor shall provide all the personnel and equipment necessary to implement the Quality Control Program. Contractor to provide the number of years/projects, project descriptions, and reference list for all cases below:
 - a. The DMM Contractor must have at least 7 (seven) years of previous successful experience with at least 5 (five) DMM projects for soil conditions and project scope similar to that of the project being bid.
 - b. The DMM contractor must have a registered California Professional Engineer (PE) who have had at least 5 (five) years of experience with at least 3 (three) DMM projects.
 - c. The DMM Contractor must have assign a project manager who have had at least 5 (five) years of experience on at least 3 (three) DMM projects.
 - d. The DMM Contractor must have assign a project engineer/ supervisor who have had at least 3 (three) years of experience with at least 2 (two) DMM projects.

- e. The DMM Contractor must assign a full-time project superintendent with at-least 3 (three) DMM projects with at least 150,000 cubic yard of total treatment volume in DMM construction.
 - f. The DMM equipment operator must have at least three years of experience with the equipment and DMM construction.
 - g. Written requests for substitution of these key personnel must be submitted prior to personnel changes. Documentation must be submitted to the owner that demonstrates that the substitute meets the requirements listed. Substitution may not be made until written approval is provided by the owner.
4. The Geotechnical Engineer will continuously observe the DMM construction. The Geotechnical Engineer will review DMM Contractor submittals to check that the Quality Control Program is being properly implemented.
 5. The established quality control procedures shall be maintained throughout the production DMM installation to ensure consistency in the installation and to verify that the work complies with all requirements indicated in the DMM Design Plans and Specifications, unless modifications to the procedures are approved in writing by the Geotechnical Engineer.
 6. DMM Contractor shall perform sample collection, storage, and transportation.
 - a. DMM Contractor shall collect one full-depth continuous coring should be made for every 3% of the total DMM elements or for every 900 square feet of treated ground, whichever produces the greater number of cores at locations specified by the Geotechnical Engineer.
 - i. The coring rig shall be a triple-barrel rig approved by the Geotechnical Engineer and capable of achieving the required recovery. The ability to achieve the recovery criteria is solely the Contractor's responsibility.
 - ii. Full-depth samples obtained by the DMM Contractor shall have a diameter of at least 3 inches.
 - iii. The continuous core sample shall extend from the top through the bottom of the Treatment Zone, and to at least 5 feet below the Treatment Zone to sample the foundation soil directly below the Treatment Zone.
 - iv. Unless otherwise directed by the Geotechnical Engineer, the full-depth samples shall be obtained along an essentially vertical alignment located one-fourth of a column diameter from the column center and not within column overlaps.
 - v. The DMM Contractor shall perform all full-depth sampling in the presence of the Geotechnical Engineer.
 - vi. Full-depth core samples shall be retrieved using triple tube continuous coring techniques after the soil-grout mixture has hardened sufficiently.
 - vii. Each core run shall be a minimum 4 feet in length.

- viii. Following logging, the engineer will select at least five specimens from each full-depth continuous core for strength testing. Each test specimen should have a length-to-diameter ratio of 2 or greater.
 - ix. A minimum recovery of 85 percent for each 4-foot core run shall be achieved for cores from within the Treatment Zones. During coring, the elevation of the bottom of the holes shall be measured after each core run in order that the core recovery for each run can be calculated.
 - x. The DMM Contractor shall determine the time interval between column installation and coring except that the interval shall be no longer than required to conduct 28-day strength testing.
 - xi. The DMM contractor should photograph each core run and submit to the Geotechnical Engineer for test sample selection.
 - xii. Upon retrieval, the core runs shall be provided to the Geotechnical Engineer for logging, uniformity inspection, and test specimen selection.
 - xiii. Following logging and test specimen selection by the Geotechnical Engineer, the entire full-depth core, including the designated test specimens, shall be immediately sealed in plastic wrap to prevent drying and transported to the laboratory by the DMM Contractor. Alternatively, the DMM Contractor may transport only the selected test specimens to the laboratory and store the remaining core on-site in a humidity and temperature-controlled storage facility as described in this Specification.
 - xiv. All core holes shall be filled with cement grout that will obtain a 28-day strength equal to or greater than the strength of the DMM. However, the Contractor shall not grout the core holes until after acceptable core recover and uniformity has been confirmed by the Geotechnical Engineer.
 - xv. The DMM Contractor shall notify the Geotechnical Engineer at least one business day (24 hours) in advance of beginning core sampling operations.
- b. In addition to coring, the DMM Contractor should obtain wet grab samples from the DMM elements at the presence of Geotechnical engineer.
- i. 3 (three) wet samples from each mixed design used in each test section as directed by the geotechnical engineer.
 - ii. One wet sample (i.e., one selected depth at one location) should be retrieved every 2 (two) production days or for every 2,500 cubic yards of treated soil, whichever produces the higher sampling frequency.
 - iii. The contractor proposes locations for wet sampling as outlined in the QC program, considering input from the geotechnical engineer based on subsurface conditions, DMM layout, review of the QC results, and observation of the soil mixing operation.
 - iv. The contractor should report all attempts, successful and unsuccessful, to obtain wet samples. Some deep mixed material may not be able to be sampled readily

- because either the mixture is too stiff or the material may not flow back into the void left after the sampler is extracted, possibly leaving a damaged element.
- v. The sampling tool is inserted into the DMM column to a designated depth, filled with treated soil, and lifted to the ground surface. The treated soil material is then poured into a container, screened for oversized lumps (gravel versus unmixed soil), and placed in 3-inch (76-mm)- diameter, 6-inch (152 mm)- long molds. Eight test specimens should be prepared from each wet sample.
 - vi. The wet treated material should be placed into the mold in three to five layers. After the placement of each layer, the specimens must be tapped or vibrated to remove trapped air bubbles. The specimens should be sealed to prevent moisture from entering or leaving the specimens, and the sealed specimens should be stored in a humid environment in accordance ASTM C192.
 - vii. For field validation testing, unconfined compressive strength testing may be performed on specimens at 3, 7, 28, and 56 or more days. For full production work, unconfined compressive strength testing may be performed at 3, 7 and 28 days.
 - viii. The DMM contractor should deliver the samples for testing to a local lab as directed by the geotechnical engineer.
 - ix. If wet samples produce results that are consistently acceptable, the frequency of wet sampling can be reduced as the project progresses.
 - x. The engineer may request additional test specimens for QA testing.
- c. Untested portions of the full-depth samples shall be retained at the laboratory until completion and acceptance of all DMM, for possible inspection and confirmation testing by the Geotechnical Engineer.
7. The DMM Contractor shall be responsible for handling of test specimens, including storing of untested specimens and transporting test specimens to the Testing Laboratory.
 - a. The laboratory testing shall be performed by the DSA accepted Testing Laboratory hired by the Owner and approved by the Geotechnical Engineer.
 - b. The samples shall be stored in a moist room as specified in ASTM C 192 until the test date.
 - c. Testing for 28-day unconfined compressive strength shall be conducted in accordance with ASTM D2166.
 8. In addition to confirmation tests performed by the Testing Laboratory, additional tests may be requested by the Geotechnical Engineer on samples collected by the DMM Contractor. Both the Testing Laboratory's testing and the Geotechnical Engineer's requested additional testing (if performed) shall demonstrate that the acceptance criteria are met prior to acceptance of the work.
 9. Daily Quality Control Report
 - a. The DMM Contractor shall submit Daily Quality Control Reports to the Geotechnical Engineer at the end of the next working day. The Daily Quality Control Report shall

document the progress of the DMM construction, present the results of the QC parameter monitoring, present the results of the strength testing, and clearly indicate if the columns have met the acceptance criteria. The DMM Contractor shall make all Daily Quality Control Reports available to the Geotechnical Engineer

- b. The Daily Quality Control Report shall include as a minimum the results of the following QC parameter monitoring for each column:
 - i. Rig number,
 - ii. Type of mixing tool,
 - iii. Date and time (start and finish) of column construction,
 - iv. Column number and reference drawing number,
 - v. Column diameter,
 - vi. Column top and bottom elevations,
 - vii. Grout mix design designation,
 - viii. Slurry specific gravity measurements (refer to Section A3.9 for number of tests and tolerance), and
 - ix. Description of obstructions, interruptions, or other difficulties during installation and how they were resolved.
- c. The Daily Quality Control Reports shall also include the following parameters recorded automatically for each column continuously and submitted in the form of either tables or figures (as agreed to by the Geotechnical Engineer):
 - i. Elevation in feet vs. real time,
 - ii. Shaft rotation speed in RPMs vs. depth,
 - iii. Penetration and withdrawal rates in feet per minute vs. depth,
 - iv. Grout injection rate in gpm vs. depth, and
 - v. The average quantity of grout in gallons per foot injected per 3-foot (or less) vertical increment of column vs. depth.

A.3.15 Acceptance Criteria

1. The Geotechnical Engineer and CGS shall make the sole determination as to whether the acceptance criteria have been satisfied. The in-place grout-soil mixture comprising the DMM Elements shall meet the following acceptance criteria:
 - a. The DMM within the Treatment Zone shall be installed within the following geometric tolerances:
 - i. The horizontal alignment of the DMM blocks shall be within 4 inches of the location shown on the approved DMM Layout Plans.
 - ii. The vertical inclination of the DMM columns shall be no more than 1: 100 (horizontal to vertical).

- iii. Overlap between any two adjacent columns shall be a minimum of 30 percent of column diameter for the entire depth, as calculated based on depth of column embedment and measured auger lateral and longitudinal inclination.
 - iv. The tops of the columns shall be at or higher than the elevations indicated on the DMM Design Plans.
 - v. The bottoms of the columns shall extend to or lower than the levels indicated on the DMM Design Plans.
- b. Two alternative specified unconfined compressive strengths are provided with corresponding minimum A_r and maximum grid spacing in **Table A.1**. The DMM Contractor shall select one of these options for the entire project.
 - c. The unconfined compressive strength shall be determined by ASTM D2166 at 28 days on samples taken by coring of the constructed DMM.
 - d. 80 percent of all unconfined compressive strength testing on core samples determined by ASTM D2166 from each tested deep mixed element shall equal or exceeds the specified strength. If a strength specimen falls below the specified strengths due to an obviously unrepresentative lump of unmixed soil in the specimen, the Geotechnical Engineer has the option to select another specimen from the same core run and allow the Testing Laboratory to test the replacement specimen and substitute the strength from the replacement specimen for the strength from the unrepresentative specimen that failed to satisfy the strength requirement. Only one such retest will be allowed per core run.
 - e. 90 percent of all the test results on core samples across the site should equal or exceed the specified strength.
 - f. To prevent a weak layer at one elevation in the DMM foundation system, strengths below the specified strength are not permitted within 10 feet of the same elevation in more than 2 nearby cored elements.
 - g. Uniformity of mixing within the target zone shall be evaluated by the Geotechnical Engineer based on the full-depth samples recovered by the DMM Contractor from the columns.
 - i. Lumps of unimproved soils shall not amount to more than 15 percent of the total volume of any core run from a continuous full-depth core sample. For evaluating the volume of unimproved lumps of soil, all of the unrecovered core length shall be assumed to be unimproved soil.
 - ii. Any individual or aggregation of lumps of unimproved soil shall not be larger than 12 inches in greatest dimension.
 - iii. Continuous core recovery shall be at least 85 percent over any full-length core.
2. If the acceptance criteria specified in this Specification are not achieved for production DMM, the failed section of DMM shall be rejected.

- a. Unless otherwise determined by the Geotechnical Engineer, the failed section of DMM shall be considered to include all DMM columns constructed during all rig shifts that occurred between the times of construction when passing tests were achieved.
- b. The DMM Contractor may conduct additional sampling and testing to better define the limits of the failed area at no additional cost to the Owner.
- c. The DMM Contractor shall submit a proposed plan for remixing or repair of failed sections for review and approval by the Geotechnical Engineer and CGS.
- d. If the treated soil that failed to meet the uniformity criteria is concentrated in a narrow elevation range forming weak planes or zones, the contractor could propose redrilling and remixing to 3 feet below and above the deficient zone. IF redrilling and remixing cannot be done efficiently, the contractor must replace the elements to the full depth. If the treated zone in the narrow elevation meets the uniformity criteria but fails to meet the strength criteria, the contractor could propose to redrill and remix the deficient zone or to assign a lower strength level to the deficient zone and install additional elements to compensate for the strength deficiency.
- e. If the treated soil that failed to pass cannot be isolated in a specific zone, the contractor must provide remedial measures for all elements constructed during all rig shifts that occurred between passing elements.
- f. Remedial measures are subject to coring and application of the specification acceptance criteria.