

HAVERHILL ELEMENTARY SCHOOL BID PACKAGE 5 - FOOTINGS AND FOUNDATIONS

PROJECT MANUAL

5/25/2023

OWNER

PORTAGE PUBLIC SCHOOLS

8107 MUSTANG DRIVE
PORTAGE, MICHIGAN 49002

PROJECT NUMBER

Architect's Project No. 21-237.25

SET NUMBER

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DOCUMENT 00 2600 - PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.
- B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 01 2500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.3 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
 - 3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

- A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing in compliance with the following requirements:
 - 1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
 - 2. Submittal Format: Submit each written Procurement Substitution Request, using form bound in Project Manual.
 - a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
 - b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:

- 1) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
 - 2) Copies of current, independent third-party test data of salient product or system characteristics.
 - 3) Samples where applicable or when requested by Architect.
 - 4) Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - 5) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - 6) Research reports, where applicable, evidencing compliance with building code in effect for Project, from ICC-ES.
 - 7) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will become necessary to accommodate the proposed substitute.
- c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
- d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.
- B. Architect's Action:
1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.
- C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

END OF DOCUMENT 00 2600

SECTION 00 3100 - AVAILABLE PROJECT INFORMATION

1.1 EXISTING REPORTS AND SURVEYS

A. SUBSURFACE INVESTIGATION REPORT

B. A copy of a geotechnical report with respect to the building site is available for viewing:

1. Title: Geotechnical Report.
2. Date: July 28, 2022.
3. Prepared by: Driesenga & Associates
4. Bound following this section.

C. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of the Architect.

D. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in the Contract Documents.

E. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to the Owner.

F. The soil boring logs from this report are included with this document.

END OF DOCUMENT 00 3100

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**DRIESENGA &
ASSOCIATES, INC.**

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July 28, 2022

via electronic mail

Ms. Paula Johnson
PORTAGE PUBLIC SCHOOLS
8107 Mustang Drive
Portage, Michigan 49002

**Re: Geotechnical Report
Portage PS – Haverhill Elementary
6633 Haverhill Avenue, Portage, Michigan
Driesenga & Associates, Inc. Project No 2250350.3A**

Dear Ms. Johnson:

Driesenga & Associates, Inc. is pleased to submit the attached report of subsurface exploration performed for the above-referenced project. The report presents the exploration procedures, subsurface conditions encountered, and our recommendations for development of the site with respect to proposed earthwork, foundation construction, and pavement design. As the project nears construction you can contact Andrew Anschuetz at 269-544-1455 in our local office to provide a quote for construction materials testing and survey needs.

Proper execution of our recommendations will affect the design, construction and performance of the structure and related facilities, and the potential associated risks involved. Therefore, the issues and recommendations presented in this report should be discussed with the project team, including Driesenga & Associates, Inc. This will increase the likelihood that the issues are understood and our recommendations are applied in a manner consistent with the project budget, tolerance of risk, and expectations for performance and maintenance.

We appreciate the opportunity to be of service to you. If you have any questions concerning this report, or if we can be of further service as design and construction progresses, please contact our office.

Sincerely,
DRIESENGA & ASSOCIATES, INC.

Michael Stork
Senior Project Geologist

Musana Nabil
Senior Project Engineer

Randy Pail, P.E.
Director of Geotechnical Engineering

GEOTECHNICAL REPORT

SITE:

**PORTAGE PS – HAVERHILL ELEMENTARY
6633 HAVERHILL
PORTAGE, MICHIGAN**

**JULY 28, 2022
PROJECT NO. 2250350.3A**

PREPARED FOR:

**PORTAGE PUBLIC SCHOOLS
8107 MUSTANG DRIVE
PORTAGE, MICHIGAN 49002**

Prepared by:



**DRIESENKA &
ASSOCIATES, INC.**

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1.0 INTRODUCTION

1.1 LOCATION

This report presents the results of the geotechnical investigation completed for the new Haverhill Elementary School located just east of the existing school building. The site is located at 6633 Haverhill Avenue in Portage, Michigan as shown on Figure 1 – Site Location (Appendix A). The property is situated on the east side of Haverhill Avenue in an area of primarily residential development. The existing elementary school will remain in place and occupied during construction of the new building.

1.2 PURPOSE

The purpose of this investigation was to determine the subsurface profile, the engineering characteristics of the subsurface soils, and to provide recommendations in regard to the proposed design and construction based on our interpretation of the test results. This report was prepared in general accordance with our proposal dated March 22, 2022, as authorized by Mr. Michael Galovan of TowerPinkster on May 2, 2022.

1.3 SCOPE

The field exploration to estimate engineering characteristics of the site soils included performing a site reconnaissance, advancing the soil borings, performing standard penetration tests, and recovering split-spoon samples. Soil boring locations were determined in the field by measuring from existing site features. Existing ground surface elevations were not provided and obtaining them was beyond the scope of this investigation.

Twenty-four (24) soil borings, designated SB-1 to SB-24, were advanced in the vicinity of the proposed building and site improvement areas on July 18 to 21, 2022, at the approximate locations



shown on Figure 2 - Boring Locations (Appendix A). The soil borings were advanced with hollow-stem augers to depths of fifteen (15) or thirty (30) feet below the ground surface. During drilling, soil samples were collected from split-spoon sampling via standard penetration testing (ASTM method D 1586) at intervals of 2.5 feet to a depth of 10 feet, and intervals of 5 feet from a depth of 10 feet to the end of each boring. The soil boring logs are contained in Appendix B. The field and laboratory procedures are described in Appendix C.

1.4 DESIGN INFORMATION

It is understood the proposed new elementary school building is to be a two-story masonry block and steel framed structure supported on poured concrete foundations and flat steel roof. The new construction will also include several new parking areas, drives and playgrounds.

Structural load information was not available as of the time of this report, but should be provided to Driesenga & Associates, Inc. for review in light of the recommendations contained herein as soon as available. For calculation purposes, maximum loads of 5,000 pounds per lineal foot of wall and 100 kips per column were assumed. Understanding that the new construction will not include any basement areas, exterior footing depths are assumed to be a minimum of 3.5 feet below the final ground surface elevation.

We have assumed maximum tolerable settlements of 1 inch total and ½ inch differential. We anticipate maximum cut/fill sections of several feet, or less, may be required to establish site grades. Any significant deviation from these assumptions should be brought to the attention of Driesenga & Associates, Inc. as soon as possible.



2.0 SITE CONDITIONS

2.1 GENERAL

The stratification of the soils, as shown on the soil boring logs in Appendix B, represents the soil conditions at the actual soil boring locations. Variations may occur away from or between the soil borings. Stratigraphic lines shown on the soil boring logs represent the approximate boundary between the soil types, but the transition may be gradual. They are not intended to show exact depths of change from one soil type to another. In addition, changes in soil type may occur between the sample intervals that are consequently not observed by the driller.

The soil boring logs in Appendix B include the drilling method, materials encountered, penetration resistances, and pertinent field observations made during the drilling operations along with the results of the laboratory testing.

2.2 SURFACE CONDITIONS

The area of the new building is currently maintained lawn and playground areas. The new pavement area are currently a combination of maintained grass and asphalt/concrete pavement. This area is relatively flat. The existing building is surrounded by maintained lawn, asphalt parking, and driveway areas associated with residential and commercial uses.

2.3 DESCRIPTION OF SUBSURFACE SOILS

Surface materials encountered at the site generally consist of either 3.5 inches of asphalt underlain by 18 inches of aggregate base material or 2 to 36 inches of topsoil. Underlying the surface materials, loose to medium dense clayey sand or silty sand was encountered to a depth of around 3 to 6 feet, underlain by loose to medium dense extending to a depth of at least 30 feet. Fill soils were encountered in several of the borings and ranged in thickness from 1 to 9 feet.



The estimated group symbol, according to the USCS, is shown in the USCS column just before the textural description of the various strata on the soil boring logs in Appendix B.

2.4 GROUNDWATER OBSERVATIONS

Groundwater was not encountered to a depth of 30 feet below grade. Hydrostatic groundwater levels and the elevations and volumes of groundwater should be expected to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, and other factors. The groundwater levels (or lack thereof) indicated by the soil borings and presented in this section represent conditions at the time the readings were taken. The actual groundwater levels at the time of construction may vary.

Groundwater measurements were attempted during drilling and again shortly after completion of the drilling operations. After drilling and collection of groundwater readings, the boreholes were backfilled with auger cuttings and the surface was repaired approximating previous conditions. Since the boreholes were backfilled shortly after drilling, long-term groundwater level information is not available from the soil borings. To obtain long-term groundwater levels, groundwater observation wells would be required.

2.5 SEISMIC SITE CLASS

The proposed building's seismic class was determined for use in the structural design of the proposed project. Soils information was obtained from the soil borings completed on-site, as well as information obtained from the "Soil Survey of Kalamazoo County" by the United States Department of Agriculture, the "Quaternary Geology of Michigan" completed by W.R. Farrand, the USGS Topographic Quadrangle and the Hydrogeologic Atlas of Michigan. It is assumed that the proposed structure falls under Building Class III according to the 2015 Michigan Building Code (MBC) Table 1604.5. Based on this information it is our determination that seismic site class D be used according to the ASCE 7 – Table 20.3-1 for structural calculations.



2.6 LIMITATIONS

Soil and groundwater conditions have been observed and interpreted at the soil boring locations only. This information has been used as the basis for our analyses and the recommendations that follow. Although we have allowed for minor variations in subsurface conditions in the development of our recommendations, conditions can vary away from and between soil boring locations. Should this become evident during construction, we should be contacted to review our recommendations. This geotechnical evaluation and report were prepared for geotechnical purposes only. We did not perform environmental related borings or analytical tests.



3.0 RECOMMENDATIONS

3.1 SITE PREPARATION

To increase the likelihood that the recommended allowable soil bearing capacities are achieved and tolerable settlements are not exceeded, the recommendations contained herein should be followed. Within the building footprint and any areas to receive fill, all existing building material, topsoil, old fill, organic-containing material, frozen soil and other unsuitable material should be removed. The clearing should extend a minimum of 5 feet beyond the limits of proposed building and pavement areas and areas to receive structural fill.

It is strongly recommended that the building pad and pavement subgrade areas be evaluated by Driesenga & Associates, Inc. after the area has been cleared and stripped. This evaluation may be performed by proofrolling with a loaded tandem axle dump truck or another method selected by the geotechnical engineer. To identify any areas of soft subgrade soil. Where soft subgrade soils are encountered, remedial actions as recommended by the geotechnical engineer will be required.

Existing fill was encountered in several of the soil borings and extended about 1 to 9 feet below the existing ground surface. Without documentation of the placement of the fill, we consider it to be “uncontrolled fill.” If documentation of the existing fill is available, we would be pleased to review it to determine its suitability of slab, pavement, and/or structural fill support.

Deeper and/or looser uncontrolled fill may be encountered at the site, particularly adjacent to existing or former structures, or in the vicinity of existing utilities. The existing fill *may* be suitable for support of slabs, pavements, and/or structural fill after additional evaluation and special preparation and only where it is not underlain by buried topsoil or other organic, deleterious or otherwise unsuitable soils and the owner accepts the risks in doing so. Some of the soil samples in the existing fill contained variable amounts of organic material/topsoil. Existing fill with excessive organics (over 4%), voids or debris should be removed and replaced with structural fill. Test pits



should be performed to identify unsuitable fill. The test pits could be performed prior to construction. However, suitability of the existing fill will need to be determined on a case-by-case basis during construction. The remaining fill, after removing unsuitable fill, is anticipated to be suitable to support floor slabs, pavements and structural fill, provided an increased risk of unsatisfactory performance is acceptable. We believe the risk of unsatisfactory performance such as cracking and settlement associated with the construction of slabs-on-grade and pavements on or above the existing fill is relatively low after preparation.

Ultimately, if the risk of poor slab and/or pavement performance is not acceptable, complete removal of the existing fill and replacement with structural fill should be performed. Based on the soil borings, the existing fill could extend 9 feet or more below the existing ground surface. If performed, the removal of the existing fill should extend a minimum of 10 feet beyond the edges of the proposed building, or laterally on a two vertical to one horizontal slope from the bottom outside edge of the foundation, whichever is greater. This action should reduce the amount and depth of undercutting during foundation construction since the unsuitable fill and any unsuitable soils directly beneath fill would be removed. For this case, the test pit evaluation would not be necessary. However, a test pit evaluation could be performed to provide a better estimate of the nature, depth and extent of the existing fill.

In all general fill areas, the exposed soil surface should be scarified to a depth of 12 inches and recompacted to a minimum of 95% of Modified Proctor maximum dry density (MDD) per ASTM D 1557 method, or 98% of MDD as determined by the Michigan Cone Method. Sand soils were encountered at or near the final subgrade level in some of the soil borings in the proposed building area. Within the proposed building area the native sand should be proof-compacted by at least six (6) passes of a 10-ton vibratory roller.

The contractor should remove standing water from the subgrade and prevent surface water from reaching the footing excavations and the prepared subgrade. In addition, construction traffic should use haul roads and should not haphazardly traffic the site. Subgrade soils that become



disturbed should be removed and replaced with structural fill or crushed aggregate. Under wet weather conditions, the subgrade may be protected by placing crushed aggregate on the exposed subgrade.

It is recommended that any fill materials be placed in or near horizontal maximum 8-inch-thick loose lifts and compacted to a minimum of 95% of Modified Proctor MDD, or 98% of Michigan Cone MDD. If a vibratory roller is used for compaction, the loose lift thickness may be increased to 12 inches. Soils used for structural fill should consist of clean sand meeting SW or SP classification in accordance with USCS criteria.

3.2 FOUNDATIONS

Considering the subsurface conditions on this site and the assumed proposed construction, it is acceptable for the proposed school building to be supported on conventional spread footings. Footings bearing on newly placed structural fill placed over suitable native soils or directly on the native sand may be designed for a maximum net allowable soil bearing pressure of 2,500 psf. The footings should not be placed on the existing fill material.

At some locations, the native sand soils may be in relatively loose condition and not suitable for support of foundations at the recommended design soil bearing pressure. In addition, these soils may become loosened below the bottom of footing level from the excavation activities or from construction traffic, especially if allowed to dry out. Therefore, the excavated footing bearing surfaces should be compacted to a minimum of 95% of Modified Proctor MDD, or 98% of MDD as determined by the Michigan Cone Method, just prior to concrete placement. A hand-operated plate compactor may be used for loose or disturbed soil that is less than 6 inches in thickness. For deeper compaction, we recommend using a hoe-pac mounted on a backhoe. Water may need to be added to achieve the desired compaction for the allowable bearing capacity.



If it is not possible to improve the sands by densification, the unsuitable soils may need to be removed and the foundations placed on suitable native soils encountered at lower levels. Alternatively, the undercut may be backfilled with crushed aggregate to the bottom of footing level. In addition, wet or easily disturbed foundation bearing soils could be encountered at some locations. If wet soils are encountered, we recommend a layer of crushed aggregate be placed on the subgrade. The thickness of this layer will depend on the conditions encountered at the time of construction. In areas where undercutting is required, the undercut should extend laterally on a two vertical to one horizontal slope from the edge of the footing.

All perimeter footings and footings in unheated areas should bear at least 42 inches below finished grade for protection from frost action. To reduce the likelihood of frost heave, trench footings should be formed vertically and should not be allowed to widen near the top. If interior footings are to bear on compacted fill, the fill should be placed in accordance with the recommendations of Section 3.1. Interior foundations can be constructed on suitable natural soils or on structural fill overlying suitable natural subgrade just below the floor slab. However, the footings and proposed bearing soils should be protected from freezing during construction if work is conducted in the cold winter months. Due to the sands encountered at the site, construction of trench footings is probably not feasible. Therefore, we anticipate footing excavations will need to be sloped back and the foundations formed. The placement of footing concrete should be done as soon as footing excavations have been completed and approved to reduce the potential for disturbance or freezing of the footing subgrade.

Prior to concrete placement, the bearing surface should be free of loose soil and standing water. The contractor should avoid stockpiling excavated materials immediately adjacent to the excavation walls. It is recommended that stockpiled materials be kept back from the excavation a minimum distance equal to half the excavation depth to prevent surcharging the excavation walls.

Total and differential settlement of foundations properly designed and constructed based on our recommendations are not expected to exceed 1 inch and ½ inch, respectively.



3.3 FLOORS

The soil below the floor slab should be prepared in accordance with the recommendations in Section 3.1. A noncohesive soils mat such as MDOT Class II sand should be provided directly below the floor slabs. The mat should be a minimum of 8 inches in thickness and compacted to a minimum of 95% of Modified Proctor MDD.

The floor slab should be suitably reinforced and proper joints should be provided at the junctions of the slab and foundation system so that a small amount of independent movement can occur without causing damage. A minimum of 6 inches of structural fill should be provided between the bottom of the slab and the top of the shallow spread footing below. Otherwise, other arrangements should be made to allow for potential relative settlements, such as grade beams, thickened slabs with appropriate reinforcing steel or other appropriate details. A modulus of subgrade reaction of 175 pci should be used in the design of slabs-on-grade.

3.4 PAVEMENTS

Specific traffic information was not available in developing these pavement recommendations. For design purposes, we have assumed that passenger vehicles and light trucks will traffic all standard duty pavement areas. Heavy duty pavement areas will include entrances, service drives and bus parking areas, and will be trafficked by buses, refuse trucks, and fire engines.

The pavement subgrade should be prepared as described in Section 3.1. Above the subgrade, the sand subbase should be constructed using a minimum of 12 inches of Michigan Department of Transportation (MDOT) Class II Fine Aggregate fill (MDOT Division 3, Section 301 “2012 Standard Specifications for Construction”, April 1, 2011) compacted to a minimum of 95% of the material’s MDD as determined by Modified Proctor.



Due to the clayey sand soils encountered at the site, site grading and stormwater controls will be important to protect paved drives and parking areas. To further protect new paved areas, perimeter underdrains should be placed beneath pavement edges within the bottom portion of the pavement sand subbase. Four (4) inch-diameter sock-tube backfilled with at least 6 inches of peastone cover should be used. The drains should flow via gravity to a common low point and into the off-site storm sewer system.

The aggregate base for pavement areas should follow MDOT Dense-Graded Aggregate Base Course Materials – Division 3, Section 302 and Division 9, Section 902, using a 21AA (Grading Requirements per MDOT Table 902-1) Limestone Dense-Graded Aggregate material with a minimum compacted thickness of 8 inches. This gravel base may be placed in one (1) lift and should be compacted to a minimum of 95% of the material's MDD as determined by Modified Proctor.

Light/medium duty bituminous pavement should consist of a 1.5 inch base course and a 1.5 inch surface course for a total thickness of 3.0 inches. Heavy duty bituminous pavement should consist of a 2.5 inch base course and a 1.5 inch surface course for a total thickness of 4.0 inches. The HMA material and binder should be selected in accordance with the Local Agency Programs Hot Mix Asphalt Selection Guidelines Revised November 1, 2017 and FHWA Approved December 26, 2017. Compaction of asphalt courses should range between 92% and 96% of the Theoretical Maximum Density (TMD).

Construction traffic should be minimized on the new pavement. If excessive construction traffic is anticipated on the pavement structure, the initial asphalt lift thickness could be increased and placement of the final lift could be delayed until the majority of the construction activities have been completed. This action will allow repair of localized failure, if any does occur, as well as reduce load damage on the pavement system.



A bond coat of emulsion should be used between the base course and wearing course when more than 48 hours have elapsed between placement of the courses, or the surface of the base course has been contaminated by soil or dust. Performance grade asphalt cement should be used in the production of all bituminous mixtures. Reclaimed Asphalt Pavement (RAP) should not be used in the surface course.

After the pavement is complete, we recommend instituting a regular maintenance program that includes sealing of cracks and patching of distressed areas. This should reduce the effect of water infiltration and associated frost action.

In areas where the durability of Portland cement concrete (PCC) is desired over bituminous pavement (i.e., loading areas, dumpster pads) a rigid pavement is recommended. Concrete pavement should be constructed on a base layer of at least 6 inches of Michigan Department of Transportation (MDOT) Class II sand subbase (Division 9, Section 902, Grading Requirements per Table 902-3). The concrete slab should consist of a minimum of 6 inches of 4,000 psi, air entrained concrete (MDOT Division 6, Section 601 – PCC Pavement and Division 9, Section 901 – Cement and Lime); however, actual design of the slab including reinforcement type and spacing should be performed by the Project Structural Engineer.

These recommendations assume typical conditions during the June through September construction season. Any substitution of materials or deviation from these stated assumptions should be reviewed to assess potential impact on the recommended design.

3.5 GROUNDWATER CONTROL

Groundwater was not encountered to a depth of 30 feet below grade. As such, groundwater problems are not expected to be a significant issue with respect to building construction. Any water which enters the footing excavation can likely be controlled by a gravity drain system, sump pump, or other minor dewatering procedure. Concrete should not be poured in footing excavations



containing water. Upon removal of any trapped water, the soils should be reviewed by a geotechnical engineer and any soft areas replaced with structural fill per Section 3.1, as necessary.

As stated in Section 3.4, perimeter underdrains should be placed beneath all pavement edges within the lower portion of the 12 inches sand subbase. Four (4) inch-diameter sock-tube backfilled with at least 6 inches of peastone cover should be used. The drains should flow via gravity to a common low point and into the on-site storm sewer system. In addition, finger drains should extend radially out from the catch basins and gutter inlets.

Perimeter foundation drains should be installed along foundations where interior finished floor elevations are lower than perimeter grades, or where exterior grades slope toward the building. In addition, all roof drains should be diverted to downspouts which carry water away from foundations and supporting walls.

3.6 TEMPORARY EXCAVATION STABILITY

If excavations are anticipated for the proposed structure and/or utilities, shoring and bracing or flattening (laying back) of the slopes may be required to obtain a safe working environment. Excavations should be sloped or shored in accordance with local, state and federal regulations, including OSHA (CFR Part 1926) excavation trench safety standards. We recommend that all excavated soils be placed away from the edges of the excavation at a distance equaling or exceeding the depth of the excavation. In addition, surface runoff water should be diverted away from the crest of the excavated slopes to prevent erosion and sloughing.

Localized areas of soft or unsuitable soils not detected by our borings or in unexplored areas may be encountered once construction begins. Vertical cuts in these soils may be unstable and may present a significant hazard because they can fail without warning. Therefore, temporary construction slopes greater than 5 feet high should not be steeper than one horizontal to one vertical



(1H: 1V) and excavated material should not be placed within 10 feet of the crest of any excavated slope.

Unbraced excavations may experience some minor localized instability (i.e., sloughing). To reduce potential sloughing, excavated slopes should be covered with plastic for protection from rainfall and moisture changes. It should be emphasized that continuous observations by personnel from our office are important during trenching or excavation operations at the site.



4.0 GENERAL COMMENTS

If significant changes are made in the plans and specifications or location of the proposed structure, a consultation should be arranged to review such changes with respect to the prevailing soil conditions. It may then be necessary to submit supplementary recommendations. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of Driesenga & Associates, Inc.

Driesenga & Associates, Inc. should be afforded the opportunity to review the project design drawings and specifications to verify the factors affecting subgrade and foundation performance comply with our recommendations.

It is recommended that the services of Driesenga & Associates, Inc. be engaged to observe excavation for the footings and to test and evaluate the soils in the footing excavations prior to placement of foundations in order to determine that the soils have the required bearing capacities. Monitoring and testing should also be performed to verify that suitable materials are used for controlled fills and that they are properly placed and compacted.

This report and any future reports or addenda performed for this site should be supplied to potential bidders prior to them submitting their proposals. We also recommend the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and foundation construction.

This report was for geotechnical purposes only. We did not sample for environmental purposes or perform any analytical testing. However, the contractor should be prepared to handle environmental conditions encountered at this site that may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers. Any Environmental Assessment reports prepared for this property should be made available for review by bidders and the successful contractor.



This report has been prepared solely for the use of the client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in this project, unless written permission is granted by Driesenga & Associates, Inc. If this report or any of its contents are utilized by parties other than our original client and the project team members, Driesenga & Associates, Inc. can not be held responsible for the suitability of the field exploration, scope of services, or recommendations made for the new project. Driesenga & Associates, Inc. also is not responsible for the interpretation of our soil boring logs and the recommendations provided herein by other parties.

Driesenga & Associates, Inc. will evaluate this report for other parties and developments at this site, provided our original Client agrees to release this information in writing. However, before this report can be relied upon by other parties, Driesenga & Associates, Inc. must review the proposed development since the new project will likely require additional field exploration, laboratory tests, analysis, and modifications to our recommendations to adequately address the needs of the new project.



APPENDIX A

•FIGURE NUMBER 1 – SITE LOCATION•

•FIGURE NUMBER 2 – BORING LOCATIONS•



Scale: NTS



Figure Number:1

Site Location

Project Name

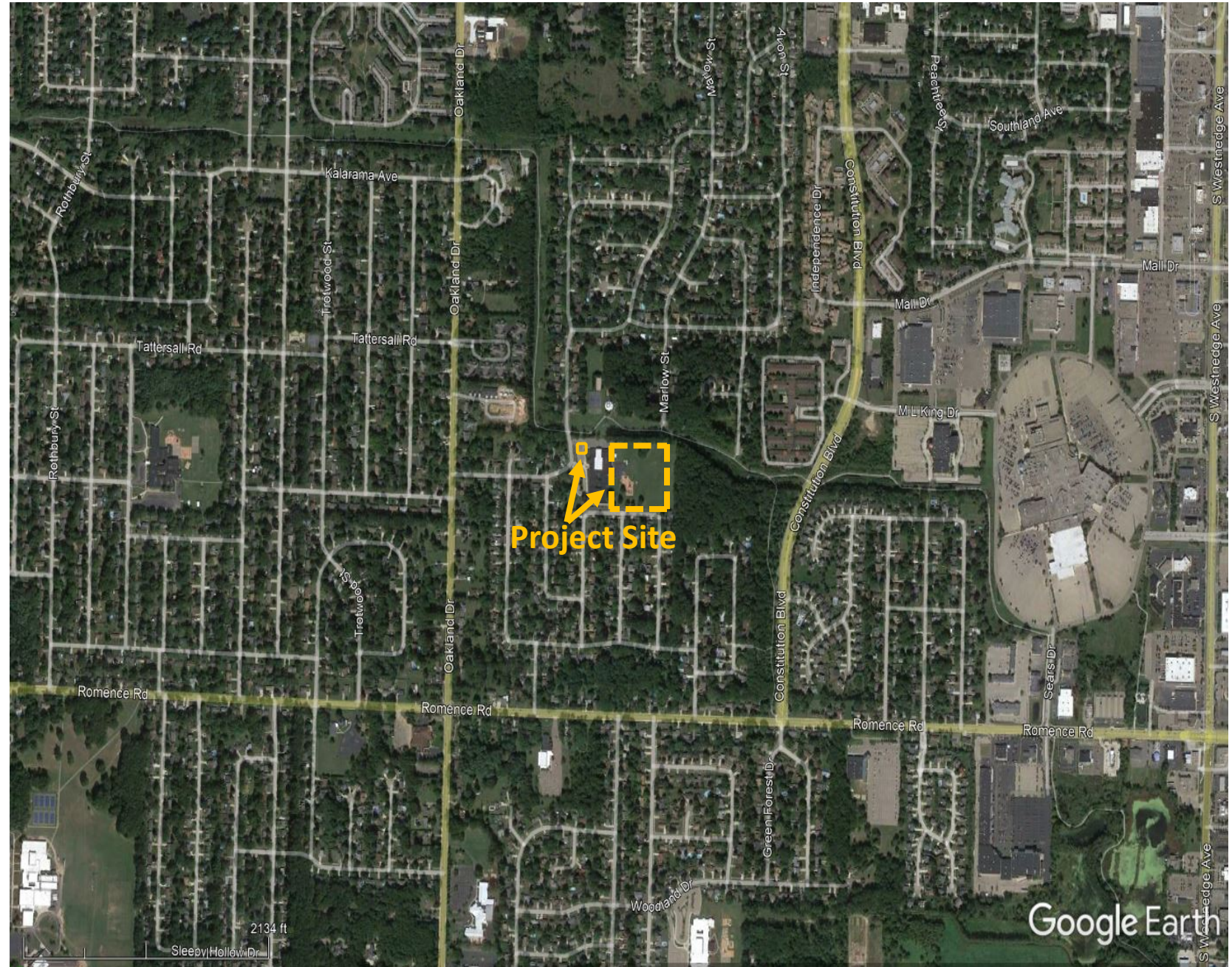
Haverhill Elementary PPS

Project Number

2250350.3A

Project Location

6633 Haverhill Avenue
Portage, Michigan





Scale: NTS


 Boring Location



Figure Number:2

Boring Locations

Project Name

Haverhill Elementary PPS

Project Number

2250350.3A

Project Location

6633 Haverhill Avenue
Portage, Michigan





APPENDIX B
·SOIL BORING LOGS·



DRIESENKA & ASSOCIATES, INC.

Engineering · Surveying · Testing

SB-1

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 21, 2022

Date Completed : July 21, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						ASPHALT - 3.5 inches						
		GW				GRAVEL - 18 inches	1	4 4 8	12			
		SC/Fill				Fill - Clayey SAND, very loose to medium dense, brown to dark brown, fine to coarse grained, some gravel, trace organics, moist.						
5		SW-GW				SAND & GRAVEL, very loose to loose, brown, fine to coarse grained, moist.	2	4 2 2	4			
							3	3 2 3	5			
10		SW				SAND, loose to medium dense, light brown, fine to medium grained, trace gravel, moist.	4	5 5 7	12			
15							5	6 8 10	18			
20												
25												
30												



DRIESENKA & ASSOCIATES, INC.

Engineering · Surveying · Testing

SB-2

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 21, 2022

Date Completed : July 21, 2022

Hole Diameter : 6-inches

Drilling Method : Hollow-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 4 inches						
		SC				Clayey SAND, medium dense, brown to dark brown, fine to coarse grained, some gravel, moist.	1	7 8 7	15			
		SW				SAND, medium dense, brown, fine to medium grained, trace gravel, moist.						
						SAND, medium dense, light brown, fine to coarse grained, moist.	2	9 9 11	20			
5		SW					3	3 6 8	14			
						SAND, medium dense, light brown, fine to medium grained, trace gravel, trace silt, moist.	4	7 11 12	23			
10		SW					5	6 10 11	21			
15												
20												
25												
30												



Engineering · Surveying · Testing

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 21, 2022

Date Completed : July 21, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0		SC				TOPSOIL - 2 inches Clayey SAND, medium dense, brown to dark brown, fine to coarse grained, some gravel, moist.	1	9 10	17			
		SW				SAND, medium dense, light brown, fine to coarse grained, moist.	2	5 7 8	15			
		SW				SAND, medium dense, light brown, fine to medium grained, trace gravel, trace silt, moist.	3	8 8 11	19			
		SW					4	8 10 13	23			
		SW					5	7 10 12	22			



Engineering · Surveying · Testing

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 21, 2022

Date Completed : July 21, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 9 inches						
		SC				Clayey SAND, medium dense, brown, fine to coarse grained, some gravel, moist.	1	8 10 9	19			
							2	4 3 3	6			
5		SW				SAND, very loose to loose, brown, fine to medium grained, trace gravel, moist.	3	3 2 2	4			
							4	2 2 2	4			
10		SW				SAND, medium dense, light brown, fine to medium grained, trace gravel, moist.	5	5 9 9	18			
15												
20												
25												
30												



DRIESENKA & ASSOCIATES, INC.

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SB-5

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 21, 2022

Date Completed : July 21, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 4 inches						
		SC				Clayey SAND, loose, brown, fine to medium grained, trace gravel, moist.	1	3 5 5	10			
5		SW				SAND, loose, brown, fine to coarse grained, trace gravel, moist.	2	3 4 4	8			
		SW				SAND, loose, brown, fine to coarse grained, trace gravel, moist.	3	3 4 3	7			
10		SW				SAND, medium dense, light brown, fine to medium grained, moist.	4	5 6 10	16			
15							5	8 12 17	29			
20												
25												
30												



DRIESENKA & ASSOCIATES, INC.

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SB-7

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 18, 2022

Date Completed : July 18, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 6 inches						
		SC				Clayey SAND, medium dense, brown, fine to coarse grained, some gravel, moist.	1	7 8 6	14			
5						SAND, loose to medium dense, light brown, fine to medium grained, trace gravel, moist.	2	6 6 4	10			
							3	4 5 9	14			
10		SW					4	7 9 14	23			
							5	8 10 13	23			
15						SAND, medium dense, light brown, fine grained, moist.	6	9 14 16	30			
20							7	10 14 14	28			
25		SP					8	10 14 17	31			
30												



DRIESENKA & ASSOCIATES, INC.

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SB-8

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 18, 2022

Date Completed : July 18, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 10 inches						
		SC				Clayey SAND, loose to medium dense, brown, fine grained, trace gravel, moist.	1	6 13 11	24			
5		SW				SAND, loose, brown, fine to medium grained, trace gravel, trace clay, moist.	2	3 2 3	5			
		SW				SAND, loose to medium dense, light brown, fine to coarse grained, trace gravel, moist.	3	3 3 2	5			
10				4 5 6	11							
15		SP				SAND, medium dense, light brown, fine grained, moist.	5	4 6 8	14			
20				6	7 11 11		22					
25		7	8 12 13	25								
30		8	9 12 16	28								



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SB-9

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 18, 2022

Date Completed : July 18, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 9 inches						
		SC				Clayey SAND, loose to medium dense, brown, fine to medium grained, a little gravel, moist.	1	8 14 14	28			
5		SW				SAND, loose, brown, fine to medium grained, trace gravel, trace clay, trace clay, moist.	2	4 5 6	11			
		SW				SAND, loose, brown, fine to medium grained, trace gravel, trace clay, trace clay, moist.	3	5 5 4	9			
10		SW				SAND, medium dense, light brown, fine to meium grained, trace gravel, moist.	4	3 3 2	5			
		SW				SAND, medium dense, light brown, fine to meium grained, trace gravel, moist.	5	6 8 9	17			
15		SP				SAND, medium dense, light brown, fine grained, moist.	6	6 7 8	15			
20		SP				SAND, medium dense, light brown, fine grained, moist.	7	5 5 8	13			
25		SP				SAND, medium dense, light brown, fine grained, moist.	8	6 7 9	16			
30												



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SB-10

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 18, 2022

Date Completed : July 18, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 7 inches						
		SC/Fill				Fill - Clayey SAND, medium dense, brown to dark brown, fine to medium grained, some gravel, trace cobble, moist.	1	15 11 7	18			
5		SC				Clayey SAND, loose to medium dense, brown, fine grained, trace gravel, moist.	2	5 8 8	16			
							3	2 3 3	6			
10						SAND, loose, light brown, fine to coarse grained, trace gravel, moist.	4	4 4 5	9			
							5	4 5 4	9			
15		SW					6	6 5 4	9			
							7	2 3 5	8			
25						SAND, medium dense, light brown, fine grained, moist.						
		SP					8	5 7 8	15			
30												



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SB-11

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 19, 2022

Date Completed : July 19, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 8 inches						
		SC				Clayey SAND, medium dense, brown, fine to coarse grained, some gravel, trace cobble, moist.	1	7 7 7	14			
							2	6 7 8	15			
5		SW				SAND, medium dense, light brown, fine to coarse grained, trace gravel, moist.	3	6 7 11	18			
							4	9 10 15	25			
10						SAND, medium dense, light brown, fine to medium grained, moist.	5	11 12 16	28			
15							6	6 8 9	17			
20		SW					7	10 12 15	27			
25							8	10 11 15	26			
30												



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SB-12

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 19, 2022

Date Completed : July 19, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion						
				DESCRIPTION							
0				TOPSOIL - 10 inches							
		SC		Clayey SAND, medium dense, brown, fine to coarse grained, some gravel, trace cobble, moist.		1	15 13 12	25			
		SW		SAND, loose, brown, fine to medium grained, trace silt, trace gravel, moist.		2	3 3 3	6			
		SW		SAND, medium dense, light brown, fine to coarse grained, trace gravel, moist.		3	9 10 9	19			
						4	5 9 9	18			
						5	4 5 7	12			
		SW		SAND, medium dense, light brown, fine to medium grained, moist.		6	6 9 11	20			
						7	5 9 8	17			
						8	7 10 12	22			
30											



DRIESENKA & ASSOCIATES, INC.

Engineering · Surveying · Testing

SB-13

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 19, 2022

Date Completed : July 19, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 16 inches						
		SC/Fill				Fill - Clayey SAND, medium dense, brown to dark brown, fine to medium grained, a little gravel, trace topsoil, moist.	1	6 10 10	20			
						Fill - Clayey SAND, loose, brown to dark brown, fine to medium grained, trace gravel, moist.	2	6 7 8	15			
		SW/Fill					3	3 3 2	5			
							4	3 3 4	7			
						SAND, loose to dense, light brown, fine to medium grained, trace gravel, moist.	5	3 3 4	7			
							6	10 17 18	35			
		SW					7	8 13 17	30			
							8	9 15 14	29			



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SB-14

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 18, 2022

Date Completed : July 18, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 10 inches						
		SC/Fill				Fill - Clayey SAND, medium dense to dense, brown to dark brown, fine to medium grained, a little gravel, trace topsoil, moist.	1	10 16 17	33			
5		SC				Clayey SAND, medium dense, brown, fine to medium grained, trace gravel, moist.	2	6 6 5	11			
		SW				SAND, loose, brown, fine to medium grained, trace clay, trace gravel, moist.	3	3 3 3	6			
10							4	3 3 4	7			
		SW				SAND, very loose, brown, fine to medium grained, moist.	5	3 2 2	4			
15							6	4 5 5	10			
		SP				SAND, loose to medium dense, light brown, fine grained, moist.	7	4 7 7	14			
25							8	5 8 10	18			
30												



DRIESENKA & ASSOCIATES, INC.

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SB-15

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 20, 2022

Date Completed : July 20, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 13 inches						
		SM/Fill				Fill - Silty SAND, medium dense, dark brown, fine grained, trace gravel, moist.	1	5 10 15	25			
		SC				Clayey SAND, loose, brown to dark brown, fine to coarse grained, some gravel, trace cobble, moist.	2	4 4 5	9			
5		SW				SAND, medium dense, brown, fine to coarse grained, a little gravel, moist.	3	5 6 7	13			
		SW				SAND, medium dense, light brown, fine to medium grained, moist.	4	12 9 11	20			
10												
15							5	6 9 12	21			
20												
25												
30												



DRIESENKA & ASSOCIATES, INC.

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SB-16

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 20, 2022

Date Completed : July 20, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 24 inches						
							1	10 10 12	22			
		SC				Clayey SAND, loose to medium dense, brown, fine to coarse grained, a little gravel, trace cobble, moist.	2	6 4 3	7			
5												
		SW				SAND, loose, brown, fine to coarse grained, a little gravel, moist.	3	4 4 3	7			
10							4	3 3 2	5			
		SW				SAND, medium dense to dense, light brown, fine to medium grained, trace gravel, moist.	5	10 13 17	30			
15												
20							6	9 15 17	32			
25							7	6 14 12	26			
		SP				SAND, medium dense, light brown, fine grained, moist.						
30							8	7 11 14	25			



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Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 20, 2022

Date Completed : July 20, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 36 inches	1	6 9 10	19			
		SC/Fill				Fill - Clayey SAND, loose, brown to dark brown, fine to coarse grained, a little gravel, trace cobble, trace topsoil, moist.	2	6 5 4	9			
5		SW				SAND, very loose, brown, fine to coarse grained, a little gravel, moist.	3	3 2 2	4			
						SAND, very loose to medium dense, light brown, fine to coarse grained, trace gravel, moist.	4	3 3 3	6			
10		SW					5	3 6 11	17			
						SAND, medium dense to dense, light brown, fine to medium grained, moist.	6	8 13 18	31			
20							7	10 14 19	33			
25		SW					8	10 13 14	27			
30												



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SB-18

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 19, 2022

Date Completed : July 19, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 6 inches						
		SC/Fill				Fill - Clayey SAND, loose to medium dense, brown to dark brown, fine to medium grained, trace gravel, trace topsoil, moist.	1	6 5 8	13			
5		SC				Clayey SAND, loose, brown, fine to medium grained, trace gravel, moist.	2	3 3 2	5			
							3	4 4 4	8			
10		SW				SAND, loose to medium dense, brown, fine to coarse grained, trace gravel, moist.	4	4 4 5	9			
							5	3 6 9	15			
20		SW				SAND, loose to medium dense, light brown, fine to medium grained, moist.	6	4 4 6	10			
							7	5 7 10	17			
30							8	6 11 11	22			



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SB-19

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 19, 2022

Date Completed : July 19, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 3 inches						
		SC/Fill				Fill - Clayey SAND, medium dense, brown to dark brown, fine to medium grained, trace gravel, trace topsoil, moist.	1	6 9 8	17			
5		SC				Clayey SAND, very loose to medium dense, brown, fine to medium grained, trace gravel, moist.	2	6 6 7	13			
		SC					3	2 2 2	4			
10		SW				SAND, loose, brown, fine to coarse grained, trace gravel, moist.	4	2 2 3	5			
		SW					5	9 12 15	27			
15		SW				SAND, medium dense, light brown, fine to medium grained, trace silt, moist.	6	7 12 17	29			
20		SW					7	7 12 11	23			
25		SW					8	8 10 16	26			
30		SW										



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SB-20

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 20, 2022

Date Completed : July 20, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 29 inches						
							1	8 9 10	19			
						SAND & GRAVEL, medium dense to dense, brown, fine to coarse grained, trace cobble, moist.	2	5 5 6	11			
5		SW-GW					3	14 15 17	32			
						SAND, medium dense to dense, light brown, fine to medium grained, trace gravel, moist.	4	11 14 18	32			
10		SW					5	9 14 15	29			
15												
20												
25												
30												



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SB-21

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 20, 2022

Date Completed : July 20, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler





Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 5 inches						
		SC/Fill				Fill - Clayey SAND, loose to medium dense, brown, fine to coarse grained, a little gravel, trace topsoil, moist.	1	9 7 9	16			
5		SW				SAND, loose to medium dense, fine to coarse grained, a little gravel, moist.	2	2 2 3	5			
		SW				SAND, medium dense, light brown, fine to medium grained, trace gravel, moist.	3	8 10 12	22			
10		SW					4	5 7 11	18			
15							5	7 10 13	23			
20												
25												
30												



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SB-22

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 20, 2022
Date Completed : July 20, 2022
Hole Diameter : 6-inches
Drilling Method : Solid-Stem Auger
Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling
Field Sampling : J. Cook
Reviewed By : M. Stork
GW Encountered : Dry
GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 20 inches						
		SC/Fill				Fill - Clayey SAND, medium dense, brown to dark brown, fine to medium grained, trace gravel, trace topsoil, moist.	1	9 11 11	22			
		SC				Clayey SAND, loose, brown, fine to coarse grained, some gravel, moist.	2	4 4 4	8			
5		SW				SAND, loose, brown, fine to medium grained, trace gravel, moist.	3	3 3 3	6			
		SW				SAND, medium dense, light brown, fine to medium grained, moist.	4	9 11 10	21			
10												
15							5	8 9 11	20			
20												
25												
30												



DRIESENKA & ASSOCIATES, INC.

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SB-23

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 20, 2022

Date Completed : July 20, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion						
DESCRIPTION											
0				TOPSOIL - 29 inches		1	6 9 14	23			
		SC/Fill		Fill - Clayey SAND, loose to medium dense, brown to dark brown, fine to medium grained, trace gravel, trace topsoil, moist.		2	3 4 4	8			
5		SW		SAND, very loose to loose, brown, fine to medium grained, trace clay, trace gravel, moist.		3	3 2 2	4			
10		SW		SAND, loose to medium dense, light brown, fine to coarse grained, trace gravel, moist.		4	3 3 3	6			
15						5	10 11 16	27			
20											
25											
30											



Engineering · Surveying · Testing

Project Name: Portage PS - Haverhill Elementary
6633 Haverhill Avenue
Portage, Michigan

Project No. 2250350.3A

Client Name: Portage Public Schools

Date Started : July 20, 2022

Date Completed : July 20, 2022

Hole Diameter : 6-inches

Drilling Method : Solid-Stem Auger

Sampling Method : Split-Spoon Sampler



Drilling Company : Great Lakes Drilling

Field Sampling : J. Cook

Reviewed By : M. Stork

GW Encountered : Dry

GW Completion : Dry

Depth in Feet	Surf. Elev.	USCS	GRAPHIC	Water Levels		Description	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
				▼ During Drilling	▽ After Completion							
0						TOPSOIL - 4 inches						
						Fill - Clayey SAND, very loose to medium dense, fine to medium grained, trace gravel, moist.	1	6 8 9	17			
5		SC/Fill					2	7 5 6	11			
							3	2 2 2	4			
10		SW				SAND, loose to medium dense, light brown, fine to coarse grained, trace gravel, moist.	4	1 3 7	10			
15							5	8 14 15	29			
20												
25												
30												



APPENDIX C
•FIELD AND LABORATORY PROCEDURES•



FIELD PROCEDURES

The soil borings were performed using a truck-mounted drill rig equipped with a standard hammer. Split-barrel samples were obtained in the soil below the bottom of the augers in general accordance with the Standard Method for Penetration and Split-Barrel Sampling of Soils. Samples were collected at 2.5 feet intervals to 10 feet below grade, and every 5 feet thereafter. After recovery, the samples were removed from the split-spoon sampler, visually reviewed and classified, placed in glass jars and transported to our laboratory for additional review.

Soil samples stored for extended periods are susceptible to moisture loss and are no longer indicative of the conditions originally encountered in the soil borings. Therefore, soil samples are usually stored in our laboratory for a period of 60 days, unless instructed otherwise.

Soil boring logs were prepared based on field notes and visual classification of the samples in the laboratory. Indicated on each soil boring log is the description of each stratum observed, the approximate depth and/or elevation of each stratum change observed, Standard Penetration Test resistance values, and the observed groundwater levels. The soil boring logs are presented in Appendix B.

LABORATORY PROCEDURES

The laboratory testing program included supplementary visual classification of the samples in general accordance with the Unified Soil Classification System. The following two pages describe the soils classification procedure.

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

**Per ASTM D 2487—00
(Based on Unified Soil Classification System)**

Soil Description: Secondary Soil Type BASIC SOIL TYPE, Consistency/Relative Density, Color, Supplemental Soil Type, Moisture, Miscellaneous comments.

Ex. Silty SAND, loose, brown, fine to medium, trace gravel, moist.

Secondary Soil Type – adjective for the BASIC SOIL TYPE describing material making up greater than 12% but less than 50% of the primary soil type by weight. For sands this also includes a description of grain size (fine, medium or coarse).

BASIC SOIL TYPE – primary constituent of sample; material making up greater than 50% of the sample by weight. Material is classified by grain size and material properties.

Consistency/Relative Density – a measurement of in-situ consistency or density of cohesive or cohesionless soils, respectively, based upon Standard Penetration Testing blow counts (N) per ASTM D 1586.

Color – visual inspection of soil appearance.

Supplementary Soil Type – a description of any other material that may be mixed with the BASIC SOIL TYPE. Qualifying terms are based on the percentage of the supplementary soil type in the sample by weight.

Moisture – description of the in-situ moisture content of the sample (dry, moist or wet).

Miscellaneous Comments – anything observed in the sample or in the field that does not fit into the above categories but should be noted (odor, etc.).

CALIBRATED AUTO HAMMER CONSISTENCY/RELATIVE DENSITY				
COHESIONLESS SOILS		COHESIVE SOILS		
SPT N-VALUES	IN-SITU RELATIVE DENSITY	SPT N-VALUES	SHEAR STRENGTH (PSF)	IN-SITU CONSISTENCY
0-3	VERY LOOSE	0-1	BELOW 250	VERY SOFT
4-8	LOOSE	2-3	250 - 500	SOFT
9-23	MEDIUM DENSE	4-6	500 - 1,000	MEDIUM STIFF
24-38	DENSE	7-12	1,000 - 2,000	STIFF
>38	VERY DENSE	13-25	2,000 - 4,000	VERY STIFF
		>26	OVER 4,000	HARD

STANDARD HAMMER CONSISTENCY/RELATIVE DENSITY				
COHESIONLESS SOILS		COHESIVE SOILS		
SPT N-VALUES	IN-SITU RELATIVE DENSITY	SPT N-VALUES	SHEAR STRENGTH (PSF)	IN-SITU CONSISTENCY
0-4	VERY LOOSE	0-2	BELOW 250	VERY SOFT
5-10	LOOSE	3-4	250 - 500	SOFT
11-30	MEDIUM DENSE	5-8	500 - 1,000	MEDIUM STIFF
31-50	DENSE	9-16	1,000 - 2,000	STIFF
>50	VERY DENSE	17-32	2,000 - 4,000	VERY STIFF
		>32	OVER 4,000	HARD

SUPPLEMENTAL TEXTURE QUALIFYING TERMS	
DESCRIPTOR	PERCENTAGE BY WEIGHT
TRACE	1-10%
LITTLE	10-20%
SOME	20-35%
AND	35-50%

SOIL CLASSIFICATION CHART (Per ASTM D2487)

Criteria for Assigning Symbols and Group Names Using Laboratory Tests ^A			Soil Classification		
			Group Symbol	Group Name	
COHESIONLESS SOILS More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 Sieve	Clean Gravels Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well-graded gravel ^F
			$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel ^F
		Gravels with Fines More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F,G,H}
			Fines classify as CL or CH	GC	Clayey gravel ^{F,G,H}
	Sands More than 50% of coarse fraction retained on No. 4 Sieve	Clean Sands Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$	SW	Well-graded sand ^F
			$Cu < 6$ and/or $1 > Cc > 3^E$	SP	Poorly graded sand ^F
		Sands with Fines	Fines classify as ML or MH	SM	Silty sand ^{G,H,I}
			Fines classify as CL or CH	SC	Clayey sand ^{G,H,I}
COHESIVE SOILS 50% or more passes the No. 200 Sieve	Silt and Clays Liquid limit less than 50	Inorganic	$PI \geq 7$ and plots on or above 'A' line ^J	CL	Lean clay ^{K,L,M}
			$PI < 4$ or plots below 'A' line ^J	ML	Silt ^{K,L,M}
		Organic	Liquid limit - oven dried < 0.75	OL	Organic clay ^{K,L,M,N}
			Liquid limit - not dried < 0.75		Organic silt ^{K,L,M,O}
	Silt and Clays Liquid limit 50 or more	Inorganic	PI plots on or above 'A' line	CH	Fat clay ^{K,L,M}
			PI plots below 'A' line	MH	Elastic Silt ^{K,L,M}
		Organic	Liquid limit - oven dried < 0.75	OH	Organic Clay ^{K,L,M,P}
			Liquid limit - not dried < 0.75		Organic silt ^{K,L,M,O}
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat	

A Based on the material passing the 3-in. sieve

B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name

C Gravels with 5 to 12% fines require dual symbols:
 GW-GM well-graded gravel with silt
 GW-GC well-graded gravel with clay
 GP-GM poorly graded gravel with silt
 GP-GC poorly graded gravel with clay

D Sands with 5 to 12% fines require dual symbols:
 SW-SM well-graded sand with silt
 SW-SC well-graded sand with clay
 SP-SM poorly graded sand with silt
 SP-SC poorly graded sand with clay

E $Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2/(D_{10} \cdot D_{60})$

F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

G If fines classify as CL-ML, use dual symbol GC-GM or SC-SM

H If fines are organic, add "with organic fines" to group name.

I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

J If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant

L If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.

M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name

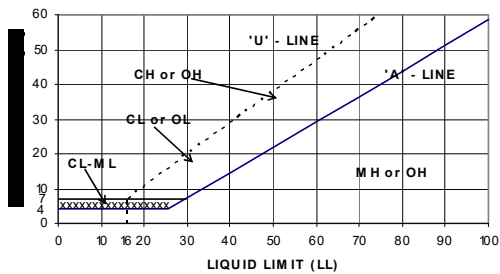
N $PI \geq 4$ and plots on or above 'A' line.

O $PI < 4$ or plots below 'A' line.

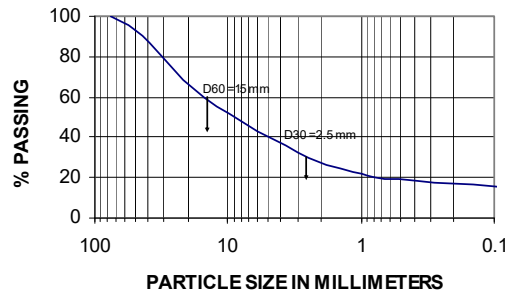
P PI plots on or above 'A' line.

Q PI plots below 'A' line.

For classification of fine-grained soils and fine-grained fraction of coarse-grained soils



SIEVE ANALYSIS



**Local Agency Programs
Hot Mix Asphalt (HMA) Selection Guidelines**

Revised: 11/01/2017

FHWA Approved: 12/26/2017

The following guidelines have been developed at the request of Local Agency Engineers for use on Local Agency projects. These guidelines have been reviewed and approved by the County Road Association of Michigan Engineering Committee. Previous experience and performance shall permit variations from these guidelines as per Sect D: Alternative Mixes.

A. HMA Mixture Type and Binder Selection

Selection is based on present day two-way commercial ADT. The commercial ADT ranges for each of the mixture types have taken into account an assumed future traffic growth rate.

Com. ADT.	Com. ADT 0-300	Com. ADT 301-700	Com. ADT 701-1000	Com. ADT 1001-3400	Com. ADT 3401- 9999
Mixture Type					
Top	LVSP or 13A, 36A	4C 5E1/4E1	5E3, or 4E3	5E10, or 4E10	5E30, or 5E10
Leveling	LVSP or 13A	3C 4E1	4E3	4E10	4E30
Base	13A / 3C	2C / 3C	3E3	3E10	3E30
Binder Grades by Region					
Superior	PG 58-34	PG 58-34	PG 58-34	PG 58-34	
Metro	PG 58-22	PG 64-22	PG 64-22	PG 64-22	PG 70-22P
All Other	PG 58-28	PG64-28	PG-64-28	PG64-28	PG70-28P

Note 1: If the designer wishes to reduce the target air voids on projects to 3.5%, a note needs to be added to the plans on the HMA Application Table stating that the air voids have been changed to 3.5% for that particular project for top and leveling courses. For mixtures meeting the definition of base course, field regress air void content to 3.0 percent with liquid asphalt cement unless specified otherwise on HMA application estimate.

Note 2: The mixture type in each traffic category listed in the above table is specifically designed to perform under their respective Commercial ADT. Selecting a mixture type that is specifically designed for a higher Comm. ADT than the project being designed may adversely affect performance.

Note 3: One course overlays on composite pavements where the prevention of cold temperature related thermal cracking is not as much of a concern, the cold temperature number of the PG binder may be decreased by one grade to help reduce costs.

Example: For a one course overlay in the Superior Region on a composite project, the recommended PG binder would be a PG58-28 instead of a PG58-34.

Note 4: To address traffic areas that are more susceptible to rutting early in pavements life such as signalized intersections and other areas of stop/start traffic use the pay item entitled **High Stress Hot Mix Asphalt Mixture**. The difference between the High Stress HMA Mixture and the typical HMA pay item is the Performance Graded binder. For High Stress Mixtures, increase the high temperature binder by one grade and add the polymer. The increase in the high temperature number results in an asphalt binder with improved high temperature stiffness or rutting resistance for both the leveling and top course.

Example: For a high stress application for a mixture type 5E3 placed in an intersection the recommended binder grade would be a PG70-28P instead of a PG64-28. Following are the recommend guides for the proper application of the Special Provision for High Stress Hot Mix Asphalt Mixture:

- a. Use this pay item 1000 feet on either side of the center of signalized intersections and other areas where stop/start traffic occurs on the mainline (for quantity calculations use 1100 feet).
- b. There are cases where the signalized intersections are spaced 1 mile or less over the entire length of the project. When this occurs, specify the High Stress HMA Mixture pay item for the entire length.
- c. All HMA approaches that are adjacent to the High Stress HMA Mixture areas should be specified using this pay item.
- d. Use of the Pay Item High Stress HMA (mix), should not be used unless it is to be distinguished from the same mix with a different PG grade.

B. Application Rates

HMA application rates shown in the table below are the required minimum and maximum rates for each of the specific mixtures. Pavement designs requiring a HMA greater than the recommended maximum will require multiple lifts of the leveling and/or base mixes.

Mixture Type	Marshall Mixture					Superpave Mixture				
	36A	13A	2C	3C	4C	LVSP	3E_	4E1	4E3+	5E_
Min. #/syd	110	165	350	220	165	165 Top or Leveling	330	165	220	165
Max. #/syd	165	275	500	330	275	220 Top 250 Leveling	410	330	275	220

Note 1: Application rate of 110 #/syd. per 1-inch thickness.

Note 2: When shoulders of 8 ft. or greater are being paved as a separate operation on a project, the following note should be added to the plans near the HMA Application Table; “For shoulders only, the mix design and/or JMF target value for Air Voids are to be adjusted to 2.5 percent.” If it is not known whether the shoulders will be placed as a separate paving operation, the note should be added.

C: Aggregate Wear Index (All Projects)

Aggregate Wear Index (AWI) is required for all aggregates used in HMA top course mixtures. The following table identifies the required minimum AWI, based on the present average daily traffic (vehicular and commercial) per lane (ADT/Lane):

ADT/Lane	Minimum AWI
<100	None
100 - 2000	220
>2000	260

D: Alternative Mixes

These guidelines provide for the selection of Hot Mixed Asphalt (HMA) and application rates utilizing the Superpave mix design system along with the Marshall Mix design system. The substitution of another HMA mixture type other than the recommended mixture is acceptable if it has demonstrated to perform under similar traffic conditions. If a local agency desires to use an HMA mixture or grade of binder other than what is contained within this guide, they must submit the change in writing. The letter or email must include the alternate mix design, the justification/reason for the change, and a statement that they accept responsibility for the outcome of the performance of the mix design that is used in lieu of the recommended mixture.

E. Non-Motorized Path Mixes

When designing a Non-Motorized Path, recommended HMA Mixes that have historically worked well include:

Superpave mixes:

HMA, LVSP

HMA, 5E_

Shared Use Path, HMA Snowmobile Wearing Cse – Special (See: 12DS806(F355))

Marshall mixes:

HMA, 13A

HMA, 36A

No AWI is required on the top course, however, if the designer wishes, he or she can use the Aggregate Wear Index (AWI) of 220 minimum.

Use PG 58-28 for all mixes, except for HMA, 5E_, which should be PG 64/28.

Application rates should match the chart on the previous page (page 3 of 4).

F. Non-Motorized Path Alternative Mixes

If a local agency desires to use an HMA mixture or grade of binder other than what is contained within this guide, or if they propose another pavement treatment or type, they must submit the change request to the LAP Staff Engineer in writing. The letter or email must include the alternate mix design, or pavement treatment, the justification and/or reason for the change, and a statement that they accept responsibility for the outcome of the performance of the mix design that is used in lieu of the recommended mixture.

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SECTION 00 4325 - SUBSTITUTION DURING PROCUREMENT REQUEST FORM

1.1 INTRODUCTORY INFORMATION

- A. Date: _____
- B. Requesting substitution of _____
- C. As specified in Section __
- D. Requested Substitute Product: __

1.2 SUBMITTING PARTY'S STATEMENT

- A. Circle "Y" for yes and "N" for no for each of the following statements and submit supporting data. Indicate impact for all statements below answered as no, with supporting data:
 - 1. (Y) (N) Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - 2. (Y) (N) Requested substitution does not require extensive revisions to the Contract Documents.
 - 3. (Y) (N) Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - 4. (Y) (N) Substitution request is fully documented and properly submitted in accordance with "Product Substitution" and "Submittals" Articles in Division 01 Section "Product Requirements."
 - 5. (Y) (N) Requested substitution will not adversely affect Contractor's Construction Schedule.
 - 6. (Y) (N) Requested substitution has received necessary approvals of authorities having jurisdiction.
 - 7. (Y) (N) Requested substitution is compatible with other portions of the Work.
 - 8. (Y) (N) Requested substitution has been coordinated with other portions of the Work.
 - 9. (Y) (N) Requested substitution provides specified warranty.
- B. I hereby certify that the above statements are true.
- C. _____
- D. Submitter's signature

END OF DOCUMENT 00 4325

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SECTION 00 6324 - BIM TRANSFER WAIVER

INTENT

- A. This document amends and supplements the Digital Data Licensing Agreement AIA C106 - 2013 for requests for BIM Model from the Architect. All provisions which are not so amended or supplemented remain in full force and effect.
- B. At the request of the Contractor, subcontractor, lower-tier subcontractor, or material supplier, and receipt of signed copy of Digital Data Licensing Agreement AIA C106, the Architect will transmit or send BIM model(s) requested.

C. MODIFICATIONS TO AIA C106

D. ARTICLE 3 – LICENSE CONDITIONS

- E. Add the following clauses after the first sentence in Article 3:
 - 1. We make no representation as to the compatibility of these files with your hardware or your software beyond the specified release of the referenced specifications.
 - 2. Data contained on these electronic files are part of our instruments of service and shall not be used by you or anyone else receiving this data through or from you for any purpose other than as a convenience in the support of construction coordination for the referenced project. Any other use or reuse by you or by others will be at your sole risk and without liability or legal exposure to Tower Pinkster Titus Associates. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against us, our officers, directors, employees, agents or subconsultants that may arise out of or in connection with your use of the electronic files.
 - 3. Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold us harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from your use of these electronic files.
 - 4. These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the hard-copy construction documents prepared by us and the electronic files, the hard-copy construction documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.
 - 5. Because information presented on the electronic files can be modified, unintentionally or otherwise, we reserve the right to remove all indicia of ownership and/or involvement from each electronic display.

END OF DOCUMENT 00 6324

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SECTION 00 6325 - SUBSTITUTION DURING CONSTRUCTION REQUEST FORM

1.1 INTRODUCTORY INFORMATION

- A. Date: _____
- B. Requesting substitution of _____
- C. As specified in Section _____
- D. Requested Substitute Product: _____

1.2 SUBMITTING PARTY'S STATEMENT

- A. Circle "Y" for yes and "N" for no for each of the following statements and submit supporting data. Indicate impact for all statements below answered as no, with supporting data:
 - 1. (Y) (N) Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - 2. (Y) (N) Requested substitution does not require extensive revisions to the Contract Documents.
 - 3. (Y) (N) Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - 4. (Y) (N) Substitution request is fully documented and properly submitted in accordance with "Product Substitution" and "Submittals" Articles in Division 01 Section "Product Requirements."
 - 5. (Y) (N) Requested substitution will not adversely affect Contractor's Construction Schedule.
 - 6. (Y) (N) Requested substitution has received necessary approvals of authorities having jurisdiction.
 - 7. (Y) (N) Requested substitution is compatible with other portions of the Work.
 - 8. (Y) (N) Requested substitution has been coordinated with other portions of the Work.
 - 9. (Y) (N) Requested substitution provides specified warranty.
- B. I hereby certify that the above statements are true.

Submitter's signature

1.3 CONTRACTOR'S STATEMENT

- A. I have reviewed this substitution request and am in agreement with the information presented and statements made. This proposal is complete, and there will be no further charges to the Owner as a result of the acceptance of this substitution.

Contractor's signature

END OF DOCUMENT 00 6325

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SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 01 2300 "Alternates" for products selected under an alternate.
 - 2. Section 01 6000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - a. Unavailability due to failure to procure products in a timely manner does not constitute substitution for cause, and will be considered as substitution for convenience.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

- e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 20 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

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SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 01 2500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 , Architect's Supplemental Instructions, or on a similar form of the Architect's choosing..

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests (Bulletins): Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 2500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 ALLOWANCES

- A. Allowance Adjustment: Base each Change Order Proposal Request for an allowance cost adjustment solely on the difference between the actual purchase amount and the allowance, multiplied by the final measurement of work in place, with reasonable allowances, where applicable, for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
1. Include installation costs in the purchase amount only where indicated as part of the allowance.
 2. When requested, prepare explanations and documentation to substantiate the margins claimed.
 3. Submit substantiation of a change in scope of work claimed in the Change Orders related to unit cost allowances.
 4. The Owner reserves the right to establish the actual quantity of work in place by independent quantity survey, measure, or count.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Unit-Price Adjustment: See Construction Managers documents Unit Prices for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

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SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
1. General coordination procedures.
 2. Coordination drawings.
 3. RFIs.
 4. Digital project management procedures.
 5. Project meetings.
- B. Related Requirements:
1. Construction Managers requirements for "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 2. Construction Managers requirements for "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 3. Construction Managers requirements for "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 4. Construction Managers requirements for "Closeout Procedures" for coordinating closeout of the Contract.
 5. Construction Managers requirements for "Project Meetings"

1.2 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.

- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.

1.4 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
 - 3. Owner's cost for Architect's services, at Architect's normal billing rate, in responding to requests for information from the Contractor, will be deducted from the Contract Amount if the intent of the documents is clear in the opinion of the Architect.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Owner name.
 - 3. Owner's Project number.
 - 4. Name of Architect.
 - 5. Architect's Project number.
 - 6. Date.
 - 7. Name of Contractor.
 - 8. RFI number, numbered sequentially.
 - 9. RFI subject.
 - 10. Specification Section number and title and related paragraphs, as appropriate.
 - 11. Drawing number and detail references, as appropriate.
 - 12. Field dimensions and conditions, as appropriate.
 - 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 14. Contractor's signature.

15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - C. RFI Forms: AIA Document G716 or software-generated form with substantially the same content as indicated above, acceptable to Architect.
 - D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 2600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.
 - E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 - F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- 1.5 DIGITAL PROJECT MANAGEMENT PROCEDURES
- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.
 1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.

2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Digital Drawing Software Program: Contract Drawings are available in Revit 2022.
 4. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement, with modifications on Document 00 6324 "BIM Transfer Waiver."
 - a. Subcontractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106, with modifications on Document 00 6324 "BIM Transfer Waiver."
- B. Conditions of Use of Architect's Digital Data Files: As follows:
1. Architect makes no representation as to the compatibility of these files with user's hardware or software beyond the specified release of the referenced specifications.
 2. Data contained on these electronic files are part of Architect's instruments of service and shall not be used by receiving party or anyone else receiving this data through or from receiving party for any purpose other than as a convenience in the support of construction coordination for the referenced project. Any other use or reuse by receiving party or by others will be at receiving party's sole risk and without liability or legal exposure to Tower Pinkster Titus Associates. Receiving party agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Architect, its officers, directors, employees, agents or subconsultants that may arise out of or in connection with receiving party's use of the electronic files.
 3. Furthermore, receiving party shall, to the fullest extent permitted by law, indemnify and hold Architect harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from receiving party's use of these electronic files.
 4. These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files receiving party receives. In the event that a conflict arises between the hard-copy construction documents prepared by Architect and the electronic files, the hard-copy construction documents shall govern. Receiving party is responsible for determining if any conflict exists. By receiving party's use of these electronic files, receiving party is not relieved of any duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.
 5. Because information presented on the electronic files can be modified, unintentionally or otherwise, Architect reserves the right to remove all indicia of ownership and/or involvement from each electronic display.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

PART 2 - PRODUCTS (Not Used)

**PROJECT NO. 21-237.25
HAVERHILL ELEMENTARY SCHOOL BID PACKAGE 5 - FOOTINGS AND FOUNDATIONS
PORTAGE PUBLIC SCHOOLS**

**PROJECT MANAGEMENT AND COORDINATION
01 3100 - 5
5/25/2023**

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

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SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Construction Managers requirements for "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 3100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Construction Managers requirements for "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 01 4000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Section 01 7700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to

- maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled date for shipment of products.
 - j. Scheduled dates for installation.
 - k. Activity or event number.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - a. Completeness: Submittal packages that do not contain all required submittals, with the exception of verification samples when selection samples are also required, will be returned without the Architect and Construction Manager taking action.
 - 3. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Resubmittal Review: Allow 15 days for review of each resubmittal.
 - 3. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture, and other similar types of variations are expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
 - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:
 - a. Reviewed: No corrections, no marks. Submittal complies with the design intent of the Contract Documents.
 - b. Furnish as Corrected: Minor corrections; all items can be fabricated or furnished without further correction; checking is complete and all corrections are obvious without ambiguity.
 - c. Revise and Resubmit: Minor corrections; noted items must not be furnished or fabricated without further corrections; checking is not complete; details of items noted are to be clarified before resubmitting; items not noted to be corrected can be fabricated or furnished under this stamp.
 - d. Rejected: Submittal is not in compliance with the design intent of the Contract Documents. Provide new submittal that complies with Contract Documents. Any delay resulting from the submission of items not complying with the Contract Documents is solely the responsibility of the Contractor, which will bear all associated costs.

- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3300

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
 - 1. Mockups are used for one or more of the following:
 - a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
 - 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 - 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory has the same meaning as testing agency.
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements, in order to provide the highest quality and performance. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

- A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional,

indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience, include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Statement on condition of substrates and their acceptability for installation of product.
 - 2. Statement that products at Project site comply with requirements.
 - 3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 5. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Statement that equipment complies with requirements.
 2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 3. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. 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 the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and will engage for the activities indicated.
1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

- H. **Manufacturer's Technical Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. **Preconstruction Testing:** Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
 - 2. **Testing Agency Responsibilities:** Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. **Mockups:** Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups of size indicated.
 - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
 - 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 - 7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 8. Demolish and remove mockups when directed unless otherwise indicated.

1.9 QUALITY CONTROL

- A. **Owner Responsibilities:** Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.

2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - b. Testing will not be performed by the installer, or a subcontractor to the installer.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 3300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in

preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

- G. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as appropriate, as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect, Construction Manager and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, through Construction Manager with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.
- B. Engage testing and inspection services except where indicated as by Owner in other Specification Sections.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.
5. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Conflicting Requirements: Where compliance with two or more standards is specified, or there is a conflict in the construction documents and where the standards or documents may establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement and refer requirements that are different but apparently equal and other uncertainties to the Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements, in order to provide the highest quality and performance.. Refer uncertainties to the Architect for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.
1. AABC - Associated Air Balance Council; www.aabc.com.
 2. AAMA - American Architectural Manufacturers Association; (see FGIA).
 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 8. ACI - American Concrete Institute; www.concrete.org.
 9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
 10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
 11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 12. AF&PA - American Forest & Paper Association; www.afandpa.org.
 13. AGA - American Gas Association; www.aga.org.
 14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 16. AI - Asphalt Institute; www.asphaltinstitute.org.
 17. AIA - American Institute of Architects (The); www.aia.org.
 18. AISC - American Institute of Steel Construction; www.aisc.org.
 19. AISI - American Iron and Steel Institute; www.steel.org.
 20. AITC - American Institute of Timber Construction; (see PLIB).
 21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
 23. ANSI - American National Standards Institute; www.ansi.org.

24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - APA - The Engineered Wood Association; www.apawood.org.
26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; [**American Society of Mechanical Engineers (The)**]; www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; www.bwfbadminton.com.
50. CARB - California Air Resources Board; www.arb.ca.gov.
51. CDA - Copper Development Association Inc.; www.copper.org.
52. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
53. CEA - Canadian Electricity Association; www.electricity.ca.
54. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
55. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
56. CGA - Compressed Gas Association; www.cganet.com.
57. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
58. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
59. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
60. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
61. CPA - Composite Panel Association; www.compositepanel.org.
62. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
63. CRRC - Cool Roof Rating Council; www.coolroofs.org.
64. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
65. CSA - CSA Group; www.csagroup.org.
66. CSI - Cast Stone Institute; www.caststone.org.
67. CSI - Construction Specifications Institute (The); www.csiresources.org.
68. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
69. CTA - Consumer Technology Association; www.cta.tech.
70. CTI - Cooling Technology Institute; www.coolingtechnology.org.

71. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
72. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
73. DHI - Door and Hardware Institute; www.dhi.org.
74. ECIA - Electronic Components Industry Association; www.ecianow.org.
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
78. ESTA - Entertainment Services and Technology Association; www.esta.org.
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsintstitute.org.
81. FGIA - Fenestration and Glazing Industry Alliance; <https://fgiaonline.org>.
82. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
85. FM Global - FM Global; www.fmglobal.com.
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridarroof.com.
87. FSA - Fluid Sealing Association; www.fluidsealing.com.
88. FSC - Forest Stewardship Council U.S.; www.fscus.org.
89. GA - Gypsum Association; www.gypsum.org.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
94. IAS - International Accreditation Service; www.iasonline.org.
95. ICC - International Code Council; www.iccsafe.org.
96. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
97. ICPA - International Cast Polymer Association (The); www.theicpa.com.
98. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
99. IEC - International Electrotechnical Commission; www.iec.ch.
100. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
101. IES - Illuminating Engineering Society; www.ies.org.
102. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
105. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
106. Intertek - Intertek Group; www.intertek.com.
107. ISA - International Society of Automation (The); www.isa.org.
108. ISFA - International Surface Fabricators Association; www.isfanow.org.
109. ISO - International Organization for Standardization; www.iso.org.
110. ITU - International Telecommunication Union; www.itu.int.
111. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
112. LPI - Lightning Protection Institute; www.lightning.org.
113. MBMA - Metal Building Manufacturers Association; www.mbma.com.
114. MCA - Metal Construction Association; www.metalconstruction.org.
115. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
116. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
117. MHI - Material Handling Industry; www.mhi.org.
118. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
119. MPI - Master Painters Institute; www.paintinfo.com.

120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
121. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
122. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
123. NADCA - National Air Duct Cleaners Association; www.nadca.com.
124. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
125. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
126. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
127. NBI - New Buildings Institute; www.newbuildings.org.
128. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
129. NCMA - National Concrete Masonry Association; www.ncma.org.
130. NEBB - National Environmental Balancing Bureau; www.nebb.org.
131. NECA - National Electrical Contractors Association; www.necanet.org.
132. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
133. NEMA - National Electrical Manufacturers Association; www.nema.org.
134. NETA - InterNational Electrical Testing Association; www.netaworld.org.
135. NFHS - National Federation of State High School Associations; www.nfhs.org.
136. NFPA - National Fire Protection Association; www.nfpa.org.
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; www.nfrc.org.
139. NGA - National Glass Association (The); www.glass.org.
140. NHLA - National Hardwood Lumber Association; www.nhla.com.
141. NLGA - National Lumber Grades Authority; www.nlga.org.
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
144. NRCA - National Roofing Contractors Association; www.nrca.net.
145. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
146. NSF - NSF International; www.nsf.org.
147. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
148. NSPE - National Society of Professional Engineers; www.nspe.org.
149. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
151. NWFA - National Wood Flooring Association; www.nwfa.org.
152. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
153. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
154. PDI - Plumbing & Drainage Institute; www.pdionline.org.
155. PLASA - PLASA; www.plasa.org.
156. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
157. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
167. SIA - Security Industry Association; www.securityindustry.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.

169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
178. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
184. TIA - Telecommunications Industry Association (The); www.tiaonline.org.
185. TMS - The Masonry Society; www.masonrysociety.org.
186. TPI - Truss Plate Institute; www.tpinst.org.
187. TPI - Turfgrass Producers International; www.turfgrassod.org.
188. TRI - Tile Roofing Industry Alliance; www.tilerroofing.org.
189. UL - Underwriters Laboratories Inc.; www.ul.org.
190. UL LLC - UL LLC; www.ul.com.
191. USAV - USA Volleyball; www.usavolleyball.org.
192. USGBC - U.S. Green Building Council; www.usgbc.org.
193. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
194. WA - Wallcoverings Association; www.wallcoverings.org.
195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
196. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
197. WDMA - Window & Door Manufacturers Association; www.wdma.com.
198. WI - Woodwork Institute; www.woodworkinstitute.com.
199. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
200. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov.
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.

8. FAA - Federal Aviation Administration; www.faa.gov.
 9. GPO - U.S. Government Publishing Office; www.gpo.gov.
 10. GSA - U.S. General Services Administration; www.gsa.gov.
 11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
 12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
 13. NIST - National Institute of Standards and Technology; www.nist.gov.
 14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
 17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
 19. USP - U.S. Pharmacopeial Convention; www.usp.org.
 20. USPS - United States Postal Service; www.usps.com.
 - 21.
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.
1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
 2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
 3. DSCC - Defense Supply Center Columbus; (see FS).
 4. FED-STD - Federal Standard; (see FS).
 5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from U.S. General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
 6. MILSPEC - Military Specification and Standards; (see DOD).
 7. USAB - United States Access Board; www.access-board.gov.
 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).
 - 9.
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.
1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
 2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); www.bhgs.dca.ca.gov.
 3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.

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PORTAGE PUBLIC SCHOOLS**

**REFERENCES
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5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; <https://tfsweb.tamu.edu/>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 4200

SECTION 01 4500
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 03 3000 and 05 1200.
 - 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 03 1000 Concrete Formwork**
 - 2. **Section 03 2000 Concrete Reinforcement and Embedded Assemblies**
 - 3. **Section 03 3000 Cast-In-Place Concrete**
 - 4. **Section 03 4100 Precast Structural Concrete: Hollow-Core**
 - 5. **Section 04 2200 Concrete Masonry Units**
 - 6. **Section 05 1200 Structural Steel**
 - 7. **Section 05 2000 Steel Joists**
 - 8. **Section 05 3000 Steel Deck**

- B. Refer to the drawings for Special Inspections requirements for the Project. The Special Inspections shown on the drawings may contain additional testing and inspection that is not listed in this specification section.

1.3 TESTING AGENCY QUALIFICATIONS

- 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 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, 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 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 of reinforcement, inspect formwork for grade, quality of material, absence of foreign matter, and other imperfections that might affect concrete placement and tolerances stated herein.
 2. Inspect formwork for shape, location and dimensions of the concrete member being formed.
 3. Inspect formwork for compliance with specified tolerances, block outs, camber, shoring ties and seal of form joints.

4. Verify condition of bond surfaces, locations and sizes of all accessories, embedment items, and anchorage for prevention of displacement.
5. Verify proper use/application of form release agents.
6. Verify in-situ concrete strength meets requirements for formwork removal in specification section 03 1000 prior to removal of shores and formwork from beams and structural slabs.
7. Inspect concrete surfaces immediately after removal of formwork and prior to any patching or repair work.

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.
5. Adhesive anchors shall be proof tested in tension as follows:
 - a) Testing Agency shall submit an adhesive anchorage proof testing plan to the SER for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
 - b) Proof testing shall be performed as a confined tension test in accordance with the guidelines of ASTM E488 and the requirements of ACI 355.4.
 - c) Testing shall be performed after the minimum curing period specified by the manufacturer.
 - d) **[5,10, or 25]** percent of each type and size of an adhesive anchor assembly and 100 percent of anchors marked (CERT) shall be proof tested in tension by the Owner's Testing Agency.
 - e) All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the SER prior to performance of the testing.
 - f) The adhesive anchors proof tension loads shall be as specified in the general notes of the structural drawings.
 - g) Anchors shall have no visible indications of displacement or damage during or after proof load application. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure.
 - h) If more than **[10%]** of the tested adhesive anchors fail to achieve the specified proof load, **[100%]** of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the SER. Immediately notify the SER of all failed proof tests.
6. Mechanical post-installed anchors shall be proof tested as follows:
 - a) Testing Agency shall submit a mechanical anchorage proof testing plan to the SER for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.

- b) **[5,10, or 25]** percent of each type and size of mechanical anchor shall be proof tested by the Owner's Testing Agency. The required proof test for the anchors is as follows:
 - c) For torque-controlled mechanical anchors, a proof torque shall be applied to the anchor using a calibrated torque wrench and the proof torque shall be achieved with no more than one-half turn of the anchor nut.
 - d) The required proof torque load for torque-controlled mechanical anchors shall be as specified in the general notes of the structural drawings.
 - e) All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the SER prior to performance of the testing.
 - f) Concrete cracking in the vicinity of the anchor during or after proof torque load application shall be considered a failure.
 - g) If more than **[10%]** of the tested mechanical anchors fail to achieve the specified proof torque load or set, **[100%]** of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the SER. Immediately notify the SER of all failed proof tests.
7. Periodic inspection for post-installed adhesive and mechanical anchors shall be provided in accordance with the building code except that continuous inspection shall be provided for the conditions identified in section A.4. The inspector shall observe all aspects of the anchor installation and shall, at a minimum, verify the following items:
- a) Hole drilling method in accordance with the Manufacturer's Published Installation Instructions (MPII) and these installation requirements.
 - b) Anchor spacing and edge distance.
 - c) Hole diameter and depth.
 - d) Hole cleaning in accordance with the MPII.
 - e) Anchor element type, material, diameter, and length.
 - f) For adhesive anchors, adhesive identification and expiration date.
 - g) For adhesive anchors, adhesive installation in accordance with the MPII.
 - h) For torque-controlled mechanical anchors, the number of turns required to achieve the anchor set torque per the MPII.

3.4 CAST-IN-PLACE CONCRETE

A. Quality Assurance:

- 1. 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.

- 2. 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 [50] cubic yards. (75 [40] cubic meters) of concrete, nor less than once for each 5000 [2500] square feet (500 [250] square meters) 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 normalweight 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 reportioned at the direction of the Engineer and Ready Mix Quality Control Representative.

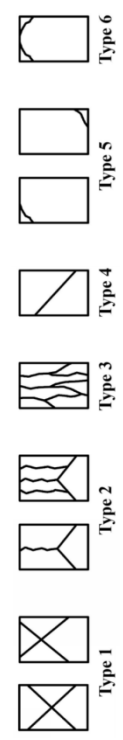
- i. Conduct strength tests of concrete as follows:
 - i. Secure sample sets in accordance with ASTM C 172.
 - ii. Mold cylinders in accordance with ASTM C 31 and cure under standard moisture and temperature conditions in accordance with ASTM C 31, Section 7 (a). Quantity of cylinders listed below is 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 early age concrete strength verification is required by the Contractor for formwork removal or stressing of post-tensioning tendons, strength shall be verified, at the Contractor's expense, by additional compression tests of field-cured cylinders or by the maturity method in accordance with ASTM C1074.
 - 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.
3. 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.
4. 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

AVERAGE DIAMETER (IN)	AVERAGE CROSS-SECTIONAL AREA (IN ²)	BREAKING LOAD (LB)	BREAK TYPE **	AVERAGE COMPRESSIVE STRENGTH (PSI)						
4	12.56	165990	Type 1	13210						



AGE AT TEST (DAYS)	DATE TESTED	CURE TYPE*	MIX I.D.	PLACEMENT LOCATION	TICKET NUMBER	SPECIMEN I.D.
7	3/8/2106	I, CA, CB	H3651	First Floor Slabs and Beams	1234	S0002
14						
28						
56						

3.5 PRECAST STRUCTURAL CONCRETE: HOLLOW-CORE

- A. Field Inspection: Acceptance of erected precast concrete will be made by the Design Professionals for general conformance with the plans and specifications.
- B. Defective Work: Precast concrete units which do not conform to specified requirements, including strength, tolerances, and finishes, shall be repaired or replaced with precast concrete units that meet requirements of this section as directed by the Design Professionals. The Contractor shall also be responsible for the cost to any other work affected by or resulting from corrections to precast concrete work.
- C. Acceptance Criteria of Concrete Strength: The compressive strength level of an individual class of concrete shall be considered satisfactory if the following requirements are met:
 - 1) The average of all sets of three consecutive strength tests equal or exceed the required f_c .
 - 2) No individual strength test falls below the required f_c by more than 500 psi.
 - 3) If criteria 1 above is not met but criteria 2 above has been, the Contractor shall immediately notify the Design Professionals and take immediate steps to increase the average of subsequent strength tests.

- D. Testing and Inspection will be in accordance with PCI MNL-116 Requirements.
- E. Precast producer shall allow Testing Agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Testing Agency and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.
- F. Compressive strength shall be based on tests of cylinders made and tested in accordance with the CAST-IN-PLACE CONCRETE section of this Specification.
- G. Quality Assurance:
 - 4) Evaluate precast producer's quality control and testing methods. Quality control inspection and testing shall occur during the manufacture of the components.
 - 5) Precast producer shall allow Testing Agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Testing Agency and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation
 - 6) Before shipment, all precast components shall be inspected to make certain the materials and workmanship conform to the requirements of the contract documents and shop drawings. Copy of the written inspection reports shall be submitted for record to the Contractor and Design Professional.
 - 7) Strength of precast concrete units will be considered potentially deficient when precast concrete units fail to comply with requirements, including the following:
 - a) Fail to meet compressive-strength test requirements. Concrete strength will be considered deficient if a cylinder strength test falls more than 500 psi below the required f'c. All units cast from the concrete that is represented by the low strength test shall be considered potentially deficient and subject to tests or replacement.
 - b) Failure to meet split cylinder strength requirements for lightweight concrete.
 - c) Reinforcement, and pretensioning and detensioning tendons of prestressed concrete do not conform to fabrication requirements.
 - d) Visual evidence of cracks exceeding .02 inches wide, excessive negative camber, or deflection in excess of calculated anticipated amounts.
 - e) Concrete curing and protection of precast units not as specified.
 - f) Concrete curing and protection of precast units against extremes in temperature fail to meet requirements.
 - g) Precast units are damaged during handling and erecting.
 - 8) When there is evidence that the strength of precast concrete units may be deficient or may not meet requirements, the Testing Agency will obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42.
 - a) A minimum of 3 representative cores will be taken from precast concrete units of suspect strength, from locations directed by Design Professionals.
 - b) Cores will be tested in an air-dry condition per ACI 301 when precast concrete units will be dry under service conditions.
 - c) Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is at least 85 percent of the 28-day design

- compressive strength and no core compressive strength is less than 75 percent of the 28-day design compressive strength.
- d) Test results will be made in writing on the same day that tests are made, with copies to Design Professionals, Contractor, and precast fabricator. Test reports will include the Project identification name and number, date, name of precast concrete fabricator, name of concrete testing agency; identification letter, name, and type of precast concrete unit or units represented by core tests; design compressive strength, compressive strength at break and type of break, corrected for length-diameter ratio, and direction of applied load to core with respect to horizontal plane of concrete as placed.
 - e) Where core test results are satisfactory and precast concrete units meet requirements, solidly fill core holes with patching mortar and finish to match adjacent concrete surfaces.
- 9) Visually inspect all field welds and test according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- H. X-Rays: The Design Professionals may order x-rays taken of any member if there is sufficient doubt about the proper existence or location of reinforcing steel, embedded items, or strands.
- I. Load Tests: The Design Professionals may order a load test of the member in the plant or in the field if there is sufficient evidence to question the structural integrity of the member.
- J. Except as specifically approved, the following is a partial list of finish defects and/or problems which are not acceptable in high quality exposed precast concrete and are means for rejection and replacement of precast pieces. These items must be corrected in manufacturing or design procedures.
- 1) Ragged or irregular edges.
 - 2) Excessive air pits and voids evident on exposed surface.
 - 3) Adjacent flat and return surfaces with more than slight difference in exposure.
 - 4) Casting lines evident from different placements.
 - 5) Visible form joints or irregular surfaces.
 - 6) Rust staining on surfaces.
 - 7) Components not matching approved sample or non-uniformity of color within a component.
 - 8) Areas of light or heavy aggregate concentration.
 - 9) Blocking or acid stains evident on surface.
 - 10) Non-uniformity of texture.
 - 11) Embedded foreign material.
 - 12) Reinforcement shadow lines.
 - 13) Damaged edges and surfaces.

3.6 CONCRETE MASONRY UNITS

A. Quality Assurance:

1. Testing Requirements:

e. Mortar:

- i. Testing Frequency: At the beginning of all masonry work take at least one test sample on three successive working days and at least one week intervals thereafter. Additional samples shall be taken whenever any change in materials or job conditions occur.
 - ii. Test compressive strength and air content test in conformance with ASTM C780.
 - f. Grout: The following testing requirements are for grout proportions determined by specified compressive strength only:
 - i. Testing Frequency: Samples of grout shall be taken for each mix design, each day grout is placed, and not less than every 5,000 square feet (465 square meters) of masonry wall surface area or fraction thereof.
 - ii. Test compressive strength in conformance with ASTM C1019.
 - iii. For self-consolidating grout also perform slump flow and Visual Stability Index (VSI) in conformance with ASTM C1611.
 - g. Compressive strength of masonry (f'm), unit strength method:
 - i. Testing Frequency: Prior to masonry construction and for every 5,000 square feet (465 square meters) of masonry wall surface area or fraction thereof.
 - ii. Sample and test units to verify conformance with ASTM C90.
 - iii. Thickness of bed joints does not exceed 5/8" (15.9 mm)
 - iv. Verify grout conforms to ASTM C476.
- 2. Inspection Requirements:
 - a. Inspect and verify the following items periodically unless otherwise noted as continuous. Periodic inspections shall be random and unannounced and shall occur at least once per week. Where items are noted as continuous, inspections shall be performed whenever and wherever the work is being performed.
 - i. Compliance with approved submittals
 - ii. At beginning of CMU construction, verify the following:
 - 1. Proportions of site-prepared mortar.
 - 2. Construction of mortar joints.
 - 3. Location of reinforcement and connectors.
 - 4. Block unit size.
 - iii. Prior to grouting, verify the following:
 - 1. Grout space.
 - 2. Grade, type, and size of reinforcement and anchor bolts.
 - 3. Placement of reinforcement and connectors.
 - 4. Proportions of site-prepared grout.
 - 5. Construction of mortar joints.
 - 6. Bond pattern.
 - 7. Tie-in at intersecting walls.
 - 8. Condition of block units after placement.
 - 9. Bond beam and/ or tie beam locations, reinforcement, and lap splice lengths.
 - iv. During CMU construction, verify the following:

1. Size and location of structural elements.
 2. Type, size, and location of anchors and/or embedments, including other details of connection of masonry to structural members, frames, or other construction.
 3. Welding of reinforcement (continuously inspect).
 4. Preparation, construction, and protection of masonry during cold weather or hot weather. For cold and hot weather requirements see Section 04 2200.
 5. Placement of grout (continuously inspect).
 6. Lintel size, location, and bearing lengths.
- v. Observe preparation of grout specimens, mortar specimens, and/or prisms.
- b. Inspections will also include verification that:
- i. Materials are properly stored.
 - ii. Installation is within specified construction tolerances.
 - iii. Proper mortar ingredients and mixing techniques are being used.
 - iv. Mortar time on board is within specified limits.
 - v. Joints are being properly tooled.
 - vi. Flashing assembly is being properly fabricated and installed.
 - vii. Weeps and vents are being installed and are functional.
 - viii. Control joints are being installed as indicated, or, as specified.

3.7 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, weld access holes and copes of Heavy Sections as defined in this Specification, examination and testing of completed welds, headed studs and deformed bar anchors, cutting of Heavy Sections, 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) 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:
 - e) Surface preparation and bolt type conforms to plans and Specifications prior to start of bolting operations.
 - f) Proper bolt storage and handling procedures per codes and standards referenced by this Specification are being followed.
 - g) Visually inspect all bolted connections.
 - h) 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.
 - i) 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.
 - j) 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.
 - k) Retest bolted connections that fail initial inspection after correction by the Fabricator or Erector.

5. Test and inspect welding and welded construction including but not limited to:
 - a) 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 Heavy Sections and high restraint welds comply with AWS requirements.
 - ii. Review of welding procedures including prequalification, qualifications test and, for Heavy Sections and 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.
 - b) 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.
 - c) 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.
 - d) Testing of welds at Heavy Sections and High Restraint Welds shall be performed not less than 48 hours after the weld has been completed.

- e) 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.
 - f) Inspection and Testing by the Testing Agency of High Restraint Welds and where Heavy Sections are to be joined by partial or complete joint penetration welds in tension:
 - 1) 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.
 - 2) 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.
 - 3) 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.
 - g) At Heavy Sections and 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.
6. Visually inspect all headed studs and deformed bar anchors for complete fusion and full 360-degree weld flash (or fillet).
- a) 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.
 - b) 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.
7. Cleaning & Painting:
- a) Examine shop painting to verify conformance with this Specification.
 - b) Examine loading and unloading of steel to visually observe that damage does not occur during shipping and handling.
- 3.8 STEEL JOISTS
- A. Quality Assurance:

1. Review mill certifications for compliance with the Contract Documents.
2. Review welders' qualification to determine compliance to Specifications.
3. Review welding procedures to determine compliance to Specifications.
4. Visually inspect weld quality, size and length
5. Visually inspect paint.
6. Verify that inspections required by manufacturer have been performed, and any corrections required as a result of inspections have been completed.
7. Inspect erected joists for damage.
8. Visually inspect placement of erected steel joists including:
 - a) Proper seat bearing
 - b) Welding from seat to support
 - c) Bolted and welded field connections
 - d) Bridging installation
 - e) Spacing
9. Submit inspection reports and state in each report whether or not **[fabrication and]** erection conform[s] to requirements of Specification and Drawings and shall specifically note deviations from them.

B. Joist manufacturer responsibilities:

1. Owner reserves the right to engage Owner's Testing Agency to perform shop inspections at any time during fabrication.
2. Notify Contractor and Testing Agency seven (7) days in advance of start of shop fabrication and three (3) days in advance of initial field delivery.
3. Comply with instructions of Testing Agency to correct deficiencies in materials and welding work as provided in Contract Documents.
4. Make available to Testing Agency lists showing identification marks, number of each different type of joist required, overall length, components size, ASTM designation of materials, camber and shop paint.

3.9 STEEL DECK

A. Quality Assurance:

1. 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.
2. 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
3. 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 05 1200.

3.10 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 Batch Plant: As required to ensure that concrete delivered to job complies with Specifications and design mix. Batch plant inspection shall be required once at start of job and thereafter if concrete falls below Specifications.
2. Inspection of Reinforcement: Provide continuous visual inspection of site fabrication. Record the steel reinforcement bar sizes, grade, length, and number of bars.
3. 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.
4. 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
5. Slump Tests: ASTM C143. Make one test from each truck.
6. 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.

7. 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

SECTION 01 5639 - TEMPORARY TREE AND PLANT 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 tree protection zone fencing, and general protection/pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Requirements:
 - 1. Section 01 5000 "Temporary Facilities and Controls" for temporary site fencing.
 - 2. Section 31 1000 "Site Clearing" for removing existing trees and shrubs.
 - 3. Section 32 9300 "Plants" for replacing damaged trees within protection zones.

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at a height 6 inches (150 mm) above the ground for trees up to and including 4-inch (100-mm) size at this height and as measured at a height of 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
- B. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape or the average of the smallest and largest diameters at a height 54 inches (1372 mm) above the ground line for trees with caliper of 8 inches (200 mm) or greater as measured at a height of 12 inches (300 mm) above the ground.
- C. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings defined defined by a circle concentric with each tree with a radius 12 times the tree's caliper size and with a minimum radius of 96 inches (2400 mm) unless otherwise indicated <Insert requirement>.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
 - b. Arborist's responsibilities.
 - c. Quality-control program.
 - d. Coordination of Work and equipment movement with the locations of protection zones.
 - e. Trenching by hand or with air spade within protection zones.
 - f. Field quality control.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
 2. Detail fabrication and assembly of protection-zone fencing and signage.
 3. Indicate extent of trenching by hand or with air spade within protection zones.
- C. Samples: For each type of the following:
 1. Organic Mulch: 1-quart volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
 2. Protection-Zone Fencing: None required.
 3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
 1. Species and size of tree.
 2. Location on site plan. Include unique identifier for each.
 3. Reason for pruning.
 4. Description of pruning to be performed.
 5. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For arborist and tree service firm.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

E. Quality-control program.

1.7 QUALITY ASSURANCE

A. Arborist Qualifications: Must have at least three of the following

1. Certified Arborist as certified by ISA.
2. Certified Arborist-Municipal Specialist as certified by ISA.
3. Licensed arborist in jurisdiction where Project is located.
4. Current member of ASCA Registered Consulting Arborist as designated by ASCA.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.8 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

D. Tree Protection Warranty:

1. Conditions. If, within a period of two years after date of substantial completion, any tree or trees in protection areas die or suffer significant loss due to damage caused by improper tree protection to the protection zone, or the tree itself, then the Contractor shall pay for all costs associated with fully removing and replacing the tree.

- a. Removal will include (but not be limited to) trimming, cutting, hauling away, stump grinding, excavation, backfill, replacement, staking, guying, and inclusion of full new tree warranty according to Section 32 9300 "Plants".
2. Replacements:
 - a. See FIELD QUALITY AND CONTROL section near the end of this specification.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Backfill Soil: Stockpiled soil mixed with planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
 1. Mixture: Well-blended mix of two parts stockpiled soil to one part planting soil.
 2. Planting Soil: Planting soil as specified in Section 32 9300 "Plants".
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
 1. Type: Shredded hardwood.
 2. Size Range: 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
 3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements:
 1. Wood Protection-Zone Fencing: Constructed of two 2-by-4-inch (50-by-100-mm) horizontal rails, with 4-by-4-inch (100-by-100-mm) preservative-treated wood posts spaced not more than 96 inches (2400 mm) apart, and lower rail set halfway between top rail and ground.
 - a. Height: 48 inches (1200 mm).
 - b. Lumber: Comply with requirements in Section 06 1000 "Rough Carpentry." Previously used materials may be used when approved by Architect.
 2. Gates: Single- or Double- swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches (914 mm).
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
 1. Size and Text: As shown on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Tie a 1-inch (25-mm) blue vinyl tape around each tree trunk at 54 inches (1372 mm) above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
 - 1. Apply 2-inch (50-mm) uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches (150 mm) of tree trunks.

3.3 PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 - 1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
 - 2. Access Gates: Install where needed; adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 35 feet (10.5 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete, and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 31 2000 "Earth Moving" unless otherwise indicated.
- B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.
- C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.
- D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:
 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 2. Cut Ends: Do not paint cut root ends.
 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 4. Cover exposed roots with burlap and water regularly.
 5. Backfill as soon as possible according to requirements in Section 31 2000 "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune tree roots 12 inches (300 mm) outside of the protection zone by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.
 - 1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
 - 2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
 - 3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
 - a. Type of Pruning: Cleaning, raising, reducing, and thinning where indicated.
 - b. Specialty Pruning: Structural restoration vista and utility where indicated.
- B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.
- C. Cut branches with sharp pruning instruments; do not break or chop.
- D. Do not paint or apply sealants to wounds.
- E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.
- F. Chip removed branches and spread over areas identified by Architect or stockpile in areas approved by Architect, unless the branches are diseased or otherwise could cause deleterious effects to any impacted portion of the project as identified by Arborist.

3.7 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
 - 1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 2 inches (50 mm) or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

- B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
 - 1. Small Trees: Provide one new tree of 4-inch to 6-inch caliper size for each tree that measures 12 inches (300 mm) or smaller in caliper size.
 - 2. Large Trees: Provide one new tree of 8-inch to 10-inch caliper size for each tree being replaced that measures more than 12 inches (300 mm) in caliper size.
 - a. Species: As selected by Architect.
 - 3. Plant and maintain new trees as specified in Section 32 9300 "Plants."

- C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 2-inch (50-mm) uniform thickness to remain.

- D. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 01 5639

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 2300 "Alternates" for products selected under an alternate.
 - 2. Section 01 2500 "Substitution Procedures" for requests for substitutions.
 - 3. Section 01 4200 "References" for applicable industry standards for products specified.
 - 4. Section 01770 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 3300 "Submittal Procedures."
- F. Substitution: Refer to Section 01 2500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
 - 2. Store products to allow for inspection and measurement of quantity or counting of units.
 - 3. Store materials in a manner that will not endanger Project structure.

4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.5 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. **Manufacturer's Warranty:** Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 2. **Special Warranty:** Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. **Special Warranties:** Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. **Manufacturer's Standard Form:** Modified to include Project-specific information and properly executed.
 2. **Specified Form:** When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. **General Product Requirements:** Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. **Standard Products:** If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.

5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect through Construction Manager in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.
 7. All products shall be free from asbestos.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

- a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 2500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 2500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 3300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 01 3300 "Submittal Procedures."
 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
1. Construction layout.
 2. Field engineering and surveying.
 3. Installation of the Work.
 4. Cutting and patching.
 5. Starting and adjusting.
 6. Protection of installed construction.
- B. Related Requirements:
1. Section 01 3300 "Submittal Procedures" for submitting surveys.
 2. Section 01 7700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 3. Section 07 8413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. 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. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 3100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - a. Include footings, foundations, anchor bolts, and similar items.
 - 6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. 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.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Remove and replace damaged, defective, or non-conforming Work.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching of the material being cut and patched. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 1000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.
- 3.7 STARTING AND ADJUSTING
- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
 - C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 4000 "Quality Requirements."
- 3.8 PROTECTION OF INSTALLED CONSTRUCTION
- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
 - B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

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PORTAGE PUBLIC SCHOOLS**

**EXECUTION
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- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 7300

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SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 01 7823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 01 7839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Section 01 7900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 7900 "Demonstration and Training."
 - 6. Advise Owner of changeover in utility services.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements.
 - 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of

unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 01 2900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit warranties including those specified in individual Sections.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format:
 - a. PDF electronic file. Architect, through Construction Manager, will return annotated file.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit on digital media acceptable to Architect.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

- h. Sweep concrete floors broom clean in unoccupied spaces.
- i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- k. Remove labels that are not permanent.
- l. Wipe surfaces of mechanical and electrical equipment[, **elevator equipment,**] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
- p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- q. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations, before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 7700

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SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Systems and equipment operation manuals.
 - 3. Systems and equipment maintenance manuals.
 - 4. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 3300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

- D. Comply with Section 01 7700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.5 REQUIREMENTS FOR OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.

6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.
- C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.

- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
- I. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1.8 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.

- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 7823

SECTION 01 7839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 01 7300 "Execution" for final property survey.
 - 2. Section 01 7823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
2. Content: Types of items requiring marking include, but are not limited to, the following:
- a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
 4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 01 3100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect and Construction Manager.
 - e. Name of Contractor.

1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- C. Format: Submit record Product Data as annotated PDF electronic file.
 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.6 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 7839

SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor and videographer.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. At completion of training, submit complete training manual(s) for Owner's use prepared in same format required for operation and maintenance manuals specified in Section 01 7823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 4000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "Project Management and Coordination."

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.

- e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 7823 "Operation and Maintenance Data."

- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, written, or demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
 - 1. Submit video recordings on CD-ROM or thumb drive.
 - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.

- c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
- E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 7900

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SECTION 03 1000
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	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 01 4500
Concrete Reinforcement and Embedded Assemblies	Section 03 2000
Cast-In-Place Concrete	Section 03 3000
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 237 – Self Consolidating Concrete.
3. ACI 301 – Specifications for Structural Concrete.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. ACI 347 – Guide to Formwork for Concrete.
6. ACI 347.2R – Guide for Shoring/Reshoring of Concrete Multistory Buildings

C. Definitions:

1. See Section 03 3000.

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/Reshoring Calculations
 - 4. Product Data
 - 5. Samples
 - 6. Compatibility Certification
 - 7. Hazardous Materials Notification
 - 8. **Submittal Schedule:** See Section 03 3000.
 - 9. **Shop Drawings:**
 - a. Submit for action: Formwork shop drawings sealed and signed by a Professional Engineer licensed in the state where the project is located. 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 and reshoring that correlates with the information contained in the shoring/reshoring calculations described below.
 - 6) Locations and dimensions of openings in structural members including floor slab, shear walls, columns and beams. See SUBMITTALS Section of Specification 03 3000.
 - 7) Location of proposed construction joints in walls, floors, slabs, and beams. See SUBMITTALS Section of Specification 03 3000.

10. **Shoring/Reshoring Calculations:** Submit for record. Calculations sealed and signed by a Professional Engineer licensed in the state where the project is located. Calculations shall clearly address but not be limited to the following:
 - a. Shoring removal and reshoring installation procedure including timing and sequencing.
 - b. Concrete age and strength at the time of each shoring/reshoring operation.
 - c. Description of construction loads assumed including concrete, formwork, and construction live load in accordance with ACI 347.
 - d. Description of the distribution of construction loads between the shored/reshored levels.
 - e. The total construction load imposed on all levels supporting shoring/reshoring at each stage of the shoring/reshoring cycle.
 - f. A written statement by the Professional Engineer that the total construction load imposed on any level supporting shoring/reshoring, at all stages of the shoring/reshoring cycle, accounting for concrete age and relative strength at time of loading, meets the requirement of Section 3.2.
 11. **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.
 12. **Samples:** At request of Architect, submit for record samples of form ties and spreaders.
 13. **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.
 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.
- B. Submittal Process: See Section 03 3000.
- C. SER Submittal Review: See Section 03 3000.
- D. Substitution Request: See Section 03 3000.
- E. Request for Information (RFI): See Section 03 3000.
- 1.7 FORMWORK DESIGN
- A. Design of Formwork, Shoring/Reshoring, 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 37-02 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

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. See Section 3.2 for shoring/reshoring requirements.
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 37-02 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) of Self-Consolidating Concrete 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 01 4500.

1.10 QUALITY CONTROL BY CONTRACTOR

- A. See Section 03 3000.

1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

- A. See Section 03 3000.

1.12 PERMITS AND WARRANTY

- A. Permits: See Section 03 3000.

- B. Warranty: See Section 03 3000. 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:

1. Formwork shall meet construction safety regulations for the state where the project is located.
2. Forms shall be removable without impact, shock or damage to concrete surfaces, the structure and adjacent materials.
3. 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.
4. 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.
5. 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, beams, ledges, balcony fascias to achieve true alignment and level soffit of edge beams and concrete edges. All such areas must be sharp, straight and true to line and level. Edge beams and concrete canopies and ledges 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. 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 beam, 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. Coordinate with materials as specified in Section 03 2000 Concrete Reinforcement and Embedded Assemblies.

PART 3 - EXECUTION

3.1 FORMWORK

A. General:

1. Inspect areas to receive formwork.
2. 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.
3. 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.
4. 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.
5. Comply with shop drawings, ACI 301, 318, 347 and Contract Documents.
6. Maintain formwork and finished work construction tolerances complying with ACI 301 and 117.
7. 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.
8. Erect forms for easy removal without hammering or prying against concrete surfaces.
9. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
10. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
11. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
12. 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.
13. Design, erect, support, brace and maintain formwork and shoring to support loads until such loads can be safely supported by the concrete structure.
14. Where specifically shown on the Contract Documents as monolithic, upturned beams, 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 03 2000.
 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
- L. 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.

- M. 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.
- N. For slabs-on-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 beams, 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 beam soffits, joists, 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.]** For multistory buildings, enough shoring should be provided for a sufficient number of floors to be built to properly support the construction loading from reshoring.
- C. Determination of early age compressive strength of concrete at time of formwork removal shall be made by compression tests of field-cured cylinders or by the maturity method in accordance with ASTM C1074. If the maturity method is used, submit sufficient data using project materials to demonstrate correlation of measurements on the structure with the compressive strength of laboratory-cured molded cylinders.
- D. Remove formwork progressively using methods to prevent shock loads or unbalanced loads from being imposed on structure. Comply with ACI 347.
- E. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.
- F. Whenever formwork is removed during the curing period, the exposed concrete shall be cured per requirements of Section 03 3000.
- G. All wood formwork, including that used in void spaces, pockets and other similar places shall be removed.
- H. Form tie holes shall be filled as per approved samples submitted to the Design Professionals.
- I. 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 03 3000.

END OF SECTION

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SECTION 03 2000
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	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 01 4500
Concrete Formwork	Section 03 1000
Cast-In-Place Concrete	Section 03 3000
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 03 3000.

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. Reproduction of Contract Drawings as shop drawings is not permitted.

1. Submittal Schedule
2. Shop Drawings
3. Product Data
4. Mill Reports
5. Reinforcement Strain Test
6. Hazardous Materials Notification

1. **Submittal Schedule:** See Section 03 3000.

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 03 3000.
 - i) Concrete accessories and embedded items. See SUBMITTALS Section of Specification 03 3000.
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.
- B. Submittal Process: See Section 03 3000.
 - C. SER Submittal Review: See Section 03 3000.
 - D. Substitution Request: See Section 03 3000.
 - E. Request for Information (RFI): See Section 03 3000.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Comply with General Conditions and Division 1, 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 01 4500.

1.9 QUALITY CONTROL BY CONTRACTOR

- A. See Section 03 3000.

1.10 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

- A. See Section 03 3000.

1.11 PERMITS AND WARRANTY

- A. Permits: See Section 03 3000.
- B. Warranty: See Section 03 3000. 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. 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.
- B. 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.

C. 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 D3963/D3963M referencing Annex A2 of ASTM A775/A775M.
 - 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. Headed Bars:

1. For bar sizes #11 ($\phi 36$) 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
 - b. Lenton Terminator by Erico
 - c. Grip-Twist Doughnut by Bar-Splice
 - d. BPI ButtonHead by BarSplice
 - e. Zap T-Lok by BarSplice
 - f. Taper-Lock End Anchor Disc by Dayton Superior
 - g. 100, 550 and 670 Series by Headed Reinforcement Corp

C. 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

D. 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.

E. 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.

F. 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.

G. 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
 - b. Keyway Splice Box by Meadow Burke
 - c. Metalstrip by Dayton Superior
 - d. DBDI Splice System by Dayton Superior
 - e. D50 DBR Coupler System by Dayton Superior
 - f. BPI Barsplicer by BarSplice
 - g. 300 Series by Headed Reinforcement Corp

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. Shallow Embedment Internally Threaded Inserts with $\frac{3}{4}$ " maximum embedment.
 - a. Acceptable Products:
 - i. Mini Undercut + by DeWalt (for post-tensioned slabs and precast hollow core slabs)
 - ii. HDI-P TZ by Hilti (for post-tensioned slabs)
 4. Adhesive Anchors:
 - a. Basis of Design: See General Notes
 - b. Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure
 - i. HIT-RE 500-V3 by Hilti, Inc.
 - ii. Epcon C6+ by ITW Red Head
 - iii. Epcon G5 by ITW Red Head
 - iv. Pure 110+ by DeWalt
 - v. SET-3G by Simpson Strong-Tie Co.
 - c. The adhesive anchor system used for post-installed anchorage to concrete shall conform to the requirements of ACI 355.4 and commentary and shall possess a current ICC- ES report demonstrating compliance with ACI 318.
 5. Expansion Anchors:
 - a. Basis of Design: See General Notes
 - b. Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure.
 - i. Kwik Bolt 1 (KB1) by Hilti, Inc.
 - ii. Power Stud+ SD1 or SD2 by DeWalt
 - iii. Power Stud + SD6 (SS) by DeWalt
 - iv. Trubolt by ITW CCNA
 - v. Strong-Bolt 2 by Simpson Strong-Tie Co.
 - c. The expansion anchors used for post-installed anchorage to concrete shall conform to the requirements of ACI 355.2 and commentary and shall possess a current ICC- ES or IAPMO UES report demonstrating compliance with ACI 318.
 6. Threaded Screw Anchors:
 - a. Basis of Design: See General Notes

- b. Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure.
 - i. Screw-Bolt + by DeWalt
 - ii. Tapcon + by ITW Red Head
 - iii. Titan HD by Simpson Strong-Tie Co., Pleasanton, CA
 7. Inserts and Coil Rods: Yield strength 65,000 psi (450MPa), ASTM B 633, manufactured by Acrow-Richmond Limited or Dayton Superior
 8. Welding Electrodes: AWS 5.5, Series E70.
 9. Welded Deformed Bar Anchors: Welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division or equivalent.
- B. Dovetail Anchor Slots:
1. Type: Formed 22 gauge (0.85mm) galvanized steel
 2. Acceptable Manufacturers:
 - i. Heckmann Building Products
 - ii. Hohmann and Barnard,
 - iii. 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.
 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.
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.
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

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, Omak 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 03 3000).
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 03 3000.

END OF SECTION

SECTION 03 3000 - 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	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 01 4500
Concrete Formwork	Section 03 1000
Concrete Reinforcement and Embedded Assemblies	Section 03 2000
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 237 – Self Consolidating Concrete.
3. ACI 301 – Specifications for Structural Concrete.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
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. 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 Contract Drawings for shop drawings is not permitted.
 1. Submittal Schedule
 2. Mix Designs
 3. Concrete Travel Times to the Project Site
 4. Hot and Cold 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. **Submittal Schedule:** The contractor shall submit for action a schedule at least twenty (20) working days prior to commencing submittals.
 - a. This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for action at least twenty (20) working days before the modification or addition is proposed to take place.
 - b. If at any time the total number of shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above.
 - c. For the purposes of developing a schedule, assume the following review rate, Shop drawings – 10 full size sheets per week.
16. **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 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.
 - a) 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.

- b) 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.
 - c) 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. Lightweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.
 - xix. 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.
17. Concrete Travel Times to the Project Site: Submit for record.
18. Hot and Cold Weather Procedures: Submit for record written procedures for placement of concrete in hot and cold weather conditions. Hot and Cold weather are as defined in the Concrete Placement section of this Specification.
19. 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.
20. **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.

Joint locations for concrete slabs to receive a terrazzo or similar finish subject to reflective cracking must be coordinated with layout of finish drawings.

21. **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.
22. **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.
23. **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.
24. **FF/FL Testing:** Submit for record. Testing Agency to test and report flatness (F_F), levelness (F_L) prior to shoring removal. Do not test slabs for levelness (F_L) that include camber, inclined surfaces or planned changes in floor surface slope. Perform F_F/F_L testing in accordance with ASTM E 1155 requirements.
25. **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.
26. **Patching Defective Concrete Finishes:** Submit for action procedures, intended locations, and product information.
27. **Conduit and Pipes Embedded in Concrete:** Submit for action layout of embedded conduit and pipes.
28. **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.
29. **[LEED Submittals:]**

B. 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.

C. 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.

D. Substitution Request

1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
2. All substitutions must be requested using the structural substitution request form included at the end of this section. Acceptance using the structural substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The structural substitution request form, even if accepted, does not constitute a change order.
3. Accepted substitutions or modifications shall be coordinated and incorporated in the work at the sole expense of the Contractor.
4. The acceptance by the Design Professionals of a specific and isolated request by the Contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.
5. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated for the review and/or incorporation of the Contractor-requested substitution, including indirect effects on other portions of the work, the Contractor is responsible for paying for additional work performed by the Design Professionals at the standard 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.
6. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

E. 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 01 4500.

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 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: 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: 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 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.
- B. Blended Hydraulic Cement:
 - 1. ASTM C595, Type IL, Portland-Limestone Cement
 - 2. ASTM C595, Type IS, Portland-Slag Cement
 - 3. ASTM C595, Type IP, Portland-Pozzolan Cement

4. ASTM C595, Type IT, Ternary-Blended Cement
- C. Aggregates for Normalweight 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, drilled piers and caissons
 - 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.
- D. 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. Provide aggregates from a single source throughout the project for exposed concrete.
 4. Aggregate shall contain the minimum absorbed moisture content recommended by the manufacturer for the project prior to batching.
 5. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed 3/4" (20mm)
- E. Water: ASTM C 1602. Clean, and free from injurious amounts of oil, acids, alkali, salts, organic material, or other deleterious materials.
- F. Supplementary Cementitious Material
1. Fly Ash: ASTM C 618, Class C or Class F.
 2. Slag Cement: ASTM C 989.
 3. Silica Fume (Microsilica): ASTM C1240.
 - a. Acceptable Products:
 - i. Force 10,000 D by GCP Applied Technologies, Inc.
 - ii. Eucon MSA by Euclid Chemical Company
 - iii. MasterLife SF 100 by Master Builders Solutions
 - iv. Sikacrete 950 DP by Sika Corporation
 4. Metakaolin: ASTM C 618, Class N.
 - a. Acceptable Products:
 - i. MasterLife MK828 by Master Builders Solutions
 - ii. HRMK 100 by GCP Applied Technologies, Inc.
 - iii. Sikacrete M-100 by Sika Corporation

5. For concrete assigned to Exposure Classes F1 and F2, as defined in ACI 318, there is no limit to the maximum amount of supplementary cementitious materials included in the mix as a percentage of total cementitious materials by mass.
6. For concrete assigned to Exposure Class F3 as defined in ACI 318, limits to the maximum amount of supplementary cementitious materials included in the mix as a percentage of total cementitious materials by mass are as follows:
 - a. Fly ash or other pozzolans conforming to ASTM C618 = 25%
 - b. Slag cement = 50%
 - c. Silica fume = 10%
 - d. Total of fly ash or other pozzolans and silica fume = 35%
 - e. Total of fly ash or other pozzolans, slag cement and silica fume = 50%
 - f. The maximum percentage limits listed above shall include the supplementary cementitious materials used in the manufacture of ASTM C595 blended cements.
7. 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.
8. Supplementary Cementitious Materials 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.

G. Ready Mixed Concrete:

1. Shall be batch-mixed and transported in accordance with ASTM C 94.

H. Self-Consolidating Concrete:

1. Produce in accordance with ACI 237R.
2. Perform the following tests and provide report prior to submitting mix design:
 - a. Resistance to Segregation: Achieve a maximum static segregation percentage of 15% when tested according to ASTM C 1610 with a VSI index of 1 maximum.
 - b. Slump Flow: ASTM C 1611 within a range of **[20"-30" (500mm-750mm)]**.
 - c. Passing Ability: ASTM C 1621 with a maximum difference of 2" (50mm) between testing with and without the J-Ring.

2.2 CONCRETE MIX DESIGN

A. Concrete Strength:

1. Shall be as indicated on the Structural Drawings
2. Where concrete strength is not indicated on the drawings, the minimum concrete strength for exposure classes as defined in ACI 318 are as follows:
 - a. F0, S0, W0, C0, C1 = 2500 psi
 - b. F1 = 3500 psi
 - c. S1, W1 = 4000 psi
 - d. F2, S2, S3, = 4500 psi
 - e. F3, C2 = 5000 psi

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 lightweight concrete less than 120 pcf (19 kN/m^3) density, air content may be up to 7% regardless of exposure condition.
3. For concrete with a specified compressive strength (f_c) greater than 5000 psi (35MPa), required air content may be reduced to $5\% \pm 1.5\%$.
4. Entrained air content noted above shall occur at point of delivery.
5. No entrained air content is required for foundations with no surface exposed to weather.
6. All interior steel trowel finished, normal weight slabs shall have a maximum air content of 3%.

D. Water-Cementitious Material Ratio (w/cm) for Normalweight Concrete

1. The total combined weight of Portland cement and all other supplementary cementitious material shall be used to determine the w/cm.
2. The w/cm shall not exceed the values indicated below, including any water added to meet specified slump in accordance with the requirements of ASTM C 94.
3. Based on Exposure Class, as defined in ACI 318, the following maximum w/cm shall be provided:
 - a. Exposure Class F0, S0, W0, C0, C1, no maximum
 - b. Exposure Class F1, max w/cm=0.55
 - c. Exposure Class S1, W1, max w/cm=0.50
 - d. Exposure Class F2, S2, S3, max w/cm=0.45
 - e. Exposure Class F3, C2, max w/cm=0.40
4. [Concrete used in slab on grade shall have a maximum w/cm ratio of 0.45.]

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 and 4" +/- 1" (100mm) for lightweight 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".

- F. Self-Consolidating Concrete Slump/Flow: Use for concrete exposed to view and heavily reinforced areas where indicated on the plans, and where conventional mixtures do not provide adequate consolidation. Minimum slump/flow diameter of **[20" (500mm)]** or as required by the successful test placement onsite, which shall verify proper workability, finish, and setting time. All self-consolidating concrete shall contain the specified high range water-reducing admixture. All self-consolidating concrete shall contain viscosity modifying admixture as required unless proper quantity and grading of fines can be achieved.
- G. 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.

2.3 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 Master Builders Solutions
 - 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. MasterPozzolith Series by Master Builders Solutions
 - 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 Master Builders Solutions
 - 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 Master Builders Solutions
 - 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 Master Builders Solutions
 - 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 Master Builders Solutions
 - 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 Master Builders Solutions
 - 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 Master Builders Solutions
 - 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.
- 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 Master Builders Solutions
 - 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 and 300C by Master Builders Solutions
 - b. Eucon Vandex AM-10 by Euclid Chemical Company
 - c. Admix C-Series by Xypex
- N. Viscosity Modifying Admixture (VMA) for Self-Consolidating Concrete (SCC):
1. ASTM C 494, Type S
 2. Acceptable Products:
 - a. MasterMatrix VMA Series by Master Builders Solutions
 - 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 Master Builders Solutions
 - 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
 3. Amino Alcohol Based:
 - a. Acceptable Product:
 - i. FerroGard 901 by Sika Corporation
 - ii. MasterLife CI 222 by Master Builders Solutions
- 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 Master Builders Solutions
 - 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 Master Builders Solutions
 - 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.
 - b. MVRA 900 by ISE LOGIK Industries
- 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.

2.4 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 Master Builders Solutions
 - d. Perma Prime 3C by Dayton Superior

2.5 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 Master Builders Solutions]**
- 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. Curing and Durability-Increasing Compound, Spray Applied
- 1. Shall conform to state and federal VOC regulations with zero VOC content.
 - 2. Not to be used with Moisture Vapor Reducing Admixtures, Integral Waterproofing Admixtures, or Latex Admixtures
 - 3. Acceptable Products:
 - a. P3 Protect by Spray-Lock Concrete Products
- E. 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
 - b. SCP 327 by Spray-Lock Concrete Protection
- F. 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 Master Builders Solutions
 - d. Liqui-Hard by W. R. Meadows
- G. Evaporation Retarder:
- 1. Acceptable Products:
 - a. MasterKure ER50 by Master Builders Solutions
 - b. Eucobar by Euclid Chemical Company
 - c. Sika Film by Sika Corporation

2.6 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 Master Builders Solutions
 - 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 Master Builders Solutions
 - c. Emeryplate FF to be used with Lumiseal WB by Laticrete International, Inc.

2.7 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 Master Builders Solutions
 - 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
- 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.

2.8 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 Master Builders Solutions
 - 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 Master Builders Solutions
- c. T78 Methyl Methacrylate Crack Sealer by Transpo Industries, Inc.

C. High Strength Flowing Repair Concrete:

- 1. For forming and pouring large volume repairs, provide shrinkage compensated repair concrete with integral corrosion inhibitor.
- 2. Minimum compressive strength 8000 psi (56MPa) @ 28-days
- 3. Prior approval by the Design Professionals is required for cold weather applications
- 4. Acceptable Products:
 - a. Eucocrete by Euclid Chemical Company
 - b. MasterEmaco S 466 CI by Master Builders Solutions
 - c. Meadow-Crete FNP by W. R. Meadows

D. Epoxy Injection:

- 1. ASTM C881
- 2. Acceptable Products:
 - a. MasterInject 1380 by Master Builders Solutions
 - 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 Master Builders Solutions
 - 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 Master Builders Solutions
 - 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 Master Builders Solutions
 - 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

2.9 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 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/m^3).
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 Master Builders Solutions
 - e) FORTO-FERRO by Forta Concrete Fiber
 - f) FiberForce 650 and 750 by ABC Polymer Industries, LLC

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 03 1000 Concrete Formwork.
 2. Remove dirt, sawdust, nails and other foreign material from formed space.
 3. Dampen wood forms by sprinkling immediately before placing.
 4. Cool metal forms by sprinkling immediately before placing.
- C. Concrete Accessories:
 1. Coordinate with Section 03 1000 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.

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-on-grade and vertical surfaces, such as column pedestals, foundation walls and other locations, as indicated.

D. Contraction Joints in Floor Slabs-on-Grade:

1. Maximum slab area controlled by jointing is 400 square feet (35 square meters).

2. Space joints at 36 times slab thickness unless a smaller spacing is indicated on the Drawings, located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
 3. Contraction joints can be provided by sawcuts, formed joints or appropriately detailed construction joints.
 4. Sawcuts shall be made as soon as possible after slab finishing as may be safely done without dislodging aggregate. The Soff-Cut saw shall be used to a depth of $\frac{1}{4}$ of slab thickness immediately after final finishing. Conventional saw shall be used as soon as possible after final finish without raveling to a depth as indicated on the Drawings.
 5. Where contraction joints coincide with construction joints, detail joint as indicated on Drawings.
- E. Joint Fillers: Coordinate with Section 03 2000 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, 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 03 2000 and Drawings.
 6. Do not place concrete having a slump outside of allowable slump range.
 7. 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.
 8. Unless adequate protection is provided, concrete shall not be placed during rain.
 9. Rain water shall not be allowed to increase mixing water or to damage the surface finish.
 10. 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.
 11. Keep subgrade moisture uniform without puddles or dry areas.
 12. Place vapor retarder directly below slabs on 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 03 1000/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.
 6. Use equipment and procedures for consolidation of concrete in accordance with ACI 309R.
 7. Do not use vibrators to move fresh concrete laterally inside forms from discharge point; shift discharge point as needed.
 8. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine.
 9. Place vibrators to rapidly penetrate placed layer and at least 6" (150mm) into preceding layer.
 10. Do not insert vibrators into lower layers of concrete that have begun to set.
 11. 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.
 12. Do not vibrate Self-Consolidating Concrete (SCC).

E. Placing Concrete Slabs:

1. Place concrete continuously without interruption between predetermined construction and contraction joints in floors.
 - a. Place slabs on 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.

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 slab shall be moist cured for a minimum of 36 hours after placement.
12. 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. Cold-Weather Placement:

1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306R and as specified in this section.
2. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C), and not more than 80°F (27°C), at point of placement.
3. Do not use frozen materials or materials containing ice or snow.
 - a. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
4. Remove frost, snow and ice from forms, reinforcement and other embedments immediately prior to concrete placement.
5. Use only the specified non-corrosive accelerating admixture previously approved as part of the cold weather mixture. Addition of calcium chloride, salt, thiocyanates or admixtures containing more than 0.05 percent chloride ions is not permitted.
6. Freeze Resistant Concrete per ASTM C1622 and Chapter 9 of ACI 212.3R may be used if approved by SER. The contractor shall prepare a plan for placing, finishing and curing procedures that assure the specified hardened properties are achieved.

J. 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. Fog spray forms, reinforcement, and subgrade just before pouring concrete.

7. 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.
8. 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 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 on 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 $SOF_L=15$. SOF_L should not be tested for parking slabs that include inclined surfaces or planned changes in floor surface slope.

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 1/4" (6mm) over 4 ft (1200mm), no offset greater than 1/16" (2mm)
 - b. Specified local $MLF_F = 15$, use 1/8" (3mm) over 4 ft (1200mm), no offset greater than 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 1/4" (6mm) in height rubbed down or chipped off.
- L. Architectural Concrete Finish:
1. Using self-consolidating concrete, provide smooth, uniform finish upon form removal with no patching, stoning or other form of repair except washing permitted unless otherwise noted for walls, columns and other surfaces exposed to view. The surface shall match the approved jobsite mock-up panel.

M. 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, dampproofing, 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.

N. 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.

O. 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.

P. 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.

3.7 CURING AND PROTECTION

A. Normal Conditions:

1. Protect concrete from premature drying, excessive hot or cold 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.
 - vii. Hand-brooming and sweeping is not sufficient.
 - viii. 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 on grade, concrete toppings, concrete pour strips, supported slabs, walls and columns, not subject to conditions of hot or cold weather concreting, in accordance with ACI 308.
 7. Cure surfaces exposed to deicing salts, brackish water, etc., such as loading dock slabs, parking garage 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. Cold-Weather Protection:
1. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40°F (4°C) for more than 3 successive days), take additional

precautions as specified in ACI 306R when placing, curing, monitoring and protecting the fresh concrete.

C. 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.

D. 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.

3.8 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.

3.9 EVALUATION AND ACCEPTANCE OF CONCRETE

- A. In accordance with ACI 301, except where otherwise specified.
- B. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements for any reason, such as lack of workability, or insufficient strength, the Contractor shall have his laboratory verify the deficiency and modify the mix design, until the specified concrete is obtained. Modified mix to be submitted for approval per Part 1 - SUBMITTALS.

3.10 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.

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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 m ³)
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) _____

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SECTION 07 2100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Extruded polystyrene foam-plastic board insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 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.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

- A. Extruded Polystyrene Board Insulation: Maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, when tested in accordance with ASTM E 84.
 - 1. Types and minimum compressive strengths per ASTM C 578 as follows:
 - a. Foundation: Type IV, 25-psi (173-kPa).
 - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - 3. Thermal Resistivity: 5.0 deg F x h x sq. ft./Btu x in. at 75 deg F (34.7 K x m/W at 24 deg C).

2.2 ACCESSORIES

- A. Insulation for Miscellaneous Voids:

1. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Provide extruded polystyrene in thickness indicated, or molded polystyrene or graphite-polystyrene foam-plastic board in increased thickness to provide an equivalent R value.
- B. Butt panels together for tight fit.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.
 1. If not otherwise indicated, extend insulation a minimum of 36 inches (915 mm) below exterior grade line.
 2. Thickness: 3 inches (51 mm), R-15 minimum unless indicated otherwise.

3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 2100