Project Manual
Including Specifications for
the Construction of

HANGAR

RATON MUNICIPAL AIRPORT
33788 U.S. Highway 64
Raton, New Mexico 87740

OWNER: CITY OF RATON
PO Box 910, 224 Savage Avenue
Raton, New Mexico 87740

ARCHITECT MOLZEN CORBIN
2701 Miles Rd SE
Albuquerque, New Mexico 87106

ARCHITECT'S PROJECT NUMBER RAT181-14

September 2021

MOLZENCORBIN
ENGINEERS | ARCHITECTS | PLANNERS

CERTIFICATIONS PAGE

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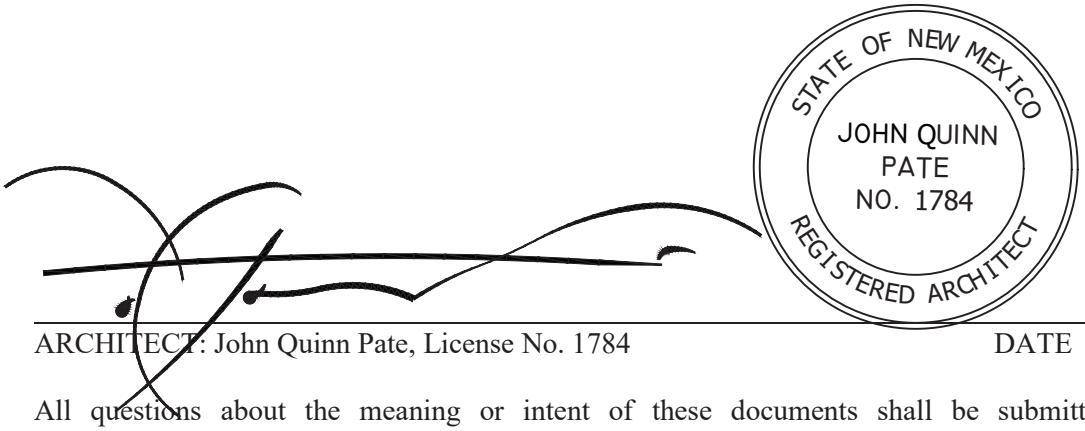
505.242.5700

ARCHITECT — Jeremy Scott Alford, RA

ARCHITECT/ LANDSCAPE ARCHITECT: — John Quinn Pate, RA/RLA

The technical material and data contained in the specifications under the supervision and direction of the undersigned, whose seal as a Professional Architect, licensed to practice in the State of New Mexico, is affixed below.



9/10/2021

ARCHITECT: John Quinn Pate, License No. 1784 — DATE

All questions about the meaning or intent of these documents shall be submitted only to the Architect/Engineer of Record, stated above, in writing. Refer to paragraph 3.2 of the Instructions to Bidders as to interpretations.

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REQUEST FOR BIDS

The City of Raton, New Mexico will open Sealed Bids at 2:00 p.m. (local time) on Wednesday, October 6, 2021 at the Raton City Hall – Commission Chambers, 224 Savage Avenue, Raton, New Mexico 87740 or other designated area at the City Offices, on the following:

Hangar at the Raton Municipal Airport,
New Mexico Department of Transportation – Aviation Division Grant: RTN-18-02

BIDDING FORMS AND TECHNICAL SPECIFICATIONS may be examined at the office of: City Clerk or the City of Raton website: https://ratonnm.gov/.

The CONTRACT DOCUMENTS may be examined at the following locations:
ARI Graphix (www.ariplans.com), 4716 McLeod NE, Albuquerque, New Mexico 87109
Construction Reporter, 4901 McLeod Dr. NE, Suite 200A, Albuquerque, New Mexico 87109
Dodge Data & Analytics, www.construction.com

Copies of the CONTRACT DOCUMENTS may be obtained at ARI Graphix (www.ariplans.com), 4716 McLeod NE Albuquerque, New Mexico 87109. Contact ARI Graphix for costs of printing CONTRACT DOCUMENTS (non-refundable) at (505) 884-0862.

A Pre-Bid Conference will be held at 1:00 p.m. (local time) on Thursday, September 23, 2021 at the project site: Raton Municipal Airport / Crews Field, 33788 U.S. Highway 64 W., Raton, New Mexico 87740 .

Mailed Bids should be addressed to the City Clerk at City of Raton, PO Box 910, 224 Savage Avenue, Raton, New Mexico 87740, with the envelope marked: "**Hangar**", on the **lower left-hand corner** of the submitted envelope. It shall be the responsibility of the Bidder to see that their Bid is delivered to the **City Clerk** by the date and time set for the Bid Request. If the mail or delivery of said Bid Request is delayed beyond the Opening Date and Time, Bids thus delayed will not be considered. A public opening will be held, and any Bidder or their authorized representative is invited to attend.

The City of Raton reserves the right to reject any or all Bids submitted.

CITY OF RATON

SCOTT BERRY, P.E.
CITY MANAGER

MICHAEL ANN ANTONUCCI
CITY CLERK / TREASURER

Published: Albuquerque Journal, Sunday, September 12, 2021
Albuquerque Journal, Sunday, September 19, 2021

City Website: https://www.ratonnm.gov

INSTRUCTIONS TO BIDDERS

ARTICLE 1 - DEFINITIONS AND TERMS

1.01 Terms used in these Bidding Documents which are defined in the Instructions to Bidders and in the Conditions of the Contract for Construction (General, Supplementary and other Conditions) have the meanings assigned in those documents.

A. **Addendum**: A written or graphic instrument issued prior to the opening of Bids which clarifies, corrects, or changes the Bidding Documents or Contract Documents. Plural: addenda.
B. **Alternate Bid**: Amount stated in the Bid as the sum to be added to or deducted from the amount of the Base Bid, if the corresponding change in the project scope, materials, and/or methods of construction is awarded by the Owner.
C. **Base Bid**: Amount stated in the Bid as the sum for which the Bidder offers to perform the Work, excluding Alternate Bids.
D. **Bid**: The offer of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed in conformance with the Bidding Documents.
E. **Bid Lot**: A major item of Work for which a separate quotation or bid is requested.
F. **Bidder**: One who submits a Bid directly to the Owner, as distinct from a subcontractor, who submits a bid to a contractor.
G. **Bidding Documents**: The Bidding Requirements and the Contract Documents, including drawings.
H. **Bidding Requirements**: Advertisement for Bid, Instructions to Bidders, Information Available for Bidders, the Bid Form, Supplements to the Bid Form, and portions of Addenda relating to any of these.
I. **Responsible Bidder**: A Bidder who submits a Responsive Bid and who has furnished, when required, information and data to prove that his financial resources, production or service facilities, personnel, service reputation, and experience are adequate to make satisfactory delivery of the construction described in the Invitation for Bid (§13-1-82 NMSA 1978).
J. **Responsive Bid**: A bid which conforms in all material respects to the requirements set forth in the Invitation for Bid (§13-1-84 NMSA 1978).
K. **Successful Bidder**: The lowest Responsible Bidder to whom the Owner, on the basis of the Owner's evaluation, makes an award. A Successful Bidder does not become the Contractor until an agreement is signed with the Owner.

ARTICLE 2 - COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the Advertisement for Bid may be obtained from the Architect/Engineer (unless another issuing office is otherwise designated). Bidding Documents may also be reviewed at the Plan Rooms designated in the Advertisement for Bid. The deposit will be refunded to Bidders who submit a bona fide Bid and return the Bidding Documents in good and complete condition within 10 calendar days after opening of Bids.

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither the Owner nor the Architect/Engineer assume responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.03 The Owner and the Architect/Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

ARTICLE 3 - BIDDER'S QUALIFICATION STATEMENT

3.01 Bidders to whom award of a Contract is under consideration shall submit information and data to prove that their financial resources, production or service facilities, personnel, and service reputation and experience are adequate to make satisfactory delivery of the construction described in the Bidding Documents (§13-1-82 NMSA 1978).

ARTICLE 4 - EXAMINATION OF BIDDING DOCUMENTS AND SITE

4.01 Before submitting a Bid, each Bidder must

A. Examine the Bidding Documents thoroughly
B. Visit the site to familiarize himself with local conditions that may in any manner affect cost, progress, or performance of the Work
C. Familiarize himself with federal, state, and local laws, ordinances, rules and regulations that may in any manner affect cost, progress, or performance of the Work, and
D. Study and carefully correlate the Bidder's observations with the Bidding Documents.

4.02 On request, the Owner will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of his Bid.

4.03 The lands upon which the Work is to be performed, rights-of-way for access thereto, and other lands designated for use by the Contractor in performing the Work are identified in the Bidding Documents.

4.04 The submission of a Bid will constitute an incontrovertible representation by the Bidder that he has complied with every requirement of this Section and that the Bidding Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the Work.

ARTICLE 5 - PRE-BID CONFERENCE

5.01 The Architect/Engineer of Record and Owner shall conduct a Prebid Conference approximately 10 or more calendar days prior to the Bid opening date stated in the Advertisement for Bids.

5.02 The Architect/Engineer of Record and his consultants, as applicable, shall be represented. Prospective Bidders, Subcontractors, and Vendors are encouraged to attend and should be prepared to ask questions regarding substitutions and/or to request clarification of the Bidding Documents. The failure of a Bidder, Subcontractor, or Vendor to attend shall be interpreted to mean that the Bidding Documents are clear and acceptable to all nonparticipants at the Prebid Conference. Such clarity and acceptability shall be presumed with respect to all Bidders.

5.03 Questions and requests for clarification are to be presented in written form. Responses will be written and issued as Addenda. No verbal response shall be binding.

ARTICLE 6 - INTERPRETATIONS AND ADDENDA

6.01 All questions about the meaning or intent of the Bidding Documents shall be submitted to the Architect/Engineer in writing. Replies will be issued by Addenda mailed or delivered to all parties recorded by the Architect/Engineer as having received the Bidding Documents. Questions received less than ten days prior to the date for opening of Bids will not be answered. Only questions

answered by formal written addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

6.02 **Duty to Seek Clarification**: The law establishes the duty of clarification in order to ensure that the Owner will have the opportunity to clarify its requirements and thereby provide a level playing field to all bidders. A contractor proceeds at its own risk if it relies upon its own interpretation of contract terms that it believes to be ambiguous instead of asking for a clarification. Bidders and Subcontractors shall promptly notify the Architect/Engineer of any ambiguity, inconsistency, or error which they may discover upon examination of the Bidding Documents or of the site and local conditions.

6.03 Addenda will be emailed with return receipt requested or otherwise sent to all who are known by the Architect/Engineer to have received a complete set of Bidding Documents.

6.04 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

6.05 No Addenda will be issued later than 3 days prior to the date for receipt of Bids, except an Addendum withdrawing the Invitation for Bids or one which includes postponement of the date for receipt of Bids.

6.06 Each Bidder shall ascertain, prior to submitting the Bid, that the Bidder has received all Addenda issued, and shall acknowledge their receipt on the Bid Form.

ARTICLE 7 - BID SECURITY/BID BOND

7.01 Bid security in an amount equal to at least five percent of the amount of the Bid shall be a bond provided by a surety company authorized to do business in this State, or the equivalent in cash, a cashier's check, or otherwise supplied in a form satisfactory to the Owner (§13-1-146 NMSA 1978). All bonds shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies", as published in federal Circular 570 by the Audit Staff Bureau of Accounts, United States Treasury Department (§13-4-18 NMSA 1978).

7.02 The bid security shall be in the amount of 5% of the highest Bid amount submitted, unless otherwise stipulated, pledging that the Bidder will enter into a contract with the Owner on the terms stated herein and will furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty.

7.03 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

7.04 When the Bidding Documents require bid security, noncompliance by the Bidder requires that the Bid be rejected (§13-1-147A NMSA 1978).

7.05 If a Bidder is permitted to withdraw his Bid before award, no action shall take place against the Bidder or the bid security (§13-1-147B NMSA 1978).

ARTICLE 8 - CONTRACT TIMES

8.01 The number of days within which, or the dates by which the work is to be substantially completed and ready for use are as set forth in the Bid Form

ARTICLE 9 - LIQUIDATED DAMAGES

9.01 Provisions for Liquidated Damages, if any, are set forth in the Bid Form

ARTICLE 10 - SUBSTITUTE MATERIAL AND EQUIPMENT

10.01 The Contract, if awarded, will be on the basis of material and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or-equal" items.

10.02 If the Contractor bases their Bid on a substitute or an “or-equal” product, they do so at their own risk. In submitting a Bid, the Contractor agrees to furnish materials, equipment, and products that are acceptable to the Architect/Engineer for the price listed in the Bid.

10.03 Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or-equal" item of material or equipment may be furnished or used by the Contractor, if acceptable to the Architect/Engineer, application for such acceptance will not be considered by the Architect/Engineer until after the "effective date of the Contract".

10.04 The procedure for submittal of any such application by the Contractor and consideration by the Architect/Engineer is set forth in the Contract Documents.

ARTICLE 11 - SUBCONTRACTORS

11.01 The bidder shall list the subcontractors or material suppliers he proposes to use for all trades or items on the subcontractor listing form. If awarded the contract, the Bidder shall use the firm listed, or himself if "General Contractor" has been listed, unless a request for a change or substitution is approved by the Architect/Engineer and the Owner for any reason as outlined herein.

11.02 The Architect/Engineer or the Owner shall consider any request for a change in the listed firms, if the Bidder can furnish evidence of being able to perform the Work in a manner more satisfactory and beneficial to both the Owner and the Bidder by not using the listed firm. Satisfactory reasons for a substitution may include the inability to bond or lack of evidence of being able to furnish acceptable materials on schedule. Also, if the Bidder has made a legitimate error in listing a low subcontractor, a request for substitution, made after the Bid opening with the Architect/Engineer and the Owner's approval, will be considered. The proof of error must be conclusive, based upon the approval of said evidence by the listed subcontractor or material supplier and/or any other confirmation satisfactory to the Architect/Engineer or the Owner.

11.03 The Bidder shall not list himself as the supplier or as the subcontractor for any trade unless he has previously performed work of this type or can prove to the Architect/Engineer and the Owner's satisfaction that he actually has, or will obtain, fully adequate facilities and plans to perform the work with his own forces.

11.04 Omission or non-compliance with the intent of the Subcontractor List will be grounds for considering a Bid as **nonresponsive**.

11.05 Prior to the award of the Contract, the Architect/Engineer will notify the Bidder in writing if either the Owner or the Architect/Engineer, after due investigation and written findings of fact, has reasonable and substantial objection to any person or organization on such list. If the Owner or Architect/Engineer has reasonable and substantial objection to any person or organization on such list and refuses in writing to accept such person or organization, the Bidder may, at his option, (1) withdraw his Bid, or (2) submit an acceptable substitute subcontractor with no increase in his Bid Price. In the event of withdrawal under this paragraph, Bid Security **will not** be forfeited.

11.06 The Successful Bidder shall, within 7 calendar days of notice of the award of a Contract for the Work, submit the following information to the Architect/Engineer: (1) A signed list of the proprietary names and the suppliers of principal items or systems of materials and equipment proposed for the Work; and (2) A list signed by all subcontractors proposed for the principal portions of the Work in accordance with the Subcontractors Listing form submitted with the Bid.

11.07 The Successful Bidder will be required to establish to the satisfaction of the Architect/Engineer and the Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

11.08 Persons and organizations proposed by the Bidder and to whom the Owner and the Architect/Engineer have made no reasonable objection under the provisions of paragraph 11.06 must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Architect/Engineer and the Owner.

11.09 No Successful Bidder shall be required to employ any subcontractor, other person, or organization against whom he has reasonable objection.

11.10 The Bidder is specifically advised that any person, for, or other party to whom it is proposed to award a subcontract under this Bid must be acceptable to the Owner after verification by the Funding Agency of the current eligibility status.

ARTICLE 12 - PREPARATION OF BID

12.01 Bids shall be submitted on forms identical to the form included with the Bidding Documents.

12.02 All Blanks on the Bid Form shall be filled in by typewriter or manually in ink.

12.03 Where so indicated by the makeup of the Bid Form, sums shall be expressed in both words and figures, and, in case of discrepancy between the two, the amount written in words shall govern.

12.04 Alterations and erasures must be initialed by the signer of the Bid.

12.05 All requested Additive or Deductive Alternate Bids shall be bid. If no change in the Base Bid is required, enter "**No Change**".

12.06 Where there are two or more major items of Work (identified as "Bid Lots") for which separate quotations are requested, the Bidder shall submit quotations for all items, unless otherwise specified.

12.07 Each copy of the Bid shall include the complete name of the Bidder and a statement that the Bidder is a sole proprietor, a partnership, a corporation, or some other legal entity. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a

corporation shall further give the state of incorporation and have the applicable New Mexico Certificate of Incorporation number or Certificate of Authority number. The Bid shall include the current Contractor's license number and type. A bid submitted by an agent shall have a current Power of Attorney attached certifying the agent's authority to bind the Bidder.

12.08 The Bid shall contain an acknowledgement of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.

12.09 The address to which communications regarding the Bid are to be directed must be shown.

ARTICLE 13 - BASIS OF BID

13.01 Lump Sum: Bidders shall submit a bid on a lump sum basis as set forth in the Bid Form

13.02 Unit Price: Bidders shall submit a Bid on a Unit Price basis for each item of Work so listed in the Bid Schedule

13.03 Allowances: See General Requirements Section 01 21 00 for Cash Allowances and Utility Service Allowances

ARTICLE 14 - SUBMITTAL OF BID

14.01 All Bidders who are submitting a Bid on this Project are required to submit the following documents:

- Bid Form
- Bid Bond
- Resident Contractor Certificate issued by the Taxation and Revenue Department if seeking preference
- Resident Veteran Contractor Certificate issued by the Taxation and Revenue Department and the Resident Veteran Preference Certification form, if seeking preference.
- Subcontractor List
- Bidder’s Qualifications Form
- Non-Collusion Affidavit of Prime Bidder

14.02 Bids shall be submitted at the time and place indicated in the Advertisement for Bid in an opaque sealed envelope marked with the Project title and name and address of the Bidder and accompanied by the aforementioned documents.

14.03 The envelope shall be addressed to the Owner as addressed on the Bid Form. The following information shall be provided on the front lower left corner of the Bid envelope: Project Title, date of opening, and time of opening. If the Bid is sent by mail, the sealed envelope shall have the notation "**SEALED BIDS ENCLOSED**" on the face thereof.

14.04 Bids received after the date and time for receipt of Bids will be returned unopened.

14.05 The Bidder shall assume full responsibility for timely delivery of Bids including those Bids submitted by mail. Hand-delivered Bids shall be submitted to the Owner or his designee and will be clocked in at the time received, which must be prior to the time specified. Bids will then be held for public opening.

14.06 Oral, telephonic, or electronic bids are invalid and will not receive consideration.

ARTICLE 15 - MODIFICATION AND WITHDRAWAL OF BID

15.01 A Bid containing a mistake discovered before Bid Opening may be modified or withdrawn by a Bidder prior to the time set for Bid Opening by delivering written or telegraphic notice to the location designated in the Advertisement for Bid as the place where Bids are to be received.

15.02 Bid security shall be in an amount sufficient for the Bid as modified or resubmitted in conformance with Section 7.02

15.03 Withdrawn Bids may be resubmitted up to the time and date designated for the receipt of Bids, provided they are then fully in conformance with the Bidding Documents.

15.04 After Bid Opening, no modifications in Bid Prices or other provisions of Bids shall be permitted. A low Bidder alleging a material mistake of fact which makes his Bid nonresponsive may be permitted to withdraw his Bid if:

A. The mistake is clearly evident on the face of the Bid Document; or
B. The Bidder submits evidence which clearly and convincingly demonstrates that a mistake was made.

Any decision by the Owner to permit or deny the withdrawal of a Bid on the basis of a mistake contained therein shall be supported by a determination setting forth the grounds for the decision. If withdrawal is permitted, Bid Security **will not** be forfeited (§13-1-106 NMSA 1978).

ARTICLE 16 - OPENING OF BIDS

16.01 Bids received on time will be opened publicly and will be read aloud, and an abstract of the amounts of the Base Bid(s) and Alternate Bids or Bid Items, if any, will be made available to the Bidders. Each Bid shall be open to public inspection (§13-1-107 NMSA 1978).

ARTICLE 17 - BIDS TO REMAIN SUBJECT TO ACCEPTANCE

17.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return Bid Security prior to the end of this period.

ARTICLE 18 - BID EVALUATION AND AWARD

18.01 The Owner shall have the right to waive **technical irregularities** in the form of the Bid of the low Bidder which do not alter the price, quality, or quantity of the construction Bid (§13-1-132 NMSA 1978).

18.02 It is the intent of the Owner to award a contract to the lowest responsible Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. The unreasonable failure of a Bidder to promptly supply information in connection with an inquiry with respect to responsibility is grounds for a determination that the Bidder is not a responsible Bidder (§13-1-133 NMSA 1978).

18.03 If the Base Bid is within the amount of funds available to finance the construction contract, contract award will be made to the responsible Bidder submitting the low Base Bid; except that, if sufficient funds are available to fund Alternate Bids, the Owner may award the contract to the responsible Bidder submitting the low combined Bid within the amount of funds available (Base Bid plus or minus alternates). If the award is based on alternates, the Owner shall accept them in the numerical

order in which they are listed in the Bid Form, as produces a net amount which is **within** the available funds.

18.04 If the lowest responsible Bid has otherwise qualified, and if there is no change in the original terms and conditions, the lowest bidder may negotiate with the Owner for a lower total bid in order to avoid rejection of all bids for the reason that the lowest bid was up to 10% higher than budgeted project funds. Such negotiation shall not be allowed if the lowest bid was more than 10% over budgeted project funds (§13-1-105 NMSA 1978).

18.05 Discrepancies in the Bid Form between words and figures will be resolved in favor of words. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies in the multiplication of units of Work and unit prices will be resolved in favor of the correct multiplication sum between the units of work and the unit prices.

18.06 Conditional Bids or Bids with additional terms will not be accepted.

18.07 Contracts solicited by competitive sealed bids require that the bid amount exclude the applicable state gross receipts taxes or applicable local option tax but that the Owner shall be required to pay the applicable tax, including any increase in the applicable tax becoming effective after the date the contract is entered into. The applicable gross receipt tax or applicable local option tax calculated at the rate in effect at the time of payment, shall be shown as a separate amount on each billing or request for payment made under the contract (§13-1-108 NMSA 1978).

ARTICLE 19 - RESIDENT CONTRACTOR AND RESIDENT VETERAN CONTRACTOR PREFERENCES

19.01 Resident Contractor means a person that has a valid resident contractor certificate issued by the Taxation and Revenue Department, but does not include a resident veteran contractor; and resident veteran contractor means a person that has a valid resident veteran contractor certificate issued by the Taxation and Revenue Department. No Contractor shall be treated as a resident contractor or resident veteran contractor in the awarding of public works contracts by the Owner unless the Contractor has qualified with the State Purchasing Agent as a resident contractor or resident veteran contractor pursuant to Section 13-1-22 NMSA 1978 and has been issued a certification number by the State Purchasing Agent.

19.02 For the purposes of awarding a public works contract using a formal bid process, a public body shall deem a bid submitted by: (a) a resident contractor to be five percent lower than the bid actually submitted; (b) a resident veteran contractor with annual gross revenues of up to three million dollars ($3,000,000) in the preceding tax year to be ten percent lower than the bid actually submitted.

19.03 To receive a New Mexico Resident Preference or a New Mexico Resident Veteran Contractor preference advantage, as applicable pursuant to §13-4-2 NMSA, must submit a valid resident contractor certificate or valid resident veteran contractor certificate issued by the taxation and revenue department with their sealed bid.

ARTICLE 20 - IDENTICAL BIDS

20.01 When two or more of the Bids submitted are identical in price and are the low bid, the Purchasing Agent or the Owner may:

A. Award pursuant to the multiple source award provisions of §13-1-153 and §13-1-154 NMSA 1978
B. Award to a resident contractor if the identical low Bids are submitted by a resident contractor and a nonresident contractor
C. Award by lottery to one of the identical low Bidders;
E. Reject all Bids and resolicit Bids for the required construction (§13-1-110 NMSA 1978).

ARTICLE 21 - NOTICE OF CONTRACT REQUIREMENTS BINDING ON BIDDER

21.01 In submitting this Bid, the Bidder represents that he has familiarized himself with the nature and extent of the Conditions of the Construction Contract (General, Supplementary, and other Conditions) dealing with federal, state and local requirements which are a part of these Bidding and Contract Documents.

21.02 Laws and Regulations: The Bidder's attention is directed to all applicable federal and state laws, local ordinances and regulations and the rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the contract throughout, and will be deemed to be included in the Contract the same as though herein written out in full.

ARTICLE 22 - REJECTION OR CANCELLATION OF BIDS

22.01 An Invitation for Bid may be canceled, or any or all Bids may be rejected in whole or in part, when it is in the best interest of the Owner. A determination containing the reasons therefore shall be made part of the Project file (§13-1-131 NMSA 1978). Bid security for rejected Bids shall be returned to the Bidder.

ARTICLE 23 - PROTESTS

23.01 Any Bidder, Offeror, or Contractor who is aggrieved in connection with this procurement (Bid) may protest to the Owner's Purchasing Agent in accordance with the requirements of the Owner's Procurement Regulations and the State Procurement Code. The protest should be made in writing within 24 hours after the facts or occurrences giving rise thereto, but in no case later than 15 calendar days after the facts or occurrences giving rise thereto (§ 13-1-172 NMSA 1978).

23.02 In the event of a timely protest under the Owner shall not proceed further with the procurement unless the Owner makes a determination that the award of contract is necessary to protect substantial interests of the Owner (§13-1-173 NMSA 1978).

23.03 The Owner or his designee shall have the authority to take any action reasonably necessary to resolve a protest of an aggrieved Bidder, Offeror, or Contractor concerning a procurement. This authority shall be exercised in accordance with adopted regulations, but shall not include the authority to award money damages or attorneys' fees (§13-1-174 NMSA 1978).

23.04 The Owner or his designee shall promptly issue a determination relating to the protest. The determination shall:
A. State the reasons for the action taken; and
B. Inform the protestant of the right to judicial review of the determination pursuant to §13-1-183 NMSA 1978.

23.05 A copy of the determination issued under § 13-1-175 NMSA 1978 shall immediately be mailed to the protestant and other bidders or offerors involved in the procurement (§13-1-176 NMSA 1978).

ARTICLE 24 - NOTICE OF AWARD

24.01 A written Notice of Award shall be issued by the Owner after review and approval of the Bid and related documents by the Owner with reasonable promptness (§13-1-100 and §13-1-108 NMSA 1978).

ARTICLE 25 - CANCELLATION OF AWARD

25.01 When in the best interest of the public, the Owner may cancel the award of any contract at any time before the execution of said contract by all parties without liability against the Owner.

ARTICLE 26 - POST-BID INFORMATION

26.01 Submittals to Architect/Engineer: Within fifteen (15) days after Notice of Award, the successful Bidder shall submit the following to the Architect/Engineer:

A. The required bonds and certificates of insurance
B. The requirements under Paragraph 11.06
C. A brief resume of the successful bidder's Superintendent.

26.02 Return of Bid Security**:** All Bid Security in the form of checks, except those of the two lowest Bidders, will be returned promptly following the opening and checking of the Bids. The retained Bid Security of the unsuccessful of the two lowest Bidders, if in the form of a check, will be returned within fifteen (15) days following the award of the contract. The retained Bid Security of the Successful Bidder, if in the form of a check, will be returned after a satisfactory contract bond has been furnished and the contract has been executed. Bid Securities in the form of Bid Bonds will be returned only upon the request of the unsuccessful Bidder, but will be released by the Purchasing Agent after the Notice of Award is sent by the Owner.

ARTICLE 27 - EXECUTION AND APPROVAL OF CONTRACT

27.01 The Contract shall be signed by the Successful Bidder and returned, together with both the Contract Bonds and Certificate of Insurance, within fifteen (15) calendar days after the date of the Notice of Award.

ARTICLE 28 - FAILURE TO EXECUTE CONTRACT

28.01 Failure by the Awarded Contractor to return the signed Contract with acceptable Contract Bonds and Certificate of Insurance within fifteen (15) calendar days after the date of the Notice of Award shall be "**just cause**" for the cancellation of the award and the forfeiture of the bid security, which shall become the property of the Owner, not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lowest responsible Bidder, or the work may be readvertised and constructed under contract or otherwise, as the Owner may decide.

28.02 If the Contract is not executed by the Owner within thirty (30) days following receipt from the Bidder of the signed Contract, with Bonds and Certificates, the Bidder shall have the right to withdraw his bid without penalty. No Contract shall be effective until it has been fully executed by all of the parties thereto.

ARTICLE 29 - NOTICE TO PROCEED

29.01 The Owner will issue a written Notice to Proceed to the Contractor stipulating the date from which Contract Time will be charged and the date Contract Time is to expire, subject to valid modifications of the Contract authorized by Change Order.

ARTICLE 30 - OTHER INSTRUCTIONS TO BIDDERS

30.01 This Project is funded in whole by funds provided by the City of Raton, New Mexico and the New Mexico Department of Transportation and is subject to applicable state procurement and public works statutes and regulations promulgated by the funding agency and the Owner

30.02- CITY OF RATON STANDARD BID TERMS AND DEFINITIONS

A. Awarded Bid: Awarding of Bid shall be made to the responsible Bidder whose Bid meets the required specifications. The City of Raton (City) reserves the right to reject any of all Bids and to waive any technical irregularity in the form of the Bid

B. Bid Protests: If any Bidder is of the opinion that the specifications as written preclude him/her from submitting a bid. His/her opinion should be made known to the Department involved in this bid request at least twelve (12) days prior to the scheduled bid opening date with a copy forwarded to the Finance Department. Bid protests will not be considered from parties which do not also furnish satisfactory documentation with their protest that their proposed system fully meets the functional intent of the TECHNICAL SPECIFICATIONS which accompany a Request for Bids.

C. Bribery and Kickback: The Procurement Code of New Mexico; (Section 13-1-28 through 13-1-99 N.M.S.A. 1978), impose a third degree felony penalty for bribery of a public official or public employee. In addition the New Mexico Criminal Statutes (Section 30-4-1, N.M.S.A. 1978): state that it is a third degree felony to commit the offense of demanding or receiving a bribe by a public official of public employee. And (Section 30-24-2, N.M.S.A. 1978): it is a fourth degree felony to commit the offense of soliciting or receiving illegal kickbacks. Also (Section 30-41-1 through 30-41-3, N.M.S.A. 1978): states that it is a fourth degree felony to commit the offense of offering or paying illegal kickbacks.

D. Campaign Contribution Disclosure Form: The Bidder shall submit a completed Campaign Contribution Disclosure Form Pursuant to Chapter 81, Laws of 2006.

E. Clarification of Bid: Bidder requiring clarification or interpretation of bid specifications shall make a written request to the Department involved in this bid request at least five (5) days prior to the scheduled bid opening date with a copy forwarded to the Finance Department. Any interpretation, corrections or changes of said Bid Specifications, Opening Date, or Time Change will be made by addendum only. Interpretations, corrections or changes of said bid made in any other manner will not be binding and the bidder shall not rely upon such interpretation, corrections and changes.

G. Envelopes: Sealed Bid envelopes shall be clearly marked on the lower left-hand corner, identified by the Bid Name and Opening Number. Failure to comply with this requirement may result in the rejection of your submitted Bid.

H. Federal Tax Identification Number: Pursuant to IRS requirements, bidder shall provide their Federal Tax ID Number if bidder is incorporated. If bidder is a sole proprietorship or partnership then they shall provide their social security number.

I. **Inspection:** Final inspection and acceptance will be made at the city's destination. Products rejected for nonconformance with the specifications shall be removed by the bidder; at his/her risk and expense promptly after notice of rejection.

J. **Modification of Bid:** Bids may be withdrawn upon receipt of written request prior to the scheduled bid opening for the purpose of making any corrections or changes. Such corrections must be properly identified and signed or initialed by the bidder. Resubmission must be prior to the scheduled bid opening time in order to be considered. After bid opening, no price modifications of submitted Bids or other provisions shall be permitted.

K. **New Mexico Tax Identification Number:** Payment may be withheld under (Section 7-10-5, N.M.S.A. 1978) if you are subject to New Mexico Gross Receipts Tax and have not registered for a New Mexico (CRS) Tax Identification number. Contact the New Mexico Taxation & Revenue Department at (505) 827-0700 for registering instructions.

L. **Non-Collusion:** In signing their Bid and Affidavit, the Bidder certifies that he/she has not, either directly or indirectly entered into action of restraint of free competition, in the connection with the submitted bid.

M. **Non-Exclusion:** Specifications of the bid request are not meant to exclude any Bidder or Manufacturer. Where a brand name or equal is indicated, it is for the purpose of describing the standard of quality, performance and characteristics desired and is not intended to restrict competition. "No Substitute" specifications may be authorized, only if required to match existing equipment. If any Bidder is of the opinion that the specifications as written preclude him/her from submitting a bid. His/her opinion should be made known to the Department involved in this bid request at least five (5) days prior to the scheduled bid opening date; with a copy forwarded to the Finance Department. Brand names and numbers are for reference only and equivalents will be considered. If bidding "EQUIVALENT" Bidder must be prepared to furnish complete data upon request, preferably with the bid to avoid awarding delay.

N. **Responsibility of Bidder:** At all times it shall be the responsibility of the Bidder to see their bid is delivered to the City Clerk by the Date and Time scheduled for opening. If the mail or delivery of said Bid is delayed beyond the scheduled opening date and time set, bid this delayed will not be considered

O. Special Notice: To preclude possible errors and/or misinterpretations, bid prices must be affixed in ink or typewritten legibly

P. **Taxes:** Bidder must pay all applicable taxes. Note: If bidder is from outside the City of Raton the successful bidder must pay Gross Receipts in the City of Raton.

Q. Withdrawal of Bid: A low bidder alleging a material mistake of fact, after bids have been opened may request their bid be withdrawn upon receipt of a written request to the finance department prior to the scheduled awarding date.

BID FORM

PROJECT: HANGAR DESIGN

THIS BID IS SUBMITTED TO: City of Raton
PO Box 910, 224 Save Avenue
Raton, New Mexico 87740

1.01 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with the Owner in the form included in the Bidding Documents to perform and furnish all Work as specified or indicated in the Bidding Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

1.02 The Bidder accepts all of the terms and conditions of the Invitation for Bid and Instructions to Bidders, including without limitation those dealing with the disposition of bid security and other Bidding Documents. This Bid will remain subject to acceptance for 30 days after the day of the Bid opening. The Bidder shall sign and submit the Agreement between Owner and Contractor (hereinafter called Agreement) with the Bonds and other documents required by the Bidding Requirements within fifteen (15) calendar days after the date of the Owner's Notice to Award.

1.03 In submitting this Bid, the Bidder represents, as more fully set forth in the Agreement, that:

A. The Bidder has examined copies of all the Bidding Documents and of the following Addenda (receipt of all which is hereby acknowledged):

No.	Date	No.	Date
No.	Date	No.	Date

B. The Bidder has familiarized himself with the nature and extent of the Bidding Documents, Work, site, locality, and all local conditions, laws, and regulations that in any manner may affect cost, progress, performance, or furnishing of the Work.

C. The Bidder has carefully studied all reports and drawings of subsurface conditions which are identified in the Information Available to Bidders and accepts the determination set forth in the Information Available to Bidders of the extent of the technical data contained in such reports and drawings upon which the Bidder is entitled to rely.

D. The Bidder has correlated the results of all such observations, examinations, investigations, explorations, tests, reports, and studies with the terms and conditions of the Bidding Documents.

E. The Bidder has given the Architect/Engineer written notice of all conflicts, errors, or discrepancies that he has discovered in the Bidding Documents, and the written resolution thereof by the Architect/Engineer is acceptable to the Bidder.

F. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm, or corporation and is not submitted in conformity with any agreement or rules of any group, association,

organization, or corporation; the Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; the Bidder has not solicited or induced any person, firm or corporation to refrain from bidding; and the Bidder has not sought by collusion to obtain for himself any advantage over any other Bidder or over the Owner.

2.01 A Bid must be submitted on all Bid Items. Segregated Bids will not be accepted.
The Bidder will complete the Work for the following price **(**s) excluding applicable gross receipts taxes:

A. LUMP SUM BID

BASE BID (exclusive of Gross Receipts Tax*)

_____

(use words)

($_____)

(use figures)

(***Utility Service Allowances and Cash Allowances included within the Allowances Specification, are included in the amounts set forth above***.)

* Gross Receipts Tax on the Bid amount(s) above at current scheduled rate for project Municipality or County is 6.0833 %. Amount shall not be included in Bid.

B. ADDITIVE ALTERNATE #1

Enlarge Building Gridline Dimensions:
1 to 4: 68'-0″.
A to D: 58'-0″.

3.01. The Bidder agrees that:

A. The Work to be performed under this Contract shall be commenced not later than ten (10) consecutive days after the date of written Notice to Proceed, and that Substantial Completion shall be achieved not later than thirty (30) calendar days after the date of written Notice to Proceed, except as hereafter extended by valid written Change Order by the Owner.

B. Should the Contractor neglect, refuse, or otherwise fail to complete the Work within the time specified, the Contractor agrees, in partial consideration for the award of this Contract, to pay to the Owner the amount of One Hundred Dollars and 00/100 ($ 100.00) per consecutive calendar day, not as a penalty, but as liquidated damages for such breach of the Contract.

C. The above prices shall include all labor, materials, removal, overhead, profit, insurance, (excluding applicable taxes), etc., to cover the finished work of the several kinds called for. Changes shall be processed in accordance with the Contract Documents.

D. It is understood that the Owner reserves the right to reject any or all bids and to waive any technical irregularities in the bidding.

4.01 The following documents are attached to and made a condition of this Bid:

A. Bid Bond

B. Subcontractor List

C. Bidder's Qualifications Form

D. Non-Collusion Affidavit

E. New Mexico Resident Contractor Preference Certificate, or

F. New Mexico Resident Veteran Contractor Preference Certificate and New Mexico Resident Veteran Contractor Certification Form

G. City of Raton Bidder's Information Form

H. Campaign Contribution Disclosure Form

5.01 The terms used in this Bid and the Bidding and Contract Documents which are defined in the Conditions of the Construction Contract (General, Supplementary, and other Conditions), included as part of the Bidding Documents, have the meanings assigned to them in those conditions.

6.01 This Bid is submitted by:

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____
(Individual's signature)

Doing business as: _____

A Partnership

Partnership Name: _____

By: _____
(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): _____

A Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____
Type (General Business, Professional, Service, Limited Liability):_____

By: _____
(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____
(CORPORATE SEAL)

Attest _____

A Joint Venture

Name of Joint Venture: _____

First Joint Venturer Name: _____ (SEAL)

By: _____
(Signature of first joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Second Joint Venturer Name: _____(SEAL)

By: _____
(Signature of second joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

Bidder's Business Address _____

_____

Phone No. _____ Fax No. _____

E-mail _____ _____

SUBMITTED on _____, 20____.

6.02 Contractor License Information:

New Mexico Contractor's License Number _____

License Classification(s) _____

New Mexico Department of Workforce Solutions Registration Number _____

Federal Identification Number (FEIN #) _____

BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:

BID

Bid Due Date:

Description *(Project Name and Include Location)*:

BOND

Bond Number:

Date *(Not earlier than Bid due date)*:

Penal sum _____ (Words) $ _____ (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER	**SURETY**
_____ (Seal)	_____ (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	Attest: _____
Signature	Signature
_____	_____
Title	Title

Note: Above addresses are to be used for giving any required notice. Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:
   3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
   3.2 All Bids are rejected by Owner, or
   3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the

provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term “Bid” as used herein includes a Bid, offer, or proposal as applicable.

NEW MEXICO SUBCONTRACTOR'S FAIR PRACTICE ACT / LISTING OF SUBCONTRACTORS

1. This project is subject to the provisions of the State of New Mexico Subcontractor's Fair Practice Act.

2. Listing Threshold: List Subcontractors for amounts exceeding the listing threshold. The listing threshold is $5,000.00 or one half of one percent of the Architect/Engineers estimate, whichever is greater. For purposes of this Project the threshold is ***$5,000.00***.

3. Portion of project to which requirements apply: Complete Project.

4. For each category of the project, which the BIDDER will be subcontracting for an amount exceeding the listing threshold indicated above, the BIDDER shall define the subcontracting categories and list only one subcontractor for each category. The listing shall be in the format indicated on the following page, and shall be completed and submitted with the Bid.

5. No CONTRACTOR whose Bid is accepted shall sublet or subcontract any portion of the Work of the Project in an amount exceeding the threshold amount given above, where the original bid amount did not designate a subcontractor, unless 1) the CONTRACTOR received no bid for that category (note: the BIDDER must designate on the list of subcontractors that "no bid was received"), or 2) the Work is pursuant to a change order that causes changes or deviations from the original contract.

6. No CONTRACTOR whose Bid is accepted shall substitute any subcontractor in place of the subcontractor listed in the Bid except as provided for in the Subcontractor's Fair Practice Act.

7. Any changes or additions of subcontractors shall be promptly reported to the Architect/Engineer in writing within two (2) calendar days of the known change or addition to the submitted List of Project Subcontractors in the Bid.

8. All subcontractors with work in excess of $60,000 must be registered with the New Mexico Department of Workforce Solutions, Labor Enforcement. Include the total of the subcontracted work and the subcontractor's New Mexico Department of Workforce Solutions Registration Number, if work is in excess of $60,000.

SUBCONTRACTOR LIST

Subcontract Category *
Estimated Value of Work*
Subcontractor's Name*
Business Location *
Phone Number
E-mail Address
Federal Id No. (FEIN #)
NM Contractor's License No.
License Categories
New Mexico Dept. of Workforce Solutions Registration No.**
Subcontract Category *:
Estimated Value of Work*
Subcontractor's Name*
Business Location *
Phone Number
E-mail Address
Federal Id No. (FEIN #)
NM Contractor's License No.
License Categories
New Mexico Dept. of Workforce Solutions Registration No.**
Subcontract Category *:
Estimated Value of Work*
Subcontractor's Name*
Business Location *
Phone Number
E-mail Address
Federal Id No. (FEIN #)
NM Contractor's License No.
License Categories
New Mexico Dept. of Workforce Solutions Registration No.**

* *Information required at time of Bid Submission*

** Required only if value of work is in excess of $60,000

(Use additional pages, as necessary)

SUBCONTRACTOR LIST

Subcontract Category *
Estimated Value of Work*
Subcontractor's Name*
Business Location *
Phone Number
E-mail Address
Federal Id No. (FEIN #)
NM Contractor's License No.
License Categories
New Mexico Dept. of Workforce Solutions Registration No.**
Subcontract Category *:
Estimated Value of Work*
Subcontractor's Name*
Business Location *
Phone Number
E-mail Address
Federal Id No. (FEIN #)
NM Contractor's License No.
License Categories
New Mexico Dept. of Workforce Solutions Registration No.**
Subcontract Category *:
Estimated Value of Work*
Subcontractor's Name*
Business Location *
Phone Number
E-mail Address
Federal Id No. (FEIN #)
NM Contractor's License No.
License Categories
New Mexico Dept. of Workforce Solutions Registration No.**

* *Information required at time of Bid Submission*

** Required only if value of work is in excess of $60,000

(Use additional pages, as necessary)

STATEMENT OF BIDDER'S QUALIFICATIONS

All questions must be answered. The data given must be clear and comprehensive. This statement must be notarized.

1. Name of Bidder _____

2. Business Address _____

3. When Organized _____

4. Bidder is a (an) _____
(Individual - Partnership - Corporation)

The full name and addresses of all persons interested in this proposal as partners and/or principal(s) are: If business is carried out in any other name(s) than that of the principal(s) or partner(s), also state such name(s) and address(es).

_____

_____

_____

CORPORATION

Corporation is incorporated in the State of: _____

President is: _____

Treasurer is: _____

Place of Business: _____

5. How many years have you been engaged in the contracting business under your present firm or trading name?_____

6. Financial Statement: (Submit upon request after Bid Opening)

7. Credit Available for this Contract $_____

8. Contracts Now on Hand, Gross Amounts $_____

9. Have you ever refused to sign a contract at your original bid?_____

10. Have you ever defaulted on a contract?_____

11. Remarks:

_____

12. Will you, upon request, furnish any other information that the Owner may require_____

13. The undersigned hereby authorizes and requests any person to furnish any information requested by the Owner in verification of the recitals comprising this Statement of Bidder's Qualifications.

Date at _____this_____ day of_____20___

Name of Bidder: _____

By: _____

Title: _____

STATE OF_____)

COUNTY OF_____)

_____, being duly sworn, deposes and says that he

is_____of_____

and that the answers to the foregoing questions and all statements therein contained are true and correct.

_____
(Name of Bidder)

Sworn to before me this: _____

Day of _____, 20____

_____
NOTARY PUBLIC

My commission expires: _____

NON-COLLUSION AFFIDAVIT OF PRIME BIDDER/SUBCONTRACTOR

STATE OF NEW MEXICO

COUNTY OF

_____, being first duly sworn, deposes and says that:

1. He/She is _____ of _____,
(title) (company)
the bidder that has submitted the attached bid;

2. He is fully informed respecting the preparation and contents of the attached bid and of all pertinent circumstances respecting such bid;

3. Such bid is genuine and is not a collusive or sham bid;

4. Neither the said bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest including this affiant, has in any way colluded, conspired, connived or agreed directly or indirectly with any other Bidder, firm or person to submit a collusive or sham bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communications or conference with any other Bidder, firm or person to fix price or prices in the attached Bid or of any other Bidder, or to fix overhead, profit or cost element of the bid price or the bid price of any other bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement and advantage against the *[owner]* or any person interested in the proposed contract; and

5. The price or prices quoted in the attached bid are fair and proper and are not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

I am/The Bidder is not indebted to the *[owner]* in any form or manner.

Signature:_____ Date:_____

Title:_____ Witness:_____

Notary: _____

My commission expires:

RESIDENT VETERANS PREFERENCE CERTIFICATION FORM

_____(NAME OF CONTRACTOR) hereby certifies the following in regard to application of the resident veterans' preference to this procurement:

"I declare under penalty of perjury that my annual gross revenues in the preceding tax year beginning January 1 and ending December 31 is less than three million dollars ($3,000,000) allowing me a 10% preference discount on this solicitation. "

"I agree to submit a report, or reports, to the State Purchasing Division of the General Services Department declaring under penalty of perjury that during the last calendar year starting January 1 and ending on December 31, the following to be true and accurate:

"In conjunction with this procurement and the requirements of this business' application for a Resident Veteran Business Preference/Resident Veteran Contractor Preference under Section 13-4-2 NMSA 1978, when awarded a contract which was on the basis of having such veterans preference, I agree to report to the State Purchasing Division of the General Services Department the awarded amount involved. I will indicate in the report the award amount as a purchase from a public body or as a public works contract from a public body as the case may be.

"I understand that knowingly giving false or misleading information on this report constitutes a crime."

"I declare under penalty of perjury that this statement is true to the best of my knowledge. I understand that giving false or misleading statements about material fact regarding this matter constitutes a crime."

_____ _____

(Signature of Business Representative)* (Date)

*Must be an authorized signatory for the Business.

The representations made in checking the boxes constitutes a material representation by the business that is subject to protest and may result in denial of an award or unaward of the procurement involved if the statements are proven to be incorrect.

To receive this preference, Bidder must also submit a copy of their Resident Veteran Contractor Certificate issued by the Taxation and Revenue Department

CITY OF RATON BIDDER'S INFORMATION

BIDDER: _____

AUTHORIZED AGENT: _____

ADDRESS: _____

TELEPHONE NUMBER: (_____) _____

FAX NUMBER: (_____) _____

DELIVERY: _____

STATE PURCHASING RESIDENT CERTIFICATION NO.: _____

NEW MEXICO CONTRACTORS LICENSE NO.: _____

ITEM (S) UNDER THIS BID ARE TO BE F.O.B. RATON, NEW MEXICO 87740. THE CITY OF RATON RESERVES THE RIGHT REJECT ANY OR ALL BIDS AND TO WAIVE ANY TECHINCAL IRREGULARITY IN THE FORM OF THE BID.

FEDERAL TAX ID NUMBER: _____

SOCIAL SECURITY NUMBER: _____

NEW MEXICO TAX IDENTIFICATION NO. (CRS): _____

CAMPAIGN CONTRIBUTION DISCLOSURE FORM

Pursuant to NMSA 1978, § 13-1-191.1 (2006), any prospective contractor seeking to enter into a contract with any state agency or local public body must file this form with that state agency or local public body. The prospective contractor must disclose whether they, a family member or a representative of the prospective contractor has made a campaign contribution to an applicable public official of the state or a local public body during the two years prior to the date on which the contractor submits a proposal or, in the case of a sole source or small purchase contract, the two years prior to the date the contractor signs the contract, if the aggregate total of contributions given by the prospective contractor, a family member or a representative of the prospective contractor to the public official exceeds two hundred and fifty dollars ($250) over the two year period.

THIS FORM MUST BE FILED BY ANY PROSPECTIVE CONTRACTOR WHETHER OR NOT THEY, THEIR FAMILY MEMBER, OR THEIR REPRESENTATIVE HAS MADE ANY CONTRIBUTIONS SUBJECT TO DISCLOSURE.

The following definitions apply:

"**Applicable public official**" means a person elected to an office or a person appointed to complete a term of an elected office, who has the authority to award or influence the award of the contract for which the prospective contractor is submitting a competitive sealed proposal or who has the authority to negotiate a sole source or small purchase contract that may be awarded without submission of a sealed competitive proposal.

"**Campaign Contribution"** means a gift, subscription, loan, advance or deposit of money or other thing of value, including the estimated value of an in-kind contribution, that is made to or received by an applicable public official or any person authorized to raise, collect or expend contributions on that official's behalf for the purpose of electing the official to either statewide or local office. "Campaign Contribution" includes the payment of a debt incurred in an election campaign, but does not include the value of services provided without compensation or unreimbursed travel or other personal expenses of individuals who volunteer a portion or all of their time on behalf of a candidate or political committee, nor does it include the administrative or solicitation expenses of a political committee that are paid by an organization that sponsors the committee.

"Contract" means any agreement for the procurement of items of tangible personal property, services, professional services, or construction.

"Family member" means spouse, father, mother, child, father-in-law, mother-in-law, daughter-in-law or son-in-law.

"**Pendency of the procurement process"** means the time period commencing with the public notice of the request for proposals and ending with the award of the contract or the cancellation of the request for proposals.

"Person" means any corporation, partnership, individual, joint venture, association or any other private legal entity.

"Prospective contractor" means a person who is subject to the competitive sealed proposal process set forth in the Procurement Code or is not required to submit a competitive sealed proposal because that person qualifies for a sole source or a small purchase contract.

"Representative of a prospective contractor" means an officer or director of a corporation, a member or manager of a limited liability corporation, a partner of a partnership or a trustee of a trust of the prospective contractor.

DISCLOSURE OF CONTRIBUTIONS:

Contribution Made By: _____

Relation to Prospective Contractor: _____

Name of Applicable Public Official: _____

Date Contribution(s) Made: _____

Amount(s) of Contribution(s): _____

Nature of Contribution(s): _____

Purpose of Contribution(s): _____

(The above fields are unlimited in size)

_____ _____

Signature Date

_____

Title (position)

--OR—

NO CONTRIBUTIONS IN THE AGGREGATE TOTAL OVER TWO HUNDRED FIFTY DOLLARS ($250) WERE MADE to an applicable public official by me, a family member or representative.

_____ _____

Signature Date

_____

Title (position)

NOTICE OF AWARD

TO: DATE:

PROJECT:

Ladies and Gentlemen:

This letter is to advise you that the governing authority at its _____ meeting, approved the construction for the above-referenced project. Pursuant to this approval, the procurement office has determined that your firm is the apparent Successful Bidder. Therefore, your firm has been awarded the construction contract for the above referenced project.

The Contract Price of your contract is as follows:

Base Bid		$
Alternate Nos.	-	$
Contract Total		$

Five copies of each of the proposed Contract Documents (except Drawings) will be provided to you by the Architect/Engineer of Record for execution. Sets of the Drawings are available for your use; please make arrangements for pick-up from the Architect's Office.

You must comply with the following conditions precedent within fifteen calendar days of the date of this Notice of Award, which shall be _____, 20___.

1. You must deliver to the Architect of Record, five fully executed counterparts of the Agreement including all Contract Documents. Each of the Contract Documents must bear your signature on the appropriate page.

2. You must deliver with the executed agreement the Performance and Payment Bond, Rider to Bonds, Agent's Affidavit and Certificate of Insurance.

3. *

(*List other conditions precedent; if none, write none.)

Please be advised that no contract with the owner is legal and binding upon the Owner until it is executed by the Mayor/County Commission Chairman and other signatures listed in the contract.

Failure to comply with these conditions within the time specified will entitle the Owner to consider your bid abandoned, to annul this Notice of Award, and to declare your bid security forfeited, to the extent of actual damages.

Within thirty days after you comply with these conditions, the Owner will return to you one fully signed counterpart of the Agreement.

(Owner)

(Authorized Signature)

(Title)

Copy: Architect/Engineer of Record
Local Government Division, DFA
Project File

AGREEMENT BETWEEN OWNER AND CONTRACTOR

THIS AGREEMENT is by and between ("Owner")

and
Agreement will be completed after Award of the Contract
("Contractor")

for the following **PROJECT**:

Architect/Engineer of Record

WHEREAS, (funding authority) has funded the above-referenced Project pursuant to (Grant Number); and (Grant Number/chapter and year of legislation or other source of funding);and

WHEREAS, the Owner, through its Mayor, upon approval of the governing body, is authorized to enter into a construction contract for the Project pursuant to §13-1-100 NMSA 1978; and

WHEREAS, the Owner has let this contract according to the established state and local purchasing procedures for contracts of the type and amount let; and

WHEREAS, construction of this Project was approved by the governing body at its meeting of _____, 20___;

The OWNER and the CONTRACTOR agree as set forth below:

ARTICLE 1 - THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, the Conditions of the Contract (General, Supplementary, and other Conditions), the Drawings, the Specifications, all Addenda issued prior to and all Modifications issued after execution of this Agreement. These documents form the Contract, and all are as fully a part of the Contract as if attached to this Agreement or repeated herein. An enumeration of the Contract Documents appears in Article 9 of this Agreement.

ARTICLE 2 - THE WORK

The Contractor shall perform all the Work required by the Contract Documents for
(Here insert the caption descriptive of the Work as used on other contract Documents.)
*

ARTICLE 3 -TIME OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

The work to be performed under this contract shall be commenced not later than ten (10) consecutive calendar days after the date of written notice to proceed. Substantial completion shall be achieved not later than *____ calendar days after the date of written notice to proceed, except as hereafter extended by valid written change order by the owner.

Should the contractor neglect, refuse, or otherwise fail to complete the work within the time specified in this article, the contractor agrees, in partial consideration for the award of this contract, to pay to the owner the amount of *_____ Dollars ($_____) per consecutive calendar day, not as a penalty, but as liquidated damages for such breach of this contract.

ARTICLE 4 -CONTRACT SUM

The Owner shall pay the Contractor in current funds for the performance of the Work, subject to additions and deductions by Change Order as provided in the Contract Documents, the Contract Sum of *_____

The Contract sum is determined as follows: (State here the base bid or other lump sum amount, accepted alternates, bid lots and unit prices, as applicable) plus applicable Gross Receipts Tax at the scheduled rate at the time each progress payment is made.

ARTICLE 5 -PROGRESS PAYMENTS

Based upon Applications for Payment submitted to the Architect/Engineer by the Contractor and Certificates for Payment issued by the Architect/Engineer, the Owner shall make progress payments on account of the Contract Sum to the Contractor for the period ending the 25th day of the month as stipulated in §13-1-158 and §57-28-5 NMSA 1978.

ARTICLE 6 -FINAL PAYMENT

Unless good cause exists, final payment, constituting the entire unpaid balance of the contract sum, shall be paid by the owner to the contractor within thirty (30) calendar days after notification of the owner by the architect/engineer that all deficiencies to the contract documents that were noted during the substantial completion inspection and listed on the attachment to the certificate of substantial completion have been corrected, and provided the contract has been fully performed and final certificate for payment has been issued by the architect/engineer. In addition, the contractor shall provide to the owner a certified statement of release of liens (AIA Document G706A or other approved form) and consent of surety.

ARTICLE 7 - GENERAL AND SPECIAL PROVISIONS

7.1 This Agreement shall be governed exclusively by the provisions hereof and by the laws of the State of New Mexico as the same from time to time exist.

7.2 Terms used in this agreement which are defined in the Conditions of the Contract shall have the meanings designated in those Conditions.

7.3 As between the parties to this Agreement: as to all acts or failures to act by either party to this Agreement, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in all events not later than the relevant Date of Substantial Completion of Work; and as to any acts or failures to act occurring after the relevant Date of Substantial Completion, not later than the date of the Owner's approval of the Final Certificate of Payment.

7.4 The Contractor shall hold harmless and indemnify the Owner against any and all injury, loss, or damage, including cost of defense - including but not limited to court costs and attorney's fees - arising out of the negligent acts, errors, or omissions of the Contractor.

7.5 This Agreement shall not become effective until: (1) approved by the governing body of the Owner; and (2) signed by all parties required to sign this Agreement and reviewed by the funding agency.

7.6 The Contractor and his agents and employees are Independent Contractors and are not employees of the Owner. The Contractor and his agents and employees shall not accrue leave, retirement, insurance, bonding, use of Owner vehicles, or any other benefits afforded to employees of the Owner as a result of this Agreement.

7.7 The Contractor, upon final payment of the amounts due under this Agreement, releases the Owner, his officers and employees, from his liabilities and obligations arising from or under this Agreement, including but not limited to all damages, losses, costs, liability, and expenses, including but not limited to attorney's fees and costs of litigation that the Contractor may have.

7.8 The Contractor agrees not to purport to bind the Owner to any obligation not assumed herein by the Owner, unless the Contractor has express written authority to do so, and then only within the strict limits of that authority.

7.9 Notices. All notices herein provided to be given, or which may be given, by either party to the other shall be deemed to have been fully given when made in writing and deposited in the United States mail, postage prepaid, in the instance of notice of termination of work also by certified mail, and addressed as shown on the cover page of this Agreement.

7.9.1 Nothing herein contained shall preclude the giving of any such written notice by personal service. The address to which notices shall be mailed to either party may be changed by written notice given by such party to the other as hereinabove provided.

7.10 Gender, Singular/Plural. Words of any gender used in this Contract Agreement shall be held and construed to include any other gender, and words in the singular number shall be held to include the plural, unless the context otherwise requires.

7.11 Captions and Section Headings. The captions and section headings contained in this Agreement are for convenience of reference only, and in no way limit, define, or enlarge the terms, scope, and conditions of this Agreement.

7.12 This document shall be executed in no less than three (3) counterparts, each of which shall be deemed an original.

7.13 Certificates and Documents Incorporated. All certificates and documentation required by the provisions of the Agreement shall be attached to this Agreement at the time of execution, and are

hereby incorporated by reference as though set forth in full in this Agreement to the extent they are consistent with its conditions and terms.

7.14 Separability. If any clause of provision of this Agreement is illegal, invalid, or unenforceable under present or future laws effective during the term of this Agreement, then and in that event, it is the intention of the parties hereto that the remainder of this Agreement shall not be affected thereby.

7.15 Waiver. No provision of this Agreement shall be deemed to have been waived by either party unless such waiver be in writing signed by the party making the waiver and addressed to the other party; nor shall any custom or practice which may evolve between the parties in the administration of the terms hereof be construed to waive or lessen the right of either party to insist upon the performance by the other party in strict accordance with the terms thereof. Further, the waiver by any party of a breach by the other party or any term, covenant, or condition hereof shall not operate as a waiver of any subsequent breach of the same or any other term, covenant, or condition thereof.

7.16 Entire Agreement. This Agreement represents the entire contract between the parties and, except as otherwise provided herein, may not be amended, changed, modified, or altered without the written consent of the parties hereto. This Agreement incorporates all of the conditions, agreements, and understandings between the parties concerning the subject matter of this Contract, and all such conditions, understandings, and agreements have been merged into this written Agreement. No prior conditions, agreement, or understanding, verbal or otherwise, of the parties or their agents shall be valid or enforceable unless embodied in this written Agreement.

7.17 Interchangeable Terms. For purposes of all provisions within this Agreement and all attachments hereto, the terms "Agreement" and "Contract" shall have the same meaning and shall be interchangeable.

7.18 Words and Phrases. Words, phrases, and abbreviations which have well-known technical or trade meanings used in the Contract Documents shall be used according to such recognized meanings. In the event of a conflict, the more stringent meaning shall govern.

7.19 Relationship of Contract Documents. The Contract Documents are complementary, and any requirement of one contract document shall be as binding as if required by all.

7.20 Pursuant to §13-1-191 NMSA 1978, reference is hereby made to the criminal laws of New Mexico (including §30-14-1, §30-24-2, and §30-41-1 through §30-41-3 NMSA 1978) which prohibit bribes, kickbacks, and gratuities, violation of which constitutes a felony. Further, the Procurement Code (§13-1-28 through §13-1-199 NMSA 1978) imposes civil and criminal penalties for its violation.

ARTICLE 8 - TERMINATION OR SUSPENSION

8.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of the General Conditions.

8.2 The Work may be suspended by the Owner as provided in Article 14 of the General Conditions.

ARTICLE 9 - ENUMERATION OF CONTRACT DOCUMENTS

9.1 The Contract Documents, except for Modification issued after execution of this Agreement, are enumerated as follows:

9.1.1 The Agreement is this executed Agreement between Owner and Contractor, Section 00 52 00.

9.1.2 The General Conditions are the General Conditions of the Contract For Construction, AIA Document A201, 2007 edition.

9.1.3 The Supplementary and other conditions of the contract are those contained in the Project Manual dated _____, and are as follows:

Document	Title	Pages

9.1.4 The Specifications are those contained in the Project Manual dated as in subparagraph 9.1.3, and are as follows: (either list the specifications here or refer to an exhibit attached to this agreement.)

Section	Title	Pages

9.1.5 The Drawings are as follows, and are dated _____ unless a different date is shown below: (either list the drawings her or refer to an exhibit attached to this agreement)

Number	Title	Date

9.1.6 The Addenda, if any, are as follows:

Number	Date	Pages

Portions of addenda relating to bidding requirements are not part of the contract documents unless the bidding requirements are also enumerated in this article.

9.1.7 Other Documents, if any, forming part of the contract documents are as follows:
(list here any additional documents which are intended to form part of the contract documents. The general conditions provide that bidding requirements such as the published invitation for bid. Instructions to bidders, sample forms and the contractor's bid are not part of the contract documents unless enumerated in this agreement. List the documents here only if intended to be part of the contract documents; i.ie, Geotechnical Engineering Services Report.)

THIS AGREEMENT is entered into as of the day and year first written above.

CONTRACTOR: **BY:** _____

(SEAL) **TITLE:**

ATTEST: **BY:**

TITLE:

OWNER:

As to legal sufficiency**:**
LEGAL COUNSEL **BY:**_____

DATE:

As to budgetary sufficiency**:**
FINANCE DIRECTOR **BY:**_____

DATE:

Clerk\Mayor\Chairman **BY:** _____

ATTEST: **BY:** _____

TITLE:

PERFORMANCE AND PAYMENT BOND

The “Performance and Payment Bond” will be AIA Document A312™–2010, a copy of which may be examined at any of the Plan Rooms or purchased from a local AIA office.

AIA Document A312™–2010 incorporates two bonds—one covering the contractor’s performance, and the other covering the contractor’s obligations to pay subcontractors and others for material and labor.

AIA Document A312–2010 obligates the surety to act responsively to the owner’s requests for discussions aimed at anticipating or preventing a contractor’s default.

RIDER TO BONDS

Performance and Payment Bond No. _____

Obligee (Owner): _____

Surety _____

Surety's New Mexico Agent:
Name:_____
Address: _____
Telephone No. (_____) _____

The Surety and Principal stipulate as follows:

Whenever, in the judgment of the Owner, the Surety on this bond shall be insolvent, or for any cause is not a proper or sufficient Surety, the Owner may require the Contractor to furnish a new or additional bond or security within ten (10) days; and thereupon, if the Owner shall so order, security shall be furnished. If such new or additional bond or security is not furnished within said time, the Owner may, at its option, take over as Surety, either doing the Work on force account, or letting the same by contract, and shall be entitled to use any equipment, materials and supplies of the delinquent Contractor in completing said Work.

The Surety hereby stipulates and agrees that no properly authorized Change Order altering Contract Time, Contract Sum, Conditions of the Contract, or the scope of nature of the Work to be performed thereunder shall in any way affect its obligation on this bond, and it does hereby waive any notice of such change.

Signed and sealed this _____ day of _____, 20 ___.

_____
(Principal) (Seal)

_____
(Witness)

_____
(Title)

_____
(Witness)

_____
(Surety) (Seal)

_____
(Title)

AGENT'S AFFIDAVIT

STATE OF _____)

COUNTY OF _____)

_____ being first duly sworn deposes and says:

That he/she is the duly appointed agent for _____

_____ and licensed or authorized to do business in the State of New Mexico.

Deponent further states that a certain bond given to indemnify the Owner in connection with the construction of _____ dated the _____ day of_____, 20___, executed by _____ _____ contractor, as principal and _____ as Surety, signed by this deponent; and deponent further states that said bond was written, signed, and delivered by him/her; that the premium on the same has been or will be collected by him; and that the full commission thereon has been or will be retained by him/her.

_____
Agent

Subscribed and sworn to before me this _____ day of _____, 20___.

_____
Notary Public

My Commission expires:

Agent's Address _____

_____

_____

Telephone Number (_____) _____

Power of Attorney for person signing for surety company must be attached to bond

CERTIFICATE OF INSURANCE - CONSTRUCTION

The “Construction Insurance Certificate” will be in accordance with AIA Document G715-1991. A copy of the Instruction Sheet and Attachment for Acord Certificate of Insurance may be examined at any of the plan rooms or purchased from a local AIA office.

ASSIGNMENT OF ANTITRUST CLAIMS

(To be executed by Suppliers, Subcontractors, and Sub-Subcontractors of Contractors)

Project:

Project Number:

agrees that any and all claims which it may have or may inure to it for overcharges resulting from antitrust violations as to goods, services, and materials purchased in connection with the above-referenced project are hereby assigned to the Owner, but only to the extent that such overcharges are passed on to the Owner.

It is agreed that the undersigned retains all rights to any such antitrust claims to the extent of any overcharges not passed on to the Owner, including the right to any treble damages attributable thereto.

FIRM:

BY:
Signed by Individual Empowered to Obligate Supplier, Subcontractor, or Sub-Subcontractor

TITLE:

DATE:

CERTIFICATE OF PROJECT OWNER'S ATTORNEY

To be completed by Project Owner's Attorney

I, the undersigned, _____, the duly authorized and acting legal representative of the (municipality/county) of _____

do hereby certify as follows:

I have examined the attached contract(s) and surety bonds and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligation upon the parties executing the same in accordance with terms, conditions and provisions thereof.

NAME:

DATE:

Address:

Telephone No. ( )

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

The "General Conditions of the Contract for Construction" AIA Document A201-2007 edition, Articles 1 through 15 inclusive, is the basis of the Contract between Owner and the Contractor and is included by reference.

MODIFICATIONS TO GENERAL CONDITIONS

The following supplements modify the "General Conditions of the Contract for Construction", AIA Document A 201, 2007. Where a portion of the General Conditions is modified or deleted by these Supplementary Conditions, the unaltered provisions of the General Conditions shall remain in effect.

1.0 Add the following subparagraph to Paragraph 1.1:

1.1.9 ADDITIONAL DEFINITIONS.

The following definitions shall apply throughout the Bidding Documents or Contract Documents unless otherwise specified:

1.1.9.1 SURETY: The person or entity obligated to provide such performance or payment as set forth in bonds required by the Contract Documents.

1.1.9.2 UNIT PRICES: Amounts stated in the Contract as prices per unit of measurement for materials or services as described in the Contract Documents.

1.1.9.3 USER: The agency or agencies or designated entity for whose use the Project is being constructed.

2.0 Substitute the following for Subparagraph 1.5.1:

1.5.1 All designs, drawings, specifications, notes, and other work developed in the performance of this Contract and copies thereof furnished by the Architect/Engineer shall be the sole property of the Owner. They are to be used only with respect to this Project and are not to be used on any other project.

3.0 Add the following Paragraph 2.5:

2.5 ADMINISTRATION OF THE CONTRACT.

2.5.1 The Owner and his agents shall at all times have access to the work whenever it is in preparation and progress. The Owner, as outlined in the Contract Documents, shall request change orders through the Architect. The final acceptance of the project shall be made by representatives of the Architect, Owner, and Contractor.

4.0 Add the following to Subparagraph 3.4.2:

3.4.2.1 After the Contract has been executed, the Architect will consider a formal request for the substitution of products in place of those specified only under conditions set forth in the General Requirements of the Technical Specifications.

5.0 Add the following Subparagraph 3.6.1:

3.6.1 Contracts solicited by competitive sealed bids shall require that the bid amount exclude the applicable state gross receipts taxes or applicable local option tax but that the Owner shall be

required to pay the applicable tax including any increase in the applicable tax becoming effective after the date the contract is entered into. The applicable gross receipt tax or applicable local option tax shall be shown as a separate amount on each billing or request for payment made under the contract (§13-1-108 NMSA 1978).

6.0 Add the following sentence to Subparagraph 3.7.1:

3.7.1 Included in the above listing is the fee charged by state or local governmental entity for the review of plans prior to issuance of the building permit.

7.0 Add the following subparagraphs to Subparagraph 3.7.1:

3.7.1.1 The Contractor must secure all building permits from the Construction Industries Division, Licensing and Regulation Department of the State of New Mexico or the Authority Having Jurisdiction designated by CID. The Construction Industries Division offices are located in Room 198, 725 St. Michael's Drive, Santa Fe, New Mexico 87503.

3.7.1.2 The Contractor will be responsible for the payment of connection charges or other such fees to cover the capital expense charges of the utility companies when listed in Allowances Specification Section. Included are the utility company's mains, trunks, or materials necessary to reach the point where the tap is made. The Contractor will be responsible for the electrical after the transformer, domestic water after the meter, fire service water at and after the detector check value, and gas after the meter.

8.0 Add the following subparagraph to Subparagraph 3.10.1:

3.10.1.1 The construction schedule shall be submitted no later than fifteen (15) days after receipt of the Notice to Proceed. The schedule shall be revised by the Contractor from time to time to reflect all changes in contract Work and adjustments in time, money, or both that are approved by the Architect/Engineer. The schedule shall show the date of commencement of work on each pertinent phase or item of construction, percentage of scheduled completion at the end of each fifteen (15) days, and the date of completion of each phase or item of work. The progress schedule shall indicate labor, materials, and equipment actually incorporated into the Work (construction in place). No progress shall be indicated for materials and equipment on the site but not incorporated into the Work. The schedule shall be submitted each month with the Pay Request, in duplicate. No payment will be made without the schedule.

9.0 Add the following subparagraph to Paragraph 3.15:

3.15.3 The Contractor shall thoroughly clean the premises at the completion of the work.

10.0 Add the following to Subparagraph 4.2.3:

4.2.3.1 Should the Architect/Engineer determine that any portion of the Work is not in compliance with the requirements of the Contract Documents, the Architect/ Engineer shall promptly notify the Owner and the Contractor of the nature of the non-compliance and the correction of the work required.

11.0 Amend Subparagraph 4.2.9 as follows:

Add the phrase "and the Owner" after the word Architect in the first sentence.

12.0 Substitute the following for "a reasonable amount" stated in line 5 of Subparagraph 7.3.7:

Overhead and profit shall be limited to the amounts as set forth in Subparagraph 7.3.7.6.

13.0 Add new subparagraph to Subparagraph 7.3.7:

7.3.7.6 The maximum allowance for overhead and profit will not exceed the following amounts:
.1 Contractor for Work performed by his own forces: 15%
.2 Subcontractor for Work performed by his own forces: 10%
.3 Contractor for Work performed by Subcontractor; Contractor may mark up the Subcontractor's Labor and Materials costs only and not the Subcontractor's marked-up price: 5%

14.0 Add new Subparagraph 7.3.11:

7.3.11 The quotation of Work under a Change Order shall be binding for sixty (60) days from the date submitted by the contractor.

15.0 Add the following Subparagraph 8.2.4:

8.2.4 If the Contractor shall neglect, fail or refuse to complete the Work within time herein specified or the time established by himself for his scheduled completion, which ever is the earliest then said Contractor does hereby agree, as part consideration for awarding of this Contract, to pay the Owner the amount specified in the contract, not as a penalty but as liquidated damages for such breach of contract as hereinafter set forth for each and every calendar day that the Contractor shall be in default after earliest time stipulated in contract for completing work. Provided, that Contractor shall not be charged with liquidated damages or any excess when delay in completion of Work is due;

16.0 Add new Subparagraphs 8.3.1.1, 8.3.1.2, 8.3.1.3:

8.3.1.1 To any performance, priority or allocation order duly issued by the government;

8.3.1.2 To unforeseeable cause beyond control and without fault or negligence of Contractor including but not restricted to, acts of God or public enemy, acts of Owner, acts of another Contractor in performance of a contract with Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and unusually severe weather; and

8.3.1.3 To any substantiated delays of Subcontractors and/or material suppliers occasioned by any of the causes specified in subsections 1 and 2 above.

17.0 Add Subparagraph 8.3.4:

8.3.4 Where individual items or designated portions of the Work require changes in completion time, but are not interrelated with items of work governed by the Contract Time, the Architect/

Engineer and the Owner may establish by Change Order separate completion dates with separate Liquidated Damages acceptable to the Contractor and leave the Contract Time unchanged.

18.0 Add Subparagraph 8.3.5:

8.3.5 Requests for and granted extensions of time shall commence on the Contractor's scheduled date of completion unless that date and the date of substantial completion are concurrent, then the extension shall apply to the Contract Time.

19.0 Add a new Subparagraph 9.5.1.8:

9.5.1.8 This contract sum has been reduced by change order.

20.0 Add to Subparagraph 9.6.1 the following sentence:

The Owner for "**good cause**" may refuse to make payment of the full amount requested by the Contractor and recommended by the Architect/Engineer in order to protect itself from loss because of subparagraphs 9.5.1.2 through 9.5.1.8, but the Owner must give the Contractor immediate written notice (with a copy to the Architect/Engineer) stating the reasons for such action.

21.0 Add the following sentence to 9.8.3:

No adjustment in retainage will be made unless approved by the Owner.

22.0 Add the following Paragraph 9.11:

9.11 LIQUIDATED DAMAGES

9.11.1 The Contractor and the Contractor's surety, if any, shall be liable for and shall pay the Owner the sums hereinafter stipulated as liquidated damages for each calendar day of delay until the work is substantially complete. Liquidated damages set forth in the Agreement will be assessed from the Contractor's scheduled completion date, unless that date coincides with the Date of Substantial Completion, then it will be assessed from that date.

23.0 Substitute the following for Subparagraph 11.1.2:

11.1.2 The limits of liability for the insurance required by Subparagraph 11.1.1 shall provide coverage for not less than the following amounts or greater if required by law:

1. Worker's Compensation (including accident and occupational disease coverages):
   a. State: Statutory
   b. Employer's Liability:
      $ 100,000 each accident
      $ 500,000 disease-policy limit
      $ 100,000 disease-each employee
2. Comprehensive General Liability (including Premises Operations; Independent Contractors' Protective; Products and Completed Operations; Board Form Property Damage):
   a. Bodily Injury:
      $ 500,000 Per Person
      $1,000,000 Each Occurrence

b. Property Damage:
   $ 500,000 Each Occurrence
   $ 500,000 Annual Aggregate
c. Property Damage Liability Insurance shall provide X, C or coverage as applicable.

3. Comprehensive Automobile Liability:
   a. Bodily Injury:
      $ 500,000 Per Person
      $1,000,000 Each Occurrence
   b. Property Damage:
      $ 500,000 Each Occurrence
      $ 500,000 Annual Aggregate
4. Umbrella excess liability:
      $1,000,000 over primary insurance.
5. Additional named insureds: The Contractor shall have the Owner, Molzen-Corbin and its Subconsultants added as additional named insureds on the Comprehensive General Liability Form or Commercial Liability Form.

24.0 Substitute the following paragraph for Paragraph 11.3:

11.3 PROPERTY INSURANCE

11.3.1 Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. Contractor shall be responsible for any deductible or self-insured retention. This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, Architect/Engineer, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or loss payee;
2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment in transit and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by these Supplementary Conditions.
3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Architect;
5. allow for partial utilization of the Work by Owner;
6. include testing and startup;
7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Architect with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued; and

11.3.2 Contractor shall purchase and maintain such boiler and machinery insurance and any other additional property insurance required by Laws and Regulations which insurance will include the interest of Owner, Contractor, Subcontractors, Architect and the officers, directors, partners,

employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

11.3.3 To the extent permitted under their respective property insurance policies, the Owner and the Contractor hereby waive all rights, each against the other for damages caused by fire or other perils to the extent covered by insurance obtained pursuant to this Article or any other property insurance applicable to the Work, except such rights as they may have to the proceeds of such insurance held by the Owner as trustee. The Owner or the Contractor as appropriate shall require the Architect/Engineer, other Contractors, Subcontractors, and Subsubcontractors to similarly waive rights of subrogation of property insurance.

11.3.4 If the Owner finds it necessary to occupy or use any portion of the work prior to Substantial Completion, such occupancy or use shall not commence prior to the time mutually agreed to by the Owner and the Contractor and, if required by the applicable insurance coverage, not prior to the time the builder's risk property insurer has consented to such occupancy or use. The Contractor's consent to such occupancy or use shall not be unreasonably withheld.

25.0 Substitute the following for Paragraph 11.4:

11.4.1 The Contractor shall post a one hundred percent (100%) Performance Bond and a one hundred percent (100%) Payment Bond, forms attached hereto with amount payable conforming to the terms of the Contract. Surety shall be a company licensed to do business in the State of New Mexico and executed by such sureties as are named in the current list of Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds as published in federal circular 570 by the Audit Staff Bureau of Accounts, U.S. Treasury Department.

11.4.2 Special attention is called to the requirements of §13-4-18 through §13-4-20, NMSA 1978, regarding a Contractor who does not have his principal place of business in the State of New Mexico for all taxes due arising out of construction services rendered under the Contract.

11.4.3 The right to sue on this Bond accrues only to the Owner and the parties to whom §13-4-18 through §13-4-20, NMSA 1978, grant such right; and any such right shall be exercised only in accordance with the provisions and limitations of said statutes.

26.0 Add the following subparagraphs to Paragraph 13.5:

13.5.7 All testing required by the Contract Documents, and retesting required as a result of the failure of the first or subsequent tests, including but not limited to testing for job mix formulae and design mixes, shall be performed by a testing laboratory under the direct supervision of a registered professional engineer licensed to practiced in the State of New Mexico, and shall be paid for by the Contractor.

13.5.8 All sampling, transportation, and storage of samples, testing, and reporting shall be undertaken by representatives of the testing laboratory. No sampling, transportation, and storage of samples, nor testing, nor reporting shall be undertaken by the Architect/Engineer, the Owner, the Contractor, or the Subcontractors.

13.5.9 Two copies of all test reports shall be furnished directly to the Architect/Engineer by the testing laboratory, and one copy directly to the Owner. All test reports shall be numbered sequentially.

27.0 Delete Paragraph 13.6 in its entirety.

28.0 Delete Paragraph 13.7 in its entirety.

29.0 Add the following to paragraph 15.2.1:

15.2.1 Present claims and disputes in the form of a written request accompanied by supporting data to the Architect/Engineer for formal decision, with a copy to the other party.

30.0 In line 3 of Subparagraph 15.3.1, substitute the word "may" before "be subject…"

ADDITIONAL CONDITIONS

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1. CONSTRUCTION INDUSTRIES LICENSING ACT

1.1 This Contract is subject to the provisions of the New Mexico Construction Industries Licensing Act (§60-13-1 to §60-13-59 NMSA 1978), the rules and regulations of the New Mexico Construction Industries Commission and the rules, regulations and codes of the various trade boards adopted pursuant to the Construction Industries Licensing Act.

2. CONTRACT AUDIT

2.1 The Owner shall be entitled to audit the books and records of a Contractor or any Subcontractor under any negotiated Contract or subcontract other than a firm fixed-price Contract to the extent that such books and records relate to the performance of such Contract or subcontract. Such books

and records shall be maintained by the Contractor for a period of three years from the date of final payment under the prime Contract and by the Subcontractor for a period of three years from the date of final payment under the subcontract unless a shorter period is otherwise authorized by the Owner in writing (§13-1-161 NMSA 1978).

3. ASSIGNMENT OF ANTITRUST CLAIMS

3.1 All contractor, suppliers, subcontractors agree that any and all claims which it may have or may inure to it for overcharges resulting from antitrust violations as to goods, services and materials purchased in connection with this Project are hereby assigned to the Owner and the funding agency, but only to the extent that such overcharges are passed on to the Owner. It is agreed that the contractor, supplier, subcontractor or sub-subcontractor retains all rights to any such antitrust claims to the extent of any overcharges not passed on to the Owner, including the right to any treble damages attributable thereto.

4. BRIBES, GRATUITIES, AND KICKBACKS

4.1 It is illegal in this state for any public employee to solicit or accept anything of value in connection with award of this Contract and for any person to offer or pay anything of value to any such public employee (§30-24-1 through §30-24-2 NMSA 1978).

4.2 Pursuant to §13-1-191 NMSA 1978 reference is hereby made to the criminal laws of New Mexico (including §30-24-1 through §30-24-2, and §30-41-1 through §30-41-3 NMSA 1978), which prohibit bribes, kickbacks, and gratuities and violation of which constitutes a felony. Further, the Procurement Code (§13-1-28 through §13-1-199 NMSA 1978) imposes civil and criminal penalties for its violation.

5. NON-RESIDENT CONTRACTOR'S REQUIREMENTS REGARDING GROSS RECEIPTS TAX SURETY BOND

5.1 §7-1-55A NMSA 1978 provides that any person (as defined in §7-1-3 NMSA 1978) engaged in the construction business who does not have his principal place of business in New Mexico and enters into a prime construction contract to be performed in this state shall, at the time such contract is entered into, furnish the Director of the Revenue Division, Taxation and Revenue Department, or his delegate with a surety bond or other acceptable security in a sum equivalent to the gross receipts tax to be paid under the contract multiplied by the applicable rate of the gross receipts tax imposed by §7-9-4 NMSA 1978 to secure payment of the tax imposed on the gross receipts from the contract, and shall obtain a certificate from the Director of the Revenue Division, Taxation and Revenue Department, or his delegate, that the requirements of this paragraph have been met.

5.2 If the total sum to be paid under the contract is changed by ten percent or more after the date the surety bond or other acceptable security is furnished, to the Director or his delegate, such person shall increase or decrease, as the case may be, the amount of the bond or security within fourteen days after the change (§7-1-55B NMSA 1978).

5.3 In addition to the above requirements, the Contractor will be subject to all the requirements of §7-1-55 NMSA 1978.

6. CONTRACTOR'S GROSS RECEIPTS TAX REGISTRATION

6.1 §7-10-4 NMSA 1978 provides that any person (as defined in §7-10-3 NMSA 1978) performing services for the State or its political subdivisions, as those terms are used in the Gross Receipts and Compensating Tax Act (§7-10-1 through §7-10-5 NMSA 1978) must be registered and be issued an identification number with the Revenue Division of the Taxation and Revenue Department of the state to pay the gross receipts tax.

6.2 For information in obtaining the identification number contact: Revenue Division, Taxation and Revenue Department, Manuel Lujan Sr. Building, 1200 St. Francis Drive, Santa Fe, New Mexico 87503, or call (505) 988-2290.

6.3 If any person who performs services for the state or its political subdivisions is not registered to pay the gross receipts tax, the Owner shall withhold payment of the amount due until the person has presented evidence of registration with the Revenue Division to pay the gross receipts tax.

7. CONTRACTS WITH NONRESIDENT PERSONS OR PARTNERSHIPS OR UNADMITTED FOREIGN CORPORATIONS, AGENT FOR SERVICE OF PROCESS

7.1 Special attention of Contractors is called to the requirements of §13-4-21 through §13-4-24 NMSA 1978, whereby a public works contract with a nonresident person or partnership or foreign corporation not authorized to do business in the State shall contain a specific provision designating an agent resident within the State, and his address, upon whom process and writs in any action or proceeding against such business may be served in any action arising out of such contract.

8. SAFETY STANDARDS AND ACCIDENT PREVENTION

8.1 With respect to all work performed under this contract, the Contractor shall:

A. Comply with the safety standards provisions of applicable laws, building and construction codes and the "Manual of Accident Prevention in Construction" published by the **Associated General Contractors of America**, the requirements of the Occupational Safety and Health Act of 1970 (P.L. 91-596), and the requirements of Title 29 of the Code of Federal Regulations, Section 1518 as published in the "Federal Register", Volume 36, No. 75, Saturday, April 17, 1971.

B. Exercise every precaution at all times for the prevention of accidents and the protection of persons (including employees) and property.

C. Maintain at his/her office or other well known place at the job site, all articles necessary for giving first aid to the injured, and shall make standing arrangements for the immediate removal to a hospital or a doctor's care of persons (including employees), who may be injured on the job site. In no case shall employees be permitted to work at a job site before the employer has made a standing arrangement for removal of injured persons to a hospital or a doctor's care.

9. PROJECT IDENTIFICATION SIGN

9.1 Refer to General Requirements Section 01 50 00 Temporary Facilities and Controls for applicability

10. EQUAL OPPORTUNITY

10.1 The Contractor, subcontractors, and all sub-subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin. The Contractor shall take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of nondiscrimination.

10.2 The Contractor, all subcontractors, and all subsubcontractors shall, in all solicitation or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, or national origin.

11. DEBARRED OR SUSPENDED CONTRACTORS

11.1 A business (Contractor, Subcontractor, or Supplier) that has either been debarred or suspended pursuant to the requirements of §13-1-177 through §13-1-180, and §13-4-11 through §13-4-17, NMSA 1978, shall not be permitted to do business with the Owner and shall not be considered for award of contract during the period for which it is debarred or suspended.

12. BUILDER'S RISK INSURANCE

12.1. The Contractor will maintain Builder's Risk Insurance (fire and extended coverage) on a 100 percent completed value basis on the insurable portions of the project for the benefit of the Owner, the Contractor, and all subcontractors, as their interests may appear.

13. STATED ALLOWANCES

13.1 The Contractor has included any and all Utility Service Allowances listed in General Requirements Section 01 21 00 in its Bid

13.2 The Contractor has included any and all Cash Allowances in its Bid listed in General Requirements Section 01 21 00 in its Bid:

13.2.1 The Contractor shall purchase the "Allowed Materials" as directed by the Owner through the Architect/Engineer on the basis of the lowest and best bid of at least three competitive bids. If the actual price for purchasing the "Allowed Materials" is more or less than the "Cash Allowance," the Contract Price shall be adjusted accordingly. The adjustment in Contract Price shall be made on the basis of the purchase price without additional charges for overhead, profit, insurance, or any other incidental expenses. The cost of installation of the "Allowed Materials" shall be included in the applicable section of the Specifications covering this work.

14. MINIMUM WAGE RATES

14.1 The Contractor warrants and agrees that he and all subcontractors shall comply with all applicable provisions of the New Mexico Public Works Minimum Wage Act, §13-4-11 NMSA 1978 (if the project is over $20,000); and other statutes pertaining to public works in New Mexico. The attached Minimum Wage Rate Determinations are declared to be prevailing and apply to the construction.

14.2 Submission of weekly payroll records to the Owner and Labor Commission is mandatory. Include the decision number on Contractor's and subcontractor's payrolls. The scale of wages shall also be posted in a prominent location at the site.

14.3 In the event it is found by the Labor Commission, that any laborer or mechanic employed by the Contractor or Subcontractor on the site of the project covered by this Contract, has been or is being paid as a result of a willful violation, a rate of wages less than the rate of wages required by the Contract, the Owner may, by written notice to the Contractor and his subcontractor, if the violation involves a Subcontractor, terminate their right to proceed with the Work or such part of the Work as to which there has been a willful failure to pay the required wages and the Owner may prosecute the Work to completion by contract or otherwise, and the Contractor shall be liable to the Owner and the State of New Mexico for any excess cost occasioned thereby.

WAGE RATE REQUIREMENTS

Wage Rate Decision(s) which follow are applicable to this project.

CO-21-1709-B

New Mexico Department of WORKFORCE SOLUTIONS

TYPE "B" – GENERAL BUILDING

Please refer to the base and fringe rate columns that pertain to the date your wage decision was approved. For instance, if your wage decision was approved on April 1, 2021, you will use the rates in the first two columns. If your wage decision was approved on May 10, 2021, use the third and fourth columns.

	Effective January 1, 2021 Through May 4, 2021		Effective May 5, 2021		Effective January 1, 2020 Through December 31, 2021
Trade Classification	**Base Rate**	**Fringe Rate**	**Base Rate**	**Fringe Rate**	**Apprenticeship**
Asbestos Workers/Heat and Frost insulators	33.01	12.06	32.26	12.06	0.60
Asbestos Workers/Heat and Frost insulators-Los Alamos County	35.44	12.06	34.69	12.06	0.60
Boilermaker/ blacksmith	34.97	28.85	34.97	28.85	0.60
Bricklayer/Block layer/Stonemason	24.97	9.50	24.46	8.81	0.60
Carpenter/Lather	25.63	11.74	24.63	11.24	0.60
Carpenter-Los Alamos County	28.37	13.44	27.80	13.19	0.60
Millwright/ pile driver	33.16	27.24	33.16	25.24	0.60
Cement Mason	21.07	10.33	21.07	10.33	0.60
Electricians-Outside Classifications-Zone 1					
Ground man	23.74	13.16	23.27	12.67	0.60
Equipment Operator	34.06	15.94	33.39	15.35	0.60
Lineman/Tech	40.07	17.57	39.28	16.91	0.60
Cable Splicer	44.08	18.65	43.21	17.95	0.60
Electricians-Outside Classification: Zone 2					
Ground man	23.74	13.16	23.27	12.67	0.60

Equipment Operator	34.06	15.94	33.39	15.35	0.60
Lineman/ technician	40.07	17.57	39.28	16.91	0.60
Cable Splicer	44.08	18.65	43.21	17.95	0.60
Electricians-Outside Classifications: Los Alamos					
Ground man	24.42	13.34	23.94	12.85	0.60
Equipment Operator	35.04	16.21	34.35	15.60	0.60
Lineman/ Technician	41.22	17.88	40.41	17.21	0.60
Cable Splicer	45.34	18.99	44.45	18.28	0.60
Electricians-Inside Classifications: Zone 1					
Wireman/ low voltage technician	33.65	12.01	32.70	11.18	0.60
Cable Splicer	37.02	12.11	35.97	11.28	0.60
Electricians-Inside Classification: Zone 2					
Wireman/ low voltage technician	36.68	12.10	35.64	11.27	0.60
Cable Splicer	40.04	12.20	38.91	11.37	0.60
Electricians-Inside Classification: Zone 3					
Wireman/ low voltage technician	38.70	12.16	37.61	11.33	0.60
Cable Splicer	42.06	12.26	40.88	11.43	0.60
Electricians-Inside Classification: Zone 4					
Wireman/ low voltage technician	42.40	12.27	41.20	11.44	0.60
Cable Splicer	45.75	12.37	44.47	11.53	0.60
Electricians-Inside Classification: Los Alamos					
Wireman/ low voltage technician	38.70	14.09	37.61	13.21	0.60
Cable Splicer	42.06	14.36	40.88	13.47	0.60
Elevator Constructor	43.25	36.37	43.80	35.25	0.60

Elevator Constructor Helper	36.19	36.37	35.04	35.25	0.60
Glazier					
Journeyman/ Fabricator	20.50	6.20	20.25	5.35	0.60
Delivery Driver	9.00	5.35	9.00	5.35	0.60
Ironworker	27.35	17.49	27.00	15.75	0.60
Painter (Brush/Roller/Spray)	17.25	7.75	17.00	6.88	0.60
Paper Hanger	17.25	7.75	17.00	6.88	0.60
Drywall- Light Commercial & Residential					
Ames tool operator	25.63	7.60	25.08	7.10	0.60
Hand finisher/machine texture	24.63	7.60	24.08	7.10	0.60
Plasterer	23.56	9.39	23.17	8.99	0.60
Plumber/Pipefitter	31.52	12.90	30.76	11.62	0.60
Roofer	25.74	7.97	25.23	7.97	0.60
Sheet metal worker					
Zone 1	33.38	17.64	31.03	17.26	.60
Zone 2 – Industrial	34.38	17.64	32.03	17.26	.60
Zone 3 – Los Alamos	35.38	17.64	33.03	17.26	.60
Soft Floor Layer	20.30	8.10	19.94	7.70	0.60
Sprinkler Fitter	31.57	23.46	30.90	22.29	0.60
Tile Setter	24.46	8.81	24.46	8.81	0.60
Tile Setter Helper/Finisher	16.53	8.81	16.53	8.81	0.60
Laborers					
Group I- Unskilled and semi-skilled	18.25	7.12	17.50	6.27	0.60
Group II- Skilled	19.25	7.12	18.50	6.27	0.60
Group III- Specialty	21.50	7.12	20.75	6.27	0.60
Masonry Laborers					
Group I- Unskilled and Semi-Skilled	18.75	7.34	18.00	6.27	0.60

Group II- Skilled	20.50	7.34	19.75	6.27	0.60
Group III- Specialty	21.00	7.34	20.25	6.27	0.60
Reinforcing iron workers and post tension	24.75	7.12	24.00	6.27	0.60
Operators					
Group I	21.96	7.47	20.95	7.27	0.60
Group II	24.12	7.47	23.11	7.27	0.60
Group III	24.58	7.47	23.57	7.27	0.60
Group IV	25.02	7.47	24.01	7.27	0.60
Group V	25.21	7.47	24.20	7.27	0.60
Group VI	25.42	7.47	24.41	7.27	0.60
Group VII	25.53	7.47	24.52	7.27	0.60
Group VIII	28.58	7.47	27.56	7.27	0.60
Group IX	30.96	7.47	29.95	7.27	0.60
Group X	34.36	7.47	33.35	7.27	0.60
Truck Drivers					
Group I-VII	16.65	8.27	16.45	7.87	0.60
Group VIII	16.71	8.27	16.51	7.87	0.60
Group IX	18.65	8.27	18.45	7.87	0.60

NOTE: All contractors are required to pay SUBSISTENCE, ZONE AND INCENTIVE according to the particular trade. Details are located in a PDF attachment at WWW.DWS.STATE.NM.US. Search Labor Relations/Labor Information/Public Works/Prevailing Wage Rates.

For more information about the Subsistence, Zone, and Incentive Pay rates, or to file a wage claim,
contact the Labor Relations Division at (505) 841-4400 or visit us online at www.dws.state.nm.us.

LABOR RELATIONS DIVISION
121 Tijeras Ave NE, Suite 3000
Albuquerque, NM 87102
Phone: 505-841-4400
Fax: 505-841-4424

WWW.DWS.STATE.NM.US

PUBLIC WORKS PROJECT REQUIREMENTS

As a participant in a Public Works project valued at more than $60,000 in the state of New Mexico, the following list addresses many of the responsibilities that are defined by statute or regulation to each project stakeholder.

Contracting Agency

- Ensure that all contractors wishing to bid on a Public Works project when the project is $60,000 or more are actively registered with the Public Works and Apprenticeship Application (PWAA) website: http://www.dws.state.nm.us/pwaa (Contractor Registration) prior to bidding.
- Please submit Notice of Award (NOA) and Subcontractor List(s) to the PWAA website promptly after the project is awarded.
- Please update the Subcontractor List(s) on the PWAA website whenever changes occur.
- All sub-contractors and tiers (excluding professional services) regardless of contract amount must be listed on the Subcontractor List and must adhere to the Public Works Minimum Wage Act.
- Ninety days after project completion please go into the PWAA system and close the project. Only contracting agencies are allowed to close the project. Agents or contractors are not allowed to close projects.

General Contractor

- Provide a complete Subcontractor List and Statements of Intent (SOI) to Pay Prevailing Wages for all contractors, regardless of amount of work, to the contracting agency within 3 (three) days of award.
- Ensure that all subcontractors wishing to bid on a Public Works project have an active Contractor Registration with the Public Works and Apprenticeship Application (PWAA) website: http://www.dws.state.nm.us/pwaa prior to bidding when their bid will exceed $60,000.
- Make certain the Public Works Apprentice and Training Act contributions are paid either to an approved Apprenticeship Program or to the Public Works Apprentice and Training Fund.
- Confirm the Wage Rate poster, provided in PWAA, is displayed at the job site in an easily accessible place.
- When the project has been completed, make sure the Affidavits of Wages Paid (AWP) are sent to the contracting agency.
- All subcontractors and tiers (excluding professional services) regardless of contract amount must pay prevailing wages, be listed on the Subcontractor List, and adhere to the Public Works Minimum Wage Act.

LABOR RELATIONS DIVISION
121 Tijeras Ave NE, Suite 3000
Albuquerque, NM 87102
Phone: 505-841-4400
Fax: 505-841-4424

WWW.DWS.STATE.NM.US

Subcontractor

- Ensure that all subcontractors wishing to bid on a Public Works project have an active Contractor Registration with the Public Works and Apprenticeship Application (PWAA) website: http://www.dws.state.nm.us/pwaa prior to bidding when their bid will exceed $60,000.
- Make certain the Public Works Apprentice and Training Act contributions are paid either to an approved Apprenticeship Program or to the Public Works Apprentice and Training Fund.
- All subcontractors and tiers (excluding professional services) regardless of contract amount must pay prevailing wages, be listed on the Subcontractor List, and adhere to the Public Works Minimum Wage Act.

Additional Information

Reference material and forms may be found in the New Mexico Department of Workforce Solutions Public Works web pages at: https://www.dws.state.nm.us/Labor-Relations/Labor-Information/Public-Works.

CONTACT INFORMATION

Contact the Labor Relations Division for any questions relating to Public Works projects by email at public.works@state.nm.us or call (505) 841-4400.

LABOR RELATIONS DIVISION **WWW.DWS.STATE.NM.US**

401 Broadway NE
Albuquerque, NM 87102
Phone: 505-841-4400
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226 South Alameda Blvd
Las Cruces, NM 88005
Phone: 575-524-6195
Fax: 575-524-6194

1596 Pacheco St, Suite 103
Santa Fe, NM 87505
Phone: 505-827-6817
Fax: 505-827-9676

Wage Decision Approval Summary

1) Project Title: Raton Hangar
Requested Date: 08/25/2021
Approved Date: 08/26/2021
Approved Wage Decision Number: CO-21-1709-B

Wage Decision Expiration Date for Bids: 12/24/2021

2) Physical Location of Jobsite for Project:
Job Site Address: US 64
Job Site City: Raton
Job Site County: Colfax

3) Contracting Agency Name (Department or Bureau): City of Raton
Contracting Agency Contact's Name: Michael Anne Antonucci
Contracting Agency Contact's Phone: (575) 445-9551 Ext.

4) Estimated Bid Opening Date: 10/07/2021

5) Estimated total project cost: $
a. Are any federal funds involved?: No
b. Does this project involve a building?: Yes - pre-engineered 3000 sf metal building
c. Is this part of a larger plan for construction on or appurtenant to the property that is subject to this project?: No
d. Are there any other Public Works Wage Decisions related to this project?: No
e. What is the ultimate purpose or functional use of the construction once it is completed?: New Hangar

6) Classifications of Construction:

Classification Type and Cost Total	Description
General Building (B) **Cost:** $	Cast-In-Place Concrete, Structural Steel, Damp Proofing, Sealants and Expansion Joints, Bi-Folding Overhead Door, Painting, Portable Fire Extinguishers, Pre-Engineered Metal Building, Plumbing, HVAC components, Electrical, Fire Alarm System, Earthwork, Concrete Sidewalks, Utility Trenching and Piping and Connecting to Existing Utilities.

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.01 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 49-division format and CSI/CSC's "MasterFormat 2011" numbering system.

B. DIVISION 01 GENERAL REQUIREMENTS apply to Work of all Specification Sections.
   1. PART 1 GENERAL of each specification section contains requirements which pertain only to that section.

C. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions include:
   1. Abbreviated Language: Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
   2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
   3. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
   4. The word "provide" means to furnish and install, complete and ready for use.

1.02 SUMMARY BY REFERENCED

A. Work of the Contract can be summarized by references to the Contract, General Conditions, Supplementary Conditions, Specification Sections, Drawings, Addenda and Modifications to the Contract Documents issued subsequent to the initial printing of this Project Manual and including, but not necessarily limited to, printed material referenced by any of these. It is recognized that Work of the Contract is also unavoidably affected or influenced by governing regulations, natural phenomenon, including weather conditions and other forces outside the Contract Documents.

1.03 WORK COVERED BY CONTRACT DOCUMENTS

A. Project will be constructed under a General Construction Contract.

B. Project Identification: Project titled "Raton Municipal Airport Hanger" located in Colfax County at 33788 U.S. Highway 64, Raton New Mexico 87740.

C. The Work consists of an approximately 3,000 sq. ft. aircraft hangar. Project Work to be incorporated:
   1. Cast-In-Place Concrete; Damp Proofing, Insulation, Sheet Metal Roofing, flashing and Trim, Elastomeric Sealants, Bi-Fold door, Painting, Pre-Engineered Metal Building, Plumbing, HVAC, Electrical Power, and Lighting; Earthwork, Asphalt, Concrete aprons, Utility Trenching, Piping and Connecting to Utilities and an Oil Separator System.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. The awarded Contractor must have a minimum of 5 years' experience as the General Contractor of Commercial Building Construction projects similar in complexity and size under the present firm or trade name.

B. Except as noted, provide and pay for all labor, materials, and equipment.

C. Pay required sales, gross receipts, and other taxes. Owner will pay Contractor applicable New Mexico gross receipts tax including local option tax and any increase in tax becoming effective after Contract date.

D. Secure and pay for permits, fees, and licenses necessary for execution of Work as applicable at time of receipt of bids or as otherwise required in other sections of the Specifications.

E. Give required notices.

F. Comply with codes, ordinances, regulations, and other legal requirements of public authorities which bear on performance of Work.

G. Request required inspections from public authorities, correct any noted deficiencies, and obtain certifications of satisfactory inspection. Deliver certificates to Owner in accordance with the Closeout Submittals Section.

1.05 USE OF THE PREMISES

A. Owner will occupy site during entire construction period.
   1. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage.
   2. Perform the Work so as not to interfere with Owner's operations.

B. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
   1. Limits: Confine constructions operations to area designated on Drawings.

2. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    a. Schedule deliveries to minimize use of driveways and entrances.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

B. Spaces for Bidders listings of values of alternates are included on the Bid Form.

1.02 RELATED SECTIONS

A. Section 13 34 19 – Pre-Engineered Metal Buildings

1.03 DEFINITIONS

A. Definition: An alternate is an amount proposed by Bidders and stated on the Bid Form for certain work that may be added to or deducted from the total Base Bid amount if the Owner decides to accept a corresponding increase or decrease in either scope of work or in products, materials, equipment, systems or installation methods described in Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate the alternate into the Work. No other adjustment is made to the Contract Sum.

1.04 PROCEDURES

A. Coordination: Coordinate related work and modify or adjust adjacent work as required to ensure that work affected by each accepted alternate is complete and fully integrated into the project.

B. Notification: Immediately following award of Contract, prepare and distribute to each party involved, notification of the status of each alternate. Indicate whether alternates have been accepted, rejected or deferred for consideration at a later date. Include a complete description of negotiated modifications to alternates, if any.

C. Selection of Alternates: The Owner shall accept alternates in the numerical order in which they are listed in the Bid Form, as produces a net amount which is within the available funds.

1.05 ALTERNATES

A. Include as part of each alternate, miscellaneous devices, appurtenances and similar items incidental to or required for a complete installation whether or not mentioned as part of the alternate.

B. Schedule:

1. Alternate #1: Enlarge Building Gridline Dimensions:

a. 1 to 4: 68'-0″.

b. A to D: 58′-0″.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Substitution Requests:
1. No product is "approved" for Substitution prior to Bid. The Contract is based on material and equipment specified in the Specifications or described in the Drawings without consideration of possible substitute or "or-equal" items.
2. Where indicated that substitute or "or-equal" item of material or equipment may be furnished or used if acceptable to the A/E, application for such acceptance shall not be considered until after the effective date of the Contract.
3. Submit written requests for Product Substitution along with a copy of the **SUBSTITUTION REQUEST FORM** following this Section, after award of the Contract for Construction and within 30 days after Notice to Proceed.

1.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. Substitutions, General: Catalog numbers and specific brands or trade names are used in materials, products, equipment and systems required by the Specifications to establish the standards of quality, utility and appearance required. Alternative products which are of equal quality and of required characteristics for the purpose intended may be proposed for use provided the Contractor complies with provisions of Contract General Conditions subject to the following provisions:
1. See Section 01 60 00: Basic Product Requirements for requirements regarding product options.
2. Substitutions will only be authorized by properly executed Change Order or Field Instruction.
3. Substitutions shall be considered when a product becomes unavailable through no fault of Contractor.
4. Owner has no obligation to entertain substitutions.

B. Substitution Provisions:
1. Documentation: Substitutions will not be considered if they are indicated or implied on Shop Drawing, product data or sample submittals. All requests for substitution shall be by separate written request from Contractor. See paragraph below for documentation required in the submission of request for substitution.
2. Cost and Time Considerations: Substitutions will not be considered unless a net reduction in Contract Sum or Contract Time results to Owner's benefit, including redesign costs, life cycle costs, plan check and permit fees, changes in related Work and overall performance of building systems.

3. Design Revision: Substitutions will not be considered if acceptance will require substantial revision of the Contract Documents or will substantially change the intent of the design, in the opinion of the A/E. The intent of the design shall include functional performance and aesthetic qualities.
4. Data: It shall be the responsibility of the Contractor to provide adequate data demonstrating the merits of the proposed substitution, including cost data and information regarding changes in related Work.
5. Determination by A/E: A/E will determine the acceptability of proposed substitutions and will notify Contractor in writing of acceptance or rejection. The determination by the A/E regarding functional performance and aesthetic quality shall be final.
6. Non-Acceptance: If a proposed substitution is not accepted, Contractor shall immediately provide the specified product.
7. Substitution Limitation: Only one request for substitution will be considered for each product.

C. Request for Substitution Procedures: Comply with provisions of Contract General Conditions and the following.
1. Contractor shall prepare a request for substitution and submit the request to A/E for review and recommendation for acceptance. Acceptance and approval of substitutions shall be by A/E.
    a. Present the request for substitution using form provided by A/E.
    b. Comply with other administrative requirements shall be as directed by Owner's Representative.
2. Substitution requests shall include complete product data, including Drawings and descriptions of products, fabrication details and installation procedures. Include samples where applicable or requested.
3. Substitution requests shall include appropriate product data for the specified product(s) of the specified manufacturer, suitable for use in comparison of characteristics of products.
    a. Include a written, point-by-point comparison of characteristics of the proposed substitute product with those of the specified product.
    b. Include a detailed description, in written or graphic form as appropriate, indicating all necessary changes or modifications needed to other elements of the Work, which will be performed by the Contractor at no additional expense to the Owner, if the proposed substitution is accepted.
4. Substitution requests shall include a statement indicating the substitution's effect on the Construction Schedule. Indicate the effect of the proposed substitution on overall Contract Time and, as applicable, on completion of portions of the Work for use by Owner.
5. Except as otherwise specified, substitution requests shall include detailed cost data, including a proposal for the net change, if any, in the Contract Sum.
6. Substitution requests shall include signed certification that the Contractor has reviewed the proposed substitution and has determined that the substitution, in combination with the cost or time savings, represents an equivalent or superior condition in every respect to product requirements and value indicated or specified in the Contract Documents, and that the substitution is suited for and can perform the purpose or application of the specified product indicated or specified in the Contract Documents.

7. Substitution requests shall include a signed waiver by the Contractor for change in the Contract Time or Contract Sum because of the following:
    a. Substitution failed to perform adequately.
    b. Substitution required changes in on other elements of the Work.
    c. Substitution caused problems in interfacing with other elements of the Work.
    d. Substitution was determined to be unacceptable by authorities having jurisdiction.
8. A request constitutes a representation that Contractor:
    a. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
    b. Will provide same warranty for Substitution as for specified product.
    c. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
9. If, in the opinion of the A/E, the substitution request is incomplete or has insufficient data to enable a full and thorough review of the intended substitution, the substitution may be summarily refused and determined to be unacceptable.

D. Contract Document Revisions:
1. Should a Contractor-proposed substitution or alternative sequence or method of construction require revision of the Contract Drawings or Specifications, including revisions for the purposes of determining feasibility, scope or cost, or revisions for the purpose of obtaining review and approval by authorities having jurisdiction, A/E will make revisions as approved in writing in advance by Owner.
2. Contractor shall pay for services of A/E for researching and reporting on proposed substitutions or alternative sequence and method of construction when such activities are considered additional services to the Design Services Contracts of A/E.
3. Contractor shall pay for costs of expenses incurred by A/E. These costs may include travel, reproduction, long distance telephone and shipping costs reimbursable at cost plus usual and customary mark-up for handling and billing.
4. Contractor shall pay such fees whether or not the proposed substitution or alternative sequence or method of construction is ultimately accepted by Owner and a Change Order executed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

SUBSTITUTION REQUEST - After Award of Contract			
Project:			**Substitution Request Number:**
Re:			**Date:**
From:			**A/E Project Number:**
To:			
Specification Title:			**Description:**
Section:	**Page:**		**Article/Paragraph:**
Proposed Substitution:			
Manufacturer:	Address:		Phone:
Trade Name:			Model No.:
Installer:	Address:		Phone:
History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old			
Differences between proposed substitution and specified:			
☐ Point-by-point comparative data attached — **REQUIRED BY A/E**			
Reason for not providing specified item:			
Similar Installation:			
Project:	Architect:		
Address:	Owner:		
	Date Installed:		
Proposed substitution affects other parts of Work: ☐ No ☐ Yes			
Explain			
Savings to Owner for accepting substitution: _____($_____)			
Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____days			
Supporting Data Attached: ☐ Drawings ☐ Product ☐ Data ☐ Samples ☐ Tests ☐ Reports			

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The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete and credit will be due to the Owner. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by:

Signed by:

Firm:

Address:

Telephone:

Attachments:

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.

☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.

☐ Substitution rejected - Use specified materials

☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: ☐Contractor ☐Subcontractor ☐Supplier ☐Manufacturer ☐ A/E

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CHANGE ORDER PROPOSAL WORKSHEET DETAIL

Project:	**From:**
Date:	**Re**:
Change Order Request Number	**Project Number:**
Worksheet No	

Complete this Worksheet for each element of Work

ADDITIONS

			Unit Prices		Subtotals		Total
Item	**Description**	**Qty**	**Materials**	**Labor**	**Materials**	**Labor**	
1							
2							
3							
4							
5							

Subtotal (Enter this number on Worksheet Summary)

DEDUCTIONS

			Unit Prices		Subtotals		Total
Item	**Description**	**Qty**	**Materials**	**Labor**	**Materials**	**Labor**	
1							
2							
3							
4							
5							

Subtotal (Enter this number on Worksheet Summary)

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CHANGE ORDER PROPOSAL WORKSHEET SUMMARY

Project:	**From:**
Date:	**Re:**
Change Order Request Number	**Project Number:**

Enter Worksheet Detail Information below

ADDITIONS

Item	Sheet	Description	Material	Labor	Equipment	Subtotal
1						
2						
3						
4						
5						
6						
7						
		Subtotal				

DEDUCTIONS

Item	Sheet	Description	Material	Labor	Equipment	Subtotal
1						
2						
3						
4						
5						
6						
7						
		Subtotal				

Subcontractor's Net:	
Subcontractor's OH&P and Bond:	
Subcontractor's Total:	**$**
Contractor's OH&P and Bond:	
Insurance:	
Contractor's Subtotal:	**$**
NM Gross Receipts Tax:	
WORKSHEET TOTAL	**$**

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END OF SECTION

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section includes:
1. Change Procedures.
2. Proposal Requests.
3. Effect of Change on Schedule.
4. Correlation of Contractor Submittals.

1.02 CHANGE PROCEDURES

A. Minor Changes in the Work:
1. AIA Form G710.
2. The A/E issues Supplemental Instructions to the Contractor for minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time.

B. Construction Change Directive:
1. AIA Form G714.
2. A/E issues Construction Change Directive which describes changes in the Work and designates methods for determining changes in Contract Sum or Contract Time.
3. Contractor proceeds with changes in the Work for subsequent inclusion in a Change Order.
4. Documentation:
   a. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.
   b. Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   c. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

C. Change Orders:
1. AIA Form G701.
2. Execution: A/E will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
3. Reservation of Rights: An executed change order represents full and final settlement of all claims arising out of a modification including all claims for delays and disruptions resulting from, caused by, or incident to such modifications.

D. Provide A/E with name of individual authorized to receive change documents, and responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

1.03 PROPOSAL REQUESTS

A. The A/E may issue a Proposal Request including a detailed description of proposed change with supplementary or revised Drawings and specifications for executing the change.

B. The Contractor may propose changes by submitting a request for change to A/E, describing proposed change and its full effect on the Work.
   1. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors as described in previous paragraph.
   2. Document requested substitutions in accordance with Section 01 25 00 – Product Requirements.

C. Proposal Format:
   1. Within 10 days, Contractor will prepare and submit a Proposal Worksheet using Work Breakdown Detail and Summary forms following this Section.
      a. For each Element of Work, calculate additions showing:
         1) Description and quantity.
         2) Material cost including delivery charges.
         3) Labor cost directly attributable to the change.
         4) Equipment rental cost.
         5) Subtotal.
      b. For each Element of Work, calculate deductions showing:
         1) Description and quantity.
         2) Material cost including delivery charges.
         3) Labor cost directly attributable to the change.
         4) Equipment rental cost.
         5) Subtotal.
      c. Subcontractor’s net change in cost.
      d. Subcontractor’s OH&P at percentage stipulated in Conditions of the Contract.
      e. Subcontractor’s Bond.
      f. Subcontractor’s Total.
      g. Contractor’s OH&P at percentage stipulated in Conditions of the Contract.
      h. Contractor’s Bond.
      i. Contractor’s Insurance.
      j. Applicable Tax.
      k. Contractor’s Total.

1.04 EFFECT OF CHANGE ON SCHEDULE

A. With proposal, 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. No change order request may include additional time required to perform the work, or additional supervision costs unless the additional work is shown to affect the critical path of the project.

1.05 CORRELATION OF CONTRACTOR SUBMITTALS

A. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.

B. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

C. Promptly enter changes in Project Record Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

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CHANGE ORDER REQUEST (PROPOSAL)

Project:	**From:**
Date:	**Re**:
Change Order Request Number	**Project Number:**

This Change Order Request (C.O.R.) contains an itemized quotation for changes in the Contract Sum or Contract Time in response to proposed modifications to the Contract Documents based on Proposal Request No. _____ .

Description of Proposed Change:

Attached supporting information from: ☐ Subcontractor ☐ Supplier _____ ☐ _____

Reason for Change:

Does Proposed Change involve a change in Contract Sum? ☐ No ☐ Yes [Increase] [Decrease_____

Does Proposed Change involve a change in Contract Time? ☐ No ☐ Yes [Increase] [Decrease] _____days

Attached pages: ☐ Proposal Worksheet Summary:
☐ Proposal Worksheet Detail(s):

Signed by: **Date**:

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ File

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Schedule of values.

B. Applications for payment.

C. Defect Assessment.

1.02 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule:
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Submittals Schedule and Application for Payment forms with Continuation Sheets.
   2. Submit the Schedule of Values to A/E at earliest possible date but no later than 7 days before the date scheduled for submittal of initial Applications for Payment.

B. Submit printed schedule on AIA Form G703 – Continuation Sheet for G702.

C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section. Identify site mobilization, bonds, and insurance.

D. Include in each line item, amount of Allowances specified in this section.

E. Include in each line item, amount of Alternates specified in this section.

F. Include separately from each line item, direct proportional amount of closeout.

G. Revise schedule to list approved Change Orders with each Application for Payment.

1.03 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by A/E and paid for by Owner.
   1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Submit five signed and notarized copies of each application on AIA Form G702 – Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702.
   1. One copy shall include waivers of lien and similar attachments if required.

C. Content and Format:
   1. Utilize Schedule of Values for listing items in Application for Payment.
   2. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor.
   3. A/E will return incomplete applications without action.

D. Submit updated construction schedule with each Application for Payment.

E. Payment Period: Submit at intervals stipulated in the Agreement.

F. Submit with transmittal letter as specified for Submittals in Section 01 33 00 – Submittal Procedures.

G. Substantiating Data: When A/E requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
   1. Current construction photographs.
   2. Record documents for review by Owner which will be returned to Contractor.
   3. Affidavits attesting to off-site stored products.
   4. Construction progress schedules, revised and current.

H. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of Values.
   3. Contractor’s Construction Schedule (preliminary if not final).
   4. Submittals Schedule (preliminary if not final).
   5. List of Contractor’s staff assignments.
   6. Certificates of Insurance and insurance policies.
   7. Performance and Payment Bonds.

J. Application for Payment at Substantial Completion:
   1. Submit an Application for Payment showing 100% completion for portion of the Work claimed as substantially complete.
   2. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   3. Reflect Certificates of Partial Substantial Completion issued in Application for Payment.

K. Final Payment Application:
   1. Submit final Application for Payment with releases and remainder of supporting documentation , including, but not limited, to the following:
      a. Proof that taxes, fees, and similar obligations were paid.
      b. Updated final statement, accounting for final changes to the Contract Sum.
      c. Final waivers from every entity involved with performance of the Work who is lawfully entitled to a lien. Evidence that claims have been settled.
      d. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims", two copies.
      e. AIA Document G706A, "Contractor's Affidavit of Release of Liens", two copies.
      f. AIA Document G707, "Consent of Surety to Final Payment", two copies
   2. Refer to Section 01 77 00 – Closeout Procedures, for final completion requirements.

1.04 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the A/E it is not practical to remove and replace the Work, the A/E will direct appropriate remedy or adjust payment.

C. At the discretion of the A/E:
   1. The defective Work may remain, but unit sum/price will be adjusted to new sum/price or,
   2. Defective Work will be partially repaired to instructions of A/E and unit sum/price will be adjusted to new sum/price.

D. Authority of A/E to assess defects and identify payment adjustments is final.

E. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Loading, hauling, and disposing of rejected products.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Coordination.

B. Preconstruction meeting.

C. Progress meetings.

D. Pre-installation meetings.

E. Requests for Interpretation (RFIs).

1.02 PROJECT COORDINATION

A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later where indicated on the Drawings.

B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

C. Coordinate space requirements, supports, and installation of mechanical and electrical Work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Consider finish elements when locating fixtures and outlets to minimize disruption to finish elements. Verify locations with Architect before installation.

E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial and full occupancy.

F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.03 PRECONSTRUCTION MEETING

A. A/E will schedule meeting after Notice of Award.

B. Attendance Required: Owner, A/E, Contractor, and major subcontractors.

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of Schedule of Values and Submittals Schedule.
5. Designation of personnel representing parties in Contract and A/E.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Scheduling.
8. Testing, Inspecting and Laboratory Services.
9. Use of premises by Owner and Contractor.
10. Owner's requirements and partial occupancy.
11. Construction facilities and controls.
12. Temporary utilities.
13. Security and housekeeping procedures.
14. Procedures for maintaining record documents.

D. Minutes shall be distributed within one week after meeting to participants.

1.04 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum bi-monthly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance Required: Job superintendent, major subcontractors and suppliers, A/E, and others as appropriate to agenda topics for each meeting.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems and Requests for information impeding planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.

10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

E. Record minutes and distribute copies within one week after meeting to participants, with copies to A/E, Owner, and those affected by decisions made.

1.05 PRE-INSTALLATION MEETINGS

A. Coordination meeting required for complex items requiring coordination and understanding among several participants.
1. Hold meetings when required in individual specification sections or the Contractor deems necessary. Meetings shall focus on specific concerns and do not relieve the Contractor of the responsibility to coordinate the Work when a pre-installation meeting is not required by a Section.
2. Hold meetings in which all trades responsible for the various assemblies of a component of the Work meet before the work begins, to discuss how each aspect is to be coordinated with other adjacent construction so that the responsibilities for installation of various components and progression of the work is clearly understood.
3. Convene pre-installation meetings at Project site prior to commencing work of specific section.

B. Require attendance of parties directly affecting, or affected by Work of specific section.

C. Notify A/E in advance of meeting date.

D. Prepare agenda and preside at meeting:
1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.

E. Record minutes and distribute copies within one week after meeting to participants, with copies to A/E, Owner, and those affected by decisions made.

1.06 REQUESTS FOR INTERPRETATIONS

A. Definition: Request from Contractor seeking interpretation or clarification of the contract Documents.

B. Procedure: Immediately on discovery of the need for interpretation of the contract Documents, and if not possible to request interpretation at the Progress meeting. Prepare and submit an RFI in the form specified.
1. RFIs shall originate with the Contractor. RFIs submitted by entities other than the Contractor will be returned to the Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

C. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
   1. Project name.
   2. Date.
   3. Name and trade of entity seeking interpretation.
   4. RFI number, numbered sequentially.
   5. Specification Section number and title and related paragraphs as appropriate.
   6. Drawing number and detail references, as appropriate.
   7. Field dimensions and conditions, as appropriate.
   8. Contractor's suggested solution(s). If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI
   9. Attachments: include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
      a. Supplementary drawings prepared by the Contractor shall include dimensions, thicknesses, and details of affected materials, assemblies and attachments.

D. RFI Form: Software generated form provided by the A/E or Contractor's approved form.
   1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. A/E's action may include a request for additional information.

F. A/E's action which may result in a change to the Contact Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Contract Modifications Procedures Section.
   1. If so, notify A/E in writing within 10 days of receipt of RFI response.

G. On receipt of A/E's action, update RFI log and immediately distribute the RFI response to affected parties. Review response and notify A/E within 7 days if Contractor disagrees with response.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Construction Progress Schedule.
   2. Submittals Schedule.
   3. Construction Progress Reporting.

1.02 CONTRACTOR'S PROGRESS SCHEDULE

A. Format: Horizontal bar chart:
   1. Approximate sheet size: 17″ x 28″.
   2. Provide separate bar for each major item of Work. Arrange in sequence and identify bars with specification section numbers and titles from Project Manual Table of Contents.
   3. Horizontal scale: Time with first work day of each month identified. Adjust scale to show entire construction period plus extensions.
   4. Vertical spacing: Allow space for notations and revisions.

B. Show complete sequence of construction by activity. Indicate:
   1. Dates for beginning and completion of each construction item.
   2. Projected percentage of completion for each item as of first work day of each month and mid-month (each 15 days).
   3. Projected percentage of completion for total Work as of first day of each month.
   4. Work of separate construction phases.
   5. Required delivery dates for Owner furnished products and required completion dates for work by others.
   6. Required dates for return of specific submittals and for selection of finishes.

C. Procedures:
   1. Submit for review by A/E three copies of preliminary Progress Schedule within 20 days of date of Agreement between Owner and Contractor but no later than submission of first payment application.
   2. Revise to address review comments and resubmit.
   3. Update Progress Schedule and submit three copies with each Application for Payment.
      a. Identify progress of each activity to date of submittal and projected completion date.
      b. Show activities modified since last submittal and other identifiable changes.
      c. Provide narrative report as needed to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken or proposed and its effect.

D. Use: The Contractor shall endeavor to manage the work in accordance with the scheduling indicated by the first approved Progress Schedule. The intent is to promote good job management, not rigidly bind the Contractor to a planned procedure. For this reason, finish activities such as painting or laying of carpet must not be scheduled concurrently with finish plastering or door installation. The Contractor shall use special care to coordinate efforts of various subcontractors, especially mechanical and electrical, to assure proper completion of their work ahead of general finish operations.

E. Coordinate Contractor's Progress Schedule with the Schedule of Values, Submittals Schedule, payment requests, and other required schedules and reports.

F. No contract work shall be done without an A/E approved progress schedule. The items in the activities for the denoted critical path will determine the controlling operations of the work.

G. During the life of the project, the Contractor shall review the progress schedule with the A/E at the regularly scheduled Progress Meetings unless otherwise specified. The Contractor shall submit a revised progress schedule within 5 working days of the review meeting if the Contractor is behind schedule or if the schedule has been modified. Revised progress schedules must be submitted to and approved by the A/E.

H. If the Contractor deviates from the currently approved progress schedule by not following the logical sequence of the critical path, payment will be withheld for the pay items for the affected activities until the Contractor submits a revised progress schedule and this schedule is approved by the A/E.

I. Reporting: Each month with the Request of Payment, submit a copy of the current Progress Schedule marked to show actual percentage of completion for each category of work, as well as the aggregate percentage of completion.

J. Behind Schedule Progress: If the actual progress curve at any time falls more than 10% behind the proposed curve, the Contractor shall promptly take the steps necessary to get the work back on schedule. It is emphasized that the purpose of this scheduling is to assure orderly management of the project and the pushing of finish activities into areas where rough activities are not completed shall not be tolerated. Neither shall last minute rush scheduling be permitted to enable the Contractor to finish on time if it involves poor construction procedures.

1.03 SUBMITTALS SCHEDULE

A. The Contractor shall prepare and keep current, for the A/E's review, a schedule of submittals which is coordinated with the Contractor's construction schedule and allows the A/E reasonable time to review submittals.

B. Submit three copies of schedule arranged in chronological order by dates required to maintain progress schedule. List the following information in a tabular format and include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates:
   1. Scheduled date for first submittal.
   2. Specification Section number and title.

3. Name of subcontractor.
4. Description of the Work covered.

1.04 CONSTRUCTION PROGRESS REPORTING

A. Submit three copies at time of discovery of Conditions affecting Construction Progress.
   1. Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report.
   2. Submit report with a request for information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Construction Submittals.

B. Related Sections requiring submittals:
1. Section 01 25 00 – Substitution Procedures.
2. Section 01 29 00 – Payment Procedures.
3. Section 01 32 00 – Construction Progress Documentation.
4. Section 01 43 00 – Quality Assurance.
5. Section 01 45 00 – Quality Control.
6. Section 01 60 00 – Product Requirements.
7. Section 01 70 00 – Execution Requirements.
8. Section 01 77 00 – Closeout Procedures.
9. Section 01 78 00 – Closeout Submittals.

1.02 SUBMITTAL TYPES NOT INCLUDED IN THIS SECTION

A. Preconstruction Submittals:
1. Certificates of insurance.
2. Payment and performance bonds.
3. Proposed subcontractor and product lists.
4. Preliminary construction progress schedule.
5. Proposed use of the site and site logistics, including signage.

B. Closeout Submittals:
1. Written notices of substantial and final completion.
2. Final application for payment.
3. Record documents: Record Drawings and Specifications, Addenda, Change Orders, Field Orders.
4. O&M data.
5. Spare parts and maintenance materials.
6. Certificates of payment.
7. Release of liens and waiver of debts and claims.
8. Consent of surety to final payment.
9. Executed warranties.
10. Keying.
11. Materials, extra stock, and tools.

1.03 CONSTRUCTION SUBMITTALS

A. Work-related Action and Informational submittals of this section are categorized as follows:
   1. Shop Drawings include specially-prepared technical data for this project, including Drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to a range of similar projects.
   2. Product data include standard printed information on materials, products and systems; not specially-prepared for this project, other than the designation of selections from among available choices printed therein.
   3. Samples include both fabricated and unfabricated physical examples of materials, products and units of work; both as complete units and as smaller portions of units of work; either from limited visual inspection or (where indicated) for more detailed testing and analysis.
      a. Samples shall be supplied for use by the A/E, and unless specifically requested on the Contractor's cover sheet, will not be returned to the Contractor.
      b. Mock-ups are a special form of samples, which are too large or otherwise inconvenient for handling in specified manner for transmittal of sample submittals.
   4. Design Data Design calculations, mix designs, analyses or other data pertaining to a part of work.
   5. Certificates and Letters of Certification:
      a. Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project Contract and clearly name the project.
      b. Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.
   6. Sample Warranties.
   7. Manufacturer's Installation Instructions include preprinted material describing installation of a product, system or material, including special notices and concerning impedances, hazards and safety precautions.

B. QA/ QC and Informational Submittals are categorized as follows and may be delivered in electronic format if desired.
   1. Test reports.
   2. Manufacturer's field reports:
      a. Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or

after installation, to confirm compliance with manufacturer's standards or instructions.

b. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

3. Construction photographs.
4. Draft Applications for Payment.
5. Schedule of values.
6. Construction progress schedules.

C. Individual submittal requirements are specified in applicable sections for each unit of work.

1.04 SUBMITTAL GENERAL REQUIREMENTS

A. Submittals Schedule: Comply with requirements of Division 1 Section "Progress Schedule" for list of submittals and time requirements for scheduled performance of related construction activities.

B. Coordination and Sequencing: Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of A/E's review with another.

C. Processing Time: Allow enough time for submittal review including time for resubmittals. Time for review shall commence on A/E's receipt of submittal.

D. Submittal Log: The Contractor shall generate and maintain a submittal log which shall include:
1. Every section requiring submittals.
2. Category of submittal required for each section.
3. Status of each category.

1.05 PREPARATION OF SUBMITTALS

A. Shop Drawings:
1. Provide newly-prepared information, on reproducible sheets, with graphic information at accurate scale (except as otherwise indicated), with name of preparer indicated (firm name).
2. Show dimensions and note which are based on field measurement.
3. Identify materials and products in the work shown.
4. Indicate compliance with standards, and special coordination requirements.
5. Do not allow Shop Drawing copies without appropriate final "Action" markings by A/E to be used in connection with the work.
6. Submit six copies to the A/E of which three will be returned to the Contractor.

B. Product Data:

1. Collect required data into one submittal for each unit of work or system; and mark each copy to show which choices and options are applicable to project.
2. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked, and special coordination requirements.
3. Maintain one set of product data (for each submittal) at project site, available for reference by A/E and others.
4. Do not submit product data, or allow its use on the project, until submittal has been returned with the A/E's final review.
5. Submit six copies to the A/E of which three will be returned to the Contractor.
6. Installer's Copy: Do not proceed with installation of materials, products or systems until final copy of applicable product data is in possession of Installer.

C. Samples:
1. Provide samples for A/E's use. Submit samples where required by a section, for selection or review and confirmation of color, pattern, texture, and "kind". Samples requested for color boards will not be returned to the Contractor.
2. Provide units identical with final condition of proposed materials or products for the work. Include "range" samples (not less than three units) where unavoidable variations must be expected, and describe or identify variations between units of each set.
3. Provide full set of optional samples where A/E's selection is required. Prepare samples to match A/E's sample where so indicated. Include information with each sample to show generic description, source or product name and manufacturer, limitations, and compliance with standards.
4. A/E will not "test" samples (except as otherwise indicated) for compliance with other requirements, which are therefore the exclusive responsibility of Contractor.

D. Mock-Ups: Mock-ups and similar samples specified in individual work sections are recognized as a special type of sample. Comply with requirements for "samples" to greatest extent possible, and process transmittal forms to provide a record of activity.

1.06 CONTRACTOR'S REVIEW

A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to A/E.

B. At time of submission, note in writing, highlight, circle or otherwise identify any deviations in submittal from Contract Documents. The Contractor must submit in writing, any request for modification to the Plans and Specifications.
1. Shop Drawings and submittals that are submitted to the A/E for review do not constitute "in writing" unless proposed modification has been described on the submittal form, brought to the attention of the A/E, and reason for modification is stated.

2. In any event, the responsibility for proposing changes to the Plans and Specifications by means of Shop Drawings or submittals, and receiving approval for such changes, resides with the Contractor. No additional costs for replacement of unapproved modifications with the original specified materials will be paid to the Contractor.

C. Do not combine items from different Specification Sections in submittal, unless called for in Specifications.

D. Approval Stamp: Stamp each submittal with a uniform, approval stamp.

E. Execute and attach to each submittal, "CONTRACTOR SUBMITTAL FORM" (sample follows this Section), to identify project, date, Contractor, subcontractor, submittal name and number.

F. General Distribution: Provide additional distribution of submittals to subcontractors, suppliers, fabricators, installers, governing authorities and others as necessary for proper performance of the work. Include such additional copies in transmittal to A/E where required to receive "Action" marking before final distribution. Record distributions on transmittal forms.

G. Begin no fabrication or work that requires submittals until return of submittals with A/E's final review.

H. Submittals which are received from sources other than through Contractor's office will be returned by A/E "without action."

1.07 A/E'S REVIEW

A. General: A/E will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. A/E will review submittals and where possible return within 2 weeks of receipt. Where submittal must be held for coordination, Contractor will be so advised by A/E.

C. Submittals requiring a color selection will be held until all Color samples and charts for the project have been received.
1. At that time, Color Boards will be prepared and submitted to the Owner for approval.
2. After final selections have been made by the Owner, those submittals will be processed by the A/E and returned to the Contractor.

D. A/E will affix stamp and initials or signature, and indicate requirements for resubmittal or review of submittal.

E. A/E will return submittals to Contractor for distribution or for resubmission.

F. Submittal Review Stamps:

1. "No Exception Taken": Reviewed for general conformity to the requirements of Drawings and Specifications. Quantities shown not verified. Contractor's full responsibility is in no way relieved by this action.
2. "Make Corrections Noted": Reviewed and noted for general conformity to requirements of Drawings and Specifications. Quantities shown not verified. Contractor's full responsibility is in no way relieved by this action.
3. "Revise & Resubmit": Reviewed and noted for general conformity to requirements of Drawings and Specifications. Provide missing information, make corrections, and resubmit as noted.
4. "Rejected/Resubmit": Reviewed and not accepted. Provide product data, Shop Drawings, certifications, warranties, etc which meet or exceed the requirements of the Drawings and Specifications and resubmit.
5. "Receipt Acknowledged": Submittal for Section is not required or submittal is being held by A/E for coordination of work with that of another Section.

G. A/E review does not constitute acceptance or responsibility for accuracy or dimensions, nor shall it relieve the Contractor from meeting any requirements of the Contract Documents, nor shall it constitute approval for any modification from the Contract Documents unless such modifications are specifically stated as such on the submittal and specifically allowed by the Engineer.

H. A/E to return submittals with only cursory review when it becomes apparent the submittals are not acceptable, and/or incomplete.

I. Payment and Time for Review of Excessive Submittals After First Resubmittal:
1. Include Contractor's statement to A/E that all costs shall be paid by the Contractor and executed by Change Order for all A/E's review time and costs at A/E's standard billing rates.
2. Submittals will be reviewed by A/E at convenience of the A/E.
3. Delays caused by the need for resubmittal shall not constitute basis for claim.

1.08 NOT ACCEPTED AND REJECTED SUBMITTALS

A. Contractor shall make corrections required by the A/E. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the Contract Drawings or Specifications; notice as required under the clause entitled, "Changes," is to be given to the A/E.

B. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Owner requiring rejection and removal of such work at the Contractor's expense.

C. If changes are necessary to submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.09 REVIEWED AND REVIEWED AND NOTED SUBMITTALS

A. The A/E's review or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory.

B. Review will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the General Conditions of the Contract is responsible for dimensions, and the satisfactory construction of all work.

C. After submittals have been reviewed by the A/E, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

#	**CONTRACTOR SUBMITTAL FORM**	
Specification No. Title/Description:	Project: **Hangar at Raton Municipal Airport**	Contractor's Submittal No.: Date: Product Description:
	CONTRACTOR:	Dates of any previous submissions:
	Subcontractor / Supplier:	Manufacturer:
	Specification No.:	Drawing Nos.:
	Are there any deviations to the Contract Documents? ☐ No ☐ Yes (Explain and Identify:) _____ *Undisclosed deviations/modifications do not relieve the Contractor from the obligation to provide the specified product and detail of installation, and may be cause for rejection of the Work. Deviations and modifications must be listed here or in a separate Request for Substitution.*	

CONTRACTOR'S CERTIFICATION: This submittal has been reviewed by the Contractor in compliance with Submittal Procedures of the CONTRACT DOCUMENTS' SPECIFICATIONS. Any deviations or substitutions to the CONTRACT DOCUMENTS have been identified above and submitted in compliance with the CONTRACT DOCUMENTS.

If this is a re-submittal, identify on a sheet(s) attached to this form all responses to comments on the previous submittal and all changes other than those specifically requested by the A/E on the previous submittal.

Signed _____ Date:

A/E'S REVIEW RESPONSE

(*Refer to Submittal Specification for explanation of categories.*)

Date Received:	No. Copies Received:
☐ **NO EXCEPTION TAKEN**	
☐ ☐ **MAKE CORRECTIONS NOTED**	
☐ ☐ **REVISE & RESUBMIT**	
☐ ☐ **REJECTED/RESUBMIT**	
☐ ☐ **RECEIPT ACKNOWLEDGED**	
By:	Date:
Date Returned:	No. Copies Returned:
A/E'S COMMENTS, IF ANY:	
A/E'S ATTACHMENTS, IF ANY:	

Note: DO NOT combine items from different specification sections into one submittal unless called for in the Section. If provisions in the "General Conditions" conflict with this form, the provisions as stated in the "General Conditions" shall prevail.

MOLZENCORBIN
ENGINEERS | ARCHITECTS | PLANNERS
2701 Miles Road SE, Albuquerque, NM 87106

END OF SECTION

SECTION 01 42 00

REFERENCE STANDARDS

PART 1 GENERAL

1.01 SUMMARY

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. Back-Up: "Back-up" as relating to any item, product, or documents within the Scope of this Contract, shall mean the total supporting and substantiating data which forms the basis of the summary as it relates to products, means, methods, costs, certificates, and similar items. Back-up shall include pertinent data required to support the summary including, but not necessarily limited to, the following:

1. Technical data, reports, and certifications.
2. Costs, both materials and labor, direct and indirect.
3. Manufacturer's recommendations.
4. Means and methods.
5. History.
6. Samples.
7. Comparative analysis.
8. Testing laboratory reports, tests, and recommendations.
9. Code authority approvals and authorizations.
10. Justification.

1.02 DEFINITIONS

A. "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."

B. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

C. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

D. "Provide": Furnish and install, complete and ready for the intended use.

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.

1.03 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: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to A/E for a decision before proceeding.

D. 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 requirements. Refer uncertainties to A/E for a decision before proceeding.

E. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1.04 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 in the following list:

AA	Aluminum Association
AAMA	American Architectural Manufacturing Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADAAG	Americans with Disabilities Accessibility Act Guidelines
ADC	Air Diffusion Council
AHA	American Hardboard Association

AHC	Architectural Hardware Consultant
AHJ	Authority Having Jurisdication
AI	Asphalt Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
AOC	Architectural Openings Consultants
APA	American Plywood Association
APWA	American Public Works Association
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWWA	American Water Works Association
AWS	American Welding Society
CBM	Certified Ballast Manufacturers
CDC	Certified Door Consultants
CFR	Code of Federal Regulations
CID	Construction Industries Division
CPSC	Consumer products Safety Commission

CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
DHI	Door and Hardware Institute
EEI	Edison Electric Institute
EHC	Electrified Hardware Consultant
ETL	Electrical Testing Laboratories
FM	Factory Mutual
FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS)
GA	Gypsum Association
GANA	Glass Association of North America
HMMA	Hollow Metal Manufacturers Association
HPVA	Hardwood Plywood and Veneer Association
IBC	International Building Code
ICEA	Insulated Cable Engineers Association
IEBC	International Existing Building Code
IECC	International Energy Conservation Code
IEEE	Institute of Electrical and Electronics Engineers
IFC	International Fire Code
ISA	Instrument Society of America
LEED	Leadership in Energy and Environmental Design
MIL	Military Specification Naval Publications and Forms Center

MPI	Master Painters Institiute
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NEC	National Electric Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NMCBC	New Mexico Commercial Building Code Code Regulations Licensing Department Construction Industries Divisions
NMDWS	New Mexico Department of Workforce Solutions
NRCA	National Roofing Contractors Association
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety & Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	Product Standard US Department of Commerce
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SIGMA	Sealed Insulating Glass Manufacturer's Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association, Inc.

SSPC	Steel Structure Painting Council
TMS	The Masonry Society
UL	Underwriters' Laboratories, Inc.
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code International Association of Plumbing/Mechanical Officials
WWPA	Western Wood Products Association

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 43 00

QUALITY ASSURANCE

PART 1 GENERAL

1.01 SUMMARY

A. Provisions for quality assurance apply to workmanship and craftsmanship applied to work executed in the performance of the Contract.
   1. Perform work with suitable qualified personnel to produce work of specified quality.
   2. Refer to applicable Standards and Codes.
   3. Refer to Workmanship requirements of trade associations.
   4. Test materials in accordance with applicable standards.
   5. Provide field samples and mock-ups to establish acceptable level of quality and a basis for judging work.
   6. Follow inspection requirements.

B. Related Work Described Elsewhere: Provisions of trade associations, manufacturer's printed instructions, recommendations, methods, and criteria for application and installation of systems and assemblies, various technical sections of these specifications, the Drawings, and References Section.
   1. Provisions of work furnished under this Contract and installed under this Contract.
   2. Provisions of work installed under this Contract furnished by others.

1.02 QUALIFICATIONS

A. Project Superintendent:
   1. The superintendence of the General Contractor for the total overall Work shall be administered by one qualified person who is thoroughly trained and experienced in the duties of a Project Superintendent.
   2. Project Superintendent shall have a minimum of 10 years of construction experience, with a minimum of 5 years being in commercial construction.
   3. Project Superintendent shall demonstrate successful completion of a minimum of five projects of similar cope and budget through a resume and letters of recommendation.
   4. The Project Superintendent shall exercise general supervision over the Work, have the decision-making authority of the Contractor, and be familiar with the specified requirements and methods to be used in the scheduling, supervision, performance, and execution of the Work.
   5. Project Superintendent's qualifications are subject to review and approval by the Owner and A/E and shall not be reassigned until final acceptance of the Work, unless permitted in writing by the Owner.

B. Subcontractors: The superintendence of trades involved in work of this project shall be administered, supervised, and directed by at least one qualified journeyman foreman who is thoroughly trained and skilled in the arts generic to his trade and such qualifications may be subject to review and approval by the A/E.

C. Workmen: Workmen engaged in the performance of work comprising a part of the total Work of this Contract shall be adequate in number, thoroughly trained and experienced in the installation of the specified and selected products and who are completely familiar with the requirements of their respective work and this Work.

D. Apprentice: Apprentice personnel shall, in the performance of their respective Work, be supervised and directed in their duties under the competent supervision and direction of experienced journeymen experienced and skilled in their trade.

E. Manufacturers: Products used in the Work of this project shall be produced by recognized manufacturers regularly engaged in the manufacturing of such and similar products with a history of successful production of products specified in the various sections of these specifications and as otherwise approved by the A/E.

1. In the use of equal or similar manufactured products proposed for inclusion into the Work, comply with the provisions of Submittal Section.

F. Fabricators, Suppliers, and Personnel: Fabricators, erectors, suppliers, installers, and applicators shall have not less than five years continuous experience in the execution of their respective duties and their qualifications may be subject for review and approval by the A/E.

G. Licensed Applicators: Applicators of specific systems, licensed by a manufacturer or company of such products, shall be qualified in every respect required by the manufacturer or company to the extent permitting the issuance of all required guarantees, warranties, and certificates of compliance to the approval of the A/E.

1.03 SUBMITTALS

A. Within ten (10) days following the execution of the Contract, submit the personal work history of the Project Superintendent proposed to be assigned to the project to its final conclusion.

B. Submittal may be in the form of a letter or standard employment “Job Application” covering the person’s last five (5) years work history and contact source, names, and telephone numbers for use in verification of qualifications and recommendations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. General: Prior to any work being performed in the execution of the Contract, personnel who supervise, or otherwise direct the scope of their respective work, shall become thoroughly familiar with surface conditions affecting their work, the interface requirements of all other trades whose work affects their work, and become completely knowledgeable with the specified materials and methods needed for the proper coordination and execution of the Work.

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.01 WORK INCLUDED

A. Quality Control and Control of Installation.

B. Tolerances.

C. Testing and Laboratory Services:
1. Provisions of cooperation with the selected testing laboratory and all others responsible for testing and inspection of the Work.
2. Requirements for testing may be described in various other sections of these specifications.
3. Where no testing requirements are described, but the Owner decides that testing is required, the Owner may direct that such testing be performed under current standards for testing. Payment for such testing will be made as described in this section.
4. Contractor shall select a testing laboratory subject to the approval of the Owner.

D. Special Inspection Services: In addition to the inspections provided by CID, the New Mexico Building Code mandates that the Owner or the Engineer or Architect acting on behalf of the owner employ one or more special inspectors who shall provide inspections during construction on elements that are critical to the safety of the structure. It is important to note that these special inspectors are not on the project in lieu of the regular CID building inspector, but rather they are on the project in addition to the regular CID building inspector.
1. Where the New Mexico Building Code mandates that the Owner employ Special Inspectors, Special Inspection Agency shall be paid by the Contractor.
2. For special inspection type and frequency refer to Structural Drawings Quality Insurance Plan for Schedule.
3. The Special Inspection Agency shall be an agency approved by the Owner as being qualified by knowledge and experience to perform the Special Inspection for the category of work being constructed.
4. More than one Special Inspector may be required to provide the varied knowledge and experience necessary to adequately inspect all of the categories of work requiring Special Inspection.
5. Requirements for inspections may be described in various sections of these specifications.

E. Manufacturers' Field Services: Requirements for manufacturers' field services may be described in various other sections of these specifications.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from A/E before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from A/E before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.04 TESTING AND INSPECTION SERVICES

A. Codes and Standards:
1. Testing, when required, will be in accordance with pertinent codes and regulations and with selected standards of the American Society for Testing and Materials.
2. Inspections will be conducted at intervals required by current building codes and regulations and include:
    a. Regulatory Inspections.
    b. Special Inspections:
        1) In addition to the inspections provided by the Code Authority having Jurisdiction, the New Mexico Building Code mandates that the Owner or the Engineer or Architect acting on behalf of the Owner employ one or more Special Inspectors who shall provide inspections during construction on elements that are critical to the safety of the structure. It is important to note that these Special Inspectors are not on the project in lieu of the regular AHJ building

inspector, but rather they are on the project in addition to the regular building inspector.

c. Seismic Inspections.

d. Structural Observations.

B. Qualifications of testing agency or laboratory: The testing agency or laboratory will be qualified to the Owner's approval in accordance with ASTM E329.

C. Agency Responsibilities:

1. Cooperate with A/E and Contractor in performance of duties.
2. Provide qualified personnel to perform required tests and inspections.
3. Notify A/E and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
4. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
5. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
6. Do not release, revoke, alter, or increase requirements of the Contract. Documents or approve or accept any portion of the Work.
7. Do not perform any duties of Contractor.

D. Agency Reports:

1. Prepare and submit certified written reports that include the following:
   a. Date of issue.
   b. Project title and number.
   c. Name, address, and telephone number of testing agency.
   d. Dates and locations of samples and tests or inspections.
   e. Names of individuals making tests and inspections.
   f. Description of the Work and test and inspection method.
   g. Identification of product and Specification Section.
   h. Complete test or inspection data.
   i. Test and inspection results and an interpretation of test results.
   j. Ambient conditions at time of sample taking and testing and inspecting.
   k. Name and signature of laboratory inspector.
   l. Recommendations on retesting and reinspecting.
2. Promptly process and distribute required copies of reports and related instructions to ensure necessary retesting and replacement of materials with the least possible delay in progress of the Work.

E. Special Inspection Reports:

1. Provide Special Inspection Reports listing all construction special inspections or reviews of testing performed during that month, noting all uncorrected deficiencies, and describing the corrections made both to these deficiencies and to previously reported deficiencies.
2. Each report shall be signed by the special inspector who performed the special inspection or reviewed the testing, regardless of whether they reported any deficiencies.
3. Each report shall be signed by the Contractor and submitted to the Engineer of Record.

F. Limits on Testing Authority:
   1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency or laboratory may not approve or accept any portion of the Work.
   3. Agency or laboratory may not assume duties of Contractor.
   4. Agency or laboratory has no authority to stop the Work.

G. Contractor Responsibilities: Cooperate with agencies performing required tests, inspections, and similar quality-control services. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   4. Preliminary design mix proposed for use for material mixes that require control by testing agency.

1.05 PAYMENT FOR TESTING

A. The Contractor will pay for initial testing and inspections services required by these specifications, the Quality Assurance Plans shown on the drawings and building code or regulatory agencies. Where the New Mexico Building Code mandates that the Owner employ Special Inspectors, Special Inspectors shall be selected by the Owner and paid by the Contractor.

B. When there is work which the Owner requires tested and inspected in addition to specified and required tests, the Contractor will pay for the tests if the work does not comply with required standard and specifications. The Owner will pay for the tests if the work does comply with the required standards and specifications.

C. Retesting and Re-inspecting: When initial reports indicate non-compliance with the Contract Documents, all subsequent retesting and re-inspecting occasioned by the non-compliance shall be performed by the same agency and costs thereof will be paid by the Contractor at no additional cost to the Owner.

1.06 CODE COMPLIANCE TESTING AND INSPECTING

A. Inspections and tests required by codes, ordinances, or by a plan approval authority, and which are made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

1.07 CONTRACTOR'S CONVENIENCE TESTING AND INSPECTING

A. Inspecting and testing performed exclusively for the Contractor’s convenience shall be the sole responsibility of the Contractor.

1.08 INSPECTION BY OWNER'S PERSONNEL

A. From time to time, personnel in the employ of the Owner may inspect the Work where the work is in progress, but shall have no authority to direct the Contractor or request changes in the Work except through the A/E.

1.09 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, warranty inspections, start-up of equipment, and test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TAKING SPECIMENS

A. Specimens for testing and samples, unless otherwise provided in the Contract documents, will be taken by the testing personnel. Sampling equipment and personnel will be provided by the testing laboratory. Deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

3.02 SCHEDULES FOR TESTING AND INSPECTING

A. By advance discussion with the selected agency, determine the time required for the agency to perform its tests and inspection and to issue each of its findings.

B. Provide required time within the construction schedule.

C. When changes of construction schedule are necessary during construction, coordinate such changes of schedule with the agency as required.

D. When the agency is ready to test or inspect according to the established schedule, but is prevented from performing its duties due to incompleteness of the Work, all extra charges attributable to the delay shall be back-charged to the Contractor and shall not be borne by the Owner.

3.03 ALTERNATIVE INSPECTION PROCEDURE

A. The A/E shall have the right to require alternative inspection procedures other than as specified when, in the A/E's judgment, other inspections are required to demonstrate compliance with the contract requirements. Costs of such alternative inspections will be borne by the Owner if products are found to comply; otherwise, costs shall be borne by the Contractor.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Types of temporary facilities and controls may include, but not be limited to:
   1. Temporary utilities,
   2. Construction facilities,
   3. Temporary construction,
   4. Construction aids,
   5. Vehicular access,
   6. Temporary barriers,
   7. Temporary controls,
   8. Project identification, and
   9. Removal of utilities, facilities, and controls.

1.02 CONDITIONS OF USE

A. The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
   1. Keep temporary services and facilities clean and neat.
   2. Minimize waste and abuse; limit availability of temporary facilities to essential and intended uses.
   3. Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
   4. Relocate temporary services and facilities as required by progress of the Work.

B. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

C. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

1.03 TEMPORARY UTILITIES

A. Types of temporary services required may include, but not be limited to water service, sewer and drainage, sanitary facilities, heating and cooling, ventilation and humidity control, electrical power, electrical distribution, lighting, surface drainage, and telephones.
   1. Standards: Comply with ANSI A10.6, NEC's "Temporary Electrical Facilities," and NFPA 241.

B. Water Service: Provide rubber hoses as necessary to serve Project site. Where non-potable water is used, mark each outlet with adequate health-hazard warning signs.

C. Sewers and Drainage:
1. If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. Connect temporary sewers to system as directed by sewer department officials.
2. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities.
3. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.
4. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
5. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
6. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.

D. Dewatering Equipment and Drains: Comply with requirements in applicable Division 32 Sections for temporary drainage and dewatering facilities, and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.

E. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Provide portable, UL rated-fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
2. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
3. Store combustible materials in containers in fire-safe locations.
4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting.
5. Prohibit smoking in occupied buildings and hazardous fire-exposure areas.
6. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

F. Heating and Cooling:
1. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.

2. Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity.
3. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.

G. Ventilation and Humidity Control:
1. Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity.
2. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.
3. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

H. Electrical Power and Distribution System:
1. General: Where possible, engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.
2. Electric Power and Distribution Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.
   a. Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125 VAC, 20A rating, and lighting circuits may be nonmetallic sheathed cable.
   b. Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
   c. Receptacles: Properly configured, NEMA-polarized outlets to prevent insertion of 110V to 120V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light and adequate for connection of power tools and equipment.
   d. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
3. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
   a. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

b. Provide one 100W incandescent lamp per 500 sq. ft., uniformly distributed, for general lighting, or equivalent illumination.
c. Provide one 100W incandescent lamp every 50′ in traffic areas.
d. Provide one 100W incandescent lamp per story in stairways and ladder runs, located to illuminate each landing and flight.
e. Install exterior-yard site lighting that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.

I. Use Charges:
1. Contractor to meter and pay for utility expenses during construction.

1.04 CONSTRUCTION FACILITIES

A. Locate field offices, storage sheds, sanitary facilities, and other facilities for easy access. Coordinate location with Owner.

B. Maintain support facilities until Substantial Completion. Remove immediately after Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

C. Sanitary Facilities: Provide temporary toilets, wash facilities. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
1. Single-occupant self-contained toilet units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material, including hand-sanitizing capability.
2. Shield toilets to ensure privacy.
3. When toilets for public use are included in the Work, provide accessible unit located on an accessible route and provide separate facilities for males and females.
4. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.

D. Drinking Water: Provide drinking-water fountains or containerized bottled drinking water, or tap supply including paper cups.

E. Field Offices: With lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading. Provide space for Project meetings, with table and chairs.

F. Storage Areas and Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section.

1.05 TEMPORARY CONSTRUCTION

A. Provide access, ramps, stairs, ladders and similar temporary access elements as required to perform the work and facilitate its inspection during installation.

B. Comply with inspection requests from Authorities having Jurisdiction.

C. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
   1. Cover finished permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.
   2. Existing Stair Usage: Use of Owner's existing stairs will be permitted, as long as stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
   3. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If, despite such protection, stairs become damaged, restore damaged areas so no evidence remains of correction work.

D. When permanent stairs are available for access during construction, finishes shall be covered and protected from damage. Damage to existing conditions will be repaired to the owner's satisfaction, prior to Project Completion.

E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
   1. Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved in writing by A/E and Owner. Provide materials suitable for use intended.
   2. Provide temporary weathertight enclosure for building exterior to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons.
      a. Provide access doors with self-closing hardware and locks.
      b. Gypsum Board: 5/8″ thick Type X for fire-rated areas.
   3. Provide temporary exitways as required by the Fire Marshall or Authority having jurisdiction.
   4. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures.
   5. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
   6. Close vertical openings of 25 sq. ft. or less with plywood or similar materials. Close horizontal openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction. Lumber and Plywood: Comply with requirements in Division 06 Section.

1.06 CONSTRUCTION AIDS

A. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

1.07 VEHICULAR ACCESS

A. Temporary Roads: Construct and maintain temporary trafficways adequate to support loads and to withstand exposure to traffic during construction period.
   1. Provide dust-control treatment that is nonpolluting and non-tracking. Reapply treatment as required to minimize dust.

1.08 TEMPORARY BARRIERS

A. Site Enclosure Fence: Before construction operations begin install enclosure fence with lockable entrance gates. Locate where indicated, or enclose entire Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.
   1. Chain-Link Fencing: Minimum 2″, 0.148″ thick, galvanized steel, chain-link fabric fencing; minimum 6′ high with galvanized steel pipe posts; minimum 2-3/8″ OD line posts and 2-7/8″ OD corner and pull posts.

B. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

C. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

D. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
   1. Dust Control:
      a. Execute Work by methods to minimize raising dust from construction operations.
      b. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
   2. Noise Control:
      a. Provide methods, means, and facilities to minimize noise produced by construction operations.
      b. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

1.09 TEMPORARY CONTROLS

A. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 01 Section "Execution Requirements" for progress cleaning requirements.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Erosion and Sediment Control: Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation. Minimize surface area of bare soil exposed at one time. Provide temporary measures including berms, dikes, and drains, and other devices to prevent water flow. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

D. Stormwater Control:
1. Stormwater pollution prevention plan: In order to discharge stormwater from a construction site, construction projects that disturb 1 acre or more of land must seek coverage under a National Pollutant Discharge Elimination System (NPDES) general construction permit. Disturbance includes, but is not limited to, soil disturbance, clearing, grading, and excavation.
   a. EPA is the Permitting Authority, Permit Number: NMR150000.
   b. Additionally, see Part 10 of the (CGP) - NPDES Construction General Permit for Stormwater Discharges from Construction Activities.
2. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.
3. Compliance with Storm Drainage Discharge Requirements:
   a. Contractor shall meet all requirements of the most current version of the NPDES General Permit for Discharge from Construction Activities (CGP).
   b. Contractor shall file a Notice of Intent (NOI) at least 14 days prior to commencing earth-disturbing activities and is required to use EPA's electronic NOI system or "eNOIsystem" to prepare andsubmit the NOI.
      1) In addition to submitting the Contractor's NOI, the Contractor shall assist the Owner in a timely fashion with the preparation and submittal of the NOI that is required to be submitted by the Owner.
   c. Contractor shall file a Notice of Termination (NOT) and is required to use EPA's electronic NOI system or "eNOIsystem" to prepare and submit the NOT.
      1) In addition to submitting the Contractor's NOT, the Contractor shall assist the Owner with the preparation and submittal of the NOT that is required to be submitted by the Owner.

E. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with pollution and environmental control requirements of authorities having jurisdiction.

F. Pest and Rodent Control: Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-control service to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

G. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

1.10 PROJECT IDENTIFICATION

A. Project Identification and Temporary Signs:
1. Project identification sign:
   a. Engage an experienced sign painter to apply graphics.
   b. Sign Size: 4′ x 8″.
   c. Sign Material: 0.75″ thick exterior grade plywood.
   d. Supports: Two, 4″ x 4″ x 8′ supports, sign bolted to supports.
   e. Color: One color background, two colors for lettering.
   f. Artwork: Graphic file will be supplied by Owner.
   g. Lettering: Minimum 2″ height.
2. Prepare temporary signs to provide directional information to construction personnel and visitors.
3. Install where directed to inform public and persons seeking entrance to Project.
4. Do not permit installation of unauthorized signs.
5. Maintain signs and supports in a neat, clean condition; repair damages to structure, framing, or sign.

1.11 BULLETIN BOARD

A. Furnish and maintain bulletin board adjacent to field office. Display the following throughout construction period:
1. Wage rates.
2. Safety requirements.
3. Official notices and announcements.

1.12 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. At earliest feasible time, when acceptable to Owner, change over from use of temporary utility to use of permanent service.

B. Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 01 Section "Closeout Procedures."

C. Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for selecting products for use in Project:
   1. Product Delivery, Storage, and Handling.
   2. Product Warranties.
   3. Product Options.
   4. Reuse of Existing Materials.

B. See individual Specification Sections for specific requirements.

1.02 DEFINITIONS

A. For the purposes of this Specification Section, the terms “material and equipment” and “products” have the same meaning and are used interchangeably.
   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. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, 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. Manufacturer’s Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

1.03 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on project, product selected shall be compatible with other products incorporated into the Project, even if other products were also options.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

1.04 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.05 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground

1.06 PROTECTION AFTER INSTALLATION

A. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove coverings when no longer needed.

1.07 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.

B. Submittal Time: Comply with requirements in Division 01.

1.08 PRODUCT OPTIONS

A. General Product Requirements:
   1. Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
   2. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

3. 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.
4. Limit selection to products with warranties not in conflict with requirements of the Contract Documents.
5. Where products are accompanied by the term "as selected," A/E will make selection.
    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, A/E will select color, pattern, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, A/E will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.
6. Where products are accompanied by the term "match sample," sample to be matched is sample provided by A/E.
7. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
8. Comply with size, make, type and quality specified, or as specifically approved in writing by the A/E.

B. Manufactured and Fabricated Products:
1. Design, fabricate and assemble in accordance with the referenced engineering and shop practices.
2. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
3. Two or more items of the same kind shall be identical, by the same manufacturer.
4. Products shall be suitable for service conditions.
5. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically requested by the Contractor and favorably reviewed by the A/E.
6. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

C. Selection Criteria:
1. Products Specified Only By Reference Standard: select any product meeting that standard.
2. Products Specified By Naming Several Products Or Manufacturers: select any one of the products or manufacturers named, which complies with the Specifications; no options or substitutions.
3. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

a. Other manufacturers' products may be accepted, provided sufficient information is submitted to allow the A/E to determine that products proposed as substitutions are equivalent to those named.
b. Contractor must submit written request for substitutions for any product or manufacturer not specifically named.
c. Proof of product equivalency is the Contractor's responsibility.
d. A/E and the named manufacturer (when manufacturer desires) shall be the judge of the acceptability of the proposed product substitution

4. Products specified by naming only one product or manufacturer shall be considered to be the "Basis of Design." The use of a Brand Name or Manufacturer within these Specifications is for the purpose of describing the standard of quality, performance and characteristics desired and is not intended to limit or restrict competition.
5. "Basis of Design" provides the performance and operational requirements of the system
   a. Term indicates specific product or system used as basis for design
   b. Manufacturers may submit their equivalent product, but only if product complies with or is superior to specified requirements, functional design and warranty. Product must also meet aesthetic characteristics of specified product wherever appearance is critical in the opinion of the Architect.
   c. Products that obviously differ in appearance and quality from "Basis of Design Product" will be rejected.

1.09 REUSE OF EXISTING MATERIAL

A. Except as specifically indicated or specified, materials and equipment removed from an existing structure shall not be used in the completed Work.

B. For material and equipment specifically indicated or specified to be reused in the Work:
   1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
   2. Arrange for transportation, storage, and handling of products which require off-site storage, restoration or renovation. Include all costs for such work in the Bid.

1.10 MANUFACTURER'S INSTRUCTIONS

A. When Contract Documents require installation of work to comply with manufacturer's instructions, such instructions must be included with:
   1. Shop Drawing and/or product data submitted if an operation and maintenance manual is not required.
   2. Operation and maintenance data if required.

B. Handle, install, connect, clean, condition, and adjust products in strict accordance with such instructions and in conformity with specified requirements.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with A/E for further instructions.
2. Do not proceed with work without clear instructions.

C. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 70 00

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for Execution of the Work, including, but not limited to, the following:
   1. Installation,
   2. Field Engineering,
   3. Cutting and patching,
   4. Protecting installed construction, and
   5. Progress cleaning.

1.02 INSTALLATION

A. Utility Requirements:
   1. The Contractor shall arrange for all spotting of lines by utility companies in advance of any excavation work.
   2. Verify utility requirements and characteristics of equipment are compatible with facility utilities. Coordinate work of various Specification Sections having interdependent requirements for installing, connecting to, and placing in service such equipment.

B. Space Requirements:
   1. Coordinate space requirements and installation of mechanical, electrical, and other work shown diagrammatically on Drawings. Follow routing shown for pipes, ducts, and wireways as closely as practicable. Utilize spaces efficiently to maximize accessibility for other installations, maintenance, and repairs.
   2. Where space is limited, coordinate installation of components to ensure maximum access for maintenance. Ensure space provided around equipment and fixtures complies with applicable codes.

C. Concealment: In finished areas, conceal pipes, ducts, and wire ways within construction except as otherwise indicated. Where practical, conceal supports, fasteners, and other attachment devices.

D. Arrangement:
   1. Unless otherwise indicated, installations shall be aligned vertically and horizontally. Place piping, conduit, wire ways, and other linear items parallel with lines of building.
   2. Coordinate mounting heights and spacing of components so that finished work is neat and orderly with organized appearance.
   3. Repetitive items such as hangers and fasteners shall be equally spaced unless indicated otherwise.

E. Blocking, anchors, and supports: Determine and coordinate requirements for blocking, anchors, and supports needed for proper installation of products. Provide necessary components whether or not indicated on Drawings or specified.

F. Finished surfaces: Coordinate locations of fixtures, boxes, and other recessed or surface mounted items with finish elements and grades to ensure proper installation and neat appearance.

G. Openings made in installed exterior surfaces shall be closed to protect construction from weather and extremes of temperature and humidity.

1.03 FIELD ENGINEERING

A. Employ Registered Land Surveyor acceptable to Owner.

B. Locate and protect survey control and reference points. Promptly notify A/E of discrepancies discovered.

C. Control datum for survey is that shown on Drawings.

D. Verify set-backs and easements; confirm Drawing dimensions and elevations.

E. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

F. Maintain complete and accurate log of control and survey work as Work progresses.

1.04 CUTTING AND PATCHING

A. Employ skilled and experienced installer to perform cutting and patching.

B. Submit written request in advance of cutting or altering elements affecting:
1. Structural integrity of element.
2. Integrity of weather-exposed or moisture-resistant elements.
3. Efficiency, maintenance, or safety of element.
4. Visual qualities of sight exposed elements.

C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
1. Fit the several parts together, to integrate with other Work.
2. Uncover Work to install or correct ill-timed Work.
3. Remove and replace defective and non-conforming Work.
4. Remove samples of installed Work for testing.
5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

D. Execute work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.

E. Identify hazardous substances or conditions exposed during the Work to A/E for decision or remedy.

F. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

G. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work. Remove debris and abandoned items from area and from concealed spaces.

H. Cut masonry and concrete materials using masonry saw or core drill.

I. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

J. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

K. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original or specified condition. Restore Work with new products in accordance with requirements of Contract Documents.
   1. Materials: As specified in product sections; match existing with new products and salvaged products for patching and extending work.
   2. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.
   3. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
   4. Prepare surface and remove surface finishes to permit installation of new work and finishes.
   5. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
   6. Where new Work abuts or aligns with existing, provide smooth and even transition.
      a. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to A/E for review.
      b. Where change of plane of 1/4″ or more occurs, submit recommendation for providing smooth transition; to A/E for review.
   7. Patch Work to match existing adjacent Work in texture and appearance.
   8. Trim existing doors to clear new floor finish. Refinish trim to specified condition.

L. Asphalt Pavement:
   1. Where existing or new pavement is damaged from construction operations, cut to install new underground utilities and where existing items are removed from paved areas:
      a. Cut pavement with saw or other means to provide neat, straight joints.

b. Where existing pavement is damaged by removals, remove additional pavement to allow clean cuts.
c. Backfill and sufficiently compact removal area prior to placement of pavement.
d. Place pavement to match existing materials and thickness.
e. Immediately after placement.

M. Special Roof Penetrations:
1. New Roofing:
a. Coordinate, locate and schedule roof penetrations prior to installation of new roof system.
b. Coordinate roof penetrations such that installation does not void roof warranty.
2. Existing Roofing:
a. Prior to penetrating, cutting, and patching existing roofing, verify with Owner if roof is under warranty. If warranted, employ roof contractor certified by manufacturer of roof system, make required inspections and notifications, and perform cutting and patching as required to ensure warranty is not violated.
b. Protect building interior during operations and return roof to weather tight condition after the work is performed.

1.05 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual Specification Sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

1.06 PROGRESS CLEANING

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

B. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

C. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

D. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

E. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

F. Remove waste materials, debris, and rubbish from site weekly and legally dispose of off-site.

G. Remove debris and rubbish from pipe chases, plenums, crawl spaces, above suspended ceilings, and other closed and remote spaces prior to enclosing space.

H. Prior to surface finishing, broom and vacuum clean interior areas to eliminate dust.

I. Washing of concrete trucks and dumping of excess cementitious material on site is not allowed. All such materials and contaminated soil shall be removed.

J. Soils and other site material contaminated by paint residues, oils, fuels, and other construction products shall be removed and replaced with equivalent soil or material.

K. Existing lawns, landscaped areas, and areas for future landscaping affected by construction operations shall be raked to remove stones, mortars, aggregates, and other construction debris in excess of 3/4″ diameter.

L. Clean mud and sediment resulting from Contractor's operations or traffic from all sidewalks, public streets and parking areas.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 75 00

STARTING AND ADJUSTING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for:
   1. Starting of systems.
   2. Testing, adjusting, and balancing.

1.02 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Owner 7 days prior to start-up of each item.

C. Prior to startup, inspect items of equipment and systems to ensure that:
   1. Installation is in accordance with manufacturer's instructions.
   2. No defective items have been installed and there are no loose connections.
   3. Power supplies are correct voltage, phasing, and frequency.
   4. Grounding and transient protection systems are properly installed.
   5. Items have been properly lubricated, belts tensioned, and control sequence and other conditions which may cause damage have been addressed.
   6. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
   7. Verify wiring and support components for equipment are complete and tested.
   8. Verify that provisions have been made for safety of personnel.

D. Execute start-up under supervision in accordance with manufacturers' instructions.
   1. When specified in individual sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment and system installation prior to startup and to supervise placing equipment and system in operation.
   2. Adjustment: Monitor systems and verify performance. Correct deficiencies. Replace defective components and equipment. Adjust equipment and systems for smooth and proper installation.
   3. Submit written report in accordance with Submittal Procedures that equipment and systems have been properly installed and are functioning correctly

1.03 TESTING, ADJUSTING AND BALANCING

A. Independent firm will perform testing, balancing and adjusting services specified in other sections.

B. Reports will be submitted by independent firm to A/E indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for Contract Closeout, including, but not limited to, the following:
   1. Closeout procedures,
   2. Final cleaning,
   3. Final completion and inspection,
   4. Maintenance service, and
   5. Correction period inspection.

1.02 CLOSEOUT PROCEDURES

A. Substantial Completion:
   1. Preliminary Procedures: Prior to requesting A/E's inspection for Certification of Substantial Completion (for either entire work or portions thereof), complete the following and list known exceptions in request:
      a. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
      b. Advise Owner of pending insurance change-over requirements.
      c. Submit specific warranties, workmanship / maintenance bonds, maintenance agreements, final certifications and similar documents.
      d. Obtain and submit releases enabling Owner's full and unrestricted use of the work and access to services and utilities, including occupancy permits, operating certificates, and similar releases.
      e. Prepare and submit Project Record Documents, operation and maintenance manuals, and similar final record information.
      f. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
      g. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
      h. Complete startup testing of systems.
      i. Submit test / adjust / balance records.
      j. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
      k. Advise Owner of changeover in heat and other utilities.
      l. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
      m. Complete final cleaning requirements, including touchup painting.

n. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

2. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, A/E will either proceed with inspection or notify Contractor of unfulfilled requirements. A/E will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor' list or additional items identified by A/E, that must be completed or corrected before certificate will be issued.
   a. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   b. Results of completed inspection will form the basis of requirements for Final Completion.

B. List of Incomplete Items (Punch List):
1. Preparation: Submit three copies 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:
   a. Organize list of spaces in sequential order, starting with exterior areas first then proceeding from lowest to highest room number.
   b. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

1.03 FINAL CLEANING

A. Employ experienced workers or professional cleaners for final cleaning.
1. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program.
2. Comply with manufacturer's written instructions.

B. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

C. Replace filters of operating equipment.

D. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
1. 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.
2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

4. Remove tools, construction equipment, machinery, and surplus material from Project site.
5. 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.
6. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
7. Sweep concrete floors broom-clean in unoccupied spaces.
8. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
9. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
10. Remove labels that are not permanent.
11. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
    b. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    c. Replace parts subject to unusual operating conditions.
    d. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    e. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    f. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
    g. Leave Project clean and ready for occupancy.

E. Comply with Safety Standards for Cleaning:
1. Do not burn waste materials.
2. Do not bury debris or excess materials on Owner's property.
3. Do not discharge volatile, harmful, or dangerous materials into drainage systems.
4. Remove waste materials from Project site and dispose of lawfully.

F. Removal of Protection: Except as otherwise indicated or requested by A/E / Engineer, remove temporary protection devices and facilities which were installed during course of the work.

G. Compliances: Comply with safety standards and governing regulations for cleaning operations. Do not burn waste materials at site, or bury debris or excess materials on Owner's property, or discharge volatile or other harmful or dangerous materials into drainage systems. Remove waste materials from site and dispose of in a lawful manner.

H. Where extra materials of value remaining after completion of associated work have become Owner's property, dispose of these to Owner's best advantage as directed.

1.04 FINAL COMPLETION

A. Preliminary Procedures:
1. Submit a final Application for Payment according to Section 01 29 00 – Payment Procedures. Submit with final releases, waivers and consents.
2. Submit certified copy of A/E's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by A/E. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
4. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
5. Notify Owner and request change over in insurance, utilities, and security; send copy of notice to A/E.
6. Submit insurance certificates for products and completed operations as required by Specification Sections.
7. Submit complete close-out package per Section 01 78 00 – Closeout Submittals.
8. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems per Section 01 79 00 – Demonstration and Training.

1.05 FINAL INSPECTION

A. Submit a written request for final inspection for acceptance. On receipt of request, A/E will either proceed with inspection or notify Contractor of unfulfilled requirements. A/E 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.

B. Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.06 MAINTENANCE SERVICE

A. Furnish service and maintenance of components indicated in specification sections for specified period from date of Substantial Completion.

B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.

D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

1.07 CORRECTION PERIOD INSPECTION

A. Thirty (30) days prior to end of one year correction period, schedule and attend a one year correction period inspection. Appropriate subcontractors shall attend.

B. Coordinate time of inspection with A/E.

C. Representatives of Owner, A/E, and appropriate consultants will attend.

D. Correct deficiencies shall be noted and addressed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following Closeout Submittals:
   1. Project Record Documents,
   2. Operation and Maintenance Manuals,
   3. Tools, spare parts, maintenance and extra stock products,
   4. Warranties, and
   5. Certificates of Inspection and Compliance.

1.02 PROJECT RECORD DOCUMENTS

A. General:
   1. Do not use Project Record Documents for construction purposes. Store Record Documents and Samples in the field office apart from the Contract Documents used for construction.
   2. Protect Project Record Documents from deterioration and loss.
   3. Provide access to Project Record Documents for A/E reference during normal working hours.
   4. Maintain one copy of each document type during construction period for Project Record Document purposes.
   5. Post changes and modifications to Project Record Documents on a weekly basis.

B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
   1. 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 prepare the marked-up Record Prints.
      a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
      b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
      c. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
         1) Clearly describe the change by note and by graphic line, as required.
         2) Date all entries.

3) Call attention to the entry by a "cloud" around the area or areas affected.
4) In the event of overlapping changes, different colors may be used for each of the changes.

d. Where changes are caused by Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification, clearly indicate the change by note in ink, colored pencil, or rubber stamp.
e. Where changes are caused by Contractor-originated proposals approved by the A/E, including inadvertent errors by the Contractor which have been accepted by the A/E, clearly indicate the change by note in erasable colored pencil.
f. Because design of future modifications to the facility may require accurate information as to the final physical arrangement of items which were originally drawn schematically on the Drawings convert schematic layouts to show its final physical arrangement.
g. Show on the job set of Record Drawings, by dimension accurate to within 1″, the centerline of each run of items described in the preceding paragraph. Clearly identify the item by accurate note such as "3" cast iron water main", etc. Show, by symbol or note, the vertical control elevation of the item. Make all identification sufficiently descriptive that it may be related reliably to the specifications.
h. The A/E may waive the requirements for conversion of schematic data where, in the A/E's judgment, such conversion serves no beneficial purpose. A/E will issue a written waiver when this applies.
i. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
j. Submit documents to A/E prior to or in conjunction with submission of Contractor's request for Substantial Completion and in accordance with Owner's procedures.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and Contract modifications. Mark copy 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. Note related Change Orders and Record Drawings, where applicable.

D. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work Bind or file miscellaneous records and identify each, ready for continued use and reference. Include the following:
   1. Addenda.
   2. Change Orders and other modifications to the Contract.
   3. Reviewed Shop Drawings, Product Data, and Samples.
   4. Manufacturer's instruction for assembly, installation, and adjusting.
   5. Test and Inspection Reports.
   6. Design Mix Records.
   7. Inspections by Authority having Jurisdiction.

1.03 OPERATION AND MAINTENANCE MANUALS

A. General:
   1. Submit two copies of each manual in final form at least 10 days before final inspection. A/E will return copy with comments.
   2. Correct or modify each manual to comply with comments. Submit two copies of each corrected manual within 10 days of receipt of A/E's comments.

B. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2″ x 11″ paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   1. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.

C. Organization: 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 a title page, table of contents, and manual contents.
   1. Title Page:
      a. Enclose title page in transparent plastic sleeve. Include the following information:
   2. Subject matter included in manual.
   3. Name and address of Project.
   4. Name and address of Owner.
   5. Date of submittal.
   6. Name, address, and telephone number of Contractor.

7. Name and address of A/E.
8. Table of Contents: List each product included in manual, identified by product name, indexed to content of volume, and cross-referenced to Specification Section number in Project Manual.
9. 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.
10. Include information needed for daily operations and management of systems and equipment. In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
11. Include the following:
    a. Product name and model number.
    b. Manufacturer's name.
    c. Equipment identification with serial number of each component.
    d. Equipment function.
    e. Operating characteristics.
    f. Limiting conditions.
    g. Performance curves.
    h. Engineering data and tests.
    i. Complete nomenclature and number of replacement parts.
12. Operating Procedures: Include startup, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
13. Systems and Equipment Controls: Describe sequence of operation, and diagram controls as installed.
14. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

D. Drawings: Attach reinforced, punched binder tabs on Drawings and bind with text.
1. If oversize Drawings are necessary, fold Drawings to same size as text pages and use as foldouts.
2. If Drawings are too large to be used as foldouts, fold and place Drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating Drawing titles, descriptions of contents, and Drawing locations.

E. Include the following in combined or separate manuals:
1. Manual for materials and finishes:
2. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations.

3. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
4. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
5. Manual for equipment and systems.
6. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
7. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications.
8. Include color coded wiring diagrams as installed.
9. Include original manufacturer's parts list, illustrations, assembly Drawings, and diagrams required for maintenance.
10. Include control diagrams by controls manufacturer as installed.
11. Include Contractor's coordination Drawings, with color coded piping diagrams as installed.
12. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
13. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

1.04 TOOLS, SPARE PARTS, MAINTENANCE AND EXTRA STOCK PRODUCTS

A. Furnish tools, spare parts, maintenance, extra products and computer programming materials in quantities specified in individual specification sections and deliver to Owner.
   1. Provide list of tools, spare parts, maintenance materials, extra stock and computer programming, materials for review by A/E.

B. Deliver to Project site and place in location as directed by Owner, extra stock as specified in sections.
   1. Owner's Representative will log in materials as delivered.
   2. Obtain receipt for delivered materials.

1.05 WARRANTIES

A. Submittal Time: Submit written warranties on request of A/E or designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2″ x 11″ paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.06 CERTIFICATES OF INSPECTION AND COMPLIANCE

A. For inspections throughout the construction period required by regulatory agencies, obtain and maintain certificates issued to show compliance.

B. Assemble certificates and any formal written evidence of regulatory compliance in three ring binder with table of contents and submit to A/E prior to or in conjunction with submission of Notice of Substantial Completion.
   1. Include Contractor's Certification that all work has been performed in compliance with the New Mexico Building Code, current edition and all of its referenced codes including, but limited to IBC, UPC, UMC, NEC.

C. Certificate of Occupancy: Prior to Substantial Completion, obtain Certificate of Occupancy from authorities having jurisdiction. Submit with Notice for Substantial Completion.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for Demonstration of Equipment and Systems and Training of Owner's Personnel.

1.02 DEMONSTRATION AND TRAINING SCHEDULING

A. Schedule demonstration and training sessions after equipment and systems have been completely installed, startup completed, and adjustments made prior to date of Substantial Completion.
   1. Submit list of names, resumes, and qualifications of personnel conducting training sessions. Provide instructors experienced in operation and maintenance procedures.
   2. Submit preliminary schedule listing times, dates, and outline showing organization and proposed contents of training sessions for approval by A/E and Owner.
   3. Provide instruction at mutually agreed-on times.
   4. Required instruction time for each item of equipment and system is specified in individual sections.

B. Owner shall be responsible for designating and notifying personnel to attend and ensuring attendance at scheduled sessions.

1.03 TRAINING MATERIALS

A. Training manuals: Loose leaf notebook format with agenda and objectives of each lesson.
   1. Manuals shall describe function, operation, and maintenance of various items of equipment and be suitable for personnel with high school education.
   2. Manuals shall be suitable for future training of Owner personnel by Owner staff.
   3. Manuals shall useful reference for staff maintaining facility.
   4. Provide three copies.

B. Visual aids: Provide charts, handouts, overhead projector slides, electronic presentations, and other visual aids required to make effective presentation and facilitate training.
   1. Equipment needed for showing visual training aids shall be provided by Contractor.

2. Visual aids shall be suitable for use by Owner's staff to train additional personnel in the future.

C. Submit report within 1 week after completion of training that sessions have been satisfactorily completed. Give times, dates, list of persons trained, and summary of instructions.

D. For equipment or systems requiring seasonal operation, perform demonstration for all seasons.

E. Utilize Operation and Maintenance (O&M) Manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.

G. Prepare and insert additional data in O&M Manuals when need for additional data becomes apparent during instruction.

1.04 DEMONSTRATION AND TRAINING SESSIONS

A. Provide demonstration and training session to emphasize operation, use, and maintenance of installed items and systems:
1. Mechanical systems specified in respective divisions.
2. Electrical systems specified in respective division.
3. Fire protection systems specified in respective divisions.
4. Other items and systems as designated by A/E or requested by Owner.

B. Conduct at project site using actual installed equipment and systems.

C. Have copies of O&M Manuals available. Use as training aids.

D. Owner shall have right to record or video tape demonstration and training sessions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes for the building.

B. Cast-in-place concrete includes the following:
1. Foundations and footings.
2. Slabs-on-grade.
3. Equipment pads and bases.

1.03 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 01 Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others if requested by Architect.

C. Shop Drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 “Manual of Standard Practice for Detailing Reinforced Concrete Structures” showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.

D. Shop Drawings for formwork indicating fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joints or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.
1. Architect's review is for general architectural applications and features only. Designing formwork for structural stability and efficiency is Contractor's responsibility.

E. Samples of materials as requested by Architect, including names, sources, and descriptions, as follows:
   1. Reglets.
   2. Vapor retarder/barrier.

F. Laboratory test reports for concrete materials and mix design test.

G. Material certificates in lieu of material laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

H. Minutes of preinstallation conference.

1.04 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:
   1. American Concrete Institute (ACI) 301, “Specifications for Structural Concrete for Buildings”.
   2. ACI 318, “Building Code Requirements for Reinforced Concrete”.
   3. Concrete Reinforcing Steel Institute (CRSI) “Manual of Standard Practice”.

B. Concrete Testing Service: Engage a testing agency acceptable to Architect to perform material evaluation tests and to design concrete mixes.

C. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section “Coordination” and the following:
   1. At least 35 days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference, including, but not limited to, the following:
      a. Contractor's superintendent.
      b. Agency responsible for concrete design mixes.
      c. Agency responsible for field quality control.
      d. Ready-mix concrete producer.
      e. Concrete subcontractor.
      f. Primary admixture manufacturers.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.
   1. Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

2.02 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615 Grade, deformed.

B. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.
   1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
   2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.03 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.
   1. Use one brand of cement throughout Project unless otherwise acceptable to Architect.

B. Fly Ash: ASTM C 618, Type F.

C. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.
   1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
   2. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.

D. Water: Potable.

E. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
      a. Air-Tite, Cormix Construction Chemicals.
      b. Air-Mix or Perma-Air, Euclid Chemical Co.
      c. Darex AEA or Daravair, W.R. Grace & Co.
      d. MB-VR or Micro-Air, Master Builders, Inc.
      e. Sealtight AEA, W.R. Meadows, Inc.
      f. Sika AER, Sika Corp.

G. Water-Reducing Admixture: ASTM C 494, Type A.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
      a. Chemtard, ChemMasters Corp.
      b. PSI N, Cormix Construction Chemicals.
      c. Eucon WR-75, Euclid Chemical Co.
      d. WRDA, W.R. Grace & Co.
      e. Pozzolith Normal or Polyheed, Master Builders, Inc.
      f. Metco W.R., Metalcrete Industries.
      g. Prokrete-N, Prokrete Industries.
      h. Plastocrete 161, Sika Corp.

H. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
      a. Super P, Anti-Hydro Co., Inc.
      b. Cormix 200, Cormix Construction Chemicals.
      c. Eucon 37, Euclid Chemical Co.
      d. WRDA 19 or Daracem, W.R. Grace & Co.
      e. Rheobuild or Polyheed, Master Builders, Inc.
      f. Superslump, Metalcrete Industries.
      g. PSPL, Prokrete Industries.
      h. Sikament 300, Sika Corp.

I. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
      a. Q-Set, Conspec Marketing & Manufacturing Co.
      b. Lubricon NCA, Cormix Construction Chemicals.
      c. Accelguard 80, Euclid Chemical Co.
      d. Daraset, W.R. Grace & Co.
      e. Pozzutec 20, Master Builders, Inc.
      f. Accel-Set, Metalcrete Industries.

J. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
      a. PSI-R Plus, Cormix Construction Chemicals.
      b. Eucon Retarder 75, Euclid Chemical Co.
      c. Daratard-17, W.R. Grace & Co.
      d. Pozzolith R, Master Builders, Inc.
      e. Protard, Prokrete Industries.
      f. Plastiment, Sika Corporation.

2.04 RELATED MATERIALS

A. Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217- inch- thick galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized sheet steel, not less than 0.0336 inch thick with bent tab anchors. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.

C. Sand Cushion: Clean, manufactured or natural sand.

D. Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:
   1. Polyethylene sheet not less than 6 mils thick.

E. Vapor Barrier: Premolded seven-ply membrane consisting of reinforced core and carrier sheet with fortified bitumen layers, protective weathercoating, and plastic antistick sheet. Water vapor transmission rate of 1 perm when tested according to ASTM E 96, Method B. Provide manufacturer's recommended mastics and gusset tape.
   1. Product: Subject to compliance with requirements, provide Sealtight Premoulded Membrane by W.R. Meadows, Inc.

F. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd., complying with AASHTO M 182, Class 2.

G. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
   1. Waterproof paper.

2. Polyethylene film.
3. Polyethylene-coated burlap.

H. Liquid Membrane-Forming Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg/sq. m when applied at 200 sq. ft./gal.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
   a. A-H 3 Way Sealer, Anti-Hydro Co., Inc.
   b. Spartan-Cote, The Burke Co.
   c. Conspec #1, Conspec Marketing & Mfg. Co.
   d. Sealco 309, Cormix Construction Chemicals.
   e. Day-Chem Cure and Seal, Dayton Superior Corp.
   f. Eucocure, Euclid Chemical Co.
   g. Horn Clear Seal, A.C. Horn, Inc.
   h. L&M Cure R, L&M Construction Chemicals, Inc.
   i. Masterkure, Master Builders, Inc.
   j. CS-309, W.R. Meadows, Inc.
   k. Seal N Kure, Metalcrete Industries.
   l. Kure-N-Seal, Sonneborn-Chemrex.
   m. Stontop CS2, Stonhard, Inc.

I. Water-Based Acrylic Membrane Curing Compound: ASTM C 309, Type I, Class B.
1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.
2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
   a. Highseal, Conspec Marketing and Mfg. Co.
   b. Sealco - VOC, Cormix Construction Chemicals.
   c. Safe Cure and Seal, Dayton Superior Corp.
   d. Aqua-Cure, Euclid Chemical Co.
   e. Dress & Seal WB, L&M Construction Chemicals, Inc.
   f. Masterkure 100W, Master Builders, Inc.
   g. Vocomp-20, W.R. Meadows, Inc.
   h. Metcure, Metalcrete Industries.
   i. Stontop CS1, Stonhard, Inc.

J. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
   a. Aquafilm, Conspec Marketing and Mfg. Co.
   b. Eucobar, Euclid Chemical Co.
   c. E-Con, L&M Construction Chemicals, Inc.
   d. Confilm, Master Builders, Inc.
   e. Waterhold, Metalcrete Industries.

K. Bonding Agent: Polyvinyl acetate or acrylic base.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
      a. Polyvinyl Acetate (Interior Only):
         1) Superior Concrete Bonder, Dayton Superior Corp.
         2) Euco Weld, Euclid Chemical Co.
         3) Weld-Crete, Larsen Products Corp.
         4) Everweld, L&M Construction Chemicals, Inc.
         5) Herculox, Metalcrete Industries.
         6) Ready Bond, Symons Corp.
      b. Acrylic or Styrene Butadiene:
         1) Acrylic Bondcrete, The Burke Co.
         2) Strongbond, Conspec Marketing and Mfg. Co.
         3) Day-Chem Ad Bond, Dayton Superior Corp.
         4) SBR Latex, Euclid Chemical Co.
         5) Daraweld C, W.R. Grace & Co.
         6) Hornweld, A.C. Horn, Inc.
         7) Everbond, L&M Construction Chemicals, Inc.
         8) Acryl-Set, Master Builders Inc.
         9) Intralok, W.R. Meadows, Inc.
         10) Acrylpave, Metalcrete Industries.
         11) \Sonocrete, Sonneborn-Chemrex.
         12) Stonlock LB2, Stonhard, Inc.
         13) Strong Bond, Symons Corp.

L. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
      a. Burke Epoxy M.V., The Burke Co.
      b. Spec-Bond 100, Conspec Marketing and Mfg. Co.
      c. Resi-Bond (J-58), Dayton Superior.
      d. Euco Epoxy System #452 or #620, Euclid Chemical Co.
      e. Epoxtite Binder 2390, A.C. Horn, Inc.
      f. Epabond, L&M Construction Chemicals, Inc.
      g. Concresive Standard Liquid, Master Builders, Inc.
      h. Rezi-Weld 1000, W.R. Meadows, Inc.
      i. Metco Hi-Mod Epoxy, Metalcrete Industries.
      j. Sikadur 32 Hi-Mod, Sika Corp.
      k. Stonset LV5, Stonhard, Inc.
      l. R-600 Series, Symons Corp.

2.05 PROPORTIONING AND DESIGNING MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch

method, use an independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

1. Do not use the same testing agency for field quality control testing.
2. Limit use of fly ash to not exceed 25 percent of cement content by weight.

B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Architect.

C. Design mixes to provide normal weight concrete with the following properties as indicated on Drawings and Schedules:

1. 3000 psi, 28-day compressive strength; water-cement ratio, 0.58 maximum (non-air-entrained), 0.46 maximum (air-entrained).

D. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:

1. Subjected to freezing and thawing: W/C 0.45.
2. Subjected to deicers/watertight: W/C 0.40.
3. Subjected to brackish water, salt spray, or deicers: W/C 0.40.

E. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
2. Reinforced foundation systems: Not less than 1 inch and not more than 3 inches.
3. Concrete containing high-range water-reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to site-verified 2 - 3 inch slump concrete.
4. Other concrete: Not more than 4 inches.

F. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in Work.

2.06 ADMIXTURES

A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F.

C. Use high-range water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water-cement ratios below 0.50.

D. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:
   1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:
      a. 4.5 percent (moderate exposure); 5.5 percent (severe exposure) for 1-1/2 inch maximum aggregate.
      b. 4.5 percent (moderate exposure); 6.0 percent (severe exposure) for 1 inch maximum aggregate.
      c. 5.0 percent (moderate exposure); 6.0 percent (severe exposure) for 3/4 inch maximum aggregate.
      d. 5.5 percent (moderate exposure); 7.0 percent (severe exposure) for 1/2 inch maximum aggregate.
   2. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent air.

E. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

2.07 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.
   1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 GENERAL

A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.02 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:
   1. Provide Class A tolerances for concrete surfaces exposed to view.
   2. Provide Class C tolerances for other concrete surfaces.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features

required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.

D. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.03 VAPOR RETARDER/BARRIER INSTALLATION

A. General: Place vapor retarder/barrier sheeting in position with longest dimension parallel with direction of pour.

B. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressure-sensitive tape.
   1. Cover vapor retarder/barrier with sand cushion and compact to depth indicated.

3.04 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for “Placing Reinforcing Bars”, for details and methods of reinforcement placement and supports and as specified.
   1. Avoiding cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Architect.

D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.05 JOINTS

A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Architect.

B. Provide keyways at least 1-1/2 inches deep in construction joints in walls and slabs and between walls and footings. Bulkheads designed and accepted for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise. Do not continue reinforcement through sides of strip placements.

D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

E. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Joint fillers and sealants are specified in Division 7 Section “Joint Sealants”.

F. Contraction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown. Use saw cuts 1/8 inch wide by one-fourth of slab depth or inserts 1/4 inch wide by one-fourth of slab depth, unless otherwise indicated.
1. Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
2. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
3. If joint pattern is not shown, provide joints not exceeding 15 ft. in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

4. Joint fillers and sealants are specified in Division 7 Section “Elastomeric Sealants”.

3.06 INSTALLING EMBEDDED ITEMS

A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting Drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

B. 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.

C. Install dovetail anchor slots in concrete structures as indicated on Drawings.

D. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.07 PREPARING FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.

B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

C. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.08 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, “Guide for Measuring, Mixing, Transporting, and Placing Concrete”, and as specified.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where

placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.

1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
3. Maintain reinforcing in proper position on chairs during concrete placement.

F. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

G. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F. 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. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.

3.09 FINISHING FORMED SURFACES

A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or 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 another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

C. Grout-Cleaned Finish: Provide grout-cleaned finish on scheduled concrete surfaces that have received smooth-formed finish treatment.
1. 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. 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.
2. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

D. Related Unformed Surfaces: 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. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.
1. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic

waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. 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. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.

1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.

D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.

E. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.12 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.

D. Provide moisture curing by the following methods:
   1. Keep concrete surface continuously wet by covering with water.
   2. Use continuous water-fog spray.
   3. 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 inch lap over adjacent absorptive covers.

E. Provide moisture-retaining cover curing as follows:
   1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

F. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:
   1. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
   2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

G. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

H. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.
   1. Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

3.13 REMOVING FORMS

A. General: Formwork not supporting 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 deg F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.14 REUSING FORMS

A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

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 joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Architect.

3.15 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Architect.

B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

1. Cut out honeycombs, rock pockets, voids over 1/4 inch 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 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect.
4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

E. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

F. Repair methods not specified above may be used, subject to acceptance of Architect.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. Laboratory tests for concrete materials and mix design will be performed in accordance with Section 01 45 23 Testing Laboratory Services.

B. Sampling and testing for quality control during concrete placement may include the following, as directed by Architect.

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
    a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
    b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
    c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below, when 80 deg F and above, and one test for each set of compressive-strength specimens.
    d. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
    e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 25 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
3. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive strength testing if adequate evidence of satisfactory strength is provided.
4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

C. Test results will be reported in writing to Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

E. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF SECTION

SECTION 07 11 13

DAMPPROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes cold-applied water-based emulsified-asphalt dampproofing and vapor-retarding coatings for:
   1. Walls or portions thereof that retain earth and enclose interior spaces and floors below grade.
   2. Dampproofing the exterior face of interior walls in cavity wall construction.

B. Related Sections:
   1. Division 03: Cast-in-Place Concrete
   2. Division 04: Masonry Assemblies Unit Masonry
   3. Division 07: Perimeter Insulation

1.02 SYSTEM DESCRIPTION

A. Performance Requirements: Provide material complying with the following requirements:
   1. Complies with ASTM D 1227, Type 2, Class I, and ASTM D 1187, Type 1 developed by CGSB.

1.03 SUBMITTALS

A. Comply with Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's technical bulletins and MSDS on each product.

C. Quality Control Submittals:
   1. Provide protection plan of surrounding areas and surfaces not to receive damproofing.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer Qualifications: Company with minimum 15 years of experience in manufacturing of specified products and systems.
   2. Applicator Qualifications: Company with minimum of 5 years experience in application of specified products and systems on projects of similar size and scope, and is acceptable to product manufacturer.
   3. Successful completion of a minimum of five projects of similar size and complexity to specified Work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Store in unopened containers in a cool, clean, dry area.

D. Do not allow materials to freeze in the container; do not store below 35°F (2°C).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products from the following manufacturer:
   1. Dampproofing:
      a. BASF Building Systems.
   2. Extruded Polystyrene Protection Board:
      a. Dow Chemical Company.
      b. Pactive GreengardA PB4.

2.02 MATERIALS

A. Cold-applied water-based emulsified-asphalt dampproofing and vapor-retarding coatings for walls or portions thereof that retain earth and enclose interior spaces and floors below grade.

B. Basis of Design: MasterSeal 615 by BASF Building Systems reinforced with short fibers for application by brush or spray
   1. Suitable for "green" or slightly damp surfaces.
   2. Non-flammable.
   3. Water clean-up.
   4. Service temperature range of -40°F to 150° F.

C. Extruded Polystyrene Protection Board: Fan-folded.
   1. Thickness - 1/4″.
   2. ASTM D1621 – Minimum compressive strength 8 psi.
   3. ASTM C272 – Maximum 0.6 % water absorption % by volume.
   4. ASTM E96 – Maximum water vapor transmission rate 0.8 g/m/24hrs.
   5. ASTM E84 – Fire Characteristics – 25 Flame Spread/250 Smoke Developed.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. Surface should be free of oil, grease, dirt, laitance and loose material.

B. Dry surfaces must be dampened with water and kept damp until application.

3.02 APPLICATION

A. Apply to exterior surfaces below grade porous surfaces as a damp proofing membrane

B. Apply to interior surfaces above grade surfaces as a vapor retarder

C. Product is not intended for use as a waterproofing membrane.

3.03 INSTALLATION

A. Apply in two coats by brush, roller or spray.
   1. Allow first coat to dry tacky to touch before applying second coat.
   2. Fill in all crevices and grooves, making sure the coating is continuous and free from breaks and pinholes.
   3. Carry coating over exposed top and outside edge of footing.
   4. Spread around all joints, grooves, and slots and into all chases, corners, reveals and soffits.
   5. Bring the coating to finished grade.

B. Backfilling:
   1. Place backfill at least 24 to 48 hours after application, but within 7 days.
   2. Do not rupture or damage the film or displace the coating or membranes.
   3. Some situations may require protection board.

C. Do not expose to long-term UV.

3.04 CLEANING

A. Clean tools and equipment immediately with hot, soapy water. Cured material can be removed with solvent.

B. Clean up and properly dispose of debris remaining on Project site related to application.

C. Remove temporary coverings and protection from adjacent Work areas.

3.05 PROTECTION

A. Protect application from damage during construction.

END OF SECTION

SECTION 07 20 00

INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section specifies thermal and acoustical insulation for buildings:
   1. Acoustical insulation is identified by thickness and words "Acoustical Insulation or Sound Attenuation Batts".

B. Related Sections:
   1. Division 03: Concrete
   2. Division 07: Thermal and Moisture Protection
      a. Section 07 11 13 – Dampproofing

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. American Society for Testing and Materials (ASTM):
   1. ASTM C553 – Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
   2. ASTM C578 – Rigid, Cellular Polystyrene Thermal Insulation.
   3. ASTM C591 – Unfaced Preformed Rigid Cellular Polyisocynurate Thermal Insulation.
   4. ASTM C612 – Mineral Fiber Block and Board Thermal Insulation.
   5. ASTM C665 – Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
   6. ASTM C1029 – Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.
   7. ASTM E84 – Surface Burning Characteristics of Building Materials.
   8. ASTM E970 – Standard Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source.

1.03 SUBMITTALS

A. Product Data for each type of insulation used.

B. Manufacturer's Installation Instructions.

C. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.04 QUALITY ASSURANCE

A. Insulation Installed in Concealed Locations Surface Burning Characteristics:
   1. Maximum 25 / 450 flame spread / smoke developed index when tested in accordance with ASTM E84.
   2. Where such materials are installed in Construction Type III, Type IV, and Type V, the flame spread and smoke developed limitations do not apply to facings that are installed behind and in substantial contact with the unexposed surface of the ceiling wall or floor finish.

B. Insulation Installed in Exposed Locations Surface Burning Characteristics:
   1. Maximum 25 / 450 flame spread / smoke developed index when tested in accordance with ASTM E84.
   2. Attic Floor Insulation (Directly Above Ceiling): Minimum 0.12 watt per sq cm critical radiant flux when tested in accordance with ASTM E970.

1.05 STORAGE AND HANDLING

A. Store insulation materials in weathertight enclosure.

B. Protect insulation from damage from handling, weather and construction operations before, during, and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Concrete Block Insulating Systems.

B. CfiFOAM, Inc.

C. Dow Chemical Co.

D. Firestone Building Products.

E. GAF Materials Corporation.

F. Owens Corning.

G. Approved Equal.

2.02 MATERIALS

A. Insulation - General:
   1. Where thermal resistance (“R” value) is specified or shown for insulation, the thickness shown on the Drawings is nominal. Use only insulation with actual thickness that is not less than that required to provide the thermal resistance specified.
   2. Where “R” value is not specified for insulation, use the thickness shown on the Drawings.

B. Rigid insulation for wall furring, perimeter/foundation, and sheathing applications:
   1. Type IV: Extruded cellular polystyrene; thermal resistance "R" per inch of 5.0; minimum compressive strength of 25 psi; water absorption by volume in accordance with ASTM C272, 0.10%; square edges; thickness indicated on Drawings.
   2. Adhesive: Type recommended by insulation manufacturer for application.

C. Accessories:
   1. Expanding Insulating Foam Sealant for filling gaps around sealing around windows and doors.
   2. Separate Vapor and Air Barrier: Translucent polyethylene film, Type 1, Class 1; 6 mil thick.
   3. Nails or Staples: Steel wire, electroplated or galvanized; type and size to suit application.
   4. Tape: As recommended by insulation manufacturer.
   5. Fasteners:
      a. Staples or Nails: ASTM F1667, zinc-coated, size and type best suited for purpose.
      b. Screws: ASTM C954 or C1002, size and length best suited for purpose with washer not less than 50 mm (2″) in diameter.
      c. Impaling Pins: Steel pins with head not less than 50 mm (2″) in diameter with adhesive for anchorage to substrate. Provide impaling pins of length to extend beyond insulation and retain cap washer when washer is placed on the pin.
      d. As recommended by the manufacturer of the insulation.
   6. Protection Board: 1/2″ EPS protection board for perimeter foundation insulation.
   7. Wire mesh (for applications of batt insulation greater than 6-1/2″ thick): Galvanized steel hexagonal wire mesh.

PART 3 EXECUTION

3.01 INSTALLATION

A. Preparation for Perimeter Insulation:
   1. Verify substrate and adjacent materials and insulation boards are dry and ready to receive insulation and adhesive.
   2. Verify substrate surface is flat, free of irregularities and materials that will impede adhesive bond.
   3. Verify insulation boards are unbroken, free of damage.

B. Perimeter Insulation:
   1. Install in full conformance with manufacturer's instructions and recommendations.
   2. Where insulation is to be installed on exterior face of foundation wall, install insulation boards over dampproofing or waterproofing specified in other sections.
   3. Where insulation is to be installed on interior face of foundation wall, install vapor barrier between soil and insulation.

4. Install boards on foundation wall in a method to maximize contact bedding; stagger joints. Butt edges and ends tight to adjacent board and to protrusions. Assure full contact of tongue and groove edges.
5. Install rigid insulating units with joints close and flush, in regular courses and with cross joints broken.
6. Where insulation is installed on exterior face of foundation wall, adhere protection boards immediately following insulation board installation.

END OF SECTION

SECTION 07 41 13

METAL ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mechanically-seamed, standing seam metal roof panels, with related metal trim and accessories for installation over metal purlins.

1.02 RELATED REQUIREMENTS

A. Division 01: General Requirements:
1. Alternates.

B. Division 07: Thermal and Moisture Protection:
1. Joint Sealants for field-applied Joint Sealants.

C. Division 13: Special Construction:
1. Metal Building Systems for steel framing supporting metal panels and roof drainage components.

1.03 REFERENCES

A. American Architectural Manufacturer's Association (AAMA): www.aamanet.org:
1. AAMA 621 – Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates.
2. AAMA 809.2 – Voluntary Specification Non-Drying Sealants.

B. American Society of Civil Engineers (ASCE): www.asce.org/codes-standards:
1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures.

C. ASTM International (ASTM): www.astm.org:
1. ASTM A653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A755 – Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
3. ASTM A792/A92M – Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
4. ASTM A980 – Standard Specification for Steel, Sheet, Carbon, Ultra High Strength Cold Rolled.
5. ASTM C645 – Specification for Nonstructural Steel Framing Members.
6. ASTM D226 – Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
7. ASTM D1003 – Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics.

8. ASTM D2244 – Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
9. ASTM D4214 – Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
10. ASTM E1592 – Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
11. ASTM E1646 – Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
12. ASTM E1680 – Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
13. ASTM E1980 – Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

D. Underwriters Laboratories, Inc. (UL): www.ul.com:
1. UL 580 – Tests for Uplift Resistance of Roof Assemblies.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Prior to erection of framing, conduct preinstallation meeting at site attended by Owner, Architect, manufacturer's technical representative, inspection agency, and related trade contractors.
1. Coordinate building framing in relation to metal panel system.
2. Coordinate openings and penetrations of metal panel system.
3. Coordinate work of Division 07 Sections “Roof Specialties” and “Roof Accessories” and openings and penetrations and manufacturer's accessories with installation of metal panels.

1.05 QUALITY ASSURANCE

A. Manufacturer / Source: Provide metal roof panel assembly and accessories from a single manufacturer providing fixed-base roll forming, and accredited under IAS AC 472 Part B.

B. Manufacturer Qualifications: Approved manufacturer listed in this Section with minimum 5 years’ experience in manufacture of similar products in successful use in similar applications.
1. Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
   a. Product data, including certified independent test data indicating compliance with requirements.
   b. Samples of each component.
   c. Sample submittal from similar project.
   d. Project References: Minimum of five installations not less than 5 years old, with Owner and Architect contact information.
   e. Sample warranty.
   f. IAS AC 472 certificate.
2. Substitutions following award of contract are not allowed except as stipulated in Division 01 General Requirements.

3. Approved manufacturers must meet separate requirements of Submittals Article.

C. Installer Qualifications: Experienced Installer (certified by metal panel manufacturer) with minimum of 5 years' experience with successfully completed projects of a similar nature and scope.
   1. Installer's Field Supervisor: Experienced mechanic certified by metal panel manufacturer supervising work on site whenever work is underway.

1.06 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets for specified products.

B. Shop Drawings: Show layouts of metal panels. Include details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2″ per 1′ of edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, roof accessories, lightning arresting equipment, and special details. Make distinctions between factory and field assembled work.
   1. Indicate points of supporting structure that must coordinate with metal panel system installation.
   2. Include data indicating compliance with performance requirements.
   3. Include structural data indicating compliance with requirements of authorities having jurisdiction.

C. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.

D. Samples for Verification: Provide 12″ long section of each metal panel profile. Provide color chip verifying color selection.

1.07 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Indicating compliance of products with requirements, witnessed by a Professional Engineer.

B. Qualification Information: For Installer firm and Installer's field supervisor.

C. IAS Accreditation Certificate: Indicating that manufacturer is accredited under provisions of IAS AC 472.

D. Manufacturer's Warranty: Sample copy of Manufacturer's Standard Warranty.

1.08 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Manufacturer's Warranty: Executed copy of Manufacturer's Standard Warranty.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect products of metal panel system during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage. Protect panels and trim bundles during shipping.
   1. Deliver, unload, store, and erect metal panel system and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.
   2. Store in accordance with manufacturer's written instructions. Provide wood collars for stacking and handling in the field.

1.10 COORDINATION

A. Coordinate sizes, profiles, locations of roof curbs and other roof-mounted equipment, and roof penetrations, based upon sizes of actual selected equipment.

1.11 WARRANTY

A. Special Manufacturer’s Warranty: On manufacturer’s standard form, in which manufacturer agrees to repair or replace metal panel assemblies that fail in materials and workmanship within 1 year from date of Substantial Completion.

B. Special Panel Finish Warranty: On manufacturer’s standard form, in which manufacturer agrees to repair or replace metal panels that evidence deterioration of factory-applied finish within 25 years from date of Substantial Completion, including:
   1. Fluoropolymer Two Coat System:
      a. Color fading in excess of 5 Hunter units per ASTM D2244.
      b. Chalking in excess of No. 8 rating per ASTM D4214.
      c. Failure of adhesion, peeling, checking, or cracking.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Manufacturer: MBCI Metal Roof and Wall Systems, Division of NCI Group, Inc.; Houston, Texas. Phone: (877)713-6224; Email: info@mbci.com; Website: www.mbci.com.
   1. Provide basis of design product, or comparable product approved by Architect in accordance with Substitutions Section.

2.02 PERFORMANCE REQUIREMENTS

A. Performance Testing:
   1. Metal roofing systems shall be tested in accordance with UL580, Class 90 rating.
   2. Metal roof panel systems shall be tested in accordance with ASTM E1592 for negative loading. Capacity for gauge, span, or loading other than those tested is permitted to be determined by interpolating between test values only.

3. Metal roof panel systems shall have a maximum air infiltration rate of 0.007 cfm/ft2 at a pressure differential of 6.24 psf. when tested in accordance with ASTM E1680.
4. Metal roof panel systems shall have no water leakage at a pressure differential of 6.24 psf when tested in accordance with ASTM E1646.
5. The panels and concealed anchor clips shall be capable of supporting a 300-pound temporary concentrated load at the panel mid-span in the installed condition. The load shall be applied over the entire panel width. The panels shall support this concentrated load without displaying permanent distortions that would affect the weathertightness of the roof system.

2.03 DESIGN REQUIREMENTS

A. General
1. Roof System shall be designed by the Manufacturer as a complete system. Members and connections not indicated on the Drawings shall be the responsibility of the Contractor. All components of the system shall be supplied or specified by the same manufacturer.

B. Design Loads: Refer to Structural Drawings for Design Criteria.
1. Design load application shall be in accordance with ASCE-7
2. Dead Loads: The dead load shall be the weight of the roof system. Collateral Loads shall be as shown on the Contract Drawings. Collateral Loads shall not be applied to the roof panels.
3. Live Loads: The panels and concealed anchor clips shall be capable of supporting a minimum uniform live load of 20 psf.
4. Snow Loads: The design ground snow loads shall be as defined on the Contract Drawings.
5. Wind Loads: The design wind speed for the metal roofing system shall be as defined on the contract documents.
6. Thermal Effects: Roof panels shall be free to move in response to the expansion and contraction forces resulting from temperature variation, as specified in the Manufacturer's Metal Roofing Systems Design Manual.
7. Rainfall Intensity: Exterior gutters and downspouts shall be designed for rainfall intensity based upon a 5-year recurrence interval for a 5-minute duration.

2.04 METAL ROOF PANELS

A. Mechanically-Seamed, Concealed Fastener, Metal Roof Panels: Structural metal roof panel consisting of formed metal sheet with vertical ribs at panel edges, installed by lapping and mechanically interlocking edges of adjacent panels, and attaching panels to supports using concealed clips and fasteners in a weathertight installation.

B. Basis of Design: MBCI, BattenLok HS, www.mbci.com/battenlokHS.html.
1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, structural quality, Grade 50, Coating Class AZ50, pre-painted by the coil-coating process per ASTM A755/A755M.
2. Nominal Coated Thickness: 24 gauge.

3. Panel Surface: Smooth with striations in pan.
4. Panel Width: 16″.
5. Panel Seam Height: 2″.
6. Joint Type: Mechanically seamed.
7. Panel Color: Black.

2.05 METAL ROOF PANEL ACCESSORIES

A. General: Provide complete metal roof panel assembly incorporating trim, copings, fasciae, gutters and downspouts, and miscellaneous flashings, in manufacturer's standard profiles as indicated. Provide required fasteners, closure strips, thermal spacers, splice plates, support plates, and sealants as indicated in manufacturer's written instructions.

B. Flashing and Trim: Match material, thickness, and finish of metal panel face sheet.

C. Panel Clips: Provide panel clip of type specified at spacing indicated on approved Shop Drawings.
1. Two-Piece Floating: ASTM C645, with ASTM A653/A653M, G90 hot-dip galvanized zinc coating, configured for concealment in panel joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.
2. Single-Piece Fixed: ASTM A653/A653M, G90 (hot-dip galvanized zinc coating), configured for concealment in panel joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.

D. Panel Fasteners: Self-tapping screws and other acceptable corrosion-resistant fasteners recommended by roof panel manufacturer. Where exposed fasteners cannot be avoided, supply fasteners with EPDM or neoprene gaskets, with heads matching color of metal panels by means of factory-applied coating.

E. Joint Sealers: Manufacturer's standard or recommended liquid and preformed sealers and tapes, and as follows:
1. Factory-Applied Seam Sealant: Manufacturer's standard hot-melt type.
2. Tape Sealers: Manufacturer's standard non-curing butyl tape, AAMA 809.2.

F. Steel Sheet Miscellaneous Framing Components: ASTM C645, with ASTM A 653/A 653M, G60 hot-dip galvanized zinc coating.

2.06 FABRICATION

A. General: Provide factory fabricated and finished metal panels and accessories meeting performance requirements, indicated profiles, and structural requirements.

B. Fabricate metal panel joints configured to accept factory-applied sealant providing weathertight seal and preventing metal-to-metal contact and minimizing noise resulting from thermal movement.

C. Form panels in continuous lengths for full length of detailed runs, except where otherwise indicated on approved Shop Drawings.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved Shop Drawings, and Project Drawings. Form from materials matching metal panel substrate and finish.

2.07 FINISHES

A. Finishes, General: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

B. Fluoropolymer Two-Coat System: 0.2 – 0.3 mil primer with 0.7 - 0.8 mil 70% PVDF fluoropolymer color coat, AAMA 621
   1. Basis of Design: MBCI, Signature 300.
   2. Color: To be selected from Manufacturer’s Standards.

C. Interior Finish: 0.5 mil total dry film thickness consisting of primer coat and wash coat of manufacturer's standard light-colored acrylic or polyester backer finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine metal panel system substrate and supports with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal panel installation.
   1. Inspect metal panel support substrate to determine if support components are installed as indicated on approved Shop Drawings. Confirm presence of acceptable supports at recommended spacing to match installation requirements of metal panels.
   2. Panel Support Tolerances: Confirm that panel supports are within tolerances acceptable to metal panel system manufacturer but not greater than the following:
      a. 1/4″ in 20′ in any direction.
      b. 3/8″ over any single roof plane.

B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with insulated metal roof panel system installation.

3.02 PREPARATION

A. Miscellaneous Supports: Install subframing, girts, furring, and other miscellaneous panel support members according to ASTM C754 and manufacturer's written instructions.

B. Flashings: Provide trim and flashings as required to complete metal roof panel system.

3.03 METAL PANEL INSTALLATION

A. Install the Metal Roofing System in accordance with an applicable UL construction method from the current UL Roofing Materials and Roofing Systems Directory.

B. UL Mechanically-Seamed, Standing Seam Metal Roof Panels:
   1. Install weathertight metal panel system in accordance with manufacturer's written instructions, approved Shop Drawings, and Project Drawings.
   2. Install metal roof panels in orientation, sizes, and locations indicated, free of waves, warps, buckles, fastening stresses, and distortions. Anchor panels and other components securely in place. Provide for thermal and structural movement.

C. Attach panels to supports using clips, screws, fasteners, and sealants recommended by manufacturer and indicated on approved Shop Drawings.
   1. Fasten metal panels to supports with concealed clips at each location indicated on approved Shop Drawings, with spacing and fasteners recommended by manufacturer.
   2. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
   3. Provide weatherproof jacks for pipe and conduit penetrating metal panels of types recommended by manufacturer.
   4. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces, and edges in contact with dissimilar materials as recommended by manufacturer.

3.04 ACCESSORY INSTALLATION

A. General: Install metal panel trim, flashing, and accessories using recommended fasteners and joint sealers, with positive anchorage to building, and with weather tight mounting. Provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal panel assembly, including trim, copings, flashings, sealants, closure strips, and similar items.
   2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.
   3. Provide concealed fasteners except where noted on approved Shop Drawings.
   4. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.

B. Joint Sealers: Install joint sealers where indicated and where required for weathertight performance of metal panel assemblies, in accordance with manufacturer's written instructions.
   1. Prepare joints and apply sealants per requirements of Division 07 Section “Joint Sealants”.

3.05 CLEANING AND PROTECTION

A. Remove temporary protective films immediately in accordance with metal roof panel manufacturer's instructions. Clean finished surfaces as recommended by metal roof panel manufacturer.

B. Replace damaged panels and accessories that cannot be repaired to the satisfaction of the Architect.

END OF SECTION

SECTION 07 92 00

ELASTOMERIC SEALANTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide elastomeric joint sealants, joint fillers and joint backer materials for complete and durable seal at all locations scheduled and as indicated on the Drawings.

1.02 RELATED WORK

A. Included Elsewhere to be Performed in Compliance with this Section:
1. Division 03: Concrete
2. Division 05: Metals
3. Division 07: Thermal and Moisture Protection
4. Division 08: Openings
5. Division 09: Finishes
6. Division 13: Special Construction

B. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.03 REFERENCES

A. ASTM C 321 – Standard Test Method for Bond Strength of Chemical-Resistant Mortars.

B. ASTM C 834 – Standard Specification for Latex Sealants.

C. ASTM C 882 – Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

D. ASTM C 919 – Standard Practice for Use of Sealants in Acoustical Applications.

E. ASTM C 920 – Standard Specification for Elastomeric Joint Sealants.

F. ASTM C 1330 – Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.

G. FS (Federal Specification) TT-S-00227E (COM-NBS) – Interim Federal Specification for Sealing Compound: Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures).

H. FS (Federal Specification) TT-S-00230C – Interim Federal Specification for Sealing Compound: Elastomeric Type, Single Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures).

I. FS (Federal Specification) TT-S-001543 (COM-NBS) – Interim Federal Specification for Sealing Compound: Silicone Rubber Base (for Caulking, Sealing, and Glazing in Buildings and Other Structures).

1.04 SUBMITTALS

A. Comply with pertinent provisions of Submittals Section.

B. Product Data: Materials list of items proposed to be provided under this Section.

C. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

D. Shop Drawings or catalog illustrations in sufficient detail to show installation and interface of the work of this Section with the work of adjacent trades.

E. Manufacturer's current recommended installation procedures which, when reviewed by Architect / Engineer (A/E), will become the basis for accepting or rejecting actual installation procedures used on the Work.

F. Color Charts of Sealants: Colors shall be selected by the A/E from the range of manufacturer's standard colors.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company regularly engaged in manufacturing and marketing of products specified in this section.

B. Applicator Qualifications:
1. Applicator shall have at least 3 years' experience in installing materials of types specified and shall have successfully completed at least three projects of similar scope and complexity.

C. Single Source Responsibility for Joint Sealants:
1. Obtain joint sealants from single manufacturer for each different product required to ensure compatibility.
2. Manufacturer shall instruct applicator in procedures for intersecting sealants.

D. Perform work in accord with ASTM C-1193 guidelines except where more stringent requirements are indicated or specified.

E. Schedule applications of waterproofing, water repellents and preservative finishes after sealant installation unless sealant manufacturer approves otherwise in writing. Cure installed sealant sufficiently prior to subsequent applications.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products in original factory packaging bearing identification of product, manufacturer, and batch number. Provide Material Safety Data Sheets for each product.

B. Store products in a location protected from freezing, damage, construction activity, precipitation, and direct sunlight in strict accordance with manufacturer's recommendations.

C. Condition products to approximately 60°F to 70°F (16°C to 21°C) for use in accordance with manufacturer's recommendations.

D. Handle all products with appropriate precautions and care as stated on Material Safety Data Sheet.

1.07 SUBSTRATE CONDITIONS

A. General:
1. Provide joints properly dimensioned to receive the approved sealant system.
2. Provide joint surfaces that are clean, dry, sound and free of voids, deformations, protrusions and contaminants that may inhibit application or performance of the joint sealant.
3. Provide a reservoir to accept sealant at expansion joints with preformed joint fillers.

1.08 PROJECT CONDITIONS

A. Do not use products under conditions of precipitation or freezing weather. Use appropriate measures for protection and supplementary heating to ensure proper curing conditions in accordance with manufacturer's recommendations if application during inclement weather occurs.

B. Ensure substrate is dry.

C. Protect adjacent work from contamination due to mixing, handling, and application of flexible epoxy joint filler.

1.09 WARRANTY

A. Deliver to the A/E signed copies of the following written warranties against adhesive and cohesive failure of the sealant and against infiltration of water and air through the sealed joint for a period of 3 years from date of completion.
1. Manufacturer's standard warranty covering sealant materials.
2. Applicator's standard warranty covering workmanship.
3. Defective work shall include, but not be restricted to, joint leakage, cracking, crumbling, melting, running, loss of adhesion, loss of cohesion, or staining of adjoining or adjacent work or surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers may be from those listed or an A/E approved equal:
1. Sonneborn(R) Building Products, ChemRex, Inc.
2. General Electric.

3. Dow Corning.
4. Pecora.
5. Tremco, Inc.
6. A/E approved equal.

B. Compatibility:
1. Provide joint sealants, joint fillers and accessory joint materials that are compatible with one another and with joint substrates under project conditions.
2. Install joint sealants, joint fillers and related joint materials that are non-staining to visible joint surfaces and surrounding substrate surfaces.

2.02 MATERIALS

A. Sealant Type A: Low-modulus, non-sag sealant; comply with ASTM C920, TT-S-00230C, Grade NS, Class 25. Acceptable sealants:
1. Single Component Urethane Type S, comply with TT-S-00230C.
   a. Sonolastic(R) NP 1.
   b. Vulkem 116, 911, 921 or 931.
   c. Tremflex 25.
   d. Pecora Dynatrol I XL.
   e. A/E approved equal.
2. Multi Component Urethane Type M, comply with TT-S-00227E.
   a. Sonolastic(R) NP 2.
   b. Dymeric 511.
   c. Vulkem 227 or 922.
   d. Pecora Dynatred.
   e. A/E approved equal.
3. Single-Component Silicones Type S, comply with TT-S-001543A.
   a. Spectrem 1, 2 or 3.
   b. Pecora 860..
   c. A/E approved equal

B. Sealant Type B: Self-leveling sealant having a Shore A hardness of not less than 25 or more than 50 and plus-or-minus 25 percent joint movement capability; comply with ASTM C920, Grade P or NS, Class 25. Acceptable sealants:
1. Single-Component Urethane, Type S, comply with TT-S-00230C:
   a. Sonolastic SL 1.
   b. Vulkem 45.
   c. Tremflex SL.
   d. Pecora Urexpan NR-201.
   e. A/E approved equal.
2. Multi-component Urethane, Type M, comply with TT-S-00227E:
   a. Sonolastic SL 2.
   b. THC-900/901.
   c. Vulkem 227 or 245.
   d. Pecora Urexpan NR-200.
   e. A/E approved equal.

C. Sealant Type C: Non-skinning and non-staining flexible sealant designed for buttering or bedding application between non-porous substrates, including galvanized steel, unpainted steel and coated metals that are squeezed together by fastening.
   1. Butyls:
      a. Tremco JS-773.
      b. Tremco Butyl Sealant.
      c. Pecora.
      d. A/E approved equal.

D. Sealant Type D: Non-sag, high-performance sealant for perimeter caulking and glazing. Acceptable products.
   1. Urethanes:
      a. Vulkem 1, 911, 921 or 931.
      b. Dymonic.
      c. Tremflex 25.
      d. A/E approved equal.
   2. Silicones:
      a. Spectrem 2 or 3.
      b. Proglaze.
      c. A/E approved equal.
   3. Other:
      a. JS-773.
      b. Tremco Butyl Sealant.
      c. Tremco Acoustical.
      d. A/E approved equal.

E. Sealant Type E: Comply with United States Department of Agriculture (USDA) guidelines for incidental food contact with the cured sealant; comply with ASTM C920, Type S or M, Grade P or NS, Class 25; select color from listing of those approved. Acceptable Sealants:
   1. Urethanes:
      a. Vulkem 116, 911, 921, or 931.
      b. Dymonic.
      c. Tremflex 25.
      d. Pecora Dynatrol I XL or II.
      e. A/E approved equal.
   2. Silicones:
      a. Proglaze.
      b. Spectrem 1, 2, or 3.
      c. Tremsil 600.
      d. Pecora 860.
      e. A/E approved equal.

F. Sealant Type F: Certified by National Sanitation Foundation as conforming to the requirements of NSF Standard 61-Drinking Water System Components-Health Effects; comply with ASTM C920, Type S or M, Grade P or NS, Class 25; select color from the NSF listing. Acceptable sealants:
   1. Single Component Urethane:
      a. Vulkem 45 or 921.

b. Dymonic.
c. A/E approved equal.

2. Multi Component Urethane:
   a. Vulkem 245.
   b. A/E approved equal.
3. Polysulfide:
   a. Pecora Synthacalk GC2+.
   b. A/E approved equal.

G. Sealant Type G: Gun grade sealant suitable for continuous water immersion, designed for use in swimming pools, fountains, cooling towers, waste water treatment plants and plaza decks; conforms to ASTM C920, Type M, Grade NS, Class 25, Use NT, T, M, A and O. USDA approved, comply with TT-S-00227E. Acceptable sealants:
   1. Multi Component Urethane:
      a. Vulkem 227.
      b. Pecora Dynatred.
      c. A/E approved equal.

H. Sealant Type H: Cold-applied self-leveling modified elastomeric sealant designed specifically for sealing joints in airport runways, terminal ramps, hangars and transportation storage areas; meeting Federal Specification SS-S-200E; SS-S-195B & TT-S-00227E: ASTM D-1850; ASTM C-920 & PA DOT 408/90.
   1. Multi-Component Urethane:
      a. Vulkem 202.
      b. Pecora Urexpan NR-300.
      c. A/E approved equal.

I. Sealant Type I: Non-sag polyurethane pick-resistant flexible security sealant having a Shore A hardness of 55. Acceptable sealants:
   1. Urethane:
      a. Vulkem 617.
      b. Pecora Dynaflex.
      c. A/E approved equal.
   2. Two-component Epoxy, Gunnable:
      a. Sonneborn/Chem Rex Epolith(R)-G.
   3. Two-component Epoxy, Pourable:
      a. Sonneborn/Chem Rex Epolith(R)-P.

J. Sealant Type J: Comply with ASTM C920, Type S or M, Grade NS, Class 25, comply with EIMA 300.01. Acceptable products:
   1. Urethanes:
      a. Vulkem 922.
      b. Dymeric 511.
      c. Pecora Dynatrol II.
      d. A/E approved equal.
   2. Silicones:
      a. Spectrem 1 or 3.

b. Pecora 890.
c. A/E approved equal.

K. Sealant Type K: Comply with ASTM C920, Type M, Grade NS, Class 50, Use NT, G, M, A and O. Acceptable Products:
1. Silicone: Tremco Spectrem 4-TS.

L. Joint Cleaner: Non-corrosive and non-staining type recommended by sealant manufacturer and compatible with joint forming materials.

M. Joint Primer: As recommended by sealant manufacturer for substrates, conditions and exposures indicated.

N. Bond Breaker: Polyethylene tape or other adhesive faced tape as recommended by sealant manufacturer to prevent sealant contact where it would be detrimental to sealant performance.

O. Joint Backer:
1. Polyethylene Foam Rod:
a. Soft: Non-gassing, reticulated closed-cell for use with cold-applied joint sealants. Comply with ASTM C 1330.
b. Closed-cell: Designed for use with cold-applied joint sealants for on-grade or below-grade applications.

P. Joint Filler: Closed-cell polyethylene joint filler designed for use in cold joints, construction joints, or isolation joints wider than 1/4″ (6 mm).
1. Size required for joint design.
2. Masking Tape: Non-staining, non-absorbent tape product compatible with joint sealants and adjacent joint surfaces that is suitable for masking.

Q. Expanding Insulating Foam Sealant for filling gaps and sealing around windows and doors.

2.03 OTHER MATERIALS

A. Provide other materials as selected by the Contractor and approved by the sealant manufacturer as compatible, which not specifically described but are required for a complete and proper installation.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

B. Applicator shall examine the areas and conditions under which work of this Section will be performed.
1. Verify conformance with manufacturer’s requirements.

2. Report unsatisfactory conditions in writing to the A/E.
3. Do not proceed until unsatisfactory conditions are corrected.

C. Preformed joint fillers in joints to be sealed should provide a reservoir to accept the sealant such as by a molded breakaway joint cap or a removable block out. Preformed joint fillers that may contact the sealant should not be impregnated with oil, bitumen, non-curing polymers or similar contaminants.

3.02 PREPARATION

A. Prepare surfaces to receive sealants in accord with sealant manufacturer's instructions and recommendations except where more stringent requirements are indicated.

B. Thoroughly clean joint surfaces using cleaners approved by sealant manufacturer whether primers are required or not.
1. Remove all traces of previous sealant and joint backer by mechanical methods, such as by cutting, grinding and wire brushing, in manner not damaging to surrounding surfaces.
2. Remove paints from joint surfaces except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer.
3. Remove wax, oil, grease, dirt film residues, temporary protective coatings and other residues by wiping with cleaner recommended for that purpose. Use clean, white, lint-free cloths and change cloths frequently.
4. Remove dust by blowing clean with oil-free, compressed air.

C. Back-Up Material:
1. Install appropriate size backer rod, larger than joint where necessary according to manufacturer's recommendations.
2. Install polyethylene joint filler in joints wider than 1/4″ (6 mm) to back-up material per manufacturer's recommendations.
3. Do not install epoxy joint filler over backer rod.

D. Bond Breaker: Install bond-breaker strip in joint to be sealed on top of back-up material to prevent adhesion of sealant to back-up material; install per manufacturer's recommendations.

E. Prime Joint Substrates Where Required:
1. Use and apply primer according to sealant manufacturer's recommendations.
2. Confine primers to sealant bond surfaces; do not allow spillage or migration onto adjoining surfaces.

F. Taping:
1. Use masking tape where required to prevent sealant or primer contact with adjoining surfaces that would be permanently stained or otherwise damaged by such contact or the cleaning methods required for removal.
2. Apply tape so as not to shift readily and remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION

A. Provide the approved sealant system indicated in the schedule, and in strict accord with the manufacturer's recommendations as approved by the A/E.

B. Install sealants immediately after joint preparation.

C. Mix and apply multi-component sealants in accord with manufacturer's printed instructions.

D. Install sealants to fill joints completely from the back, without voids or entrapped air, using proven techniques, proper nozzles and sufficient force that result in sealants directly contacting and fully wetting joint surfaces.

E. Install sealants to uniform cross-sectional shapes with depths relative to joint widths that allow optimum sealant movement capability as recommended by sealant manufacturer.

F. Tool sealants in manner that forces sealant against back of joint, ensures firm, full contact at joint interfaces and leaves a finish that is smooth, uniform and free of ridges, wrinkles, sags, air pockets and embedded impurities.
   1. Dry tooling is preferred; tooling liquids that are non-staining, non-damaging to adjacent surfaces and approved by sealant manufacturer may be used if necessary when care is taken to ensure that the liquid does not contact joint surfaces before the sealant.
   2. Provide concave tooled joints unless otherwise indicated to provide flush tooling or recessed tooling.
   3. Provide recessed-tooled joints where the outer face of substrate is irregular.

G. Remove sealant from adjacent surfaces in accord with sealant and substrate manufacturer recommendations as work progresses.

H. Protect joint sealants from contact with contaminating substances and from damages. Cut out, remove and replace contaminated or damaged sealants, immediately, so that they are without contamination or damage at time of substantial completion.

3.04 INSTALLATION SCHEDULE

A. Sealant Type A:
   1. For exterior and interior joints in vertical surfaces and non-traffic horizontal surfaces such as, but not limited to:
      a. Control and expansion joints in cast-in-place concrete.
      b. Joints on precast beams and planks.
      c. Joints between architectural precast concrete units.
      d. Control and expansion joints in unit masonry.
      e. Control and expansion joints on exposed interior surfaces of exterior walls.
      f. Joints between different materials listed above.
      g. Perimeter joints between materials listed above and frames of exterior and interior doors, windows, storefronts, louvers, elevator entrances and similar openings.

h. Control and expansion joints in ceiling and overhead surfaces.
i. Perimeter joints on exposed interior surfaces of exterior openings.
j. Trim or finish joints subject to movement.

B. Sealant Type B:
1. For exterior and interior joints in horizontal and sloped traffic surfaces such as, but not limited to:
a. Control, expansion and isolation joints in cast-in-place concrete.
b. Control, expansion and isolation joints in structural precast concrete units.
c. Joints between architectural precast concrete paving units.
d. Tile control and expansion joints.
e. Joints between different materials listed above.

C. Sealant Type C:
1. For interior or exterior joints in vertical surfaces between laps in fabrications of sheet metal:
a. Metal building roof and side wall panels.
b. Between dissimilar metals to prevent galvanic action.
c. Air ducts.

D. Sealant Type D:
1. For general architectural sealing and caulking not listed above such as:
a. Under metal thresholds and saddles.
b. Bedding sealant for sheet metal flashing.
c. For frames of metal or wood and glazing.
d. Silicone only around plumbing fixtures.

E. Sealant Type H: For exterior joints in horizontal concrete surfaces including airport runways, refueling aprons, highways and other areas subject to fuel spillage.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish hollow metal doors and frames as specified and shown on plans and schedules.

B. Metal Frames:
1. Non-rated door frames.

C. Fire-Rated and Non-Rated Steel Doors:
1. Flush design

D. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound rated doors; where two requirements conflict, comply with the most stringent.

1.02 RELATED WORK

A. Division 7: Thermal and Moisture Protection:
1. Insulation
2. Elastomeric Sealants

B. Division 8: Openings:
1. Finish Hardware

C. Division 9: Finishes:
1. Painting

1.03 REFERENCE STANDARDS

A. SDI Standards:
1. SDI-108-10(R14) Recommended Selection and Usage Guide for Standard Steel Doors
2. SDI 110-09 Standard Steel Doors and Frames for Modular Masonry Construction
3. SDI-111-09 Recommended Details and Guidelines for Standard Steel Doors, Frames, Accessories and Related Components
4. SDI-112-08 Zinc-Coated (Galvanized/Galvannealed) Steel Doors and Frames
5. SID 113-13 Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies

6. SDI-117-13 Manufacturing Tolerances for Standard Steel Doors and Frames
7. SDI-118-12 Basic Fire Door, Fire Door Frame, Transoms/Sidelight and Window Frame Requirements
8. SDI 122-15 Installation Troubleshooting Guide for Standard Steel Doors and Frames
9. SDI-124-16 Maintenance of Standard Steel Doors and Frames
10. SDI 128-16 Guidelines for Acoustical Performance of Standard Steel Doors and Frames

B. ANSI Standards:
1. ANSI/UL 10B-2009 Fire Tests of Door Assemblies
2. ANSI/UL 10C-2009 Positive Pressure Fire Tests of Door Assemblies
3. ANSI/NFPA 80-2010 Fire Doors and Fire Windows
4. ANSI/NFPA 252-2012 Fire Tests of Door Assemblies
5. ANSI/SDI A250.3-2007 (R2011) Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
6. ANSI/SDI A250.4-2011 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings
7. ANSI/SDI A250.6-2003 (R2009) Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
8. ANSI/SDI A250.7-1997 (R2007) Nomenclature for Standard Steel Doors and Steel Frames
9. ANSI/SDI A250.10-1998 (R2011) Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
10. ANSI/SDI A250.11-2012 Recommended Erection Instructions for Steel Frames (Formerly SDI-105)
11. A115 Hardware Preparation in Steel Doors and Steel Frames
12. A115.IG Installation Guide for Doors and Hardware

C. ASTM Standards:
1. ASTM A1008-2012 Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A568-2011 Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
3. ASTM A1011-2012 Standard Specification for Steel Sheet and Strip, Hot-Rolled, Car-bon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
4. ASTM A653-2011 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
5. ASTM A879-2012 Standard Specification for Sheet Steel, Zinc Coated by the Electrolyte Process for Applications Requiring Designation of the Coating Mass on Each Surface
6. ASTM A924-2010 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

1.04 QUALITY ASSURANCE

A. Manufacturer shall meet or exceed all standards as noted in Section 2.01 references.

B. Fire and smoke rated assemblies shall be manufactured in accordance with Underwriters Laboratories established procedures and shall bear the appropriate labels for each application.

C. No product shall be manufactured prior to receipt of approved hardware schedule and templates.

1.05 SUBMITTALS

A. Submit shop drawings prior to manufacturing and/or delivery of product to the site.
   1. Shop Drawings shall show elevations of each door design, door construction details, hardware locations, dimensions, and shapes of materials, anchorage and fastening methods, door frame types and details, and finish requirements. Submit for each frame type and door type:
   2. Identify each unit with door and window marks and numbers.
   3. Relate numbers to Architect's frame, door and window schedules.

1.06 SIZES

A. Standard Doors and frames shall be sized to fit openings as scheduled on the Drawings and may include:
   1. Widths in F.t-In.: 2′-0″, 2′-4″, 2′-6″, 2′-8″, 2′-10″, 3′-0″, 3′-4″, 3′-6″, 3′-8″, 3′-10″, and 4′-0″.
   2. Sizes shown are for single doors only; equal pairs of doors use twice the width indicated. Pairs of doors can consist of two unequal door widths.
   3. Heights in Ft-In: 6′-8″, 7′-0″, 7′-2″, 7′-10″ and 8′-0″.

B. Custom Doors and Frames shall be fabricated for special applications to fit openings as scheduled on the Drawings.

1.07 DELIVERY, STORAGE AND HANDLING

A. Products shall be marked with architects opening number on all doors, frames, misc. parts and cartons.

B. All doors and frames shall be stored vertically under cover. The units shall be placed on at least 4″ high wood sills or in a manner that will prevent rust or damage.

C. ANSI/SDI A250.8-2017 The use of non-vented plastic or canvas shelters that can create a humidity chamber shall be avoided.

D. A 1/4″ space between the doors shall be provided to promote air circulation. If the wrapper on the door becomes wet, it must be removed immediately.

PART 2 PRODUCTS

2.01 MATERIALS

A. All steels used to manufacture doors, frames, anchors, and accessories shall meet at least one or more of the following requirements:
   1. Cold rolled steel shall conform to ASTM designations A1008, “Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability” and A568, “Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for”.
   2. Hot rolled, pickled and oiled steel shall comply with ASTM designations A1011, “Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability” and A568, “Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for”.
   3. When specified, hot dipped zinc coated steel shall be of the alloyed type and comply with ASTM designations A924, “Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process” and A653, “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process”.

B. Thermal-Rated Insulating Assemblies: Provide at exterior locations and elsewhere as scheduled on Drawings, assembly with u-factor of 0.24 Btu/hr ft. 2°F or better.

C. Sound Rated Assemblies: Provide door and frame assemblies which have been fabricated as sound reducing type tested in accordance with ASTM E90 and provide sound ratings of STC33 or better.

2.02 FRAMES

A. Exterior frames shall be 16 gauge full profile welded type construction.

B. Finish: Factory primed, for field finishing.

C. Frames for Glazing:
   1. Mullions and transom bars shall be joined to adjacent members by welding or by rigid mechanical connection which maintains alignment of parts and assure performance when field assembled.
   2. Vertical mullions shall be supplied with floor anchors
   3. Prepare frames for glass and glazing installed on the exterior rabbet of the frame assembly unless detailed otherwise on the Drawings.
   4. Glazing beads shall be flush type formed channel, min 5/8″ height and accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

D. Provide frames, other than slip-on drywall type with a minimum of three anchors per jamb suitable for the adjoining wall construction. Provide anchors of not less than 0.042″ in thickness or 0.167″ diameter wire. Frames over 7′-6″ shall be provided with an additional anchor per jamb.

E. Slip-on drywall frame anchors shall be as provided by the manufacturer to assure performance.

F. Base anchors shall be provided, other than slip-on drywall type, with minimum thickness of 0.042″. For existing masonry wall conditions that do not allow for the use of a floor anchor, an additional jamb anchor shall be provided.

G. Welding shall conform to ANSI/AWS-101-94:
   1. Welded joints shall be ground to a smooth uniform finish.

H. Butt joints of mullions, transom bars, center rails and sills shall be coped accurately and securely welded.

I. Fire labeled frame products shall be provided for those openings requiring fire protection ratings as indicated on the Drawings.

J. Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

2.03 DOORS

A. Doors shall be of types indicated on the Drawings.

B. Door Faces:
   1. Full Flush: Each door face shall be formed from a single sheet of steel with no visible seams on the surface to the faces. A full height vertical seam shall be permitted on the door edges.

C. Exterior Doors:
   1. Level 3, Extra Heavy Duty, 16 gauge, 1-3/4″ thick.
   2. Model 1, full flush design.
   3. Core: Core shall be insulated with KraftPaper honeycomb, polystyrene, polyurethane, mineral board at the discretion of the manufacturer in accordance with ANSI/SDI A250.8, “SDI-100, Recommended Specifications for Standard Steel Doors and Frames”, Section 2.3.2.

D. Door construction per ANSI/SDI A250.8-200319E.

E. End closure: The top and bottom of the doors shall be closed with either flush or inverted channel closures. The channels or closures shall have a minimum material thickness of 0.042″.

F. Door edge design: shall be in accordance with ANSI/SDI A250.8, “SDI-100, Recommended Specifications for Standard Steel Doors and Frames”, Section 2.3.1.3.

2.04 HARDWARE PREPARATION

A. Mortise, reinforce drill and tap doors and frames as required for mortised hardware furnished under Division 08 Sections, Finish Hardware and under Division 28 Sections, Electronic Safety and Security in accordance with a final approved hardware schedule and templates provided by the hardware supplier and security supplier, including a minimum 1/2″ raceway for electrical hardware, electric hinges and power transfers, door position switches, and other electrified hardware.

B. Minimum hardware reinforcing gages shall comply with Table 4 of ANSI/SDI A250.8, “SDI-100, Recommended Specifications for Standard Steel Doors and Frames”.

C. Follow SDI 127C for Frame cutout limits.

D. Provide metal mortar guards for mortised cutouts for frames in masonry walls.

E. Obtain templates from hardware and security suppliers.

F. Interior frames shall be prepared for single stud door silencers, three per frame.

G. Drilling and tapping for surface door closers, door closer brackets, and adjusters shall be done in the field by the installer.

H. Astragals for Double Doors: Specified in Section 08 71 00.
1. Exterior Doors: Steel, Z-shaped.
2. Fire-Rated Doors: Steel, shape as required to accomplish fire rating.

2.05 FINISH

A. Doors and frames shall be leveled and ground smooth.

B. Apply mineral filler to eliminate weld scars and other blemishes

C. Prime Finish:
1. Doors and frames shall be thoroughly cleaned, and chemically treated to insure maximum paint adhesion.
2. All surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on.
3. The finish shall meet the requirements for acceptance stated in ANSI/SDI A250.10 “Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames”.

2.06 DESIGN CLEARANCES

A. The clearance between the door and frame head and jambs shall be 1/8″ in the case of both single swing and pairs of doors.

B. The clearance between the meeting edges of pairs of doors shall be 1/8″ to 1/4″ for fire rated doors 1/8″ ± 1/16″.

C. The clearance at the bottom shall be 3/4″.

D. The clearance between the face of the door and door stop shall be 1/16″ to 1/8″.

E. All clearances shall be, unless otherwise specified, subject to a tolerance of ± 1/32″.

PART 3 EXECUTION

3.01 INSTALLATION

A. Verify that rough openings are no less than 3/16″ larger on all three sides than the intended overall frame size.

B. Frames shall be installed plumb, level, rigid and in true alignment as recommended in ANSI/SDI A250.11, “Recommended Erection Instructions for Steel Frames” and A115.IG, “Installation Guide for Doors and Hardware”.

C. All frames other than slip-on types shall be fastened to the adjacent structure so as to retain their position and stability. Dry-wall slip-on frames shall be installed in prepared wall openings in accordance with manufacturer’s instructions.

D. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

E. Install fire rated doors and frames in accordance with NFPA 80 shall be installed and fastened to maintain alignment with frames to achieve maximum operational effectiveness and appearance.

F. Doors shall be adjusted to maintain perimeter clearances as specified. Shimming shall be performed by the installer as needed to assure the proper clearances are achieved.

G. Installation of hardware items shall be in accordance with the hardware manufacturer’s recommendations and templates. A115.IG, “Installation Guide for Doors and Hardware” and ANSI/SDI A250.6, “Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames” shall be consulted for other pertinent information.

H. Contractor shall seal/caulk around frames in place.

3.02 PRIME COAT TOUCH-UP

A. Immediately after erection, areas where prime coat has been damaged shall be sanded smooth and touched up with same primer as applied at shop.

B. Remove rust before above specified touch-up is applied.

C. Touch-up shall not be obvious.

D. Before job painting is started, finish on frame and doors shall comply with finish on approved sample.

3.03 CLEAN

A. Complete painting prior to glass installation.

B. Clean surface promptly after installation of windows, exercising care to avoid damage to finish. Remove excess glazing and sealant compounds, dirt, and other substances.

3.04 PROTECTION

A. Protect installed hollow metal work against damage from other construction work.

3.05 SCHEDULE

A. As indicated on Drawings.

END OF SECTION

SECTION 08 34 16

VERTICALLY BI-FOLD HANGAR DOOR

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Section 01 23 00 – Alternates

B. Section 13 34 19 – Pre-Engineered Metal Buildings

1.02 QUANTITY

A. Doors for this project will consist of one bi-fold doors.

B. Size of Door:
1. Clear open width and height.
2. Hangar door with door in up position, shall have a minimum clear opening height and width as shown on Drawings.

C. Placement of the Bi-Fold Door Unto the Building:
1. Door shall be mounted flush with exterior walls of building.

1.03 GENERAL / CONTRACTORS REQUIREMENTS

A. Design Criteria:
1. The bi-fold hangar doors shall be designed to the same loading requirements for live, dead and wind loads as the hangar building.
2. The doors shall be engineered to resist all anticipated loads without sagging, bowing, or conflicting with its smooth and efficient operation.
3. The design shall be furnished, approved, and sealed by a Professional Engineer registered in the state where the project is located.
4. The building header shall be designed to accommodate horizontal and vertical building deflections to support the bi-fold door in all positions (with the proper lateral bracing).
5. The building's door columns shall be framed of the proper design and size to reinforce the opening (with lateral bracing) and to carry all loads and vibrations imposed thereon.
6. The bi-fold door should have solid footing with sill directly underneath the door frame and extending outward from the door to provide a base for the door's weather seal. This also prevents flow of water into, or under, the door installation.
7. The finished floor of the building should be designed to prevent flow of water under the door installation. Sills shall have a slight slope outward of the bi-fold door to prevent water flow under the door installation.

1.04 GENERAL / ELECTRICAL REQUIREMENTS

A. The Building Contractor shall furnish and install a prewired electrical door operating mechanism to control each bi-fold door.

B. The Contractor is responsible and required to completely install the prewired electrical door operating mechanism, push button controls , devices and electrical conduit and wiring to the door operating controls.

C. The electrical door mechanism and control shall be field wired by the Contractor (not the door manufacturer).

D. Control panel with “up” / “down” / “off” switch pre-wired to motor, and over-ride controls with the required number of adequately sized insulated electrical conductors.

1.05 GENERAL / ELECTRICAL POWER OPERATOR FOR THE BI-FOLD DOORS

A. All electrical controls and devices shall conform to the requirements of the current National Electrical Code 513, NEMA, and be UL approved.

B. Provide UL Listed Electric Operator, size and type as recommended by the manufacturer.

C. The operator is furnished complete and consists of a motor and factory-wired control panels consisting of main fused disconnect switch, magnetic reversing starters, limit switches and push button controls, control circuit transformers, relays, timing devices, and warning devices.

1.06 SUBMITTALS

A. Product Data: Submit manufacturer’s Specification Sheets for each Bi-fold Door, plus product data and installation instructions. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide roughing-in diagrams, include the following:
   1. Summary of forces and loads on walls and jambs.
   2. Setting Drawings, templates, and installation instructions for built-in or embedded anchor devices.

B. Shop Drawings: Submit Shop Drawings for approval prior to fabrication. Include detailed plans, elevations, details of framing members, required clearance, anchors, and accessories. Include relationship with adjacent materials. The make and type of door, operators and controls shall be clearly shown. Door weight, method of suspension, operation, and all fastenings shall be indicated.
   1. Submit each of the following manufacturer’s Manuals / Diagrams:
      a. Bi-fold door literature,
      b. Installation manual,
      c. Operating instructions,
      d. Maintenance data / manual,
      e. Safety decal placement guide manual / warning labels, and

f. Electrical system manual for the bi-fold door system.
1) Electrical schematics.
2) Electrical wiring diagram.

2. Diagrams of potentially hazardous locations related to the operation of the door.
3. Shop Drawings for approval.
a. Submit Shop Drawings specific for this project.
1) Note: Generalized project Drawings not specific to this project will not be acceptable.

1.07 QUALITY ASSURANCE

A. Source Limitations: Obtain bi-fold doors through one source from a single manufacturer.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing bi-fold doors similar to those indicated for this project and with a record of successful in-service performance.

C. Installer Qualifications: Engage an experienced installer who is an authorized representative of the door manufacturer for both installation and maintenance of units required for this project.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of Bi-Fold doors and accessories. Other manufacturers' systems with equal performance and dimensional characteristics may be considered. Refer to Optional Upgrade Equipment.

E. Pre-Installation Conference: Schedule a Pre-Installation Conference prior to commencement of field operations that might affect installation of bi-fold doors to establish procedures for maintaining optimum working conditions, and to coordinate this work with related and adjacent work.

F. The Contractor shall touch up all scratches, abrasions or other slight painting defects with the same type and color of paint as originally applied.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in manufacturer's labeled protective packages. Store and handle in strict compliance with manufacturer's written instructions and recommendations. Protect from damage from weather, excessive temperatures and constructions operations.

B. Inspect vertical bi-fold doors upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect. Otherwise, remove and replace damaged items as directed.

C. Place bi-fold door frame units on minimum 4″ high wood blocking. Store doors components and packages at building site under cover. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately.

D. The Contractor shall store the sheet, panels, components and other manufactured items so that they will not be damaged or deformed. Store metal sheets or panels so that water accumulations will drain freely. Do not store sheets or panels in contact with other materials which might cause staining.

1.09 APPROVED MANUFACTURERS

A. The bi-fold doors supplied by a manufacturer who is regularly engaged in the manufacture of aircraft hangar doors for a minimum of 10 years, and upon request from the Owner provide a list of completed projects.
   1. Bi-fold door shall be as manufactured by:
      a. Schweiss Bi-Fold Doors, PO Box 220, Fairfax, Minnesotta 55332; Phone: 507-426-8273.
      b. Or approved equal.

B. Other manufacturer's seeking approval of their products must comply with requirements of the Instructions to Bidders.

1.10 BI-FOLD DOOR FRAMEWORK

A. Fabrication / Construction Requirements:
   1. Hangar doors shall be of the electrically operated bi-fold canopy type and shall be integral with the hangar building design.
   2. When in the open position the doors shall have a slight slope to direct drainage away from the building.
   3. Door shall be hinged horizontally at the top and center, and be arranged to open by moving frame out and up.
   4. Door frames shall have pre-located top hinges to align with the building truss members.
   5. Door shall be self-contained with only the top hinges, bottom door rollers, and column followers / wind rails.
   6. The door framework shall consist of jig welded steel tube sections engineered by the door manufacturer to resist all anticipated loads without sagging, bowing, or conflicting with its smooth operation.
   7. Structural steel door framing members shall be ASTM A500 Grade B square structural welded steel tubing.
   8. All labor, materials, accessories, equipment and services necessary to furnish a complete installation of a bi-fold hangar door as indicated by the manufacturer. Including frame, sections, brackets, guides, tracks, hardware, operators and installation instructions.
   9. Shop connections shall be welded.
   10. Field connections shall be bolted.

1.11 DRIVESHAFT / LIFT DRUMS

A. The solid steel driveshaft with lift drums mounted on bottom cord of door runs continuously along entire door width providing an even lift of the door at all times.

B. The drive shaft shall be attached to the door frame with (greaseable) bearing mounts wherever there is a cable drum installed, to minimize stress on the shaft.

C. Solid Driveshaft and lift drums shall be in sufficient amount to give 5:1 safety factor.

1.12 LIFTING METHODS

A. Lift Straps:
1. The door power unit shall be operated by a system of lifting straps (not cables),lifting drums, and drive shafts.
2. Lift straps attached to a retainer on the upper door frame passing through a strap guide attached at the top chord of the door frame, thereby transmitting forces directly to header of building and relieving door of unnecessary stresses.
3. The lift straps shall have adjustable slack take-up device to keep proper tension on each lift strap.
4. The lift drums must be properly shielded to avoid any potential hazards to people.
5. Lift straps and lift drums shall be manufacturer's standard adequately sized in sufficient amount to give 5:1 safety factor.

1.13 HEAVY DUTY HINGES

A. Heavy Duty Steel Hinges furnished complete. Each Hinge set shall be 10.50″ wide , pins shall be 11/16″ diameter minimum.

1.14 DOOR TRUSSES

A. Internal truss – standard:
1. An extra heavy duty center truss shall be installed in the center of the interior side.
2. There will be a truss at the base of the door to provide extra strength.

1.15 HEAVY DUTY SIDE ROLLERS

A. The bi-fold hangar doors shall include 3″ heavy duty minimum guide rollers with sealed bearings on bottom of door at jamb location.

1.16 COLUMN FOLLOWERS / WIND RAILS

A. System provided by the door manufacture to hold the base of the door securely against the building when the door is in the closed position.
1. Solid square columns secure only in the closed position = Wind Rails.

1.17 WIND PINS

A. Automatic Wind Pins:
1. Center wind pins 1″ diameter minimum.
2. Provide a sturdy installation.
3. Must automatically engage / disengage.

1.18 MANUAL LATCHING SYSTEMS

A. Standard Manual Latch – Standard:
   1. The latching system shall be provided on both sides of the doors.
   2. A manually latching system will be furnished so that the door is manually unlocked before the door can be opened and manually relocked after the door is in the closed position.

PART 2 PRODUCTS

2.01 PAINT

A. The door frame members and parts shall be factory primer finished with gray primer.

2.02 TOP AND BOTTOM RUBBER SEALS

A. Provide manufacturer's standard seal continuous at top, bottom of each door.

B. The door shall be equipped with neoprene weather stripping at heads and jambs to prevent flow of moisture into the door installation. Sills shall have a special fabric reinforced high grade rubber astragal. The entire door perimeter shall be weather tight.
   1. Note: That existing bituminous surface varies and seals shall be placed accordingly.

2.03 WEATHER SEAL KIT

A. The sides, and center of each bi-fold can be sealed off with a special weather stripping. The center of the door must have a self-sticking foam cushion seal. The entire door perimeter must be weather tight.

2.04 BI-FOLD DOOR ELECTRIC POWER OPERATOR – BOTTOM DRIVE

A. Location of Power Operator:
   1. Motor shall be located on bottom chord of door frame.

B. Electrical Controls:
   1. All electrical controls and devices shall be designed to meet National Electrical Code Section 513.
   2. All controls are pre-wired and factory tested.

2.05 ELECTRIC MOTOR / VOLTAGE / PHASE

A. Electric Motor / Voltage / Phase:
   1. Service: 208 VAC, Single-Phase.
   2. Motor shall be totally enclosed capacitor start.
   3. 208V electric motor with overload protection direct mounted to a gear reduction box and winding drum.

4. The size of the motor shall be as recommended by the manufacturer.
5. Door operator shall be pre-wired at factory complete with 24 VAC control system.

2.06 GEAR MOTOR

A. The gear motor is equipped with an electric brake, which will stop and hold door in any position of door travel.

B. Provide high starting torque, reversible, continuous duty, Class A insulated, electric motors complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction, from any position.

C. A magnetic starter, with 24V control unit for reliability is standard.

D. Design operator so motor may be removed without disturbing limit switch adjustment and without affecting emergency auxiliary operator.

2.07 CONTROL STATIONS

A. Two-button constant hold control station for opening and closing bi-fold door.
1. Two-button constant contact dead man switch, prevents operator from leaving control panel while door is in motion, either “up” or “down”.
2. When the operator takes their hand off the “up” / “down” button, the door immediately stops regardless of its opening / closing position.
3. The motor automatically stops when the door reaches either the full open or closed position.

2.08 LIMIT SWITCHES

A. Heavy duty limit switch box shall be weatherproof.

B. Heavy duty limit switch box shall provide adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
1. Note : Safety edges shall not be used as limit switches.

2.09 ELECTRICAL DISCONNECT

A. Provide Electrical Disconnect to completely disable the door, for service, maintenance, and emergency backup operations.

B. Mount disconnect so it is accessible from floor level.

2.10 EXECUTION

A. Examination:
1. Examine wall and overhead areas, including opening framing and blocking, with Installer present, for compliance with requirements for installation tolerances, clearances, and other conditions affecting performance of Work of this Section.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

PART 3 INSTALLATION

3.01 GENERAL

A. Door manufacturer is required to coordinate with the metal building manufacturer in the development of the exact installation details, and provide weights and door loadings to building manufacturer.

B. Install door, track, and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports according to Shop Drawing, manufacturer's written instructions, and as specified.

C. Fasten vertical track assembly to framing at not less than 24″ o.c. Hang horizontal track, hinges from structural overhead framing with angle or channel hangers welded and/or bolt fastened in place. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track, hinges and door-operating equipment.

D. Top and Bottom Limits Settings:
1. Each bi-fold door has a recommended clear opening setting, specified by the manufacture. Do not over travel the door beyond the recommended setting.

E. Exterior Wall Panels:
1. Metal building erector to install the same exterior wall panels that are on the building, use the same type on the bi-fold doors. Install the proper trims that are recommended by the manufacturer.

F. Apply Proper Safety Markings:
1. Apply Proper Markings for any potentially hazardous locations related to the operation of the door. Follow the pictorial diagram included in the door installation manual.

G. Installing Warning Labels:
1. Furnish warning labels for any potentially hazardous locations related to the operation of the door.
2. Fasten warning labels to the bi-fold door frame and by the operator's station in accordance with manufacturers' instructions, NO EXCEPTIONS.

H. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

3.02 ELECTRICAL WORK

A. Contractor is Responsible for:
1. The Contractor is responsible and required to completely install the prewired electrical door operating mechanism, push button controls, devices and electrical conduit, and wiring to the door operating controls.

2. Detail wiring for power, signal, and control systems.
    a. Differentiate between manufacturer-installed and field installed wiring and between components provided by door manufacturer and those provided by others.
3. Install bi-fold doors in accordance with manufacturers' instructions.

3.03 ADJUST AND CLEAN

A. Lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion and fitting weather tight for entire perimeter.

B. Prime Coat Touch Up:
1. Immediately after erection, sand smooth any rusted or damaged areas of prime coat.
2. Touch-up damaged coating and finishes and repair minor damage.
3. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned, and apply touch up of compatible air drying primer.

C. Final Adjustments:
1. Lubricate bearings and moving parts, adjust open and closed limits and doors to operate easily, free from warp, twist, or distortion and fitting weathertight for the entire perimeter.
2. Check and readjust operating finish hardware items, leaving vertical bi-fold doors undamaged and in complete and proper operating condition.

3.04 DEMONSTRATION

A. Startup Services: Engage a qualified-authorized Service Representative to perform startup services and to train Owner's Maintenance Personnel as specified below:
1. Test and adjust controls and safeties.
2. Replace damaged and malfunctioning controls and equipment.
3. Train Owner's Maintenance Personnel on procedures and schedules related to startup and shut down, operating, troubleshooting, servicing, and preventative maintenance.
4. Review data in the installation and maintenance manuals.
5. Schedule training with Owner at least 7 days advance notice.

3.05 WARRANTY

A. The Contractor shall warrant the door to be free of defects in accordance with the General Conditions, except the warranty shall be extended by manufacturer's 2-year written warranty against defects in materials and workmanship, against problems which arise through normal anticipated usage of the door during the warranty period. The warranty shall be signed by the manufacturer.

B. Additional warranty on the straps.
1. In addition to the warranty specified above, the door manufacturer shall warrant the original lift straps for a period of 5 years, against defects in material.

3.06 OPTIONAL UPGRADE EQUIPMENT

A. Top Override Safety Switches:
   1. Upper override switch that disconnects power to door if upper limit fails or if limits are overridden.
   2. This safety feature is designed to prevent the door from traveling beyond its recommended clear opening height. If the door passes its full clear opening height, it will activate the override and stop the door automatically.

B. # 2 Side Latch Safety Switches:
   1. Side latch safety switches eliminate possible damage if door is opened while in locked position.
   2. These switches are designed to prevent the door from operating while the side latches are locked in the closed position.

C. # 3 Warning Lights And Horn:
   1. Warning lights and horn, which alerts persons in the area that door is opening or closing.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes surface preparation and field application of paints, stains, varnishes, and other coatings.
   1. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

B. Extent of painting work is indicated on drawings and schedules, and as herein specified.

C. Work includes painting and finishing of interior and exterior exposed items and surfaces throughout project, except as otherwise indicated.

D. Surfaces to be painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces, whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard colors or finishes available.

E. Following categories of work are not included as part of field-applied finish work:
   1. Prefinished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal toilet enclosures, prefinished partition systems, architectural casework, and finished mechanical and electrical equipment, including light fixtures, switchgear, and distribution cabinets.
   2. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas.
   3. Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.
   4. Operating Parts: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting.

F. Following categories of work are included under other sections of these specifications:
   1. Shop Primers: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metalwork and similar items.

G. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, or nomenclature plates.

1.02 REFERENCES

A. ASTM International:
1. ASTM D16 – Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products
2. ASTM D4442 – Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials
3. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials

B. National Fire Protection Association (NFPA):
1. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials

C. Painting and Decorating Contractors of America (PDCA):
1. PDCA Architectural Painting Specification Manual

D. The Society for Protective Coatings (SSPC):
1. SSPC Steel Structures Painting Manual

E. Underwriters Laboratories Inc.:
1. UL 723 – Tests for Surface Burning Characteristics of Building Materials

F. National Association of Corrosion Engineers (NACE) International.

1.03 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples:
1. For initial color selection.
2. For each color and sheen after selection of colors is made.

C. Coating Maintenance Manual:
1. Upon completion of project, furnish coating maintenance manual. Basis of Design: Sherwin Williams “Custodian Project Color and Product Information” report or equal.
a. Manual shall include an Area Summary with finish schedule, Area Detailing designating where each product/color/finish was used, product data pages, SDS Sheets, care and cleaning instructions, touchup procedures, and color samples of each color and finish used.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

B. Coordination of Work: Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

1.05 PRE-INSTALLATION MEETING

A. Schedule pre-installation meeting with Owner and A/E 1 week minimum prior to commencing work of this Section.

1.06 DELIVERY AND STORAGE

A. Delivery: Deliver materials to job site in original, new, and unopened packages and containers bearing manufacturer's name and label and following information:
1. Name or title of material.
2. Fed. Spec. number, if applicable.
3. Manufacturer's stock number and date of manufacture.
4. Manufacturer's name.
5. Contents by volume, for major pigment and vehicle constituents.
6. Thinning instructions.
7. Application instructions.
8. Cleaning instructions.
9. Color name and number.

B. Storage:
1. Store materials not in actual use in tightly covered containers.
2. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.
3. Protect from freezing where necessary.
4. Keep storage area neat and orderly.
5. Remove oily rags and waste daily.
6. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Apply water-based paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50°F (10°C) and 90°F (32°C), unless otherwise permitted by paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45°F (7°C) and 95°F (35°C), unless otherwise permitted by paint manufacturer's printed instructions.

C. Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

D. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

1.08 EXTRA MATERIALS

A. Supply 1 gallons of each color, and type; store where directed.

B. Label each container with color, room locations, and date in addition to manufacturer's label.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sherwin Williams Paints (Listed in Schedule).

B. Products by the following manufacturers may be substituted for scheduled products when equivalent in performance:
1. Dunn Edwards Paint Company.
2. Benjamin Moore.
3. Kwal-Howells.
4. ICI Paints.

2.02 COMPONENTS

A. Coatings: Ready-mixed, except field catalyzed coatings.
1. Prepare coatings:
a. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
b. For good flow and brushing properties.
c. Capable of drying or curing free of streaks or sags.

2.03 MATERIALS

A. Material Quality:
1. Provide best quality grade of various types of coatings regularly manufactured by listed manufacturers.
2. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Color Pigments: Pure, no-fading, applicable types to suit substrates and service indicated.

PART 3 EXECUTION

3.01 INSPECTION

A. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of the Work.

B. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.

C. Starting of painting work will be construed as Applicator’s acceptance of surfaces and conditions within any particular area.

D. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.02 GENERAL PREPARATION

A. Product label directions must be read and followed.

B. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition. Clean surfaces before applying paint or surface treatments.
1. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.

C. When using a commercially available solvent or cleaner, observe recommended precautions:
1. Follow all manufacturers' specifications for product use and preparation.
2. Test cleaning materials on an isolated or hidden area to determine that the desired result is achieved and that no damage or discoloration occurs as a result of the product's use.
3. Do not mix chemical compounds. Some cleaners may react with other solutions, creating toxic or poisonous vapors.
4. Remove cleaners thoroughly.
5. When working with toxic or caustic substances, wear protective clothing and gear as recommended by the substance manufacturer.
6. Use the proper tools for the cleaning job at hand, and use these tools in a safe and proper manner.

D. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

E. Surfaces must be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion.
   1. Provide barrier coats over incompatible primers or remove and reprime as required. Notify A/E in writing of any anticipated problems in using specified coating systems with substrates primed by others.

F. Remove mildew before painting by washing with a solution of one part liquid household bleach and three parts of warm water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow the surface to dry 48 hours before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing, and follow all precautions as listed on the cleaning product label. Quickly wash off any of the mixture that comes in contact with skin. Do not add detergents or ammonia to the bleach/water solution.

G. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place that are not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Following completion of painting of each space or area, reinstall removed items.

3.03 SUBSTRATE PREPARATION

A. Follow the required preparation method identified in the manufacturer's product data sheet and the recommended SSPC surface preparation method.

B. Aluminum: Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP1, Solvent Cleaning.

C. Asbestos Siding: Remove all dust and dirt. If siding has weathered and become porous, treat with Masonry Conditioner.

D. CMU: Remove all loose mortar and foreign material. Surface must be free of laitance, concrete dust, dirt, form release agents, moisture curing membranes, loose cement, and hardeners. Cure concrete and mortar at least 30 days at 75°F. The pH of the surface should be between 6 and 9. On tilt-up and poured-in-place concrete, commercial detergents and abrasive blasting may be necessary to prepare the surface. Fill bug holes, air pockets, and other voids with a cement-patching compound.

E. Brick: Must be free of dirt, loose and excess mortar, and foreign material. Allow brick to weather for at least 1 year, followed by wire brushing to remove efflorescence. Treat the bare brick with one coat of Loxon Exterior Acrylic Masonry Primer.

F. Concrete: SSPC-SP13 or NACE 6. This standard gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems. The requirements of this standard are applicable to all types of cementitious surfaces, including cast-in-place concrete floors and walls, precast slabs, masonry walls and shotcrete surfaces. An acceptable prepared concrete surface should be free of contaminants, laitance, loosely

adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.

G. Cement Composition Siding/Panels: Remove all surface contamination by washing with an appropriate cleaner, rinse thoroughly and allow to dry. Scrape and sand existing peeled or checked paint to a sound surface. Pressure-clean, if needed, with a minimum of 2100 psi pressure to remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, and peeling or defective coatings. Allow the surface to dry thoroughly. If the surface is new, test it for pH; many times the pH may be 10 or higher.

H. Copper: Remove all oil, grease, dirt, oxide, and other foreign material by cleaning per SSPC-SP 2, Hand Tool Cleaning.

I. Drywall - Interior and Exterior: Must be clean and dry. Set and spackle nail heads. Tape and cover joints with a joint compound. Sand spackled nail heads and tape joints smooth, and remove dust prior to painting. Spackle exterior surfaces with exterior grade compounds.

J. Exterior Composition Board (Hardboard): Some composition boards may exude a waxy material that must be removed with a solvent prior to coating. Whether factory primed or unprimed, exterior composition board siding (hardboard), clean thoroughly and prime with an alkyd primer.

K. Galvanized Metal: First, Solvent Clean per SSPC-SP1 and apply a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP7 is necessary to remove these treatments.

L. Plaster: Allow to dry thoroughly for at least 30 days before painting. Ventilate rooms while drying; heat rooms in cold, damp weather. Repair damaged areas with an appropriate patching material. Allow bare plaster to cure and harden. Treat textured, soft, porous, or powdery plaster with a solution of 1-pint household vinegar to 1 gallon of water. Repeat until the surface is hard; rinse with clear water and allow to dry.

M. Previously Coated Surfaces: Maintenance painting will frequently not permit or require complete removal of all old coatings prior to repainting. However, remove all surface contamination such as oil, grease, loose paint, mill scale dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers to assure sound bonding to the tightly adhering old paint. Clean and dull glossy surfaces of old paint films before repainting. Fill and sand surface irregularities smooth. Thoroughly wash with an abrasive cleanser to clean and dull in one operation, or, wash thoroughly and dull by sanding. Spot prime any bare areas with an appropriate primer. Check for compatibility by applying a test patch of the recommended coating system, covering at least 2 to 3 square feet. Allow to dry one week before testing adhesion per ASTM D3359. If the coating system is incompatible, complete removal is required (per ASTM 4259, see Concrete).

N. Steel:

1. Structural, Plate, etc.:

a. Clean by one or more of the nine surface preparations described below. These methods were originally established by the Steel Structures Council in 1952 and are used throughout the world for describing methods for cleaning structural steel. Visual standards are available through the Steel Structures Painting Council, SSPC-VIS 1-89. A brief description of these standards, together with numbers by which they can be specified, follow:

1) Solvent Cleaning, SSPC-SP1: Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Provide ventilation as recommended by the Solvent manufacturer.

2) Hand Tool Cleaning, SSPC-SP2: Hand Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that this process remove adherent mill scale, rust, and paint. Before hand tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP 1.

3) Power Tool Cleaning, SSPC-SP3: Power Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that this process remove adherent mill scale, rust, and paint. Before power tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP 1.

4) White Metal Blast Cleaning, SSPC-SP5 or NACE 1: A White Metal Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Before blast cleaning, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP 1 or other method proposed by the installer and agreed upon by the A/E.

5) Commercial Blast Cleaning, SSPC-SP6 or NACE 3: A Commercial Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be limited to no more than 33 percent of each square inch of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Before blast cleaning, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP 1 or other method proposed by the installer and agreed upon by the A/E.

6) Brush-Off Blast Cleaning, SSPC-SP7 or NACE 4: A Brush-Off Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface. Before blast cleaning, remove visible deposits of oil or

grease by any of the methods specified in SSPC-SP 1 or other method proposed by the installer and agreed upon by the A/E.

7) Power Tool Cleaning to Bare Metal, SSPC-SP11: Metallic surfaces that are prepared according to this specification, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portions of pits if the original surface is pitted. Prior to power tool surface preparation, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP 1, Solvent Cleaning, or other method proposed by the installer and agreed upon by the A/E.

8) Near-White Blast Cleaning, SSPC-SP10 or NACE 2: A Near-White Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be limited to no more than 5 percent of each square inch of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Before blast cleaning, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP 1 or other method proposed by the installer and agreed upon by the A/E.

9) High- and Ultra-High Pressure Water Jetting for Steel and Other Hard Materials, SSPC-SP12 or NACE 5: This standard provides requirements for the use of high- and ultra-high pressure water jetting to achieve various degrees of surface cleanliness. This standard is limited in scope to the use of water only without the addition of solid particles in the stream.

O. Water Blasting, NACE Standard RP-01-72: Remove oil, grease, dirt, loose rust, loose mill scale, and loose paint by water at pressures of 2,000 to 2,500 psi at a flow of 4 to 14 gallons per minute.

P. Stucco: Clean and remove loose stucco. If recommended procedures for applying stucco are followed and normal drying conditions prevail, the surface may be painted in 30 days. The pH of the surface should be between 6 and 9.

Q. Wood - Exterior: Must be clean and dry. Prime and paint as soon as possible. Scrape, sand, and spot-prime knots and pitch streaks before full priming coat is applied. Patch all nail holes and imperfections with a wood filler or putty and sand smooth. Apply caulk after priming.

R. Wood - Interior: Store finishing lumber and flooring in dry, warm rooms to prevent absorption of moisture, shrinkage, and roughening of the wood. Sand surfaces smooth with the grain, never across it. Correct surface blemishes and clean area of dust before coating.

S. Vinyl Siding: Clean vinyl siding thoroughly by scrubbing with a warm, soapy water solution. Rinse thoroughly.

3.04 MATERIALS PREPARATION

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density, and stir as required during application.
   1. Do not stir surface film into material.
   2. Remove film and, if necessary, strain material before using.

3.05 APPLICATION

A. General:
   1. Apply paint in accordance with manufacturer's directions.
   2. Use applicators and techniques best suited for substrate and type of material being applied.
   3. Provide finish coats which are compatible with prime paints used.
   4. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint, until paint film is of uniform finish, color, and appearance.
      a. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
   5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Do not paint surfaces behind permanently-fixed equipment or furniture.
   6. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, not-specular black paint.
   7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
   8. Finish exterior doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated.
   9. Sand lightly between each succeeding enamel or varnish coat.
   10. Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

B. Scheduling Painting:
   1. Apply first-coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Minimum Coating Thickness:
1. Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as recommended by coating manufacturer.

D. Prime Coats:
1. Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others.
2. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

E. Pigmented (Opaque) Finishes:
1. Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage.
2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

F. Transparent (Clear) Finish:
1. Use multiple coats to produce glass-smooth surface film of even luster.
2. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.
3. Provide satin finish for final coats.

G. Completed Work:
1. Match approved samples for color, texture, and coverage.
2. Remove, refinish, or repaint work not in compliance with specified requirements.

3.06 CLEAN-UP AND PROTECTION

A. Clean-Up:
1. During progress of work, remove from site discarded paint materials, rubbish, cans, and rags at end of each work day.
2. Upon completion of painting work, clean window glass and other paint-spattered surfaces.
    a. Remove spattered paint by proper methods of washing and scraping.
    b. Use care not to scratch or otherwise damage finished surfaces.

B. Protection:
1. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work.
2. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
3. Provide "Wet Paint" signs as required to protect newly-painted finishes.
4. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
5. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.07 EXTERIOR PAINT SCHEDULE

A. Metal - Non-Ferrous, Galvanized or Shop-Primed Ferrous:
   1. First Coat: S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series.
   2. Second Coat: S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series (2.0-4.0 mils dry per coat).

3.08 INTERIOR PAINT SCHEDULE

A. Concrete - Concrete Floors, Non-Vehicular:
   1. First Coat: S-W H&C Clarishield Water-Based Wet-Look Concrete Sealer.
   2. Second Coat.: S-W H&C Clarishield Water-Based Wet-Look Concrete Sealer (100-200 sq. ft./gal.).

B. Metal - Non-Ferrous, Galvanized or Shop-Primed Ferrous:
   1. First Coat: S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series.
   2. Second Coat: S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series (2.0-4.0 mils dry per coat).

END OF SECTION

SECTION 10 44 00

FIRE EXTINGUISHERS AND ACCESSORIES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Fire Extinguishers.

B. Accessories.

C. The extent of portable fire extinguishers and brackets are shown on the Drawings.

1.02 RELATED WORK

A. Painting.

1.03 REFERENCES

A. NFPA10 – Portable Fire Extinguishers.

B. American National Standard ANSI A-117.1 2003.

C. Underwriters Laboratories Inc.:
1. UL - Fire Protection Equipment Directory.

1.04 QUALITY ASSURANCE

A. Conform to NFPA 10 requirements for portable fire extinguishers.

B. Provide fire extinguishers and accessories by a single manufacturer.

C. Conform to ASTM E814-83 for fire resistive wall performance where necessary.

D. Conform to ANSI A-117.1 on maximum cabinet projection of 4″.

1.05 SUBMITTALS

A. Submit brochure and product data in compliance with Section 01 33 23 – Shop Drawings, Product Data, and Samples.

B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. J.L. Industries, Inc., 4450 West 78th Street Circle, Bloomington, Minnesota 55435; Phone: (952) 835-6850, Fax: (952) 835-2218.

B. Larsen's Manufacturing Company.

C. Badger Fire Protection.

D. Potter Roemer.

E. Manufacturers of equivalent products submitted and approved in accordance with Section 01 25 00 – Substitution Procedures.

2.02 FIRE EXTINGUISHERS

A. 10 lb. capacity Multipurpose Dry Chemical Type, UL listing 4A:60B:C.

2.03 ACCESSORIES

A. Provide Extinguisher Brackets sized to support extinguisher type where brackets are indicated on the Drawings.

B. Graphic Identification: Provide vertical wall signage to be applied to wall surface above each extinguisher furnished.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install items included in this section in locations and at mounting heights indicated:
   1. Install wall brackets, maximum 48″ from finish floor to top of extinguisher handle.

B. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

C. Position cabinet signage as required by authorities having jurisdiction

END OF SECTION

SECTION 13 34 19

PRE-ENGINEERED METAL BUILDINGS

PART 1 GENERAL

1.01 SCOPE

A. Furnish and install a pre-engineered metal building to include shop fabricated structural steel building frame; metal wall system, sloped interlocking seam roof system including gutters and downspouts; trim, closure seals, building insulation and accessories.

B. Related Work:
1. Section 07 41 13 – Metal Roofing specifies roof panels to be installed under the work of this Section.
2. Section 08 33 13 – Hollow Metal Doors and Frames
3. Section 08 34 16 – Vertically Bi-Fold Hanger Door

1.02 DESCRIPTION

A. The building shall be a clear rigid frame with columns, ridged frame roof beams and a gable roof.

B. Actual building length and width shall be as shown on Drawings.

C. The roof shall have a ridgeline at its center and shall be sloped as shown on the Drawings.

D. The eave height shall be as shown on the Drawings.

1.03 QUALITY ASSURANCE

C. Perform Work in accordance with AISC and MBMA Low Rise Building Systems Manual.

D. Insulation Surface Burning Characteristics:
1. Batt Insulation: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

E. The building and accessories shall be a warranted system and the product of one manufacturer.

F. The Design is based on Alliance Steel Building Systems. However, products of similar design are available from other manufacturers and will be considered for approval in advance by the Architect. Product names and numbers used are similar to Alliance products and are used only as a descriptive standard of quality. Consideration will be made for manufacturer standard product differences.

G. Installer Qualifications:
   1. Demonstrated Quality of Workmanship.
   2. Minimum Number of Installations: Five.
   3. Minimum Age of Installations: 2 years

H. Requirements of Regulatory Agencies and Accepted Standards
   1. Latest edition of New Mexico Uniform Building Code.
   2. Latest edition AISC “Specifications for the Design, Fabrication, and Erection of Steel Buildings”.
   3. Latest edition of AISI “Specifications for the Design of Light gage Cold Formed Steel Structural Members”.

1.04 SUBMITTALS

A. Manufacturer's Instructions: Submit preparation requirements and anchor bolt placement.

B. Manufacturer's product data.

C. Color Charts: Submit for color selections for walls, roofing and trim.

D. Design Analysis:
   1. The Design Analysis shall be the design of a licensed Professional Engineer experienced in Design of this Work and shall include complete calculations for the building, its components, and the foundations. Calculations shall be stamped by a New Mexico Registered Professional Engineer.
   2. Foundations shown on the Drawings are based on loads derived from a representative set of similar building types and are to be used for bidding purposes only. The Engineer of Record will verify that the foundations shown are adequate for the building supplied using the criteria in paragraph Foundations. All loads from the Pre-Engineered Metal Building are to be provided so the foundation can be verified. Assumptions and conclusions shall be explained, and cross-referencing shall be clear.
   3. Wind forces on various parts of the structure, both positive and negative pressure, shall be calculated with the controlling pressure summarized.
   4. Lateral forces due to seismic loading shall be calculated and tabulated for the various parts and portions of the building. Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a licensed Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the Design. A narrative of the computer program delineating the basic methodology shall be included. Computer program output shall be annotated and supplemented with sketches to verify the input and output.
   5. Critical load conditions used in the final sizing of the members shall be emphasized.
   6. The Design Analysis shall include the name and office phone number of the Designer, who shall function as a point of contact to answer questions during the detail Drawing review.

E. Building dimensions are shown on Drawings:
   1. Building dimensions shall be as standard be as standard with manufacturer, not less than those indicated but exceeding the indicated dimensions only by the amount of the closest standard size thereto. Eave height shall be measured from the top of finished floor to intersection of insides of roof and sidewall sheets. The clear height between finished floor and bottom of roof steel shall be as indicated.

F. Shop Drawings:
   1. Submit complete descriptive Drawings that will detail the following:
      a. Required modifications to the slab and foundation details.
      b. All vertical and lateral design loads shall be as listed in the STRUCTURAL DESIGN CRITERIA on the Drawings and shall be shown clearly in the calculations submitted as part of the Shop Drawings. All reactions for the design of foundations shall be provided so that the foundation system maybe verified.
      c. Complete framing and erection plans and details.
      d. Anchor bolt setting plan.
      e. Covering and flashing details.
      f. Door and window interface details including framing around garage doors.
      g. All other details necessary to clearly indicate the proper assembly of all building parts.

G. Sample Warranty.

H. Certifications:
   1. Submit Certifications of the Following:
      a. Building has been designed in accordance with the design criteria shown on the Drawings.
      b. Special loads imposed by the overhead mechanical equipment, and miscellaneous building appurtenances on the building frames have been included in the Design.

I. Welder Qualifications: On request.

1.05 THE WORK

A. In the event of questions concerning the division of work specified and related to this section, the Contractors shall direct their questions directly to the Prime Contractor.

B. It is the intention of these specifications that all components of whatever nature necessary to produce and install the complete weathertight building, that is both operational and functional for the purposes intended, be included, and that all costs for such be therefore included in the Bid.

C. Verify and coordinate with other trades as required.

D. No extra cost shall be allowed for failure to comply with the above.

1.06 RELATED WORK

A. Foundations:
   1. Foundations including anchor bolt embedment length shall be as designed by the Engineer in consideration of the soil conditions of the building site.
   2. Reactions for the design of foundations shall be supplied by the building manufacturer.
   1. Anchor rod diameter shall be as specified by the building manufacturer and shall be supplied by the Contractor.

1.07 PRODUCT DELIVERY AND STORAGE

A. Deliver items in manufacturer's original, unopened crating and protective packaging.

B. Store materials where they will not be damaged in any way.

C. Handle so as to prevent damage to finished surface.

1.08 JOB CONDITIONS

A. Prior to commencing erection of any members, inspect footings, preformed channels and anchoring for dimensional accuracy and suitability for the purpose intended.

B. Coordinate with other trades as required.

C. Report discrepancies to Architect.

D. Field modification of parts shall be the responsibility of the building erector, and shall be in accordance with the highest standards.

1.09 WARRANTY

A. Furnish 20 year warranty to include coverage for exterior pre-finished surfaces color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading

PART 2 PRODUCTS

2.01 STRUCTURAL FRAME

A. Structural Steel Design:
   1. All hot-rolled structural steel members shall be designed in accordance with the latest edition of AISC “Specifications” and all cold formed steel structural members shall be designed in accordance with the latest edition of AISI “Specifications”.
   2. See Design Drawings for design criteria.

B. Primary Framing:
   1. Rigid Frames:
      a. Frames shall consist of welded up plate section columns and roof beams complete with necessary splice plates for bolted field assembly.
      b. All base plates, cap plates, compression/splice plates and stiffener plates shall be factory welded into place and have the connection holes shop fabricated.
      c. Columns and roof beams shall be fabricated complete with holes in webs and flanges for the attachment of secondary structural members and bracing except for field work as noted on manufacturer's Erection Drawings.
      d. All bolts for field assembly of frame members shall be high strength, direct-tension indicating bolts as shown on Erection Drawings.

C. Secondary Structural Members:
   1. Purlins and Girts:
      a. Purlins and Girts shall be “Z” or “C” shaped, precision roll formed.
      b. Girts shall be 8″ deep “Z” or “C” sections.
      c. Purlins shall be 8″ or 9-1/2″ deep “Z” sections.
      d. Outer flange of all girts shall contain factory punched holes for panel connections.
      e. Outer flange of purlins shall contain factory punched holes for panel connections. Optional purlins are also available without factory punched holes for panel connections.
   2. Bracing:
      a. Bracing shall be located by Manufacturer as indicated on Drawings.
      b. Diagonal bracing shall be hot rolled of size indicated on Erection Drawings, and attached to columns and roof beams where and as indicated on Erection Drawings. Bracing shall not in any way interfere with doors, windows, or other Architectural features.
      c. Sag rods, when required, shall be hot rolled and installed as indicated on Erection Drawings.
      d. Flange and purlin braces when required by the Structural Design shall be provided and installed.
      e. Provide lateral loads so that the CMU wall system design maybe verified.

D. Welding
   1. Welding procedures and operator qualifications and welding quality standards shall be in accordance with the American Welding Society Structural Welding Code. Inspection other than visual inspection as defined by AWS, Paragraph 8.15. 1, shall be identified and negotiated prior to Bidding.
   2. Certification of welder qualifications shall be supplied when requested.

E. Structural Painting:
   1. Prior to painting, the fabricator shall clean the steel of loose rust, loose mill scale, dirt and other foreign material. Unless otherwise specified, the fabricator shall not sandblast, frame clean or pickle prior to painting. The fabricator shall then factory coat all steel with one coat of primer paint formulated to equal or exceed the performance requirements of Federal Specification TT-P-636.

2. Shop coat of paint is primer and is intended to protect the steel for a short period of exposure. Subsequent finish painting, if required, is to be performed in the field by others.

2.02 ROOFING

A. General:
1. The roof shall be per the Architectural specifications and is generally described as standing seam roofing.
2. Details shall be in accordance with the manufacturer's Drawings and these construction documents.
3. Installation shall be in accordance with the manufacturer's Drawings and these construction documents.

B. Panels:
1. General:
   a. Panels shall be “standing seam” type panels as per the Architectural Specification.
   b. Panels shall be per the Architectural Specifications.
   c. Panel width shall be as required to provide 36″ coverage.
   d. Each panel shall have corrugations per Architectural Specifications. Panels shall be of maximum possible lengths to minimize end laps. Required end laps are to be located over and fastened to secondary structural members. End laps shall be not less than 6″.
   e. Panel side laps shall be per Architectural Drawings.
   f. Ridge assembly shall be designed to allow roof panels to move with expansion and contraction.
2. Panel Design:
   a. Panels shall be designed in accordance with AISI “Specifications” an in accordance with sound engineering methods and practices.
   b. Panels shall be designed to support the uniformly distributed design dead and live loads shown on the Drawings without exceeding a deflection-to span ratio of 1/ 240 (two-span condition).
3. Provisions for Expansion / Contraction:
   a. Provisions for thermal movement of the roof panels shall be accomplished per the Manufacturer’s recommendations.
   b. The roof shall provide for expansion/contraction without detrimental effect on the roof panels when ambient air temperature varies +/- 100°F from the temperature at which the roof was installed.
4. Panel Finish:
   a. Exterior:
      1) See Architectural Specifications.
5. Fasteners:
   a. Panels to Structural Members: 1/4-14″ x 7/8″ Type AB self-tapping, 3/8″ hex-headed galvanized screws with 5/8″ o.d. metal-backed neoprene washers or per Architectural specifications.
   b. Panel to panel connections: 1/4″-14″ x 7/8″ Type AB self-tapping, 3/8″ hex-headed galvanized screws with 5/8" o.d. metal backed neoprene washers.

6. Miscellaneous Materials:
    a. Material used in flashing and transition parts shall be painted or finished to match the roof panel material as specified.

2.03 ROOF LINER SYSTEM

A. Materials:
1. The liner system consists of the following materials:
    a. Unfaced light density fiberglass metal building insulation.
    b. Metal Building Insulation:
        1) Complies with ASTM C991 Type I.
        2) Complies with NAIIMA 202-96 REV 2000.
        3) Flame Spread Index <25 and Smoke Developed Index <50 when tested in accordance with ASTM E84, NFPA 255 and UL 723.
        4) Thermal Resistance Available R-Values: R-11.
        5) Unfaced.
2. Fabric liner facing / vapor barrier composed of woven high-density polyethylene coated on both sides with polyethylene. Complies with the following:
    a. ASTM C1136, Types I through Type VI:
        1) Type I-IV exception for dimensional stability (value is <2.0%).
        2) Perm Rating: ≤0.02 when tested in accordance with ASTM E 96 Procedure A.
        3) Flame Spread Index: <25 and Smoke Developed Index: <50, when tested in accordance with ASTM E84.
        4) Color: White.
3. Vapor Barrier Adhesive: Complies with the following:
    a. Application temperature 10°F to 110°F.
4. Double-Sided Vapor Barrier Tape: Complies with the following:
    a. Width: 0.75".
    b. Rubber based and free film.
5. Patch Tape: Complies with the following:
    a. Adhesive added to one side.
    b. Installation temperature from 10°F to 110°F.
    c. 3" width.
6. Metal Banding / Straps: Complies with the following:
    a. Coated steel.
    b. 1.0" wide.
    c. Structural Steel Grade 50 pe ASTM C653.
    d. Exposed Color to Match Vapor Barrier: White.
7. Thermal Breaks:
    a. Closed Cell Polyethylene Foam Tape for Wall Applications: Complies with the following:
        1) 0.125" thick to 0.375" thick.
        2) 3.0" wide.
    b. Thermal Spacer Blocks: Complies with the following:
        1) Extruded or expanded polystyrene.
        2) Minimum width 3".
        3) Thickness 0.5" – 1.0".

8. Light Gage Steel Fasteners:
    a. Zinc-plated cold-forged steel.
    b. Head Color to Match Vapor Barrier: White.
    c. Contain rubber sealing washer.
9. Heavy Gage Steel Fasteners:
    a. Zinc-plated cold-forged steel.
    b. Head Color to Match Vapor Barrier: White.
    c. Contain rubber sealing washer.
10. Insulation Hangars:
    a. Insul-hold insulation hangers.

2.04 WALL SYSTEMS

A. Insulated Metal Wall Panels:
1. Basis of Design: MCBI, LS-36.
2. G-90 Galvanized Coated Steel: ASTM A 653.
3. Exterior Face Sheet: 24 gauge,
    a. Finish: Fluoropolymer two-coat system.
    b. Manufacturer shall warrant that coating shall not blister, peel, crack, chip, or experience material rust through for 20 years. For a period of 20 years chalking shall not exceed #8 - ASTM D4214 and fading shall be 5E Color Difference Units or less.
4. Interior Face Sheet: 24 gauge,
    a. Finish: Fluoropolymer two-coat system.
5. Panel Width: 36″.
6. Panel Thickness: As required to meet performance requirements.
7. Insulating Core: Polyurethane with zero ozone depletion potential blowing agent.
    a. Closed Cell Content: 90% or more as determined by ASTM D6226.
    b. Comprehensive Strength: As required to meet structural performance requirements and with a minimum of 22 psi as determined by ASTM D1621.
    c. Sheer Strength: As required to meet structural performance requirements and with a minimum of 36 psi as determined by ASTM C 273.
    d. Tensile Strength: As required to meet structural performance requirements and with a minimum of 41 psi ASTM D 1623.
    e. Minimum Density: 2.0 pcf (32 kg/m3) as determined by ASTM D 1622.
    f. Thermal Resistance (R-Value): R-13.

2.05 FACTORY LAMINATED METAL BUILDING INSULATION

A. FHC rating of 25/50 in accordance with ASTM Specification E84 and bear UL and the NAIMA 202-96® (Rev. 2000) standard identification labels

B. Fiber glass blanket insulation shall be formaldehyde-free, engineered specifically for the lengths and widths needed for metal building construction in accordance with ASTM Specification C 991, Type II with the exception of width tolerance.
1. Manufacturers
    a. CertainTeed Corporation,

b. Knauf Fiber Glass,
c. Johns Manville Corporation, and
d. Owens Corning.

2. Facing shall be PSK-LD white propylene film, fiber-glass and polyester scrim, 11# natural kraft meeting ASTM C1136-90 requirements:
   a. WVTR Perm: 0.09.
   b. Tensile Strength: 40lb./in. MD, 30 lb./in. XD.
   c. Mullen Burst: 60 psi.
   d. Beach Puncture: 125.
   e. NRC: .85.
3. Thermal resistance of Roof System:
   a. Roof System: R-value 19 +11 LS.
   b. Wall System: R-value 13+13 CI.

2.06 ACCESSORIES

A. Wind Bracing: As required by system manufacturer to accomplish the occupational purpose as illustrated in the Drawings. Comply with all provisions of the 2006 IBC and all regulatory agencies. Portal frames as required at open bays.

B. Pipe Flashing: All pipe flashing units shall be constructed of E.P.D.M. rubber as manufactured by DuPont (Nordel 1440 Hydro-Carbon). Units shall be black in color. A ductile aluminum (alloy A- 1 600 - 0) reinforcing ring shall be bonded to the rubber flange on the base of the flashing unit. Install in accordance with manufacturer's standard details for metal buildings. See Mechanical and Electrical Drawings for number, size, and location.

C. Roof Openings: Provide single piece metal curbs to match roof panel configurations. Check location of center of gravity of equipment to assure equal distribution of weight on structure below roof. Determine any additional structural requirements or modifications and provide for it. Allow duct clearance for anticipated thermal movement. Comply with manufacturer's standard details. See Mechanical Drawings for number, size and location of all required roof penetrations.

D. Rain Gutter and Downspouts:
1. Gutter shall be manufacturer's standard and shall be fabricated from galvanized steel, ASTM Specification A525, G90 coating, latest issue.
2. Gutters shall have a factory finish to match Metal Roofing (Galvalume) and shall be supported by matching galvanized hangers from roof panels.
3. Preformed corner closures shall be installed to match the contour configuration of the trim and gutter.
4. Preformed weather seals shall be installed to completely fill roof configuration voids prior to installation of the roof gutter.
5. Comply with all manufacturer recommendations.
6. Provide and install compatible and matching (Galvalume) downspouts as indicated on Drawings.

E. Gable Trim:
1. Provide and install manufacturer's standard gable trim. Fabricate from

galvanized steel, ASTM Specification A525, G90 coating, latest issue.
2. Gable trim shall have a factory finish to match metal roofing (Galvalume).
3. Provide end closures as required.
4. Provide weather seals as required.

F. Wall Penetrations:
1. Provide openings and required flashing, reinforcing, sealants and all accessories in accordance with manufacturer's recommendations and industry standards for all wall penetrations as indicated on the Drawings.
2. Coordinate with mechanical and other contractors as required.

G. At wall panels installed over metal stud framing, provide hat channels as noted and weather barrier: Two layers 15# asphalt-coated building felt or equal.

2.07 OPENINGS

A. Provide opening framing for vertically bi-fold door and louvers.

B. Provide panel trim and flashings for vertically bi-fold door and louvers.

PART 3 EXECUTION

3.01 GENERAL

A. Erect buildings and install accessories in accordance with Erection Drawings using proper tools and equipment. Erection practices shall conform to Section 5, MBMA "Code of Standard Practices". There shall be no field modifications to primary structural members except as authorized and specified by the manufacturer.

3.02 EXAMINATION

A. Verify foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position.

3.03 INSTALLATION

A. Install complete system in accordance with manufacturer's printed instructions and approved Shop / Erection Drawings. Employ only skilled mechanics experienced and familiar with the system. Any required adjustments and field modifications are included in the Scope of Work and shall be made in a manner acceptable to the Architect. All work shall be level and plumb and suitable for the purpose intended for a complete and watertight assembly.

B. Cleaning: Remove all waste materials, leave premises clean and free of all foreign matter and soil.

END OF SECTION

SECTION 26 00 10

GENERAL CONDITIONS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Labor, equipment, tools, materials, supplies, and operations necessary to install a complete electrical system, including that which may be reasonably implied on the Drawings or in the Specifications as being incidental to the work of Division 26.

B. Labor, equipment, tools, materials, supplies, and operations required to make a completely electrically operable system of the equipment furnished under other Divisions of this Specification.

1.02 MISCELLANEOUS MATERIALS

A. The Drawings are not intended to and do not show all equipment such as junction boxes, outlet boxes, conduit, fittings, mounting and miscellaneous hardware, and similar. Even though such items may not be specifically mentioned in the Specifications nor shown on the Drawings, nor noted on Shop Drawings, if they are necessary to make a complete installation, include them in the work required under this Division.

1.03 QUALITY ASSURANCE

A. Use only thoroughly trained and experienced personnel who are completely familiar with the requirements of this work and with the recommendations of the manufacturer of the specified items to fabricate, install, and test the work of this Division.

B. Where the Specifications or Drawings call for equipment or methods to be of better quality or higher standards than required by referenced Codes or Standards, the Specifications and Drawings shall prevail.

1.04 SUBSTITUTIONS

A. When requesting substitution of material for products specified in this Division, comply with Section 01 25 00 – Substitution Procedures. Include as part of the request detailed descriptions and drawings showing all resultant changes to the electrical work.

B. The design of certain equipment may be related to factors not immediately obvious. Changes in design of equipment may require technical justification, or require changes be made in other equipment to match the proposed changes, or require the equipment be supplied as specified, or any combination of the above, at no additional cost to the Owner.

1.05 LOCATION OF ELECTRIC EQUIPMENT

A. The Drawings or other Specification sections define the approximate location of services, cabinets, panelboards, switches, lights, receptacles, and other equipment. Determine the most suitable location by actual measurement during construction. Maintain clearance required by NEC Article 110. Propose final location and obtain approval of the Engineer in advance of installation.

B. Coordinate location and configuration of electrical work with the work of other trades to avoid interference, to assure convenient access for operation and maintenance of equipment, for optimum luminaire placement, and for neat appearance.

1.06 SIZE AND RATING OF MATERIALS

A. The size and rating of the conductors, conduits, overcurrent protection devices, disconnect devices, motor starters, and other related equipment used to provide and control electric supply to the various power consuming equipment furnished under this contract have been determined based on the requirements of the specified equipment. If the requirements of the power consuming equipment actually furnished causes a need to change the rating of any of these materials:
   1. Consult with the Engineer to determine the changes necessary to provide and control electric supply to the equipment furnished, and
   2. Install the agreed upon materials at no increase in the Contract amount or time.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26 00 20

CODES, PERMITS, AND FINES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 COMPLIANCE

A. This Section applies to Division 26 and to Division 40 Section 40 61 13 – Control System Documents and Procedures and to Sections referenced therein.

B. Perform electrical work and provide material and equipment in compliance with the State of New Mexico Electrical Code (NMAC, Title 14, Chapter 10, Part 4) and other national, state, and local codes, regulations, laws, and ordinances. It will be the responsibility of the Engineer to resolve conflicts between the above and the Specifications or the Drawings.

C. Without relieving the Contractor from the obligation to comply with all provisions of the NMEC and other codes and standards, attention is directed to NMAC 14.10.4.11 B. (1) "Section 110.2 Approval." Approval by the Engineer is required for all electrical wiring, equipment, or material for which a (UL) safety standard does not exist.

1.02 PERMITS

A. Obtain electrical permits. This applies whether or not the AHJ requires a permit for the structural/process portion of a project.

1.03 INSPECTIONS AND CERTIFICATES

A. Arrange and pay for electrical inspections.

B. Correct deficiencies noted as a result of inspections then arrange for additional inspections.

C. Furnish properly executed certificates of final electrical inspection and approval from the AHJ at the conclusion of the work and before final acceptance of the work by the Owner.

D. It is recognized that inspection by the AHJ is intended to determine whether the work is in compliance with applicable codes, not to determine whether the work is in compliance with the Contract Documents.

1.04 PAYMENTS TO THE AHJ

A. Include in the Bid the cost of permits and initial inspections.

B. No change in the Contract Amount will be allowed for other costs associated with this Section, such as but not limited to the cost for certification of non-labeled equipment, additional inspections, and fines/penalties levied by the AHJ. Exception: If a Change Order results in charges from the AHJ for an additional permit and/or additional inspections, then itemized, documented costs will be included in the Change Order amount.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26 00 40

PROJECT RECORD DOCUMENTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 GENERAL

A. Except as may be stated below, this Section applies to Division 26, to Section 40 61 13 – Control System Documents and Procedures and to Sections referenced therein. It contains minimum requirements; also comply with Section 01 78 39 – Project Record Documents.

1.02 LEGIBILITY

A. Materials that are not sufficiently legible to the Engineer may be returned without being reviewed.

B. Materials of marginal legibility may be accepted for preliminary review but rejected for use as final Record Documents.

C. Minimum text height on project-specific submittal drawings such as schematics, connection diagrams, loop diagrams, and similar: 1/8 inch.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONTRACT DRAWINGS

A. Maintain a complete set of Contract Drawings in "Record" condition. Mark, initial, and date changes, modifications, or corrections as they occur.

B. Show by dimensions and by correct scale the location and burial depth of underground conduits, duct banks, conduit stubouts, and direct buried cables. Show location and depth at each end and at every bend.

C. Show all differences between electrical and instrumentation design and the actual construction of electrical and instrumentation systems.

D. Have the Drawings available for inspection by the Engineer during standard work hours at the project site.

E. Furnish the "Record" Contract Drawings to the Engineer after completing the work and tests.

3.02 RECORD DRAWINGS/SUBMITTALS

A. Maintain a complete set of Shop Drawings in "Record" condition. Mark, initial and date changes, modifications, or corrections as they occur.

B. Where required in the equipment sections, return field marked Shop Drawings to the respective manufacturer who shall transfer "Record" markings to the original tracings, stamp the originals "Record" and place the date adjacent to the stamp.

C. Where a connection diagram is required as part of the submittals for a Section of these Specifications, whether in Division 26 or Division 40 or not, the Record documents for that section shall include copies of the connection diagrams that show all field interconnection information. Where a wire goes to a field device, such as a STOP pushbutton, the interconnection information may simply say "STOP pushbutton, field." Where a wire goes to an equipment where it is terminated on a terminal board, show the wire destination by equipment name or abbreviation, then terminal board number, then terminal point number, VFD1-B 6 for example.

D. Furnish other "Record" Shop Drawings to the Engineer.

END OF SECTION

SECTION 26 00 60

EXTRA MATERIALS AND SPARES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Extra materials, such as spare parts, maintenance materials, and special tools for Division 26, Section 40 61 13 – Control System Documents and Procedures, for Sections referenced therein, and for other Sections as required below.

B. Marking, packaging, and delivery of extra materials as required in Division 1.

1.02 SUBMITTALS

A. Include detailed descriptions of extra materials in the submittal materials for specific Sections and show in the Master List as required in Section 01 78 44 – Spare Parts and Maintenance Materials.

PART 2 PRODUCTS

2.01 EXTRA MATERIALS AND SPARES REQUIRED

A. If the equipment submitted differs from that specified and the manufacturer recommends extra materials, provide extra materials of equal function to those specified. Also provide additional materials if so recommended in the manufacturer's Operation and Maintenance Manual. Information on all additional materials and substituted materials shall be properly submitted to the Engineer for approval before materials are purchased.

B. Regardless of the Division/Section in which the equipment is specified, provide spares of every type and rating of fuse used in the project. Provide minimum quantity as shown below but provide more if so specified elsewhere.
1. Fuses of 250V or Less: One standard package or ten, whichever is greater.
2. 600V Fuses: Six (6).

C. Regardless of the Division/Section in which the equipment is specified, provide minimum quantity of spares as shown below but provide more if so specified elsewhere.
1. 24V Power Supply: One spare.
2. PLC Power Supply Card or Module: One spare.
3. Ethernet Switch: One spare.

D. As required in specific Sections.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE WIRE AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low voltage wire and cable.

1.02 SYSTEM DESCRIPTION

A. Furnish wire and cable for all systems except:
1. Where supplied as part of an equipment or system.
2. Where specifically stated otherwise in other parts of the Specifications or on the Drawings.

B. Install, connect, mark, and test all wire and cable.

1.03 SUBMITTALS

A. Manufacturer's standard literature.

PART 2 PRODUCTS

2.01 600V POWER AND GENERAL-PURPOSE WIRE (COPPER)

A. Meet NEC 310, UL 83, and the ANSI C8 Series.

B. Conductor: Copper.

C. NEC Type: THWN/THHN.

D. Minimum wire size unless specifically noted otherwise on the Drawings:
1. 480V: #10 AWG.
2. 120/208/240V: #12 AWG.
3. Control: #14 AWG, stranded.
4. Grounding/bonding conductors: #12, except #14 for control runs.

2.02 OTHER WIRE AND CABLES

A. As supplied under other Sections or as required on the Drawings or Schedules.

PART 3 EXECUTION

3.01 COLOR CODING

A. 600V Power and General-Purpose Wire:
1. Neutral and ground as required by NEC. Where two neutrals are run in a conduit, make one white and one grey. For three: One white, one grey, and one white that is field marked with a band of grey tape at each end.
2. 480V Phases: Brown, orange, yellow (A, B, C, respectively).
3. 120/240V: Black and blue.
4. 120/208V: Black, blue, violet (A, B, C, respectively).
5. Motor Control Leads:
   a. THWN/THHN: Red to field devices with white (grey) neutral.
   b. Tray Cable: Inherent to cable.
6. THWN/THHN: #14 to #10 AWG: Colored insulation.
7. THWN/THHN: Larger than #0: Tape may be used.

B. Color shall be the same from end to end of a run. Do not change conductor color at splices or terminal boards.

3.02 MARKING

A. Mark all field conductors unless directed otherwise on the Drawings or Schedules.

B. Text:
1. All lighting circuits and power circuits: Panel designation and circuit number, such as, LP1-12, or PPA-23, 25, 27.
2. Mark otherwise as specifically shown on the Drawings or Schedules.

C. Method:
1. Hot marked (embossed, not just surface printed) heat shrink tubing of the proper diameter, Raychem, or
2. Typed or computer printed, wrap-on, cloth adhesive labels held in place with a length of clear heat shrinkable tubing, or
3. Typed or computer printed, wrap-on labels held in place with a wrapped and heat bonded cover, 3M ScotchCode, or
4. Engineer reviewed equivalent.
5. Direct hot marking of wire or labeling methods, which depend solely on adhesive for attachment, are not acceptable.

D. Location: Install wire markers at every connection point to terminal boards, control stations, indicators, starters, instruments, and similar equipment, and at all splices.

3.03 TAGGING

A. Tag conductors and cables unless directed otherwise on the Drawings or Schedules.

B. Text:
   1. All lighting circuits and power circuits: Panel designation and circuit number, such as, LP1-12, or PPA-23, 25, 27.
   2. Mark otherwise as specifically shown on the Drawings or Schedules.

C. Method:
   1. Loosely group conductors of same service. Use tie wraps to keep grouped.
   2. Install marking tag as specified in Section 26 05 53 – Electrical Identification.

D. Location: In pull boxes, handholes, manholes, and other enclosures where accessible but neither terminated nor spliced. It is not necessary to tag conductors in 4 x 4 or smaller boxes, or in conduit bodies.

E. Mark the cover of 4 x 4 or smaller boxes with a permanent black felt tip marker to indicate wiring content as required in Paragraph 3.03.B above.

3.04 INSTALLATION

A. Install all wiring in conduit, except where specifically allowed otherwise on the Drawings.

B. Bending Radii: Not less than permitted by ICEA or as recommended by cable manufacturer, whichever is greater.

C. Cable in cable trays, open wireway, and trenches:
   1. Except for individual THWN grounding conductors, use TC or PLTC only.
   2. Maintain separation between AC and DC cables.

D. Splicing:
   1. Power Circuits:
      a. Splicing of THWN/THHN and XHHW-2 conductors is permissible in boxes, enclosures, handholes, manholes or similar accessible and protected locations.
      b. Splicing in conduit bodies is not permitted.
   2. Control circuits and instrument wiring:
      a. No splicing allowed.
      b. If intermediate connections are required, provide enclosure and terminal block(s) where allowed by Engineer. Mark conductors as required above in this Section. Mark terminal boards as required in Section 26 27 27 – Wire Connectors and Accessories.
   3. Direct buried splices allowed only as shown on the Drawings or Schedules.

3.05 UNUSED CONDUCTORS

A. When a cable has conductors, which are not shown to be terminated then fold them back and tape in place. Do not cut short.

3.06 GROUNDING CONDUCTORS

A. Grounding Electrodes/Grounding Electrode Conductors: Bare copper.

B. Equipment Grounding Conductors: Insulated as required in Paragraph 2.01, or as part of a cable. Bare copper where shown thus on the Drawings.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Furnish, install, connect, and test a complete grounding system for all non-current carrying conductive components and grounded circuit conductors of the wiring system, building structural steel, metallic piping, motor controls and panels, transformer neutrals and cases, motor frames, and other electrical systems and components.

B. Where grounding systems are not shown on the Drawings, as a minimum, ground in accordance with the NEC.

C. Where grounding systems are shown on the Drawings and are more stringent than required by the NEC, the Drawings take precedence.

1.02 SUBMITTALS

A. Literature for electrolytic ground rods.

PART 2 PRODUCTS

2.01 GROUND RODS

A. High carbon steel rod with minimum 0.01″ thick electroplated copper coating.

B. Minimum 5/8″ diameter and minimum 10′ long; provide larger if so scheduled or shown on the Drawings.

C. Nehring Electrical Works Company NCC series (NCCS series for sectional rods) or Engineer approved equivalent.

2.02 ELECTROLYTIC GROUND RODS

A. Manufacturer:
1. Minimum 10 years' experience manufacturing electrolytic ground rods.
2. ISO 9002 certified.

B. Ground Rod:
1. UL listed.
2. 100% self-activating/sealed and maintenance free without addition of chemical or water solutions.

3. Operate by hygroscopically extracting moisture from the air to activate the electrolytic process improving performance.
4. 100% copper 2″ nominal diameter hollow copper tube with a minimum wall thickness of 0.083″.
5. Permanently capped on the top and bottom with air breather holes in the top of the tube and holes in the bottom of the tube for electrolyte drainage into the surrounding soil.
6. Factory filled with non-hazardous Calsolyte to enhance grounding performance.
7. 10′ long unless shown otherwise by schedule or Drawings.
8. Provide a stranded 4/0 AWG Cu ground wire that is bonded to the side of rod by means of heavy-duty exothermic welding process.
9. 25-year Manufacturer's Warranty.
10. Lyncole XIT or Engineer approved substitution.

C. Backfill Material:
1. Provide manufacturer recommended quantity but minimum 50 pounds per rod.
2. Natural volcanic, non-corrosive form of clay grout backfill material free of polymer sealants, which absorbs approximately 14 gallons of water per 50 pound bag for optimal 30% solids density and which has a pH value of 8-10 with maximum resistivity of 3 ohm-m at 30% solids density.
3. Lynconite II or Engineer approved substitution.

2.03 GROUND ACCESS BOX

A. Composite Box:
1. For non-traffic applications only.
2. Provide snap-lock flush cover with "breather" holes.
3. Nominal 12″ diameter by 10″ high.
4. Lyncole model XB-12F or Engineer approved substitution.
5. Use only where specifically called for on Drawings.

B. Precast Concrete Access Box, Medium Traffic:
1. Slots for conduit entrances.
2. Minimum size 10″ diameter by 12″ high.
3. Round cast iron grate flush cover with "breather" slots.
4. Lyncole Model XB-12C or Engineer approved substitution.
5. Unless shown otherwise on the Drawings, use in dirt areas, in sidewalks, and in asphalt dust aprons.

C. Precast Concrete Access Box, Heavy Traffic:
1. Minimum 12″ diameter by 10″ high.
2. Cast iron frame with lifting sockets.
3. Triangular cast iron cover with breather holes.
4. Lyncole model XB-22 or Engineer approved equal.
5. Unless shown otherwise on the Drawings, use in driveways, parking lots, access aprons, alleys (paved or otherwise), private streets, and public streets.

2.04 GROUND CONDUCTORS AND TAPS

A. Stranded soft-drawn bare copper.

B. Conductor Size: NEC Article 250, unless shown larger on Drawings.

2.05 CONNECTIONS

A. Use heavy duty exothermic welding process (HDEWP) or NEC/UL approved/listed compression connectors for all copper to copper grounding connections and for copper to ground rod connections.

B. Use NEC/UL approved/listed compression connectors from copper conductor to structural reinforcing rod. Burndy Hyground Hygrid YGL-C or Figure 6 Hytap YGHP-C, or equal.

C. Connection to power equipment (switchboard, MCC, panelboard, AFD, and similar): Install compression lugs on wire and bolt lugs to equipment ground bus.

PART 3 EXECUTION

3.01 CONDUIT AND RACEWAY SYSTEMS

A. Conduit Systems at Panels and Boxes: Double locknuts with sealing-type locknut on outside. Use bonding jumpers for conduits installed in concentric or eccentric knockouts and between conduits installed at non-metallic boxes.

B. Conduit Systems: Install a green insulated grounding conductor in all conduits for the length of the conduit. Size conductor in accordance with the NEC, as a minimum, unless otherwise specified on the Drawings. Use grounding bushing and connectors.

C. Install a #4/0 (minimum) bare copper grounding conductor under all underground primary power duct banks. No grounding conductor is required in primary conduits.

D. Install bare copper grounding conductors within or under other duct banks as shown on the Drawings.

3.02 SOLID GROUND RODS

A. Install in firm soil outside of excavated areas.

B. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.

C. Unless either excluded or shown otherwise on the Drawings, install access box at each rod. If box will have concrete cast adjacent to it, install 1/2″ expansion material around box before pouring concrete. Set box flush with concrete surface.

D. Depth:
   1. Where access box is installed, drive rod so top is 4″ below finished grade.
   2. Where access box is not installed, drive rod so top is 24″ below finished grade.

3.03 ELECTROLYTIC GROUND RODS

A. Install according to manufacturer's instructions.

B. Use for lightning protection grounds, whether specifically differentiated on the Drawings or not.

C. Use for other grounds where shown on the Drawings.

D. Install precast concrete access box at each rod. If box will have concrete cast adjacent to it, install 1/2″ expansion material around box before pouring concrete. Set box flush with concrete surface.

3.04 STRUCTURE GROUNDING ELECTRODE SYSTEM

A. Where shown on the Drawings, install bare copper grounding conductor in the concrete of the footing. Braze copper conductor to the tail of a reinforcing rod at minimum four places. Bond copper conductor to equipment where shown. Bond copper conductor to building structural steel columns, metallic piping, and similar, whether shown or not.

3.05 MARKING OF GROUND ACCESS BOXES

A. If called for on the Drawings, mark each ground access box.

B. Where an access box is surrounded by concrete, stamp the legend "GND" into the concrete adjacent to the box, minimum 1″ high letters.

C. Where an access box is surrounded by asphalt, pour a 20″ x 6″ x 12″ deep concrete marker in a nearby non-traffic area with the legend "GND BOX XX FT" where XX is the distance between the marker and the box and an arrow pointing to the box, minimum 1″ high characters.

D. Where an access box is surrounded by dirt, pour a 6″ x 12″ x 12″ deep concrete marker adjacent to it. Stamp the legend "GND" into the concrete, minimum 1″ high letters.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Strut Systems.

B. Supports.

C. Anchors.

1.02 SUBMITTALS

A. Information on materials and construction.

B. Provide diagrams to show how installed.

PART 2 PRODUCTS

2.01 CORROSION RESISTANT METAL STRUT SYSTEM

A. Channel:
1. Designed with edges turned in, forming lips which allow special spring-loaded nuts to be inserted anywhere along the channel.
2. Material: 6063-T6 aluminum or Type 316L stainless steel.

B. Spring loaded nut and spring:
1. Nut made of Type 316L Stainless Steel and designed to provide positive locking in place when tightened.
2. Spring made of zinc chromate plated steel or stainless steel.

C. Braces, brackets, and structural shapes used in the assembly of metal strut: 6063-T6 aluminum, 5052-H32 aluminum, or Type 316L Stainless Steel.

D. Threaded rod, bolts, and nuts: Type 316L Stainless Steel.

E. All materials by the same manufacturer and designed as a system.

F. Dimensions and Style:
1. Single strut: 1-5/8″ by 1-5/8″ – 12 gage, solid.
2. Back-to-back strut: 1-5/8″ x 3-1/4″ – 12 gage, solid.
3. As specifically noted otherwise on Drawings.

G. Unistrut, B-Line, Superstrut, or Engineer reviewed equivalent.

2.02 FIBERGLASS STRUT SYSTEM

A. Strut and hanger rod construction: Linear glass strands, continuous mat laminates, and corrosion-resistant polyester resins simultaneously pultruded to form a uniform rigid thermoset shape.

B. Fiberglass: Self-extinguishing with UL 94 V-O classification.

C. Hanger rod washers: Stamped from pultruded flat stock.

D. Hanger rod square nuts: Made from pultruded flat stock.

E. Hanger rod hex nuts and strut nuts: Injection molded.

F. Hanger rod beam clamps and pipe straps: Steel, with 15 mil PVC coating and SS bolts.

G. Deflection versus loading and recommended loading: Equal to or better than that of Rob Roy Industries Rob-Glass Fiberglass Strut Support System.

H. Single strut: 1.715 by 1.76 by 0.15 wall by length.

I. Back-to-back strut: 1.715 by 3.52 by 0.15 wall by length.

2.03 METAL STRUT SYSTEM

A. Same as Paragraph 2.01 except galvanized or painted steel.

B. Hardware: Zinc or cadmium plated.

2.04 ANCHORS

A. Comply with the requirements of Division 5, specifically with Section 05 50 01 – Anchor Bolts and Chemical Anchors. Lead shields with lag bolts: not acceptable. Concrete tapping screws: not acceptable.

B. Anchors placed in poured concrete: Stainless steel expansion bolts, such as Hilti, Wejit, or equal, or chemical anchors.

C. Anchors placed in concrete masonry units:
1. Chemical anchors.
2. Toggle bolts may be used in hollow portions of concrete masonry units in Non-Process Indoor Areas.

PART 3 EXECUTION

3.01 ANCHORS

A. Comply with the installation requirements of Section 05 50 01 – Anchor Bolts and Chemical Anchors.

3.02 SUPPORT OF ALUMINUM CONDUIT AND BOXES

A. Support with stainless steel bolts, washers, and nuts and aluminum clamps, plates, angles, and/or strut.

3.03 SUPPORT OF OTHER CONDUIT AND BOXES

A. Support with stainless steel bolts, threaded rod, washers, and nuts and stainless-steel clamps, plates, angles and/or stainless-steel strut.

B. As allowed in Paragraph 3.05.

3.04 FLEXIBLE STRAP

A. Flexible steel and/or copper perforated straps (such as plumber’s tape) are not acceptable for support of any electrical item.

3.05 USAGE OF STRUT

A. Do not install fiberglass strut where exposed to sunlight.

B. Do not cast fiberglass or aluminum strut in concrete.

C. Follow manufacturer's recommendation as to maximum loading.

D. Do not exceed deflection stated in manufacturer’s literature.

E. Unless specifically allowed otherwise on Drawings, use painted Metal Strut Systems (Paragraph 2.03), only in Non-Process Indoor Areas.

F. Unless specifically allowed otherwise on Drawings, use galvanized Metal Strut Systems (Paragraph 2.03), only in Non-Process Indoor Areas, and in indoor spaces in which liquid sewage or sludge is not handled, such as a blower room.

END OF SECTION

SECTION 26 05 33.13

ELECTRICAL CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Conduit and accessories.

1.02 SUBMITTALS (NOT REQUIRED)

PART 2 PRODUCTS

2.01 RIGID METAL CONDUIT (RMC)

A. Steel RMC:
1. Meet NEC 344 and ANSI C80.1.
2. Listed and labeled under UL6 or CSA recognized.
3. Electro-galvanized on outside, inside, and on threads.

2.02 RIGID NONMETALLIC CONDUIT (RNC)

A. Might be referred to as RNMC on the Drawings.

B. Meet NEC 352 and NEMA TC2.

C. Listed/labeled under UL 651 for use with conductors operating at 90°C.

D. Ultraviolet resistant.

E. Schedule 40 Polyvinyl Chloride Except Schedule 80:
1. Where called for in the schedule.
2. Where installed exposed, or
3. Where called for on Drawings.

F. Glue all Joints Except:
1. Provide bell and spigot expansion joint with O rings where required for expansion/contraction, and
2. Provide glue to thread fittings for transition to threaded conduit systems.

G. Fittings and Cement: By conduit manufacturer.

H. Carlon Plus 40 (Plus 80), or Engineer reviewed equivalent.

2.03 ELECTRICAL METALLIC TUBING (EMT)

A. Meet NEC 358. Listed/labeled under UL 797.

B. Connectors and Couplings:
   1. Steel, not die-cast.
   2. Rain-tight compression type, T&B TC11xA or equivalent.
   3. Neither set screw nor indenter type will be acceptable.

2.04 FLEXIBLE METAL CONDUIT (FMC)

A. Meet NEC 348. Listed/labeled under UL 1.

B. Steel.

C. Use a single piece for each run. Do not use couplings.

D. Connectors: Steel squeeze type, Appleton Catalog Numbers 7480 through 7490, or Engineer reviewed equivalent.

2.05 OTHER CONDUITS

A. Meet requirements of appropriate NEC article and applicable UL standard.

B. Use only after specific written approval of the Engineer.

2.06 FLEXIBLE EXPLOSION-PROOF COUPLING (XPFC)

A. Listed/labeled under UL 886.

B. Braided steel or copper alloy with inner insulating sleeve.

C. Fittings: Threaded.

D. Crouse-Hinds Series EC, or Engineer reviewed equivalent.

2.07 CABLE CONNECTOR

A. Aluminum liquid tight, strain relief type, T & B 29XXSST series.

B. Where installed through enclosure wall, also use sealing ring with SS retainer, T & B 5262 series.

PART 3 EXECUTION

3.01 CONDUITS REQUIRED

A. Many conduits and associated conductors are not shown or are only partially shown on plan views in the Drawings. Install as if fully shown.

B. In addition to conduits that are shown on plan views in the Drawings:
   1. Install conduits as shown in any conduit schedules. If schedules are used, they are appended to this Specification or are included on the Drawings.

2. An entry in a conduit schedule requires conduits and conductors end-to-end, complete. For example, there is only one entry for a given motor feeder, even though there is one conduit and set of conductors shown from the starter to the local disconnect switch and another from the disconnect switch to the motor.
3. Install as implied for circuiting, such as where a panelboard circuit number is shown adjacent to a wiring device, and from switches to associated luminaires.
4. Install as called for in panelboard schedules.
5. Install as called for in tables shown as part of schematic diagrams.
6. Install as required for control of process equipment. Pay special attention where recommendations of the manufacturer of the process equipment supplied differ from that shown in the design.
7. Install as required for a complete system.
8. Install as called for on the One-Line Diagram.

3.02 INSTALLATION

A. Conduit Bends:
1. Factory made or made with a conduit bending machine recommended by the conduit manufacturer.
2. If EMT is specifically allowed in the matrix of conduit usage, then bends in EMT may be made with a hand bender which fully supports the side walls.

B. Wrench tighten all threaded joints, couplings, fittings, and connectors.

C. Run conduits concealed in finished areas and where indicated on the Drawings. In many places, such as at motors and surface-mounted wiring devices in pump rooms and electrical rooms, the end of a run may be an exposed vertical riser even though the symbol used for the conduit denotes concealed.

D. Run exposed conduit either parallel with or perpendicular to structural members of the building or structure except where allowed otherwise by the Engineer.

E. The only conduit that may be above a roof is conduit that serves equipment on that roof. Locate roof penetrations so no horizontal runs of conduit are required on the roof.

F. Conduit installed above lay-in ceilings will be considered to be concealed and need not comply with parallel/perpendicular requirements for exposed conduit. Route to avoid interference with piping, duct work, and luminaries. Locate conduit well above the lay-in ceiling. Support independently of ceiling suspension wires.

G. Do not install conduit on slabs, decks, sidewalks or floors where it may create a trip hazard. The Engineer or Owner judges what conditions are “trip hazards”. Conduits may be installed on slabs only with written permission from the Engineer or Owner.

H. Drainage: Avoid pockets in conduit runs. Provide suitable drainage fittings in low spots in exposed conduit. Weep holes not permitted.

I. Field Cuts and Threads:
   1. Cut ends of conduit square. Ream to remove burrs and sharp edges.
   2. Non-factory threads: Same effective length, thread dimensions, and taper as factory cut threads.
   3. Carefully remove burrs from threads.
   4. For steel RMC, paint conduit threads with vinyl repair compound, same as used for PVC RMC.

J. Supports:
   1. Comply with NEC and Section 26 05 29 – Hangers and Supports.
   2. In horizontal conduits runs install one-hole conduit straps with the anchor below the conduit.

K. Conduit Ends:
   1. Where conduits terminate in hand holes, manholes, trenches, floor cavities, or similar, or through concrete into open-bottom enclosures plug spaces between conductors/cables and conduit with duct seal.
   2. Protect conduit ends during construction to prevent entrance of foreign material.
   3. Install insulated throat grounding bushing on conduit ends and install bonds as specified in Section 26 05 26 – Grounding and Bonding, and as required by the NEC.
   4. Where conduits enter an enclosure from underground, whether through concrete or from earth (such as in a transformer), set end of conduit at 2-3″ above the surrounding or nearby concrete.

L. Clean and swab inside by mechanical means to remove foreign materials and moisture before wires or cables are installed, also for spare conduits.

M. Spare Conduits:
   1. Blow a pull string through the conduit.
   2. If end is buried or exposed to weather, glue pull string to inside of cap with silicone seal, let set, leave adequate slack, then install cap.
   3. Where not exposed to weather, seal conduit end with duct seal.

N. Use anti-seize compound on threads of aluminum RMC.

O. Where shown on Drawings, provide sleeves for conduit penetrations. Where the penetration is through the wall of a process structure which contains water, provide mechanical “link-seals” between the inside of the sleeve and the outside of the conduit. Seal other penetrations with 40-year rated silicone seal.

P. Requirements where conduits enter/exit a structure/building below grade:
   1. Do not run conduits in/through footings.
   2. Bury conduits larger than 2″ trade size minimum 12″ below the bottom of the footing.

3. Fewer than five conduits of 2″ trade size or less in a loose grouping may penetrate the stem wall.
4. More than five conduits of any size in a grouping:
    a. Bury minimum 12″ below the bottom of the footing or
    b. Submit structural details of blockouts and reinforcing through the stem wall for review by the Engineer. After conduits are installed through a blockout, fill the remaining space with non-exothermic, non-shrink grout.

Q. Expansion Joints: Where conduit spans building expansion joints or in long duct runs, use expansion fittings and bonding jumpers.

3.03 APPLICATION

A. RMC:
1. Steel RMC is not permitted direct buried.
2. Aluminum RMC is not permitted:
    a. In contact with earth.
    b. Embedded in concrete.
    c. In contact with concrete below grade, outdoors, or in wet indoor locations.

B. RNC:
1. Do not use where exposed to direct sunlight.
2. Permitted underground or direct buried.
3. Do not use RNC elbows for underground installations with conduit sizes 2″ or greater. Elbows may be RTRC or PVC RMC.

C. EMT:
1. Use only where shown in the matrix of conduit usage.

D. Flexible Conduits:
1. Use for final connection to luminaires, motors, dry type transformers, HVAC equipment, water heaters, unit heaters, and similar applications.
2. Do not install within a wall or slab. Do not install as/in a penetration of a wall or slab.
3. Do not install in lengths of more than 18″ except:
    a. For connection of lay-in luminaries.
    b. For connection of equipment where O&M manual recommends moving it for maintenance, such as certain models of uninterruptible power supply systems.
    c. For connection of adjustable frequency drives.
    d. Where proposed in writing case-by-case by the Contractor and specifically allowed by the Engineer. No other exceptions to length restrictions.
4. LFMC and LFNC: Allowed as a factory component of luminaires and/or process equipment.
5. FMC: Allowed as a factory component of luminaries.
6. Use FMC for connections to adjustable equipment and devices in air ducts or plenums.

E. All Conduits:
   1. Use type specifically called for on the matrix of conduit usage. If not shown in the matrix of conduit usage, comply with requirements shown on the Drawings. If not shown in either the matrix of conduit usage or on the Drawings, refer to the matrix of conduit usage for all other work.
   2. No plastic conduit allowed above lay-in ceilings where the cavity functions as an air-handling plenum, regardless of matrix of conduit usage.
   3. Do not install exposed conduits in finished areas, such as laboratories, offices, training rooms, and similar. Clarify any questionable area with the Engineer in the field before installing.

F. Matrix of Conduit Usage:
   1. A matrix of conduit usage may be shown on the Drawings.
   2. If multiple columns are marked, any marked type is allowed subject to NEC restrictions and restrictions above, such as but not limited to those concerning buried conduits, elbows, penetrations, exposed installation, and use in cavities.
   3. Different parts of a run may be of different type conduit, such as where a flexible connection is required.
   4. If a column is marked "C" then use only where concealed in a wall or above a gypsum board or lay-in ceiling.
   5. If a column is marked "CA" then use only above a gypsum board or lay-in ceiling.
   6. If a column is marked "E" then use only for connections between electrical supply and control equipment, not for connection of utilization equipment and not for connection of field devices such as flow transmitters and hand switches. A marking of "E" is typically intended to be limited to electrical rooms.
   7. If a column is marked "H" then use only above 6′ or directly above equipment where not subject to damage.
   8. See matrix of conduit usage for other column marking notes.
   9. Where the matrix of conduit usage shows RNC for outdoor use, it is allowed only where protected from direct sun exposure, such as under a bridge or under a digester cover.

3.04 SIZE

A. The Drawings and/or conduit schedules may show a minimum size for certain conduit runs. Where size is not shown, then comply with Paragraph C. below.

B. If a conduit size has to be increased because a motor or other equipment furnished by the Contractor requires more power (and therefore larger wire and conduit than shown) than the specified motor or equipment, then include the cost of the larger conduit in the Bid.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates and marking tags.

1.02 SUBMITTALS

A. Not required.

PART 2 PRODUCTS

2.01 NAMEPLATES (NP)

A. Minimum Character Height:
1. 1/2″ for the title of equipment which meets any of the following criteria.
   a. Oil-filled transformers
   b. Engine generator sets.
   c. Motor Control Centers (MCC).
   d. Floor mounted PLC enclosures.
   e. Automatic and manual transfer switches.
   f. Service disconnecting means.
   g. Equipment 400A or greater.
   h. Equipment greater than 600V.
   i. Equipment with interrupt rating greater than 22 kAIC.
2. 3/8″ for the title of equipment which do not meet the criteria above and meets any of the following criteria.
   a. Dry transformers.
   b. Individual starters.
   c. Individual MCC sections.
   d. Panelboards rated less than 400A.
   e. Motor/equipment disconnecting means.
   f. Motor and/or control terminal boxes.
   g. Wall mounted control panels.
3. 1/8″ minimum for other text but larger as specified below or if called for on the Drawings.

B. Engraved Nameplates:
1. Black engraving stock with white core, unless shown otherwise, below or on the Drawings.
2. Gravoply, or Engineer reviewed equivalent.

C. Printed Nameplates:
   1. Vinyl, self-adhesive tape. Provide white, tan (sand) or gray for least contrast with color of surrounding surface.
   2. Color of lettering: Black.
   3. Brady™ Handimark® printer With Brady B-580 tape or Engineer reviewed equivalent.

2.02 CAUTION AND WARNING NAMEPLATES

A. Comply with NEC and OSHA requirements.

B. Engraved Nameplate: Red with white text.

C. Instead of an engraved or custom-printed label, a standard, off-the-shelf label, such as from Seton, is acceptable.

D. Character Size: 1/4″ minimum height.

2.03 MARKING TAGS

A. Engraved plate as in Paragraph 2.01 with minimum 1/8″ character height.

B. Drill hole for attaching.

C. Attach with tie wrap.

PART 3 EXECUTION

3.01 NAMEPLATES REQUIRED

A. Motor Nameplates:
   1. Install a red nameplate on each motor or other electrically controlled equipment that has maintained (two-wire), remote, or automatic control.
   2. Character size: Caution: 1/2″ characters; Balance: 1/4″.
   3. Text equivalent to “CAUTION. THIS EQUIPMENT MAY START AUTOMATICALLY OR REMOTELY.”
   4. Instead of an engraved or custom-printed label, a standard, off-the-shelf label, such as from Seton, is acceptable. Comply with NEC and OSHA requirements.

B. Voltage Warnings: As required by NEC and OSHA.

C. Where called for in other Sections.

D. As scheduled.

E. As required on the Drawings. Generally, a note on a Drawing will call for a nameplate or NP. The type (engraved or printed) is mentioned on the Drawings only if an engraved NP is required in a location in which a printed nameplate might otherwise be allowed in the Paragraphs below.

3.02 MOUNTING OF NAMEPLATES

A. Engraved Nameplates:
   1. Use indoors or outdoors.
   2. On panel fronts, attach with screws or drive rivets. Elsewhere, attach with 30 year rated silicone seal.
   3. Attach with edge parallel to edge of enclosure or device plate.

B. Printed Nameplates:
   1. Use only inside a fully enclosed and roofed building or structure.
   2. Do not use where exposed to sunlight, precipitation, freezing temperatures.
   3. Do not use where Drawings call for engraved nameplates.
   4. Self-adhesive.
   5. Attach with edge parallel to edge of enclosure or device plate.

3.03 SCHEDULE

A. Minimum nameplate requirements. Refer to Drawings and other Sections for additional requirements. Where italicized enter equipment specific information and where bold text is fixed.
   1. Panelboards, switchgear, MCCs and similar:
      a. Equipment Name.
      b. Line 2: Fed From: Source equipment.
   2. Transformers:
      a. Line 1: Equipment Name.
      b. Line 2: Fed From: Source Equipment.
      c. Line 3: Feeding: Destination Equipment.
   3. Automatic and Manual Transfer Switches:
      a. Nameplate 1:
         1) Line 1: Equipment Name.
         2) Line 2: Feeding: Destination Equipment.
      b. Nameplate 2 (Install next to respective position/indication):
         1) Line 1: Source 1: Source Equipment.
      c. Nameplate 3 (Install next to respective position/indication):
         1) Line 1: Source 2: Source Equipment.
   4. Equipment disconnecting means located near the respective equipment, starter/equipment controllers not located in an MCC and similar:
      a. Line 1: Equipment Name.
      b. Line 2: Equipment Tag Number.
      c. Line 3: Fed From: Source equipment.
   5. MCC Cubicles (Starters):
      a. Line 1: Equipment Name.
      b. Line 2: Equipment Tag Number.
      c. Line 3: Starter Type and size (e.g. VFD, FVNR Size 2, RVSS).
      d. Line 4: Load HP rating.

6. MCC Cubicles (Circuit Breaker):
    a. Line 1: Circuit breaker rating.
    b. Line 2: Feeding Equipment Name.
7. MCC Cubicles (Feeders):
    a. Line 1: Feeder Circuit Breaker or Feeder Lugs.
    b. Line 2: Fed From: Source equipment.
8. MCC Cubicles (Miscellaneous):
    a. Line 1: Description of cubical (e.g. Spare FVNR Size 1, E-Net I/O).
    b. Line 2: Tag number if applicable.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panelboards.

1.02 SUBMITTALS

A. Summary Sheet showing:
1. Voltage, phases, and main bus ampacity.
2. MLO Panels: Type of main lugs.
3. MCB Panels: Main breaker rating.
4. Neutral and ground bar ratings.
5. Bus material and plating.
6. Short circuit rating.
7. Flush or surface mount, enclosure NEMA type, and trim details.
8. Rating and arrangement of branch circuit breakers.
9. Description of specified factory assembled modification including, but not limited to, sub-feed breakers, sub-feed lugs, feed-through lugs, and metering transformers.

B. Panelboard layout showing all circuit breakers, strapping and mounting hardware for future circuit breakers, and space for future strapping and mounting hardware.

C. If the submitted circuit breaker layout differs from the Drawings then demonstrate that the phase current balance will be substantially the same.

1.03 OPERATIONS AND MAINTENANCE DATA

A. As-Built Layout Drawing showing location, ampacity, and poles of each breaker.

B. Copies of all directories.

C. Settings used for electronic trip units and ground fault relays.

1.04 QUALITY ASSURANCE

A. Conform to the following:
1. UL 50 Enclosures for Electrical Equipment.
2. UL 67 Panelboards.
3. NFPA 70 National Electrical Code.
4. NEMA PB1 Panelboards.
5. UL 489, “Molded Case Circuit Breakers and Circuit Breaker Enclosures”.
6. NEMA AB1, “Molded Case Circuit Breakers”.

PART 2 PRODUCTS

2.01 PANELBOARDS – COMMON REQUIREMENTS

A. Voltage, phases, and current ratings as shown on Drawings.

B. Minimum branch circuit breaker space as shown on Drawings.

C. Minimum Box Width:
1. 14″ for:
   a. 100A, Single-Phase, flush mounted.
   b. 100A, 208Y/120V, 3-Phase, flush mounted.
2. 20″ for all others.

D. Main circuit breaker (MCB) or main lugs only (MLO) as shown on Drawings.

E. Bus: Tin plated aluminum unless shown otherwise on the Drawings or Schedule.

F. Ground Bar: Furnish all panelboards with a ground bar having a screw for each pole.

G. Neutral Bar:
1. 208Y/120V and 120/240V single phase panelboards: Provide 100% neutral bar with a screw for each pole unless shown otherwise on the Drawings or Schedules.
2. 480Y/277V panelboards which are used as service equipment: Provide 100% neutral bar.
3. 480Y/277V panelboards which power 277V loads, such as site lighting and UV systems, and elsewhere required on the Drawings: Provide 100% neutral bar with a screw for each pole.
4. 480V panelboards which power no 277V loads: No neutral bar required.

H. Furnish sub-feed breakers, sub-feed lugs, feed-through lugs or other factory options as shown on Drawings.

I. Flush or surface mount as shown on Drawings.

J. Listed and labeled for service entrance use if used for service entrance equipment or so indicated on Drawings.

K. Circuit Breakers:
1. Furnish circuit breakers recommended by the manufacturer of the panelboard for use in the panelboard furnished.
2. Provide as shown on Drawings or Schedules.

L. Furnish all required strapping and mounting hardware required for the future installation of a circuit breaker of the frame size shown where “FUTURE” is shown on the Drawings or Schedules.

M. Furnish a panelboard with the required space for the future installation of strapping, mounting hardware, and circuit breakers where "SPACE" is shown on the Drawings or Schedules."

N. Circuit Breaker Mounting and Connection:
1. Connection between line side of circuit breaker and bus by direct bolted connection, or
2. Connection between line side of circuit breaker and bus by spring tension jaws designed to produce increased contact pressure under fault conditions and entire circuit breaker secured in place with bolt, and
3. No restriction on ability to mount circuit breakers of different frame size or number of poles opposite each other.

O. Manufacturers and Types:
1. Cutler-Hammer: Pow-R-Line 1 and Pow-R-Line 2.
2. General Electric: AQ, AE, and AD.
3. Square D: NQOD and NF.
4. Engineer reviewed equivalent.

2.02 ENCLOSURE AND TRIM

A. Enclosure rated NEMA 1, NEMA 3R, NEMA 4, NEMA4X SS or NEMA 12 as shown on Drawings or Schedules.

B. Enclosure constructed of zinc-coated sheet steel for all but NEMA4X SS.

C. For NEMA 3R, 4, and 12, provide enclosure with exterior surfaces prepared, primed and painted in a light grey, ANSI 49 or similar color, at the factory.

D. Flush mounted 208Y/120V and 120/240V single phase panelboards rated 100A: Furnish with decorative trim fastened to the box on four sides with screws or screwdriver operable captive latches and a hinged and latched door to cover access to circuit breaker operating handles but without access to any energized parts.

E. Flush mounted 208Y/120V and 120/240V single phase panelboards rated greater than 100A and all flush mounted 480V panelboards: Furnish "door-in-door" trim.
1. Inner door with hinges and latch to cover access to circuit breaker operating handles but without access to any energized parts.
2. Outer door hinged on one side and secured on remaining sides with captive screws or screw driver operated latches. Provide door that provides full access to wiring gutter on all four sides when open.
3. Provide decorative trim around box to cover the gap between the enclosure and the wall surface.
4. Provide trim prepared, primed and painted in a light grey, ANSI 49 or similar color, at the factory.

F. Furnish Surface Mounted Panelboards with "Hinged Trim" Cover:
1. Inner door with hinges and latch to cover access to circuit breaker operating handles but without access to any energized parts.

2. Trim hinged at one edge of box and secured on remaining sides with captive screws or screw driver operated latches. Provide door that provides full access to wiring gutter on all four sides when open.
3. Provide trim prepared, primed, and painted in a light grey, ANSI 49 or similar color, at the factory.

G. Furnish latched and lockable door with metal frame cardholder with clear plastic window on inside of door for panel directory.

H. Provide other features as shown on the Drawings or Schedules.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. General: Provide circuit breakers as integral components of panelboard with indicated features, ratings, characteristics, and settings.

B. Future Devices: Equip compartments with mounting brackets, supports, bus connections and necessary appurtenances for future circuit breakers as show on the Drawings or Schedules.

C. Molded-Case Circuit Breakers:
1. General: UL489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."
2. Suitable for use with conductors operating at 75°C.
3. Characteristics: Frame size, trip rating, number of poles, and short-circuit interrupting capacity rating as shown on the Drawings or Schedules.
4. Interrupting capacity not less than shown on the Drawings or Schedules. Furnish all circuit breakers with full interrupting capacity. Do not use series ratings.
5. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous over-current trip protection for each pole.
6. Adjustable instantaneous trip devices: Front adjustable; factory adjusted to low trip setting.
7. Solid state trip devices: When called for on the Drawings, provide molded case circuit breakers that use solid-state trip devices.
8. Furnish circuit breakers for lighting circuits that are switching duty rated.
9. Furnish heating, air conditioning, refrigeration (HACR) rated circuit breakers when called for on the Drawings or Schedules.
10. Furnish single pole circuit breakers with ground fault interrupting capability when called for on the Drawings or Schedules. When required furnish Class A (6ma.) or Class B (30ma.) as shown on the Drawings or Schedules.

D. Electronic Circuit Breaker Trip Devices: True RMS sensing, microprocessor based, solid-state overcurrent trip device system that includes one or more integrally mounted current transformer or sensor per phase, a release mechanism, and the following features:
1. Temperature compensation to assure accuracy and calibration stability from -20º. to +55ºC.

2. Time-current tripping functions, field adjustable with the breaker closed and energized, as scheduled or shown on the Drawings, often abbreviated as L, S, I, and G.
    a. Adjustable long-time pick-up current.
    b. Adjustable long-time-delay.
    c. Adjustable short-time pick-up current.
    d. Adjustable short-time-delay.
    e. Adjustable instantaneous trip current.
    f. Adjustable ground-fault pick-up current.
    g. Adjustable ground-fault-delay.
    h. Selectable I2t function on short-time-delay.
    i. Selectable I2t function on ground-fault-delay.
3. Clear, sealable cover over adjustments.
4. Other factory options as shown on the Drawings or Schedules.
5. Trip Indication: Labeled lights or mechanical indicators indicating long-time overload, short-time overload, instantaneous, or ground fault as cause of trip. If lights are used, furnish with integral power source capable of maintaining indication for not less than 48 hours.
6. Arrangement to permit testing of all functions without removal from panelboard and to permit viewing and adjustment of all functions without removal of any metal panels.
7. Furnish 80% rated circuit breakers unless otherwise shown on the Drawings or Schedules.

E. Other devices as shown on the Drawing or Schedules.

PART 3 EXECUTION

3.01 PANELBOARD INSTALLATION

A. Install panelboards following manufacturer's instructions.

B. Mount panelboards plumb and rigid.

C. Mount flush panelboards so that the trim fits flat against finished wall.

D. For MLO panelboards, install compression lugs on conductors with press and die recommended by lug manufacturer. Bolt lug to bus.

3.02 IDENTIFICATION

A. Properly and accurately label panel directories by hand during construction.

B. Install neatly typed, accurate directories in holders prior to Substantial Completion.

C. Identify panelboard and its source with a nameplate.

3.03 KEYS

A. Keep panelboard keys properly marked and identified with panel number and location.

B. Furnish the Owner at least two copies of all panelboard keys, with tag showing identifying number and location of panel.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wiring Devices: Switches, receptacles, covers.

1.02 SUBMITTALS

A. Complete manufacturer's catalog cuts.

PART 2 PRODUCTS

2.01 TOGGLE SWITCHES

A. Heavy-duty, "silent" AC type, 20 A, 120 VAC – 277 VAC.

B. Back and side wiring feature. Positive clamping with screw-activated pressure plate.

C. Poles and Contact Action: As shown on the Drawings.

D. Motor Switching Rated:
1. 1-1/2 horsepower at 120 VAC.
2. 2 horsepower at 240 VAC.

E. Manufacturers:
1. Hubbell HBL1221, HBL1222, HBL1223, HBL1224 series.
2. Pass & Seymour 20AC1, 20AC2, 20AC3, 20AC4 series.
3. Engineer reviewed equivalent.

F. Other features or switches as shown on the Drawings or Schedules.

2.02 DUPLEX RECEPTACLES

A. Commercial Grade Duplex Receptacle:
1. NEMA 5-15R.
2. Back and side wiring feature. Positive clamping with screw activated pressure plate.

B. GFCI Receptacle:
1. NEMA 5-15R.
2. Side wired.
3. Flush polycarbonate face.
4. Trip level: 4 to 6 mA.
5. Trip time: .025 sec. nominal.
6. Operating temperature: -35º to +66ºC.

7. Hubbell GF5252A series, Leviton 6599 series, Pass & Seymour 1591 series, or Engineer reviewed equivalent.

C. All toggle switches and duplex receptacles: By same manufacturer. Other switches and receptacles by the same manufacturer, except where shown by a different manufacturer in the Schedule or on the Drawings.

2.03 OTHER RECEPTACLES

A. Other devices as scheduled or as shown on the Drawings.

2.04 DEVICE PLATES

A. Proper for the device(s) installed.

B. Use a single plate for multiple devices.

C. Oversize Polycarbonate or Nylon:
1. Premium grade.
2. Match device color.
3. Use on flush boxes in appropriate areas.
4. Use standard size plate if oversized plate is not manufactured.
5. Hubbell PJ series or Engineer reviewed equivalent.

D. Standard Size Polycarbonate or Nylon:
1. Premium grade.
2. Match device color.
3. Use on surface-mounted boxes in appropriate areas.
4. Use on flush boxes in appropriate areas if oversized plate is not manufactured.
5. Same manufacturer, material, and appearance as oversize Polycarbonate or Nylon.

E. 302/304 Stainless Steel: Hubbell S1, or Engineer reviewed equivalent.

F. Telephone Plates: Match material and general appearance of other device plates in the area.

G. Special Plates: As scheduled or as shown on the Drawings.

H. Outdoor Toggle Switch Covers: Wet location lift cover, self-closing.

I. Damp Location Duplex Receptacle Cover and Box:
1. Single horizontal self-closing lid.
2. Die cast aluminum or polycarbonate.
3. UL listed as raintight in the closed position.
4. Meet NEC 406.8 (A).
5. Box: Designed for the specific cover and device combination and recommended by the manufacturer of the cover for use with the particular weatherproof cover.

J. Wet Location Duplex Receptacle Cover and Box:
1. Single horizontal self-closing.
2. Polycarbonate.
3. Paintable.
4. Other features as shown on the Drawings or Schedules.
5. UL listed as NEMA 3R with a cord connected.
6. Meet NEC 406.8 (B) (1).
7. Unless shown differently on the Drawings or Schedules, furnish Carlon E9UHG, TayMac 60310, or Engineer approved equivalent.
8. Box: Designed for the specific cover and device combination and recommended by the manufacturer of the cover for use with the particular weatherproof cover.

PART 3 EXECUTION

3.01 DEVICE COLOR

A. Special Colors:
1. Where scheduled.
2. Where called for on the Drawings.
3. Where manufacturer's or industry standard for device, such as orange for isolated ground receptacles and red for emergency power receptacles.

B. All others: White.

3.02 USAGE OF RECEPTACLES

A. Furnish GFCI Type Receptacles at Each Location:
1. Where required by NEC or
2. Where scheduled or
3. Where called for on the Drawings.

B. Unless shown otherwise on the Drawings or Schedules, use commercial grade receptacles as specified herein.

3.03 COVER TYPE

A. Wet Location, In-use: Outdoors and in process areas not excepted immediately below.

B. Damp Location: Indoor, above-grade process areas except spaces, such as blower rooms, that have no piping that carries sewage or sludge.

C. Stainless Steel: In laboratories, offices, meeting rooms, lobbies and other similar office/commercial type areas.

D. Standard Size Polycarbonate/Nylon or Galvanized Steel: Indoor surface-mounted device boxes.

E. Oversize Polycarbonate/Nylon: Indoor flush-mounted device boxes.

F. As scheduled or as called for on the Drawings.

3.04 INSTALLATION POSITION

A. Mount toggle switches at 42-inches centerline above finished floor unless shown otherwise on the Drawings.

B. Indoors: Mount duplex receptacles at 18-inches centerline above finished floor, unless shown otherwise on the Drawings.

C. Outdoors and In Areas Considered Wet Location: Mount duplex receptacles at 30-inches centerline above finished grade or finished floor unless shown otherwise on the Drawings.

3.05 IDENTIFICATION

A. Mount nameplate above cover plate of each receptacle and switch.

B. Text:
1. Receptacles: Panelboard designation and circuit number(s). For example: "PP3-2, 4, 6" or "LP2IG-17."
2. Switches: Circuit designation as above and description of lights controlled.
3. Otherwise as shown on the Drawings or Schedules.

END OF SECTION

SECTION 26 27 27

WIRE CONNECTORS AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wire connectors and accessories.

1.02 SUBMITTALS

A. If products from manufacturer and of the model shown in Part 2 are to be furnished, submittals are not required and will not be reviewed.

B. If products from a different manufacturer or of a different model than shown in Part 2 are to be furnished:
   1. Submit complete manufacturer's cuts.
   2. Furnish other material demonstrating product equivalence as directed by the Engineer.

C. If a manufacturer and model are not shown in Part 2, furnish complete manufacturer's cuts.

PART 2 PRODUCTS

2.01 600V WIRE NUTS

A. UL listed and CSA certified for 600V maximum building wire, 1000V maximum fixture wire, 105ºC. maximum temperature rating.

B. Color coded outer shell to identify manufacturer approved wire combinations.

C. Nylon insulated.

D. Reusable.

E. Scotch 3M Ranger 312 or Ranger 512, or Engineer reviewed equivalent.

2.02 BUTT CONNECTORS

A. Non-insulated, brazed seam or seamless, compression type.

B. Insulation: Tubular pre-stretched EPDM rubber cold shrink insulators. 3M 8420 series or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 WIRE NUTS

A. For splices on copper conductors #8 AWG and smaller.

B. Consult manufacturer's instructions for approved wire nut based on combination of wires being spliced.

C. Do not use for splices that may become submerged, such as in manholes, handholes, underground pull boxes, and wet wells.

D. Do not use for control or instrumentation conductors.

3.02 COMPRESSION TYPE CONNECTORS

A. Use only the tool and die specified by the manufacturer for installation.

3.03 BUTT CONNECTORS

A. For splices on 120, 240, 480V circuit conductors #6 AWG and larger (except at motors). Use only where specifically required on Drawings.

END OF SECTION

SECTION 26 28 13

LOW-VOLTAGE FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

B. Fuse blocks and holders.

1.02 SUBMITTALS

A. Catalog cuts.

B. Time-current characteristic curves.

C. Current limitation curves.

D. Operating temperature characteristics.

E. Submit only for the types of fuses, blocks, and holders required by the Drawings.

1.03 EXTRA MATERIALS

A. Section 26 00 60 – Extra Materials for Electrical Systems

PART 2 PRODUCTS

2.01 CURRENT LIMITING, DUAL-ELEMENT, TIME DELAY FUSES

A. Time Delay: 10 seconds minimum at 5X rated current.

B. Note Well: Overload portion of dual element shall open at a temperature not greater than 300°F.

C. Interrupting Rating at rated voltage: 300,000A RMS symmetrical.

D. UL Class RK-5.

E. 250 VAC: Bussmann Fusetron FRN-RK_SP or Engineer reviewed equivalent.
600 VAC: Bussmann Fusetron FRS-RK_SP or Engineer reviewed equivalent.

2.02 FAST CURRENT LIMITING, DUAL-ELEMENT, TIME DELAY FUSES

A. Time Delay: 10 seconds minimum at 5X rated current.

B. Note Well: Overload portion of dual element shall open at a temperature not greater than 300ºF.

C. Interrupting Rating: 300,000A RMS symmetrical.

D. UL Class RK-1.

E. 250 VAC: Bussmann Low Peak LPN-RK or Engineer reviewed equivalent.
600 VAC: Bussmann Low Peak LPS-RK or Engineer reviewed equivalent.

2.03 HIGH AMPACITY, FAST CURRENT LIMITING, TIME DELAY FUSES

A. Open at 150% of rated current within 4 hours.

B. Time Delay: 4 seconds minimum of 5X rated current.

C. Interrupting Rating: 300,000A RMS symmetrical.

D. U.L. Class L.

E. 600 VAC: Bussmann Low-Peak KRP-C or Engineer reviewed equivalent.

2.04 CONTROL TRANSFORMER PRIMARY AND INSTRUMENT FUSES

A. Open at 135% of rated current within 1 hour.

B. Time Delay: 4 seconds minimum at 3X rated current.

C. Interrupting Rating: 200,000A RMS symmetrical.

D. UL Class CC, with rejection feature.

E. 600 VAC: Bussmann CC-Tron FNQ-R or Engineer reviewed equivalent.

2.05 SMALL DIMENSION CONTROL CIRCUIT FUSES

A. Bussmann AGC, ABC, MDL, MDQ, MDX, or Engineer reviewed equivalent, to match current and voltage of circuit. Use dual-element fuses unless recommended otherwise by equipment manufacturer or shown as fast acting on the Drawings.

2.06 REJECTION FUSE BLOCKS FOR 2.01 AND 2.02 FUSES

A. Base: Phenolic.

B. Box terminals.

C. Bussmann Class R Phenolic or Engineer reviewed equivalent.

2.07 REJECTION FUSE BLOCKS FOR 2.04

A. Base: Phenolic.

B. Copper alloy box terminals.

C. Bussmann BC603-1B, BC603-2B, BC603-3B, or Engineer reviewed equivalent.

2.08 REJECTION FUSE HOLDERS FOR 2.04

A. Body: Phenolic, with mounting holes for bolting to panel, and screw knob.

B. Combination 1/4″ quick connect/solder terminals.

C. Bussmann HPF-RR or Engineer reviewed equivalent.

2.09 FUSEHOLDERS FOR 2.05

A. Body: Phenolic with bayonet knob.

B. Voltage Rating: 250V.

C. Maximum fuse size: 20A.

D. Terminals: 1/4″ right angle quick connect.

E. Bussmann HTB-48I or Engineer reviewed equivalent.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surge protective devices for low voltage electrical power systems.

1.02 SUBMITTALS

A. Manufacturer’s literature, including rating information.

1.03 O&M MANUAL

A. List of suppressors used on this project with manufacturer's name, SPD type, part (catalog) number, and (for each part so provided) serial number. The use of a generic or typical part number will not be acceptable. Provide the part number which was used to order the part with all choices and options included. If a part number is given on a nameplate on the actual part, then include that number on this list. If the ordering number and the nameplate number differ, include both numbers and explain the difference.

PART 2 PRODUCTS

2.01 SURGE PROTECTIVE DEVICES (SPD): COMMON REQUIREMENTS

A. Comply with the requirements of:
1. UL 1449 – Third Edition.
2. IEEE C62.41. Location/exposure Categories below refer to this standard.
3. IEEE C62.45 for test methods.
4. ISO 9001: 2000 certified.

B. Testing:
1. Performed by an independent testing laboratory.
2. Test as a complete unit. Testing of the surge current capacity of a single MOV or SAD and extrapolation of overall rating from that is not acceptable.

C. Voltage: As shown on the Drawings.

D. Surge Capacity: As shown on Drawings or Schedule.

E. Protection modes for units installed at service equipment and at the transformer or first panelboard of a separately derived system: line to neutral and line to ground.

F. Protection modes for units installed downstream of the above units: Line to neutral, line to ground, and neutral to ground.

G. Repetitive impulse: 5,000 hits.

H. Response Time: Less than 1 nanosecond.

I. Voltage Protection Rating, (VPR – 3kA): Not more than shown in the following table using tests as defined in UL1449 – Third Edition.

Voltage	Type	L-N	L-G	N-G	L-L	In	SCCR	MCOV
208/120	1	700	700	700	1000	20 kA	200 kA	150
480/277	1	1200	1200	1200	1800	20 kA	200 kA	320
480V Delta	1	-	1800	-	2000	20 kA	200 kA	550
240/120	2	330	-	330	700	10 kA	200 kA	150

J. Environmental:
1. Temperature: - 25ºC to + 60ºC.
2. Humidity: 0% to 95%, non-condensing.

K. Internally protected against short-circuit and overload. Suitable for connection to the circuit which it is protecting by means of a molded-case switch.

L. Warranty:
1. Type 1: 10-year full replacement warranty.
2. Type 2: 5-year full replacement warranty.

M. Enclosure as shown on the Drawings.

N. Hard-wired.

O. Where sine wave tracking is required in "Type" paragraphs below, provide hybrid design incorporating filters, capacitors, or other technology in addition to MOVs and SADs to remove low voltage high frequency disturbances at any phase angle that will limit the let-through voltage of an A1 Ring Wave voltage relative to the applied 60 Hz. voltage to not more than shown in the following table.

P. Other Features:
1. LED indication of operational state of suppressor for each phase/mode.
2. Modular plug-in suppressor units for easy replacement.
3. Symmetrically balanced metal oxide varistors (MOV).
4. As required in "Type" paragraphs below.
5. As shown on the Drawings or Schedule.

2.02 TYPE

A. Surge Capacity of 250 kA and Greater:
   1. High surge current device designed for service equipment and rated for location/exposure Category C3.
   2. Features: Dry form C contact for external alarm indication.

B. Surge Capacity Greater Than 100 kA and Less Than 250 kA:
   1. High surge current device designed for service equipment and rated for location/exposure Category C3.
   2. Features: Dry form C contact for external alarm indication.
   3. Sine wave tracking.

C. Surge Capacity of 100 kA or Less:
   1. Sine wave tracking.
   2. Dry form C contact for external alarm indication, only if shown on the Drawings or Tag List.

PART 3 EXECUTION

3.01 INSTALLATION OF HARD-WIRED SPD

A. Plan the installation in advance so that an SPD is installed immediately adjacent to (above, left, right, or below) the protected equipment.

B. Connect to circuit being protected by means of a molded case switch (non-automatic circuit breaker) or circuit breaker as shown on the Drawings.

C. Connect SPD with minimum #8 stranded wire or as shown on the Drawings, whichever is greater. If manufacturer recommendation is different, the Engineer will resolve conflicts.

D. Make connecting conductors as short as practical: Maximum 24″. Sharp bends in conductors are not acceptable. If the configuration of the SPD is such that shorter lead length can be achieved by mounting the enclosure rotated 90 or 180 degrees from “normal” then do so if allowed by the manufacturer of the SPD. Do not mount with hinge on bottom.

3.02 SCHEDULE

A. Type and surge capacity as shown below unless shown otherwise on Drawings.
   1. 480V Switchboards: Type 1,250 kA surge capacity.
   2. 480V MCCs: Type 1, 150 kA surge capacity.
   3. 480V Panelboards: Type 1, 150 kA surge capacity.
   4. 208/120V Panelboards: Type 2, 80 kA surge capacity.
   5. 240/120V Panelboards: Type 2, 80 kA surge capacity.

END OF SECTION

SECTION 26 50 10

LED LUMINAIRES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Luminaires, lamps, mounting hardware, and accessories for interior and exterior lighting applications as specified and/or as shown in the Luminaire Schedule and/or Drawings.

1.02 SUBMITTALS

A. For luminaires which are listed by manufacturer and type and/or catalog number in the Luminaire Schedule or Drawings, provide:
   1. Bill of Material:
      a. Type Number.
      b. Manufacturer's name and model name.
      c. Complete catalog number.
      d. Driver voltage and current.
      e. Catalog number.
   2. Cut sheets for each luminaire.

B. For manufacturers, type, and catalog numbers not listed in the Luminaire Schedule or Drawings:
   1. Comply with Section 01 25 00 – Substitution Procedures.
   2. Unless waived in writing by the Engineer, provide pre-wired sample for Engineer review, which will be returned, or prepare a presentation to engineer on proposed luminaires.
      a. Pre-wired with 15A, 120 VAC plug.
   3. NRTL certification and verification.
   4. Lighting layout showing performance of proposed luminaires which shall meet minimum maintained fc levels as shown on the in the Schedule or on Drawings.
   5. IES photometric files.
   6. Supporting data for L_{xx} value with respect to site conditions.
   7. All data as required in Paragraph A. above.

1.03 OPERATION AND MAINTENANCE DATA

A. Bill of Material, meeting the requirements of Paragraph 1.02 A., for all luminaires. If some items were allowed as substitutions, add them to the Bill of Material. It is not necessary to provide cut sheets or literature except as required below for replacement parts.

B. Manufacturers maintenance data, including replacement parts list. Provide illustrations of parts and their location in the luminaire assembly.

1.04 CATALOG NUMBERS

A. Recognize that a particular catalog number shown below or in the Schedule may not exactly represent the features required in the description below or in the Schedule, such as:
   1. Type of driver for a multi level or diming luminaire.
   2. Battery backup provisions.
   3. Integral photocell.
   4. Integral motion detection.

B. Provide luminaires having all required features and show complete, detailed catalog numbers and options in the submittal.

PART 2 PRODUCTS

2.01 LED LUMINAIRES

A. Voltage: 120 VAC unless shown otherwise in the Schedule or on the Drawings.

B. Modular Design. Capable of replacing driver, LED light bars, and accessories independently for failure replacement or upgrades.

C. CRI: 70 minimum

D. Driver Current: 350 mA unless shown otherwise in the Schedule or on the Drawings.

E. Temperature: 3500K unless shown otherwise in the Schedule or on the Drawings.

F. Foot Candle (FC) Levels: As recommended by IESNA or as shown in the Schedule or on the Drawings, whichever is greater.

G. Mounting: As shown on the Drawings.

H. Proper UL listings for dry/damp, wet, and hazardous (wet locations and vapor tight NEMA 4X) locations.

I. Driver:
   1. Power Factor: > .90.
   2. Total Harmonic Distortion (THD): <20%.
   3. Integral surge suppression protection in accordance with IEEE C62.41.2 and ANSI 62.41.2.

2.02 BATTERY BACKUP LUMINAIRES

A. Where shown in the Luminaire Schedule and/or Drawings, furnish self-diagnostic battery system for standby operation.

B. Provide a minimum 1300 lumens per luminaire of illumination for 90 minutes during a power outage.

C. Furnished, installed in the driver channel, and wired by luminaire manufacturer. Indicator lights easily visible from below.

2.03 OCCUPANCY SENSOR

A. Wall-mounted with manual override.

B. Single-point or 3-way as required on Drawings.

C. Infrared and ultrasonic motion sensors, plus photocell.

D. Cooper OSW-DT or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's recommendations and the Drawings. If not available from the manufacturer of the specific equipment and not shown on the Drawings, install according to the best trade practice.

B. Furnish fittings, hangers, stems, parts, etc., as required for proper installation.

C. Securely support luminaires so that they are level and in vertical and horizontal alignment unless specifically shown otherwise on the Drawings.

D. Clean luminaires, install lamps, and test systems prior to acceptance by the Engineer.

3.02 SCHEDULE

A. Provide luminaires which comply with the requirements of this Section and with the requirements of the Luminaire Schedule on the Drawings.

END OF SECTION

SECTION 31 00 00

EARTHWORK BACKFILLING AND COMPACTION FOR STRUCTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
1. Preparing and grading subgrades for slabs-on-grade, and walks.
2. Excavating and backfilling for buildings and structures.
3. Drainage and moisture-control fill course for slabs-on-grade.
4. Subbase course for walks.
5. Subsurface drainage backfill for walls and trenches.
6. Excavating and backfilling trenches within building lines.
7. Excavating and backfilling for underground mechanical and electrical utilities and appurtenances.

1.03 DEFINITIONS

A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.

B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.

D. Subbase Course: The layer placed between the subgrade and base course in a paving system or the layer placed between the subgrade and surface of a pavement or walk.

E. Base Course: The layer placed between the subbase and surface pavement in a paving system.

F. Drainage Fill: Course of washed granular material supporting slab-on-grade placed to cut off upward capillary flow of pore water.

G. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

I. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.04 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product data for the following:
1. Each type of plastic warning tape.
2. Filter fabric.

1.05 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

B. Testing and Inspection Service: A qualified independent Geotechnical engineering testing agency will classify proposed on-site and barrow soils to verify that soils comply with specified requirements, and will perform required field and laboratory testing. The testing laboratory shall mail a copy of each test report to the Architect. Laboratory tests for soil classification will be performed in accordance with Section 01 45 00 – Quality Control and Sheet S-002 Quality Assurance Plan.

C. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section “Coordination”.
1. Before commencing earthwork, meet with representatives of the governing authorities, Owner, Architect, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.06 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.
   1. Provide a minimum 48-hours' notice to the Architect and receive written notice to proceed before interrupting any utility.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations. See Geotechnical Report.

B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.

C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.

D. Backfill and Fill Materials: Satisfactory soil materials.

E. Subbase and Base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, ASTM D 2940, with at least 95 percent passing a 1-1/2 inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Subbase or base materials.

G. Bedding Material: Subbase or base materials with 100 percent passing a 1 inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate grading size 57, with 100 percent passing a 1-1/2 inch sieve and not more than 5 percent passing a No. 8 sieve.

I. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100 percent passing a 1-1/2 inch sieve and 0 to 5 percent passing a No. 50 sieve.

J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.02 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.
1. Tape Colors: Provide tape colors to utilities as follows:
   a. Red: Electric.
   b. Yellow: Gas, oil, steam, and dangerous materials.
   c. Orange: Telephone and other communications.
   d. Blue: Water systems.
   e. Green: Sewer systems.

C. Filter Fabric: Manufacturer's standard nonwoven pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination.
1. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test method in parentheses:
   a. Grab Tensile Strength (ASTM D 4632): 100 lb.
   b. Apparent Opening Size (ASTM D 4751): #100 U.S. Standard sieve.
   c. Permeability (ASTM D 4491): 150 gallons per minute per sq. ft.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Tree protection is specified in 1500-3.06.B.

3.02 DEWATERING

A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.03 EXCAVATION

A. Explosives: Do not use explosives.

B. Classified Excavation: Excavation is classified and includes excavation to required subgrade elevations. Excavation will be classified as earth excavation or rock excavation as follows:
   1. Earth excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with soil and other materials encountered that are not classified as rock or unauthorized excavation.
      a. Intermittent drilling or ripping to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

3.04 STABILITY OF EXCAVATIONS

A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.

3.05 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1.2 inches. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Excavate to rough grade all building and pavement areas and scarify to a depth of eight inches below rough grade elevations. Any soft and “spongy” areas shall be removed as directed by the geotechnical engineer.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.07 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
   1. Clearance: 12 inches each side of pipe or conduit.
   2. Clearance: As indicated

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.
   1. For pipes or conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
   3. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.

3.08 APPROVAL OF SUBGRADE

A. Notify Architect when excavations have reached required subgrade.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Architect.

3.09 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Architect.
   1. Fill unauthorized excavations under other construction as directed by the Architect.
   2. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Backfill excavations promptly, but not before completing the following:
   1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for record documents.
   3. Testing, inspecting, and approval of underground utilities.
   4. Concrete formwork removal.
   5. Removal of trash and debris from excavation.
   6. Removal of temporary shoring and bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings. Place concrete to level of bottom of footings.

C. Provide 4 inch thick concrete base slab support for piping or conduit less than 30 inches below surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

D. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
   1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.

G. Place and compact final backfill of satisfactory soil material to final subgrade.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 FILL

A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
   1. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.

B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.

C. Place fill material in layers to required elevations for each location listed below.
   1. Under grass, use satisfactory excavated or borrow soil material.
   2. Under walks and pavements, use subbase or base material, or satisfactory excavated or borrow soil material.
   3. Under steps and ramps, use subbase material.
   4. Under building slabs, use drainage fill material.
   5. Under footings and foundations, use engineered fill.

3.14 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.
      a. Stockpile or spread and dry removed wet satisfactory soil material.

3.15 COMPACTION

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.

C. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557:
   1. Under structures, building slabs, steps, behind retaining walls, and pavements, compact the top 12 inches below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
   2. Under walkways, compact the top 6 inches below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
   3. Under lawn or unpaved areas, and non-structural areas compact the top 6 inches below subgrade and each layer of backfill or fill material at 90 percent maximum dry density.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between existing adjacent grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 1.2 inches.
   2. Walks: Plus or minus 1.2 inches.
   3. Pavements: Plus or minus 1/2 inch.

C. Grading Inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10 foot straightedge.

3.17 SUBBASE AND BASE COURSES

A. Under pavements and walks, place subbase course material on prepared subgrades. Place base course material over subbases to pavements.
   1. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 95 percent of ASTM D 4254 relative density.
   2. Shape subbase and base to required crown elevations and cross-slope grades.
   3. When thickness of compacted subbase or base course is 6 inches or less, place materials in a single layer.
   4. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders at least 12 inches wide of acceptable soil materials and compact simultaneously with each subbase and base layer.

3.18 FIELD QUALITY CONTROL

A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

1. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.
    a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.
    b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.
2. Footing Subgrade: At footing subgrades, perform at least one test of each soil stratum to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of each subgrade with related tested strata when acceptable to the Architect.
3. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
4. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
5. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.

B. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace material to depth directed by the Architect; reshape and recompact at optimum moisture content to the required density.

C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

SECTION 31 22 00

GRADING

PART 1 GENERAL

1.01 WORK INCLUDED

A. This work shall consist of shaping road beds and side ditches to subgrade preparation to the depths indicated on the Drawings.

1.02 REFERENCE STANDARDS

A. American Society for Testing and Materials International:
   1. ASTM D1556 – Density of Soil in Place by the Sand-Cone Method.
   2. ASTM D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   3. ASTM D2167 – Density of Soil in Place by the Rubber-Balloon Method.
   4. ASTM D2216 – Laboratory Determination of Moisture Content of Soil.
   5. ASTM D6938 – In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 QUALITY ASSURANCE

A. Testing Laboratory:
   1. Contractor will provide material testing for quality control during earthwork operations.

1.04 JOB CONDITIONS

A. Do not construct embankments when atmospheric temperature is below 35^{o}F.

PART 2 PRODUCTS

2.01 BORROW

A. Borrow shall consist of materials obtained from approved borrow areas designated by the Engineer for the construction of embankments.

B. Provide free of vegetation.

2.02 WASTE

A. Disposal of excess excavation shall be the responsibility of the Contractor. Excess material to be placed in location reviewed by Engineer.

2.03 EXCAVATION

A. Includes excavation, removal, backfill, and satisfactory disposal of all materials encountered in the work.

2.04 EMBANKMENT

A. Embankment construction shall consist of the formation of embankments with suitable material from on-site excavation.

PART 3 EXECUTION

3.01 GENERAL

A. Excavation and embankments for the roads shall be finished to the contours, shapes, dimensions, and elevations shown on the Drawings.

B. No materials shall be wasted without permission from the Engineer.

C. Perform clearing operations prior to beginning excavation, grading, and embankment operations.

3.02 SUBGRADE PREPARATION

A. See Section 31 23 13 – Subgrade Preparation.

3.03 GRADING

A. Provide uniform slopes and rounded changes in slope, free of low spots.

B. The degree of grade control shall not deviate from true grade and profile more than one-half inch as measured by a 10-foot straightedge.

C. Drainage:
1. Provide and maintain positive surface water drainage around and away from open excavations.
2. Keep opened excavations dry.
3. Remove free water in excavations promptly.

3.04 EMBANKMENT

A. Embankments shall meet the compaction requirements specified in Subsection 3.05.

B. No frozen material, brush, sod, or unsuitable material shall be placed in the embankments.

C. In the distribution of embankment material, avoid lenses differing substantially from the surrounding material.

D. Deliver materials to the embankment in such a manner as to result in a well and uniformly compacted embankment.

3.05 EMBANKMENT AND BACKFILL COMPACTION

A. General:
1. Compact in 8-inch loose horizontal layers.
2. Use moistened material when necessary.
3. Layers shall be uniformly compacted before a succeeding layer is placed.
4. Add water in sufficient quantity to obtain the specified compaction.
5. Do not allow free water to stand on an embankment surface.
6. Compaction shall be accomplished by approved methods and equipment.

B. Degree of Compaction:
1. Optimum density will be determined in accordance with ASTM D1557.
2. Perform compaction as follows:

Description	Percent of Maximum Dry Density to Be Not Less Than	Variation of Optimum Moisture
Embankment and backfill under roads, lift station, or where otherwise scheduled	95	+2
General area grading not included in the above	90	+2

3.06 FIELD QUALITY CONTROL

A. Field control of density of in-place material will be determined in accordance with any of the following methods:
1. Nuclear Method, ASTM D6938.
2. Rubber-Balloon Method, ASTM D2167.
3. Sand-Cone Method, ASTM D1556.

B. Field control of moisture content will be determined in accordance with either of the following methods:
1. Nuclear Method, ASTM D6938.
2. Laboratory Determination, ASTM D2216.

C. In-place density and moisture tests to be taken at intervals to be determined by the Engineer.

END OF SECTION

SECTION 31 23 01

EXCAVATION AND FILL FOR SITE WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Site Excavation, Filling and Backfilling.

B. Precast Utility Structure Excavation, Filling, and Backfilling.

C. Compaction of Fill and Backfill.

D. Finish Grading.

1.02 RELATED WORK

A. Section 31 23 00 – Excavation, Backfill, and Compaction for Structures

1.03 REFERENCES

A. ASTM C33 – Standard Specification for Concrete Aggregates.

B. ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

C. ASTM D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D. ASTM D4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.04 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures:
   1. Laboratory Test Results for Select Fill, Ordinary Fill, and Pea Gravel:
      a. Moisture-density relationships (ASTM D1557).
      b. Gradation (ASTM C136).
      c. Liquid limit, plastic limit, plasticity index (ASTM D4318).

1.05 PROTECTION

A. Protect trees, shrubs, lawns, and other features remaining as a portion of final site.

B. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from equipment and vehicular traffic.

C. Protect above and below grade utilities which are to remain.

D. Notify Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

E. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.

F. Grade excavation top perimeter to prevent surface water run-off into excavation.

G. Protect structure walls, foundation, and similar features from structural stress during backfilling operations.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Material removed from excavations may be used for fill or backfill provided such material meets the requirements for fill and backfill specified in this Section. Some blending of materials may be necessary.

B. Exclude debris, large rocks, roots, organic material, expansive material and other deleterious materials.

C. Provide additional fill materials if necessary from off-site locations obtained by Contractor.

D. Do not use any materials containing any contaminants that may endanger public health. Do not use mine tailings.

E. Do not use any materials which have not been reviewed by the Engineer.

2.02 MATERIALS

A. Select Fill:
1. Clean, well graded, relatively cohesionless material free of organic or frozen matter.
2. Largest rock or clod dimension, 1″.
3. Plasticity index less than 8.
4. Maximum percent passing sieve (unless otherwise reviewed by Engineer):
    a. #10, 50%.
    b. #40, 30%.
    c. #200, 15%.

B. Ordinary Fill:
1. Clean, free of organic or frozen matter.
2. Largest rock or clod dimension, 3″.
3. Normally acceptable are Unified Soil Classification System Classified Materials: GW, GP, SW, SP, GM, SM, or GC.

C. Normal Backfill:
   1. Excavated earth or sand thoroughly mixed to create uniform material.
   2. Free of trash, debris, organic or frozen matter.
   3. Largest rock or clod dimension, 2″.

D. Pea Gravel:
   1. Mineral aggregate graded 0.25″ to 0.38″.
   2. Free of soil, clay and shale; free of organic, frozen debris, or foreign matter.

E. Sandfill:
   1. Clean, well-graded material conforming to requirements of ASTM C33 for fine aggregate.

F. Moisture Barrier: 10 mil minimum polyethylene sheet.

PART 3 EXECUTION

3.01 GENERAL

A. The type of bearing material and the thickness and extent of structural fill (if required) are shown on the Drawings.

B. Interior non-structural slabs-on-grade are to be supported on granular fill not less than 6″ thick on structural fill not less than 1′ thick. See Drawings for location where sand fill over polyethylene moisture barrier is required over granular fill.

C. Do not place or compact fill or backfill when the atmospheric temperatures are below 35°F. Protect completed fill or backfill areas from freezing. Recondition, reshape and recompact to the requirements of this section without additional cost to the Owner any areas which are damaged by freezing.

3.02 SHEETING, SHORING AND BRACING

A. Provide sheeting, shoring and bracing where required to hold walls of excavation and to protect workers and existing construction. Contractor shall be responsible for proper sizing and placement of Work.

B. Remove sheeting, shoring and bracing in manner to avoid damage to disturbance to Work. Leave sheeting and shoring in place where removal will endanger Work, adjacent construction or personnel. If sheeting or shoring is to be left in place, remove all traces of sheeting or shoring to a minimum depth of 2′-0″ below finish grade unless otherwise reviewed by the Engineer.

3.03 CLEARING AND GRUBBING

A. General: Clearing and grubbing are required for all areas shown on the plans to be excavated or where fill is to be constructed.

B. Clearing:
   1. Remove and dispose of trees and other vegetation, downed timber, snags, brush, and rubbish within areas to be cleared.

C. Grubbing:
   1. Remove stumps, matted roots, and roots larger than 2″ in diameter from within 6″ of the surface of areas on which fills are to be constructed, and within 18″ of finished subgrade of roadways.
   2. Areas disturbed by grubbing shall be filled as specified in this section for embankment.

3.04 PREPARATION

A. Excavation:
   1. Identify required lines, levels, contours, and datum.
   2. Identify all underground utilities and other facilities. Stake and flag locations.
   3. Identify and flag surface and aerial utilities.
   4. Maintain and protect existing utilities remaining which pass through work area.

B. Backfilling:
   1. When necessary, compact subgrade surfaces to density requirements for backfill material.
   2. Cut out soft areas of subgrade not readily capable of in situ compaction. Backfill with select fill and compact to density equal to requirements for subsequent backfill material.

3.05 EXCAVATION

A. Earth excavation shall consist of the excavation and removal of suitable soils for use as embankment as well as the satisfactory disposal of all vegetation, debris, and deleterious materials encountered within the area to be graded and/or in a barrow area.

B. Excavate soil to the extent required for structure foundations, construction operations, and other work. See Drawings for extent of excavation required beneath and adjacent to structures.

C. Barricade open excavations, keep spoil piles out of the way of the Owner's personnel and otherwise maintain safe access by the Owner's employees to the Owner's facilities during construction.

D. Do not undercut existing construction.

E. Do not permit surface water to enter open excavations. Provide barriers and positive drainage away from excavations as necessary. Remove promptly any water which may enter excavations from any source.

F. Machine slope banks.

G. After excavations are complete, notify Engineer for inspection of completed excavation. Do not begin placement of fill or begin other construction operations until excavation is reviewed by Engineer.

H. Fill unauthorized over excavated areas beneath structures with select fill and compact to density required for subsequent fill or backfill. If unauthorized excavation will result in structure being supported partly on select fill and partly on native material, extend excavation under entire structure and fill as specified below. Fill unauthorized overexcavated areas away from structures with fill of the type specified for subsequent fill compacted to the density specified.

I. Dispose of all excess excavated material and material unsuitable for backfilling generated by construction activities, off-site or as directed by Owner, unless otherwise stated in Contract Documents at no additional cost to Owner. Properly dispose of all materials in accordance with regulatory requirements.

3.06 SUBGRADE TREATMENT

A. At areas to receive structural fill, scarify the exposed native soils to a depth of not less than 12″. Add or remove water as necessary to bring the scarified material to optimum moisture content (within -0, +2 percentage points). Compact the scarified soil to not less than 95 percent of maximum dry density as determined by ASTM D1557.

3.07 FILLING AND BACKFILLING

A. Provide all fill material required to complete Work, either from on-site excavations or imported from off-site, at no additional cost to Owner.

B. Backfill areas to contours and elevations shown on Drawings using unfrozen materials.

C. Place fill under structures and elsewhere as shown on the Drawings. Fill all unauthorized or excess excavations to the elevations shown or specified.

D. Backfill systematically, as early as possible, to allow maximum time for natural settlement. Do not backfill over porous, wet or spongy subgrade surfaces.

E. Backfilling Around Structures:
1. Backfill after concrete has attained sufficient strength to withstand backfill pressures without detrimental effects.
2. Prevent displacement of construction during backfilling operations; backfill opposite sides simultaneously.

F. Placement:
1. Maintain surfaces free of water, debris, and other deleterious materials.
2. Place backfill and fill materials in successive horizontal layers not more than 8″ in loose depth.

3. Place material at optimum moisture content (plus or minus two percentage points).
4. Material too dry or too wet shall be moistened or aerated to extent necessary to bring moisture content to within specified limits.

G. Compaction:
1. Compact fill and backfill using appropriate equipment as needed to achieve the densities specified below. Densities are expressed as percentages of the maximum dry density as determined by ASTM D1557.
2. Do not use heavy equipment in areas where existing construction may be damaged by the use of such equipment. Repair or replace without additional cost to the Owner, any damage to existing construction caused by earthwork operations.

H. Slope grade away from building minimum 2″ in 10′ unless noted otherwise. Fill depressions and provide for positive drainage away from buildings and structures.

I. Make changes in grade gradual. Blend slopes into level areas. Finish grade to smooth uniformly sloping surfaces to elevations required for drainage.

J. Finish surface by grading to provide finished appearance.

K. Place polyethylene moisture barrier at locations shown on the Drawings. Overlap not less than 6″ at all joints; tape joints securely. Protect from damage during placement of sand fill. Repair any rips or tears. Place not less than 3″ of sand fill over polyethylene moisture barrier beneath slabs-on-grade where shown on Drawings.

3.08 TOLERANCES

A. Top Surface of Backfill: ±2″.

B. Top Surface of Fill Beneath Structures: -1+0″.

3.09 FIELD QUALITY CONTROL

A. Section 01 45 00 – Quality Control.

B. Test Schedule:
1. One field density test for each 250 square yards of prepared subgrade.
2. One field density test for each 100 cubic yards of fill or for each layer of fill, whichever results in the greater number of tests.
3. Or where directed by Engineer.

C. If tests indicate that work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

3.10 SCHEDULE OF FILL AND BACKFILL

Area	Type of Material	Degree of Compaction
Beneath footings and slabs more than 10″ thick and for a distance outside their perimeters equal to the depth of fill.	Select fill	95%
Beneath slabs less than 10″ thick; pavements (except roadways) unless otherwise shown on Drawings.	Select fill	90%
General fills and embankments on the site.	Ordinary fill	90%
Non-structural areas except as otherwise shown on Drawings or directed by the Engineer.	Ordinary fill	85%
Backfill behind walls and below or adjacent to additional construction.	Select fill	95%
Backfill behind retaining walls.	Ordinary fill	90%
Backfill except as described above.	Normal backfill	90%
Where indicated on Drawings.	Select fill	95%
Fill within treatment structures, fill beneath interior slabs on grade over moisture barrier.	Sand fill	95%

END OF SECTION

SECTION 31 23 13

SUBGRADE PREPARATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Preparing the completed subgrade prior to placement of subsequent pavement section components to the grade and dimensions indicated on the Drawings. This is inclusive of all processing, shaping, compacting, watering, protecting and any removal and replacement of unsuitable material to prepare the subgrade satisfactorily for completion of the pavement section.

1.02 REFERENCES

A. American Society for Testing and Materials International:
1. ASTM D1556 – Density of Soil in Place by the Sand-Cone Method
2. ASTM D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
3. ASTM D2167 – Density of Soil in Place by the Rubber-Balloon Method
4. ASTM D2216 – Laboratory Determination of Moisture Content of Soil
5. ASTM D6938 – In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 QUALITY ASSURANCE

A. Testing Laboratory:
1. Contractor shall provide material testing for quality control during subgrade preparation.

PART 2 PRODUCTS

2.01 SUITABLE MATERIALS

A. Suitable materials shall consist of materials obtained on site reviewed by the Engineer for the purpose of subgrade preparation.

B. Any underlying soft or otherwise unsuitable material shall be removed and replaced with suitable material.

C. Provide free of vegetation.

2.02 WASTE

A. Disposal of excavated materials shall be the responsibility of the Contractor. Excess material to be placed in location designated by Owner or Engineer.

PART 3 EXECUTION

3.01 PREPARATION

A. Excavations and embankments for the roads and site grading shall be finished to the shapes, dimensions, and elevations shown on the Drawings.

B. Perform clearing operations prior to beginning excavation, grading, and embankment operations.

C. Processed, watered, and compacted to not less than 90% of modified Proctor density (ASTM D1557) at optimum moisture content ±2%, to a depth of 12″ minimum.

D. Material that cannot be processed satisfactorily to meet these specifications shall be considered unsuitable.

3.02 GRADING

A. Provide uniform slopes and rounded changes in slope, free of low spots.

B. The degree of grade control shall not deviate from true grade and profile more than one-half inch as measured by a 10′ straight edge.

C. Drainage:
1. Provide and maintain positive surface water drainage around and away from open excavations.
2. Keep opened excavations dry.
3. Remove free water in excavation promptly.

3.03 FIELD QUALITY CONTROL

A. Sample and Test:
1. At intervals not to exceed 200′.
2. At locations designated by the Engineer.

END OF SECTION

SECTION 32 12 01

PAVING, GRAVEL SURFACING, AND RESURFACING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Subgrade preparation.

B. Crushed aggregate base course.

C. Prime coat.

D. Asphaltic concrete surface course.

E. Paving repair and replacement.

F. Repair and replacement of gravel and other surfacing.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO T 11 – Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
2. AASHTO T 27 – Sieve Analysis of Fine and Coarse Aggregates
3. AASHTO T30 – Mechanical Analysis of Extracted Aggregate
4. AASHTO T 89 – Determining the Liquid Limit of Soils
5. AASHTO T 96 – Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
6. AASHTO T 104 – Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
7. AASHTO T 180 – Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
8. AASHTO T 205 – Density of Soil In-Place by the Rubber-Balloon Method
9. AASHTO T 238 – Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
10. AASHTO T 239 – Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

B. American Society for Testing and Materials International:
1. ASTM C127 – Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
2. ASTM C128 – Relative Density (Specific Gravity) and Absorption of Fine Aggregate
3. ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates
4. ASTM D1188 – Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
5. ASTM D2171 – Viscosity of Asphalts by Vacuum Capillary Viscometer

6. ASTM D2726 – Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
7. ASTM D2950 – Density of Bituminous Concrete in Place by Nuclear Methods

C. Asphalt Institute Manuals:
1. MS-2 – Asphalt Mix Design Methods
2. MS-4 – The Asphalt Handbook

1.03 SUBMITTALS

A. Section 01 33 23 – Shop Drawings, Product Data, and Samples:
1. Aggregate: Material certificates and laboratory analysis.
2. Prime and tack coats: Material certificates for each load.
3. Asphaltic Concrete:
   a. Job mix formula for each type supported by:
   b. Evidence of mix design procedure.
   c. Complete aggregate analysis.
   d. Marshall curves.
   e. Mixing and placing temperatures.
   f. Job mix formula may be one successfully used in the area if supported by recent certified test reports.

1.04 TESTING AND INSPECTION

A. Testing: Take representative samples from the asphalt plant and the laydown surface and test in accordance with the following standard test procedures:
1. Bulk Specific Gravity of Compacted Bituminous Mixtures: ASTM D1188 or ASTM D2726.
2. Quantitative Extraction of Bitumen from Bituminous Paving Mixtures: ASTM D2171.
3. Sieve or Screen Analysis of Fine and Coarse Aggregates (extracted sample): ASTM C136.
4. Density of Bituminous Concrete in Place:
   a. Nuclear Method ASTM D2950 or,
   b. ASTM D1188 or ASTM D2726.

PART 2 PRODUCTS

2.01 MATERIALS

A. Subgrade: Existing in-place soil except that organic materials, solid obstructions, muck and other unsuitable materials shall be removed. Filling pockets in the subgrade with base course material or asphalt will generally not be permitted.

B. Crushed Aggregate Base Course: Base course aggregate shall be composed of materials consisting of crushed stone, crushed or screened gravel, caliche, sand or a combination of such materials. Base course aggregate shall be free from vegetable matter and all other deleterious materials. When the stationary plant method is used, base course aggregate will be accepted immediately following mixing based on periodic samples taken from the pugmill output. When a road mix method is used,

base course aggregate will be tested for acceptance on samples taken from the watered and completely processed window.

1. Base course aggregate will be tested in accordance with AASHTO methods provided below or in accordance with other approved methods:

Mechanical Analysis	AASHTO T 27
Passing No. 200 Sieve	AASHTO T 11
Liquid Limit	AASHTO T 89
Los Angeles Abrasion	AASHTO T 96
Soundness (5 cycle-Magnesium Sulfate Solution)	AASHTO T 104
Linear Shrinkage	
Materials Testing Control Manual	

2. Base course aggregate materials shall be combined in such proportions that the resulting composite blend meets the requirements of one of the following classes:

Sieve Size	Class A	Class B
1″	100	100
3/4″	80-100	85-100
No. 4	30-60	40-70
No. 10	20-45	30-55
No. 200	3-10	4-12
Soundness	18 or less	18 or less
L.A. Abrasion	50 or less	50 or less
L.L.	25 or less	25 or less

3. Fifty percent by weight of all plus No. 4 materials shall have a minimum of two mechanically fractured faces.

C. Prime and Tack Coats: Emulsified asphalt suitable for the intended use and local soil conditions.

D. Asphaltic Concrete: Mixture of mineral aggregate and paving asphalt (asphalt cement) mixed at a central mixing plant delivered as specified:

1. Asphalt cement: As recommended in the approved job-mix formula.
2. Aggregates:
   a. Tested in accordance with the following AASHTO methods:

Mechanical Analysis	AASHTO T 30
Passing No. 200 Sieve	AASHTO T 27
Liquid Limit	AASHTO T 89
Los Angeles Abrasion	AASHTO T 96
Soundness (Magnesium Sulfate)	AASHTO T 104

   b. Asphalt concrete aggregate shall have a percent of wear of 40 or less and the course aggregate shall have a soundness loss of 15 or less. All material passing the No. 40 sieve shall be non-plastic. The amount of

crushing shall be regulated so that at least 60 percent, by dry weight, of the plus No. 4 sieve material shall have a minimum of 2 fractured faces.

c. Gradation requirements:

Class "A"

Sieve Size	Percent Passing
1″	100
3/4″	80-100
1/2″	60-90
3/8″	50-80
No. 4	33-60
No. 8	23-45
No. 40	7-20
No. 200	2-8

Class "B"

Sieve Size	Percent Passing
3/4″	100
1/2″	75-95
3/8″	65-85
No. 4	40-60
No. 10	32-45
No. 40	10-22
No. 200	3-8

The grading of the combined aggregates as selected for the job mix design, shall be within the designated limits, and shall not vary from the high limit on one sieve to the low limit on the adjacent sieve, or vice versa, but shall be uniformly graded from coarse to fine. The percentages shown are based on the weight of dry aggregate only. Sieve analysis shall be made in accordance with ASTM C136 or AASHTO T 30.

3. Proportioning: The job-mix formula designed to achieve the following test properties subject to verification by field testing:

	Surface Course
Stability (Marshall - 75 Blow Briquette)	1500 lbs.+
Flow (Marshall)	8-16
Percent of Voids	3-7
Percent of Voids Filled With Asphalt	75-85
Percent Asphalt Cement Content by Weight	
Optimum of Total Mix	+0.4 percent
Sand Equivalent	40 or more
Compaction (percent of max. laboratory density)	96 percent minimum

4. Tolerances: If a mixture produced varies from the designated amounts by more than the following tolerances, proper changes shall be made until subsequent mixtures are within those tolerances:

Passing No. 4 and larger sieves	+7 percent
Passing No. 8 to No. 100 sieves (incl.)	+4 percent
Passing No. 200 sieve	+2 percent
Bitumen (tank strap method)	+0.3 percent
Bitumen (extraction method)	+0.5 percent
Temperature of Mixture	+20°F
Hydrated Lime	+0.3 percent
Portland Cement	+0.3 percent

5. Voids: For the purpose of calculating the percentage of voids in total mix and voids filled with asphalt, the specific gravities of the various aggregates shall be selected as follows:
   a. When the absorption of the aggregate, as determined by applicable ASTM C128 or ASTM C127, is less than one percent, the apparent specific gravity shall be used.
   b. When the absorption of the aggregate, as tested by ASTM C128 or ASTM C127, is one percent or greater, the mean between the bulk and the apparent specific gravities shall be used.

E. Open Graded Friction Course: Mixture of crushed stone or crushed gravel and bituminous materials mixed at a central mixing plant delivered as specified:
1. Asphalt Cement: As recommended in the approved job-mix formula.
2. Aggregates:
   a. Shall be crushed stone or crushed gravel, composed of hard durable pebbles or fragments so as to provide a material that will meet the following grading requirements when tested by means of AASHTO T 11 and T 30.
   b. At least 75 percent of the material retained on the No. 4 Sieve shall be particles having at least two fractured faces.
   c. Shall be free from vegetable matter, lumps or balls of clay, adherent films of clear or other material that will prevent through coating with asphaltic material.
   d. Shall have a percentage of wear of not more than 40 or less, and shall have a soundness loss of 8 or more.
   e. Shall be from a single source, blending from multiple source will not be permitted.
   f. Gradation Requirements:

Sieve Size	Percent Passing
1/2″	100
3/8″	90-100
No. 4	25-55
No. 10	0-10
No. 40	0-8
No. 200	0-4

F. Mine tailings may be incorporated into the work only with the prior specific written approval of the Engineer.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Rough Grading Requirements: Section 31 23 01 – Excavation and Fill for Site Work.

B. Any underlying soft or otherwise unsuitable material shall be removed and replaced with suitable material from excavation or borrow.

C. Scarified, watered, and compacted to 95 percent of modified Proctor density (AASHTO T 180) at optimum moisture content ±2 percent, to a depth of 12″ minimum.

D. Subgrade upon which pavement, sidewalk, curb and gutter, driveways or other structures are to be directly placed shall not vary more than 1/4″ from the specified grade and cross section. Subgrade upon which subbase or base material is to be placed shall not vary more than 1/2″ from the specified grade and cross section. Variations within the above specified tolerances shall be compensating so that the average grade and cross section specified are met.

3.02 CRUSHED AGGREGATE BASE COURSE

A. Subgrade:
1. Cleaned of all loose and deleterious materials.
2. Free from frozen material.
3. Top 6″ shall have a moisture content not exceeding optimum ±2 percent as determined by AASHTO T 180.

B. Mixing and Placing:
1. Mixing shall provide a homogenous mixture of unsegregated and uniformly dispersed materials as placed in position for compacting.
2. Plant and equipment shall be adequate in all respects.
3. Spread and compact base course in layers which will permit the required density to be obtained.
4. Density requirements will be determined by AASHTO T 180.
5. Unless otherwise provided, base course compacted to not less than 100 percent of the laboratory established density.
6. Densities will be determined in compliance with AASHTO T 205, use of nuclear methods in conformity with AASHTO T 238 and T 239, or other approved methods.
7. Top surface of base course shall not deviate in excess of 1/4″ when tested with a 10′ straightedge in any direction. All deviations from this tolerance shall be corrected.

C. Acceptable Mixing and Placing Methods:
1. Stationary Plant Method:
   a. Base course material and water mixed in an approved mixer.

b. Water added during the mixing operation in the amount necessary to provide the optimum moisture content for placement ±2 percentage points.
c. The base course material transported to the job site while it contains the proper moisture content and placed without delay on the roadbed by means of an approved aggregate spreader.

2. Travel Plant Method:
   a. Material for each layer of base course placed through an aggregate spreader or window sizing device.
   b. Base uniformly mixed by a traveling mixing plant.
   c. During mixing, water added in an amount sufficient to provide the optimum moisture content ±2 percentage points at the time of placement of material.
3. Road Mix Method:
   a. Material for each layer of base course placed.
   b. Materials mixed by means of motor graders or other suitable equipment until the mixture is uniform throughout.
   c. Water added during mixing sufficient to provide the optimum moisture content ±2 percentage points at the time of placement of material.

3.03 PRIME COAT

A. The use of prime coat shall be optional with the Contractor, recognizing that its primary value is in protecting the base course before it is covered with the asphalt surface course. If prime coat is used, it shall be so applied that it will penetrate and seal, but not flood, the base course surface. Any excess prime coat shall be dried up with blotter sand. Prime coat shall be properly cured out before the surface course is placed.

3.04 TACK COAT

A. The contact surfaces of all cold pavement joints, curbs, gutters, manholes, and the like, shall be cleaned and painted with tack coat just before the adjoining asphaltic concrete is placed.

B. Where multi-lift construction is called for, a light tack coat shall be used between lifts if the underlying surface has become dirty or give other signs that the lifts may not bond together properly without the aid of a tack coat. However, tack coat shall be used as sparingly as possible to achieve the intended purpose.

3.05 ASPHALTIC CONCRETE

A. The base course shall be cleaned, inspected, and all deficiencies corrected well in front of the laydown machine. Removing deficient base course material and filling the pocket with asphaltic concrete will not generally be permitted.

B. Manhole frames and valve covers shall be adjusted prior to placing the surface course.

C. At the time of delivery to the site of the work, the temperature of mixture shall be not lower than that required to obtain the density specified.

D. When hauling time from the mixing plant to the job site exceeds two hours or when inclement weather prevails, bituminous mixtures shall be covered with tarpaulins while being hauled. The tarpaulins shall completely cover the load and be firmly tied down. Mixtures shall be delivered to site of the work without segregation of the ingredients.

E. Asphalt concrete may be placed when the temperature is 40ºF and rising and the weather is favorable as determined by the Engineer. None may be placed in wet weather or on a wet surface.

F. The asphalt concrete shall be evenly spread upon the subgrade or base to such a depth that after rolling it will be of the specified cross section and grade of the course being constructed.

G. Depositing and spreading of the asphalt concrete shall be accomplished by means of self-propelled mechanical spreading and finishing machine designed especially for that purpose and which permits depositing and spreading in a strip 8′ to 14′ in width. The machine shall be equipped with a vibrating or tamping screed capable of being accurately regulated and adjusted to distribute a layer of the material to a definite predetermined thickness and template. The paving machine shall be equipped with an automatic leveling device controlled from an external guide. The initial pass for each course shall be made using a paver equipped with a 40′ minimum external reference, except this shall not apply when asphaltic concrete is placed adjacent to concrete pavement or gutter. Subsequent passes shall utilize a matching device of 1′ minimum length, riding on the adjacent lift.

H. Placing once commenced must be continued without interruption. No greater amount of the mixture shall be delivered in any one day than can be properly distributed and rolled during that day during daylight hours.

I. In narrow, deep or irregular sections, intersections, turnouts, or driveways, where it is impractical to spread and finish the base and level the surface mixtures by machine methods, the Contractor may use spreading equipment or acceptable hand methods reviewed by the Engineer.

J. Care shall be exercised in connection with the construction of joints to ensure that the surface of the pavement is true to grade and cross section.

K. In making the joint along any adjoining edge such as a curb, gutter, or an adjoining pavement and after the hot mixture is placed by the finishing machine, sufficient hot material shall be carried back to fill any space left open. This joint shall be properly "set up" with the back of a rake at proper height and level to receive the maximum compression under rolling. The work of "setting up" this joint shall be performed by competent workmen who are capable of making a correct, clean, and neat joint.

L. Longitudinal and transverse joints shall be made in a careful manner. Well-bonded and sealed joints are required. Joints between old and new pavements or between successive days' work shall be carefully made in such a manner as to insure a thorough and continuous bond between the old and new surfaces. In the case of surface course, the edge of the old surface course shall be cut back for its full depth so as to expose a fresh surface and, if necessary, to obtain a well-bonded joint, shall be painted with a tack coat after which the hot surface mixture shall be placed in contact with it and raked to a proper depth and grade. Before placing mixture against contact surfaces of curbs, gutters, headers, manholes, etc., they shall be painted with a tack coat.

M. Rolling shall be commenced with a steel wheel roller along the lower edge of the area to be rolled and be continued until the edge is thoroughly compacted, after which the roller shall be gradually advanced to the crown point, both sides being rolled in a like manner. Rolling shall be continued with steel and pneumatic wheel rollers until the layer has become thoroughly compacted throughout and is true to grade and cross section.

N. Rollers shall be maintained in good mechanical condition, and those that cannot be operated without jerking or driven along a straight path shall not be used. No leakage from any roller shall be allowed to come in contact with the pavement being constructed nor shall any roller be permitted to stand motionless on any portion of the work before it has been properly compacted. Steel roller wheels shall be treated with water or oil to prevent the adherence of the asphalt concrete, and water or oil may be used on pneumatic-tired rollers but the quantity used must not be such as to be detrimental to the surface being rolled.

O. Final rolling of the top or finish course shall be accomplished with a steel wheel roller, removing all surface imperfections, including indentures made by pneumatic-tired rollers.

P. Rolling of any asphaltic concrete course shall be continued until all roller marks are eliminated and a density of at least 96 percent of the density of a laboratory specimen of the same mixture has been obtained.

Q. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand operated mechanical tampers. Any mixture that becomes mixed with foreign materials or in any way is defective shall be removed, replaced with fresh mixture, and compacted to the density of the surrounding pavement.

R. Upon completion, the pavement shall be true to grade and cross section. Except at intersections or any changes of grade, when a 10′ straightedge is laid on the finished surface parallel to the centerline of the roadway, the surface shall not vary from the edge of the straightedge more than 3/16″. Areas that are not within this tolerance shall be brought to grade immediately following the initial rolling. After the completion of final rolling, the smoothness of the course shall be checked, and the irregularities that exceed the specified tolerances or that retain water on the surface shall be corrected by removing the defective work and replacing with new material as directed by the Engineer at the expense of the Contractor.

S. The Contractor shall cut samples as requested by the Engineer for testing the in-place compacted thickness of any asphaltic concrete course. Any area found to be more than 1/4″ deficient in thickness shall be removed and satisfactorily replaced by the Contractor. If the average of all the thickness tests indicate that the entire course is deficient in excess of 1/8″, the Contractor shall provide a 1″ asphaltic concrete surface course overlay at no additional cost to the Owner or other corrective action as reviewed by the Engineer.

3.06 RESTORATION OF EXISTING SURFACES

A. Roadways, parking areas, other traveled areas not scheduled:
1. Fully restored equivalent to what existing surfacing would have been when new.
2. Materials and installation as appropriate to conform to this Section.
3. Thickness, grades, alignment, and materials to match existing.
4. All work performed on NMDOT right-of-way shall meet the Standard Specifications for Road and Bridge Construction (current edition) and conform with NMDOT requirements.
5. All pavement cuts to be by saw or other methods to give straight edges and lines.
6. Asphalt pavement to be placed with laydown machine when practical.
7. Pavement removal and replacement payment limit: Pipe outside diameter plus 40″ for all non-scheduled surfaces regardless of width actually removed and replaced.

3.07 SCHEDULE OF THICKNESSES AND GRADATION

A. Thickness required as shown on the Drawings.

B. Gradation shall be Class “B”.

END OF SECTION

SECTION 32 16 01

CONCRETE APRON

PART 1 GENERAL

1.01 WORK INCLUDED

A. This work shall consist of the construction of portland cement concrete curb and gutter, sidewalk, and drivepads as indicated on Drawings.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO M 33 – Preformed Expansion Joint Filler for Concrete (Bituminous Type).
2. AASHTO M 153 – Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
3. AASHTO M 173 – Concrete Joint-Sealer, Hot-Poured Elastic Type.
4. AASHTO M 55 – Steel Welded Wire Reinforcement, Plain, for Concrete.

1.03 QUALITY ASSURANCE

A. Allowable Tolerances:
1. Finished surfaces will not be acceptable if varying from a straight line by more than 1/8″ when checked with a 10′ straightedge.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT CONCRETE

A. See Section 03 30 00 – Cast-In-Place Concrete.

2.02 JOINT FILLERS

A. Preformed expansion joint filler - AASHTO M 33 or M 153.

2.03 JOINT SEALERS

A. AASHTO M 173

2.04 REINFORCING

A. AASHTO M 55

B. 6 x 6 – W 2.9 x W 2.9 steel welded wire reinforcement furnished in flat sheets with supporting chairs shall be installed in all drive pads.

PART 3 EXECUTION

3.01 INSPECTION

A. Prior to placing forms, check to see that the subgrade has been compacted to the degree required by Section 31 23 13 – Subgrade Preparation.

3.02 CONCRETE

A. Formwork to be constructed in accordance with Section 03 30 00 – Cast-in-Place Concrete.

B. Construct concrete in accordance with Section 03 30 00 – Cast-in-Place Concrete.

C. Concrete shall be poured to thicknesses and dimensions shown on Drawings.

3.03 FINISHING

A. Curb and Gutter:
1. Give concrete a light broom finish with the brush marks parallel to the curb line or gutter line.

B. Sidewalk and Drivepads:
1. Give concrete a light broom finish with the bush marks perpendicular to the curb line or gutter line.

3.04 JOINTS

A. Provide Control Joints at 6′ on Center Maximum:
1. Extend joint into the concrete for at least one-third of the depth and make it approximately 1/8″ wide.

B. Provide 1/2″ preformed expansion joints at 36′ on center maximum, at curb returns and adjacent to buildings, walls and other immovable objects.

C. Edge all edges not specifically dimensioned with a 1/4″ or a 3/8″ edging tool.

D. Seal all joints.

3.05 BACKFILLING

A. Remove all forms.

B. Do not place earth backfill or pavement adjacent to curb and gutter or sidewalk until at least 7 curing days have elapsed.

C. Backfill with approved material.

D. Thoroughly compact backfill to the same density as the subgrade and at the proper moisture content.

3.06 SCHEDULE

A. Concrete for curb and gutter, sidewalk, and drivepads on this project shall meet the following requirements:
   1. Compressive Strength at 28 Days: 3,000 psi.
   2. Design Slump: 4″ maximum

END OF SECTION

APPENDIX A:

Laboratory Evaluation of Airfield Pavements at Raton Municipal Airport, March 9, 2009

Laboratory Evaluation of the Airfield Pavements at Raton Municipal Airport

Raju Bisht

and

Rafiqul A. Tarefder

March 9, 2009

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Appendix

1. Introduction

Laboratory testing was carried out to classify, define the properties, and calculate the California Bearing Ratio (CBR) of the soil samples received from Raton Municipal Airport, Raton in New Mexico. This is a part of the study carried out by New Mexico Department of Transportation (NMDOT) and the civil engineering department at UNM (University of New Mexico) for Federal Aviation Authority (FAA) to evaluate the condition of various airfield pavements in New Mexico. The purpose of the tests is to identify runways and taxiways that need corrections and at the same time compare and verify the results from the non-destructive tests. The airport is located on the northeast side of New Mexico and has two runways: 7-25 and 2-20. Non-destructive tests like the Falling Weight Deflectometer (FWD) and the skid resistance tests were carried out on both the runways and taxiways. Asphalt concrete cores and soil samples were collected from 20 selected locations: two locations on the apron, three locations on taxiway B, four locations on taxiway A, five locations on runway 7-25, and six locations on runway 2-20. The soil samples were tested and classified in accordance with the ASTM standards. The California Bearing Ratio (CBR) value was calculated using the empirical formula.

2. Methodology

The general layout of the airport with the borehole locations are presented in Fig.1. A total of 80 cores and 83 soil samples from different depths of 20 boreholes were tested in the laboratory. Soil samples were oven dried for the particle size analysis and air dried for the Atterberg limits. After sieve analysis, the hydrometer analysis was carried out for the portion passing the no. 200 sieve if it was in excess of 10 % of the total mass. This was done in accordance with ASTM D 2487 – 00: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil

Classification System) and ASTM D 422 – 63 (Reapproved 1998): Standard Test Method for Particle-Size Analysis of Soils. Atterberg limit tests followed the ASTM D 4318 – 00: Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. The sieve analysis results were plotted to determine the diameters D_{60}, D_{30}, and D_{10} corresponding to percents finer than 60 %, 30 %, and 10 % respectively. Based on the results of the particle size distribution, the soil was classified according to the Unified Soil Classification System. The CBR value is calculated according to the formula recommended in Mechanistic-Empirical Pavement Design Guide.

$$CBR = 28.09 D_{60}^{\ 0.358} \quad \text{..... Eq. (1)}$$

The results of all the tests and calculations are presented in the Appendix. The summary of the results and the soil profile are given in Table 1 and Figure 2 for runway 7-25, Table 2 and Figure 3 for runway 2-20, Table 3 and Figure 4 for taxiways A and B, and Table 4 for the apron.

3. Discussion

For all the locations, the base course is mainly well graded gravel (GW) with sand or well graded sand (SW) with gravel. For the apron, the results show that the base course is GW and SW with CBR value of 66 to 51. For the taxiways, the base course values range from 53 to 78. For runway 2-20, the values range from 63 to 72. The CBR value ranges from 54 to 77 for runway 7-25. All these values are fair to good for base course based on Table 3 (FAA :AC 150/5320 - 6D Part 1: Airport Pavement Design and Evaluation).

As for the type of subgrade soils and their strength, there is a variation in the CBR values depending on the percentage of fines. The total depth of different samples is about 5.0 feet. The different types of soils encountered are:

SW-SM - Well graded sand with silt.

SP-SM - Poorly graded sand with silt.

SW-SM – Well graded sand with silt and gravel.

SC – clayey sand.

The CBR values range from 20 to 77 for both the runways due to high percentage of gravel in some of the samples. These values are mainly good or good to excellent for subgrade based on Table 5 (FAA :AC 150/5320 - 6D Part 1).

The skid resistance values obtained from the field and analyzed. The skid number values for runway 2-20 at 5, 20 and 30 feet from the center line are presented in Table 6, Table 7 and Table 8. Similarly, the skid number values for runway 7-25 at 5, 20 and 30 feet from the center line are presented in Table 9, Table 10 and Table 11. For both the runways, the values are between 50 and 60. These values are higher than the minimum value of 50 but close to the maintenance planning value of 60 based on Table 12 (FAA: AC 150/5320 – 12C).

4. Conclusion

- Although the skid numbers are slighter higher for runway 7-25 as compared to runway 2-20, the numbers are very close to the maintenance and planning value of 60.

- The CBR values for the base course of both the runways and taxiway are above 50 and therefore good.

- The subgrade material for both the runways and taxiway is mostly well or poorly graded sand with silt and gravel. Subgrade has mostly good to excellent CBR values.

References

1. ASTM D 2487 – 00. Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

2. ASTM D 422 – 63 (Reapproved 1998). Standard Test Method for Particle-Size Analysis of Soils.

3. ASTM D 2487 – 00. Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

4. FAA: AC 150/5320 – 6D Part 1. Airport Pavement Design and Evaluation.

5. Mechanistic-Empirical Pavement Design Guide, Appendix CC-1, p 7.

Figure 1. General Layout with Borehole Locations of Raton Municipal Airport

Table 1: Summary sheet - Runway 7-25

Location	Hole No.	Depth, inches		Layer Thickness	Group Symbol	CBR
		From	To			
Runway 7-25	1	0	9	9	PMBP	
		9	21	12	GW	77
		21	26	5	GP-GM	56
		26	42	16	SC	32
		42	60	18	SM	42
	2	0	6	6	PMBP	
		6	20	14	GW	68
		20	28	8	SC	30
		28	44	16	SC	29
		44	64	20	SC	36
	3	0	7	7	PMBP	
		7	22	15	GW	72
		22	47	25	SP-SM	37
		47	70	23	GW	72
	4	0	8	8	PMBP	
		8	22	14	SW	54
		22	30	8	SP-SM	35
		30	45	15	GP-GM	61
		45	64	19	GP-GM	60
	5	0	7	7	PMBP	
		7	13	6	SW	56
		13	24	11	SP-SC	37
		24	30	6	SW-SM	43
		30	46	16	SM	26
		46	64	18	SW-SM	46

Table 2: Summary sheet - Runway 2-20

Location	Hole No.	Depth, inches		Layer Thickness	Group Symbol	CBR
		From	To			
Runway 2-20	9	0	8	8	PMBP	
		8	15	7	GW	72
		15	33	18	GP	61
		33	40	7	GP-GC	58
		40	53	13	GP	61
		53	71	18	GP-GC	56
	10	0	8	8	PMBP	
		8	14	6	GW	68
		14	28	14	GW-GC	54
		28	42	14	GW-GC	55
		42	51	9	GW-GC	58
		51	60	9	GP	70
	11	0	5	5	PMBP	
		5	11	6	GW	64
		11	30	19	SP-SC	32
		30	43	13	SC	17
		43	68	25	SC	20
	12	0	7	7	PMBP	
		7	15	8	GW	66
		15	32	17	GP	77
		32	62	30	53	53
	13	0	6	6	PMBP	
		6	15	9	GW	63
		15	36	21	GP	50
		36	56	20	GP-GC	33
		56	67	11	GP-GC	66
	14	0	7	7	PMBP	
		7	12	5	GW	66
		12	18	6	GW	65
		18	33	15	GP	52
		33	48	15	GP	68

		48	55	7	GW-GC	41

Table 3: Summary sheet - Taxiway A and B

Location	Hole No.	Depth, inches		Layer Thickness	Group Symbol	CBR
		From	To			
Taxiway A	15	0	6	6	PMBP	
		6	14	8	GW	66
		14	21	7	SC	29
		21	28	7	SC	29
		28	46	18	SC	22
		46	58	12	SP-SC	35
	16	0	6	6	PMBP	
		6	13	7	GW	78
		13	27	14	SC	20
		27	39	12	SP-SC	42
		39	63	24	SC	21
	17	0	6	6	PMBP	
		6	12	6	SW	53
		12	20	8	GW-GC	60
		20	64	44	GP-GC	60
	18	0	7	7	PMBP	
		7	15	8	GW	66
		15	40	25	SC	23
Taxiway B	6	0	6	6	PMBP	
		6	10	4	SP	53
		10	21	11	SW-SC	43
		21	54	33	SP	43
		54	60	6	GP	64
	7	0	6	6	PMBP	
		6	10	4	GW	56
		10	18	8	SC	27
		18	27	9	SC	21
		27	36	9	SP	30
		36	50	14	SP-SM	35
	8	0	6	6	PMBP	
		6	10	4	GW	57
		10	36	26	SC	23
		36	46	10	SC	21
		46	60	14	SC	21

Table 4: Summary sheet - Apron

Location	Hole No.	Depth, inches		Layer Thickness	Group Symbol	CBR
		From	To			
Apron		0	2	2	PMBP	
		2	13	11	GW	66
		13	23	10	GP	64
		23	52	29	GP	64
	19	52	59	7	SP-SC	49
		0	3	3	PMBP	
		3	12	9	SW	51
		12	17	5	SP-SC	37
	20	17	44	27	SP-SC	35

Note:

PMBP - Plant mixed bituminous pavement

GW - Well graded gravel

GP - Poorly graded gravel

SW - Well graded sand

SP – Poorly graded sand

SW –SM - Well graded sand with silt

SP –SM - Poorly graded sand with silt

SW –SC - Well graded sand with clay

SP –SC - Poorly graded sand with clay

SM – Silty sand

SC – Clayey sand

Table 5: Typical California Bearing Ratio (CBR) Values

Name	CBR	Value as Subgrade	Value as Base Course
Gravel or sandy gravel well graded	60 - 80	Excellent	Good
Gravel or sandy gravel poorly graded	35 - 60	Good to excellent	Poor to fair
Gravel or sandy gravel uniformly graded	25 - 50	Good	Poor
Silty gravel or silty sandy gravel	40 - 80	Good to excellent	Fair to good
Clayey gravel or clayey sandy gravel	20 - 40	Good	Poor
Sand or gravelly sand well graded	20 - 40	Good	Poor
Sand or gravelly sand poorly graded	15 - 25	Fair to good	Poor to not suitable
Sand or gravelly sand uniformly graded	10 - 20	Fair to good	Not suitable
Silty sand or silty gravelly sand	20 - 40	Good	Poor
Clayey sand or clayey gravelly sand	10 - 20	Fair to good	Not suitable

Figure 2. Soil Profile of Runway 7-25 with CBR Values

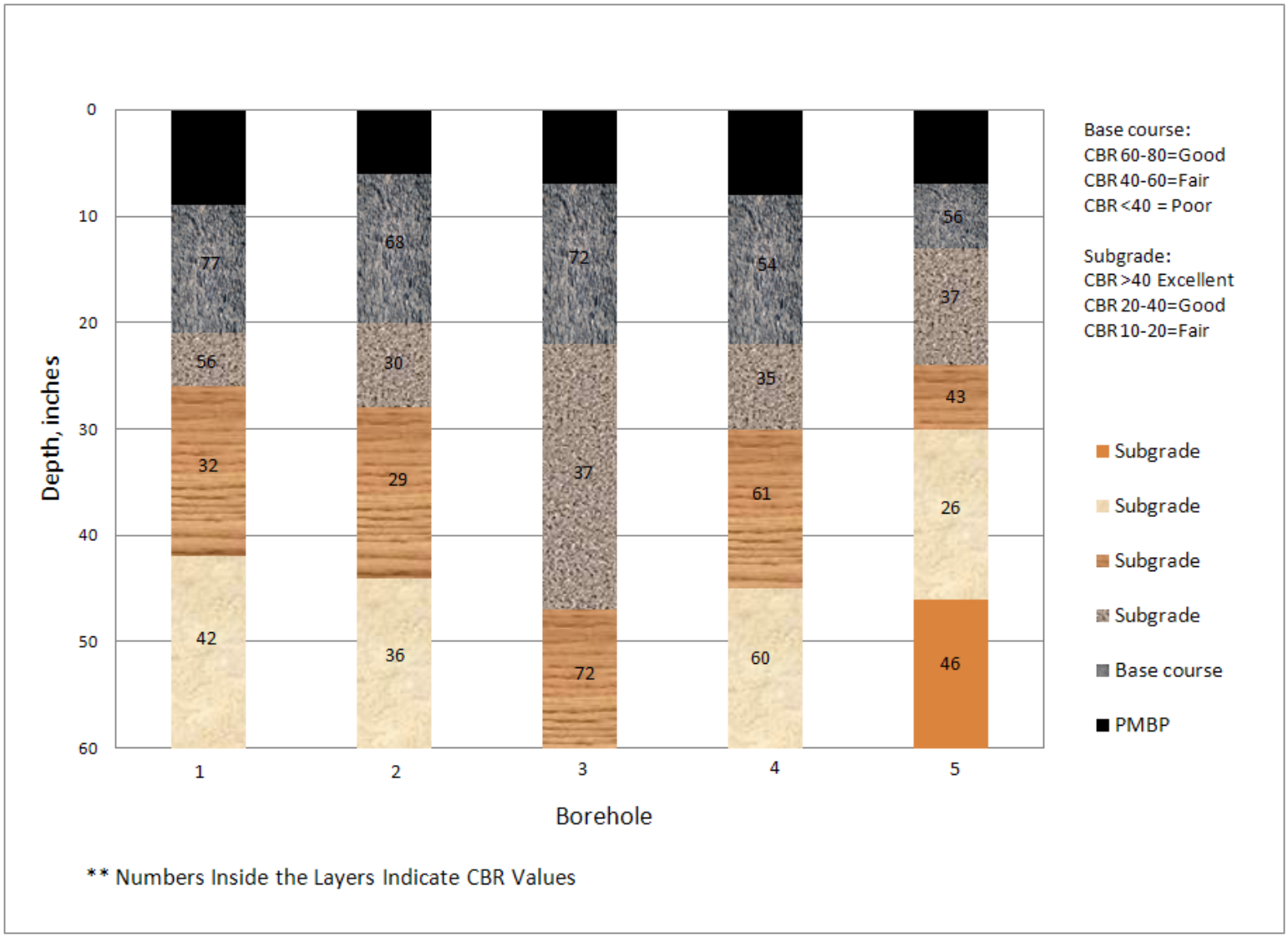

Figure 2. Soil Profile of Runway 2-20 with CBR Values

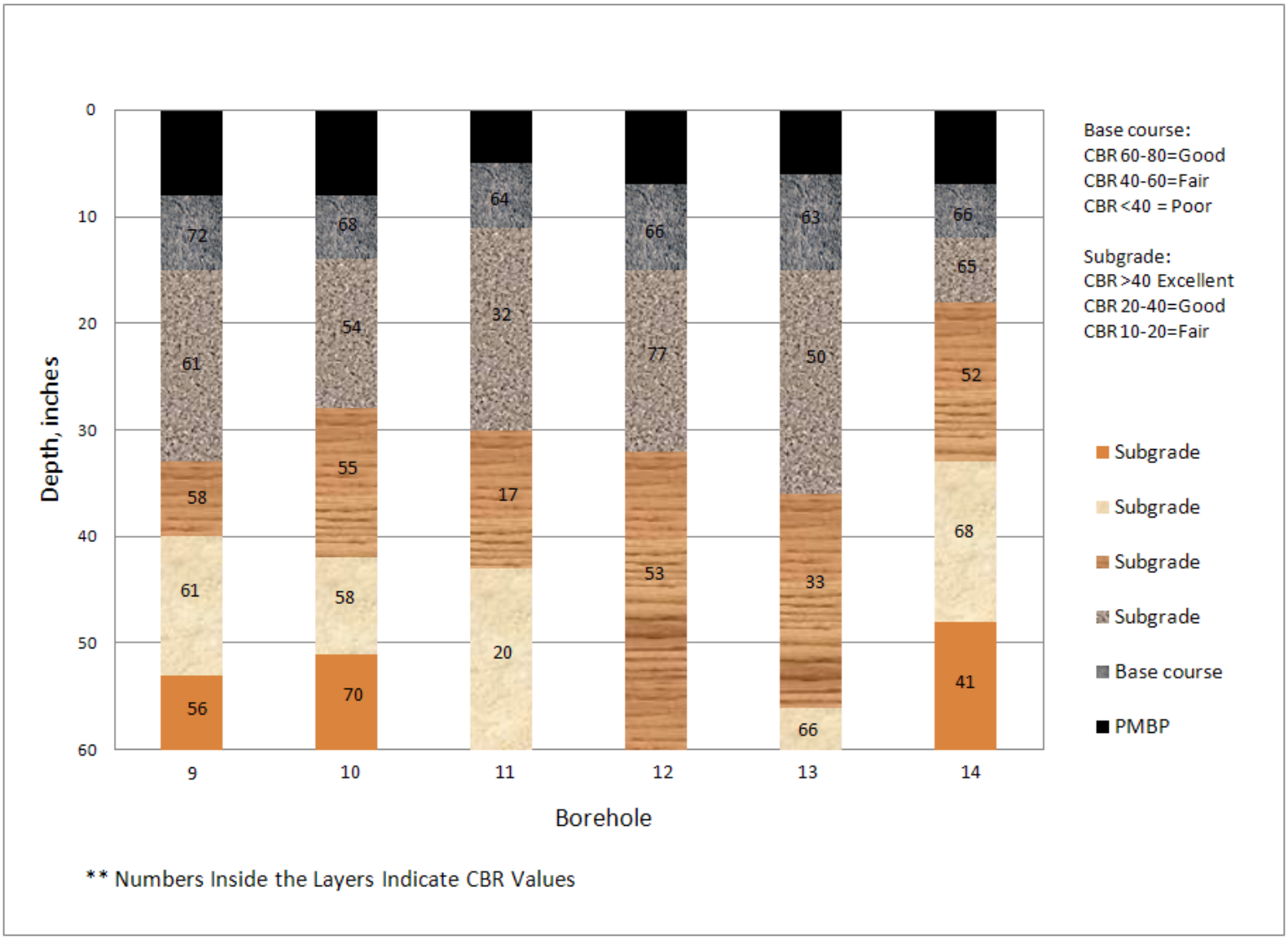

Figure 4. Soil Profile of Taxiway A and B with CBR Values

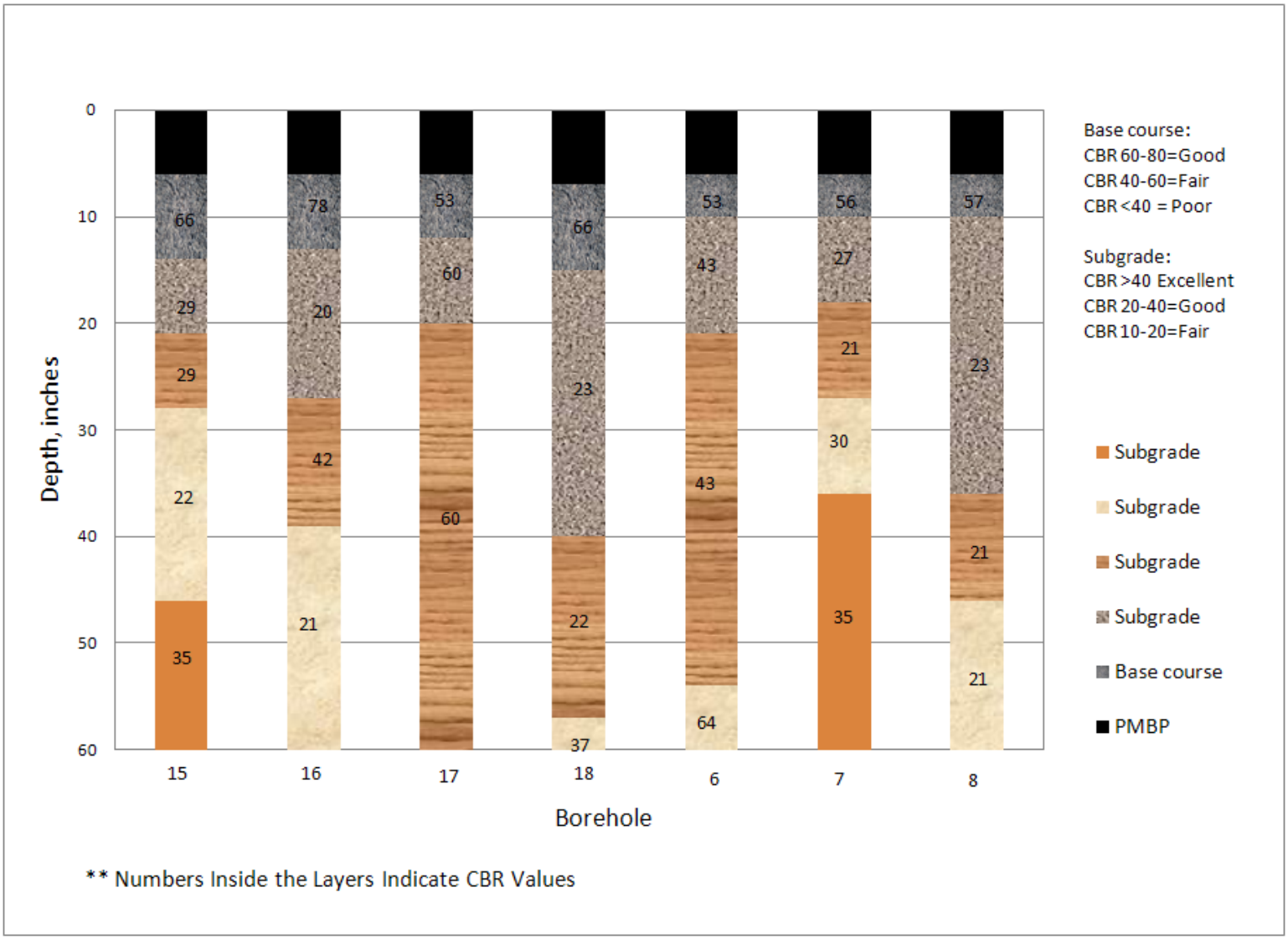

Table 6: Skid Resistance Data for Runway 2-20 (5 Ft from Center Line)

Test No	Location	Avg SN	Min SN	Max SN	Peak	% Slip
1	North Bound	57.4	53	62	89.6	83
2		56.2	46	61	88.1	80
3		52.1	45	61	93.39	80
4		54	30	62	91.88	80
5		56.9	50	64	93.64	82
6		59.1	51	63	91.29	81
7		58.5	55	61	88.21	82
8		57.5	40	63	89.97	81
9		12.3	-141	69	85.39	80
10		59.2	55	63	85.27	82
11		58.5	54	62	90.66	81
12		57.8	51	61	88.72	82
13	South Bound	31.4	-332	61	85.66	82
14		50.4	23	62	82.69	87
15		57.2	50	63	88.92	81
16		56.8	48	63	87.48	82
17		56.8	48	61	92.19	80
18		54.6	35	60	83.26	83
19		34.9	-297	61	91.03	80
20		44.8	-102	60	76.89	81
21		-4.6	-400	62	91.95	81
22		-0.4	-512	59	83.89	82
23		49.2	-81	63	89.81	80
24		-45.6	-372	63	41.12	80
25		29.5	-222	64	86.77	80

Table 7: Skid Resistance Data for Runway 2-20 (20 Ft from Center Line)

Test No	Location	Avg SN	Min SN	Max SN	Peak	% Slip
26	North Bound	62	57	66	93.03	81
27		53.4	34	68	93.63	82
28		12.9	-175	82	-74.64	78
29		59.7	50	69	82.43	82
30		63.1	54	69	91.17	82
31		4	-525	91	179.66	79
32		16.7	-235	68	90.79	82
33		-19	-466	71	34.14	77
34		40.8	-161	85	82.87	82
26		59.1	50	65	87.66	83
27		59.1	53	67	86.59	82
28		58.1	55	62	87.86	80
29		58.3	51	62	80.03	83
30		57.1	49	64	88.75	80
31		53.3	46	58	85.43	82
32		52.6	45	61	75.59	81
33		12	-405	70	73.09	82
34		55	34	60	89.12	80
3	South Bound	59.9	54	67	95.43	80
4		57.8	52	67	79.75	89
5		59.8	50	67	96.63	81
6		56.6	43	72	77.63	81
7		60.3	50	68	81.18	80
8		64.9	60	70	97.14	82
9		58.1	51	68	80.2	86

Table 8: Skid Resistance Data for Runway 2-20 (30 Ft from Center Line)

Test No	Location	Avg SN	Min SN	Max SN	Peak	% Slip
1	North Bound	37.2	-135	66	79.76	81
2		59.1	49	66	89.89	81
3		53.5	30	65	87.01	82
4		58.4	48	64	94.72	82
5		54.9	1	65	94.48	80
6		52.9	29	69	91.21	81
7		58.7	31	67	87.16	80
8		-96.4	-622	64	97.59	81
9		0.8	-459	73	85.82	80
10		41.6	-76	57	73.43	82
1	South Bound	53.9	46	59	88.57	81
2		51.5	46	62	70.18	83
3		47	42	54	75.82	82
4		55.7	42	65	86.47	82
5		59	55	63	89.82	82
6		56	51	61	89.07	82
7		56.1	49	67	77.93	85
8		57.3	52	64	87.47	81
9		60	53	67	85.33	80

Table 9: Skid Resistance Data for Runway 7-25 (5 Ft from Center Line)

Test No	Location	Avg SN	Min SN	Max SN	Peak	% Slip
1	South Bound	56.1	39	64	96.7	80
2		54.2	46	61	93.93	80
3		61.4	57	66	90.87	81
4		61.7	58	65	89.73	82
5		57.4	54	61	92.12	81
6		60.6	56	65	92.35	80
7		57.1	53	63	95.52	81
8	North Bound	61	56	65	93.03	79
9		61.2	55	66	92.1	80
10		58.2	36	66	94.04	81
11		59.9	56	64	88.86	81
12		60.1	57	63	87.19	81
13		60.3	56	64	91.22	81
14		61.7	56	66	91.11	82
15		60.5	57	65	84.96	81

Table 10: Skid Resistance Data for Runway 7-25 (20 Ft from Center Line)

Test No	Location	Avg SN	Min SN	Max SN	Peak	% Slip
1	South Bound	65.7	56	70	91.93	80
2		60.1	-47	70	93.64	80
3		64.2	55	69	90.32	82
4		65.2	62	68	89.13	82
5		64.5	60	68	92.23	82
6		63.8	58	69	92.57	81
7		64.2	60	68	91.68	81
8		58.1	55	63	92.96	82
9	North Bound	65.1	61	69	92.46	81
10		62.2	58	66	91.78	81
11		50.5	-178	69	89.46	81
12		26	-323	70	91.94	80
13		63.2	58	67	91.15	81
14		53.7	-49	67	88.28	82
15		55.8	-86	68	88.25	80
16		66.2	64	69	86.93	80

Table 11: Skid Resistance Data for Runway 7-25 (30 Ft from Center Line)

Test No	Location	Avg SN	Min SN	Max SN	Peak	% Slip
1	South Bound	58.9	20	67	87.24	80
2		64	59	68	86.5	81
3		64	58	70	84.63	82
4		59.7	55	65	87.2	82
5		60.6	51	66	88.17	81
6		58.8	41	68	93.22	81
7		62.9	44	69	88.63	81
8	North Bound	58.5	-53	74	88.9	82
9		48.1	-74	70	95.44	82
10		57.6	20	69	90.94	82
11		54.1	-60	67	93.38	81
12		4.6	-500	68	93.12	81
13		36.4	-216	72	90.66	80
14		58.2	-62	68	89.01	80

Table 12: Friction Level Classification for Runway Pavement Surfaces

Tester	40 mph			60 mph		
	Min	Maintenance Planning	New design/ Construction	Min	Maintenance Planning	New design/ Construction
Mu Meter	0.42	0.52	0.72	0.26	0.38	0.66
Dynatest Consulting Inc. Runway Friction Tester	0.50	0.60	0.82	0.41	0.54	0.72
Airport Equipment Co. Skiddometer	0.50	0.60	0.82	0.34	0.47	0.74
Airport Surface Friction Tester	0.50	0.60	0.82	0.34	0.47	0.74
Airport Technology USA Safegate Friction Tester	0.50	0.60	0.82	0.34	0.47	0.74
Findlay, Irvine, Ltd. Griptester Friction Meter	0.43	0.53	0.74	0.24	0.36	0.64
Tatra Friction Tester	0.48	0.57	0.76	0.42	0.52	0.67
Norsemeter RUNAR (operated at fixed 16 % slip	0.45	0.52	0.69	0.32	0.42	0.63

Source: FAA: AC 150/5320 – 12C

APPENDIX

Raton Municipal Airport

Borehole 1

Location: Runway 07-25, 950 ft. from SW threshold of Runway 25

Depth: 9 – 21 inches

Bag No: WT FL

Sample Weight (g): 1948.9

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	1191.1	694.2	35.6	64.4
9.5	483.6	1047.8	564.2	28.9	35.4
4.75	532.2	868.2	336.0	17.2	18.2
2.00	464.5	624.0	159.5	8.2	10.0
0.425	369.5	468.0	98.5	5.1	5.0
0.150	415.0	463.8	48.8	2.5	2.4
0.075	327.6	348.5	20.9	1.1	1.4
Pan	378.0	404.0	26.0	1.3	
		Total	1948.1		

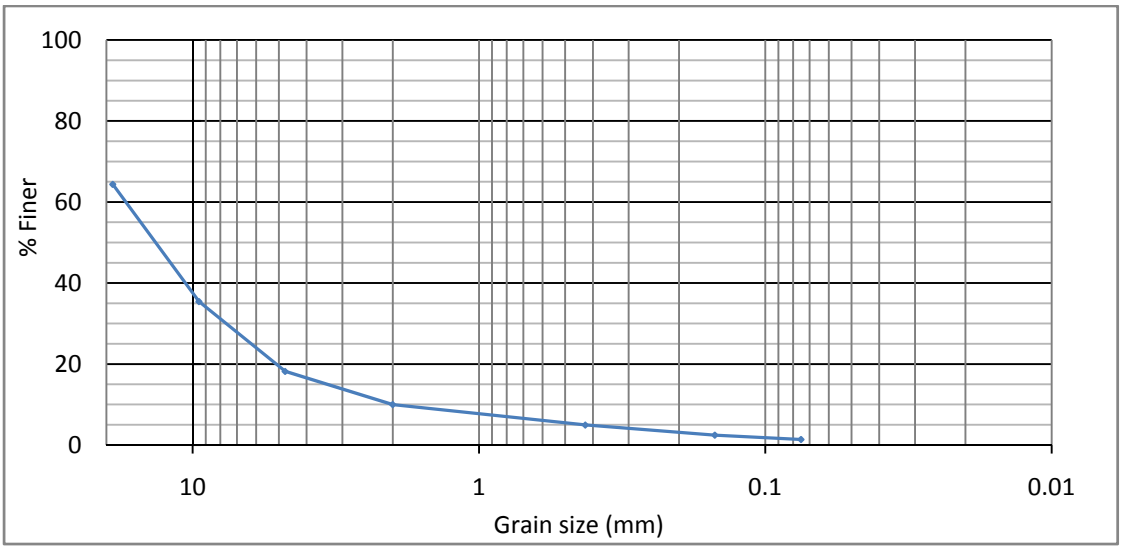

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 18.2 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 81.8 %. The amount of material passing sieve no. 4 and sieve no. 200 is 18.2 % and 1.4 %, so the percent of sand is 16.8 %.

$D_{60} = 17.0$ $D_{30} = 7.8$ $D_{10} = 2.0$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 8.5$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.2$

$CBR = 28.09(D_{60})^{0.358} = 77$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 77 is good for base course.

Depth: 21 – 26 inches

Bag No: N 2

Sample Weight (g): 631.2

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	518.1	21.2	3.4	96.6
9.5	483.6	652.4	168.8	26.7	69.9
4.75	532.1	679.6	147.5	23.4	46.5
2.00	464.5	561.4	96.9	15.4	31.2
0.425	369.5	457.2	87.7	13.9	17.3
0.150	414.9	459.0	44.1	7.0	10.3
0.075	327.5	351.8	24.3	3.9	6.4
Pan	377.9	418.0	40.1	6.4	
		Total	630.6		

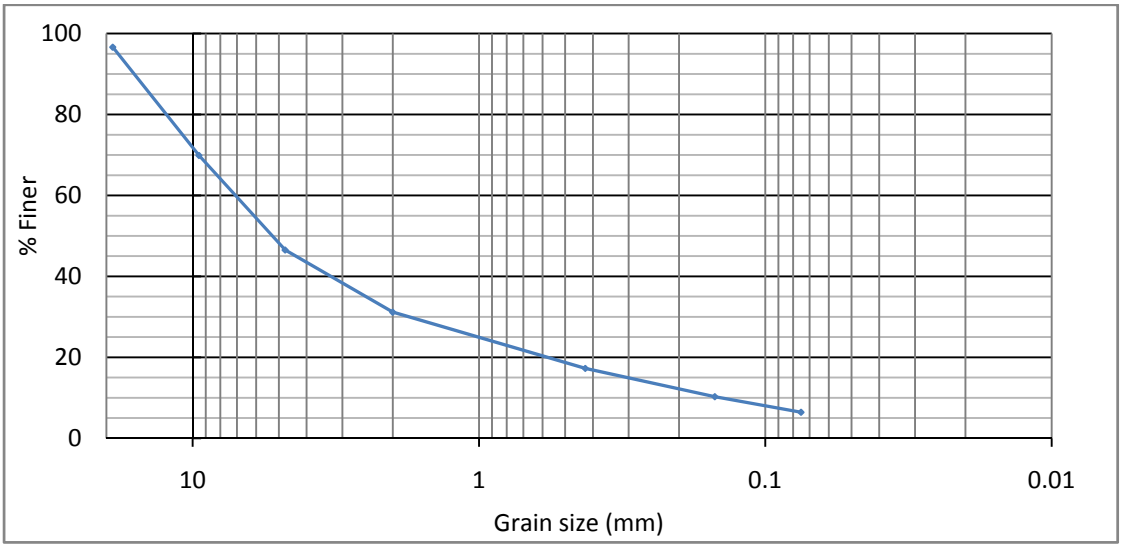

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 46.5 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 53.5 %. The amount of material passing sieve no. 4 and sieve no. 200 is 46.5 % and 6.4 %, so the percent of sand is 40.1 %.

$D_{60} = 7.0$ $D_{30} = 1.8$ $D_{10} = 0.2$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 41.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 3.4$

$CBR = 28.09(D_{60})^{0.358} = 56$

The group symbol for the soil is GP-GM and the group name is poorly graded gravel with silt and sand. The CBR value of 56 is excellent to good for subgrade.

Depth: 26 – 42 inches

Bag No: N 13

Sample Weight (g): 631.7

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0	0.0	100.0
9.5	483.9	519.5	35.6	5.6	94.4
4.75	532.2	579.0	46.8	7.4	87.0
2.00	464.5	584.7	120.2	19.0	67.9
0.425	370.2	544.3	174.1	27.6	40.4
0.150	415.5	516.9	101.4	16.1	24.3
0.075	327.8	390.2	62.4	9.9	14.4
Pan	378.0	468.0	90	14.2	
		Total	630.5		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	45	41	23	9.6	9.50	0.080	11.7
0.5	43	39	23	9.9	9.80	0.057	11.1
1	41	37	23	10.2	10.10	0.041	10.6
2	38	34	23	10.7	10.59	0.030	9.7
4	37	33	23	10.9	10.79	0.021	9.4
8	35	31	23	11.2	11.09	0.015	8.9
15	32	28	23	11.7	11.58	0.011	8.0
30	31	27	22	11.9	11.78	0.008	7.7
60	28	24	22	12.4	12.28	0.006	6.9
120	27	23	21	12.5	12.38	0.004	6.6
240	26	22	21	12.7	12.57	0.003	6.3
480	25	21	21	12.9	12.77	0.002	6.0
1440	23	19	21	13.2	13.07	0.001	5.4

Specific gravity: 2.7

G_s correction factor (α): 0.99

Sample weight (g): 50

Suspension constant (k): 0.01297

Zero correction (mm): 4

% passing no. 200 sieve: 14.4

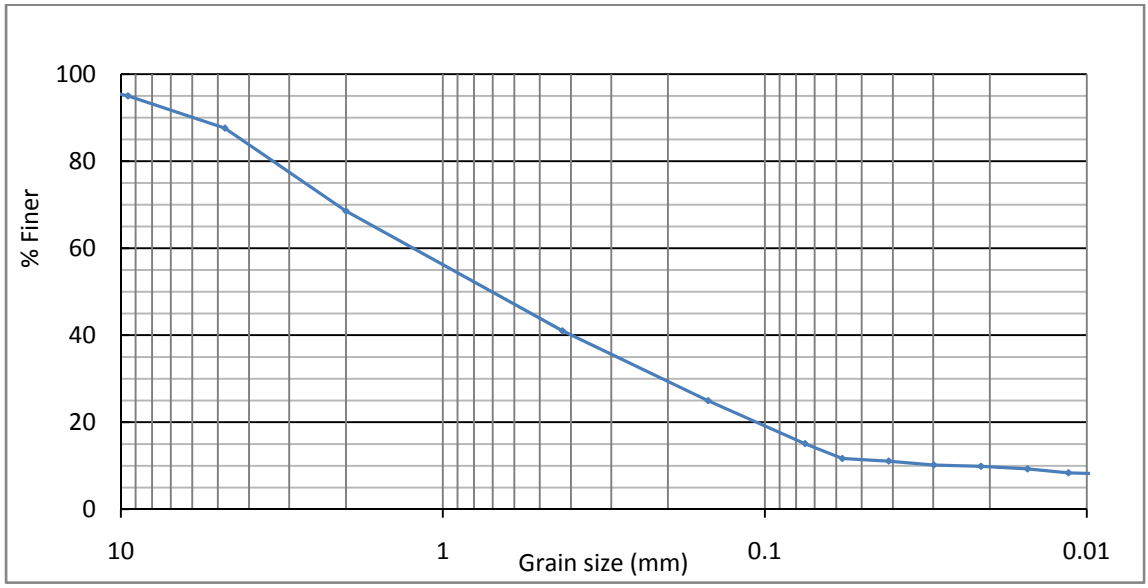

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 87.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 13.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 87.0 % and 14.4 %, so the percent of sand is 72.6 %.

D_{60} = 1.4 D_{30} = 0.2 D_{10} = 0.032

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 43.8$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.0$

$CBR = 28.09(D_{60})^{0.358} = 32$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 32 is good for subgrade.

Table 3: Liquid Limit Data

Can No.	Weight of can, $W_{1\ (g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Number of blows, N
M7	21.6	29.4	27.3	36.8	17
M8	21.5	30.8	28.5	32.9	31
M9	21.7	30.0	28.1	29.7	35

Table 4: Plastic Limit Data

Can No.	Weight of can, $W_{1\ (g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Average, %
M10	21.2	29.3	28.3	14.1	16
M11	21.3	28.1	27.1	17.2	

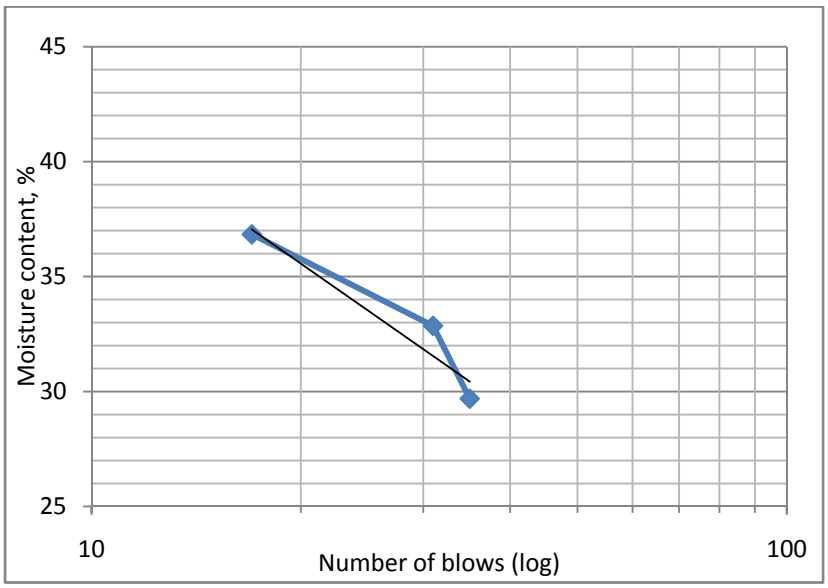

Figure 2: Liquid Limit

Liquid limit (LL): 34

Plastic limit (PL): 16

Plasticity index (PI): 18

ω - % passing no. 200 sieve

$$CBR = \frac{75}{1 + 0.728\,\omega\,PI} = 26$$

Depth: 42 – 60 inches

Bag No: WT IV

Sample Weight (g): 652.8

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	512.9	16.0	2.5	97.5
9.5	483.9	596.2	112.3	17.2	80.3
4.75	532.2	621.8	89.6	13.7	66.6
2.00	464.5	568.0	103.5	15.9	50.8
0.425	370.2	508.2	138.0	21.1	29.6
0.150	415.5	478.5	63.0	9.7	20.0
0.075	327.8	358.4	30.6	4.7	15.3
Pan	378.0	477.1	99.1	15.2	
		Total	652.1		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	46	42	23	9.4	9.31	0.080	12.7
0.5	43	39	23	9.9	9.80	0.058	11.8
1	40	36	23	10.4	10.30	0.042	10.9
2	36	32	23	11.1	10.99	0.031	9.7
4	34	30	23	11.4	11.29	0.022	9.1
8	29	25	23	12.2	12.08	0.016	7.6
15	28	24	23	12.4	12.28	0.012	7.3
30	26	22	22	12.7	12.57	0.008	6.7
60	25	21	22	12.9	12.77	0.006	6.4
120	24	20	21	13.0	12.87	0.004	6.1
240	23	19	21	13.2	13.07	0.003	5.8
480	22	18	21	13.3	13.17	0.002	5.5
1440	21	17	21	13.5	13.37	0.001	5.1

Specific gravity: 2.7 G_s correction factor (α): 0.99

Sample weight (g): 50 Suspension constant (k): 0.01312

Zero correction (mm): 4 % passing no. 200 sieve: 15.3

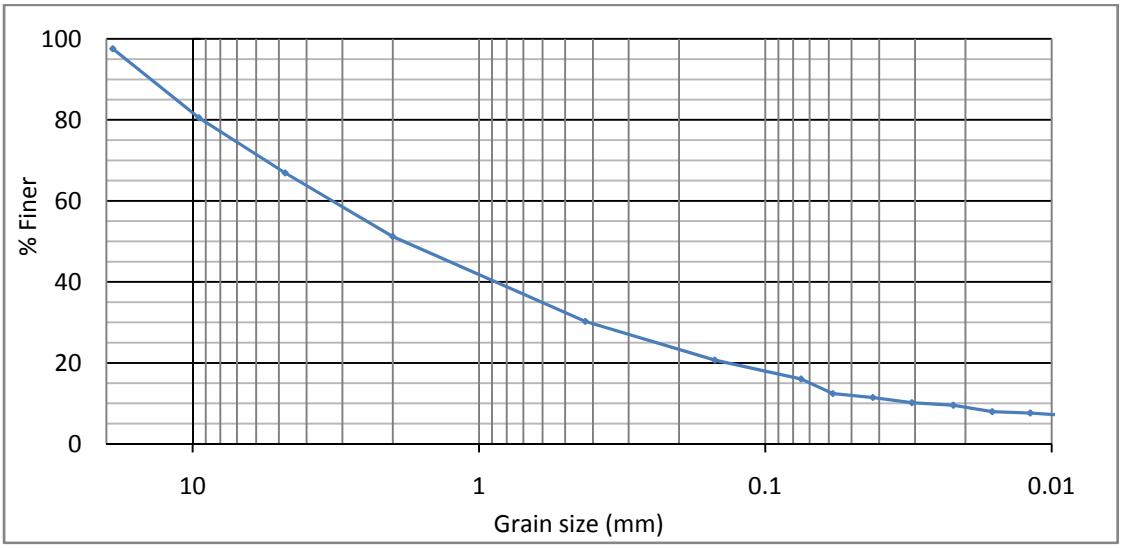

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 66.6 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 33.4 %. The amount of material passing sieve no. 4 and sieve no. 200 is 66.6 % and 15.3 %, so the percent of sand is 51.3 %.

D_{60} = 3.2 D_{30} = 0.42 D_{10} = 0.034

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 94.1$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.6$

$CBR = 28.09(D_{60})^{0.358} = 42$

The group symbol for the soil is SM and the group name is silty sand with gravel. The CBR value of 42 is good for subgrade.

Raton Municipal Airport

Borehole 2

Location: Runway 07-25, 2000 ft. from SW threshold of Runway 25

Depth: 6 – 20 inches

Bag No: WT IH

Sample Weight (g): 2010.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	918.8	421.9	21.0	79.0
9.5	483.6	995.3	511.7	25.5	53.6
4.75	532.1	1056.8	524.7	26.1	27.4
2.00	464.5	803.0	338.5	16.8	10.6
0.425	369.5	519.1	149.6	7.4	3.2
0.150	414.9	450.7	35.8	1.8	1.4
0.075	327.5	342.7	15.2	0.8	0.6
Pan	377.9	389.3	11.4	0.6	
		Total	2008.8		

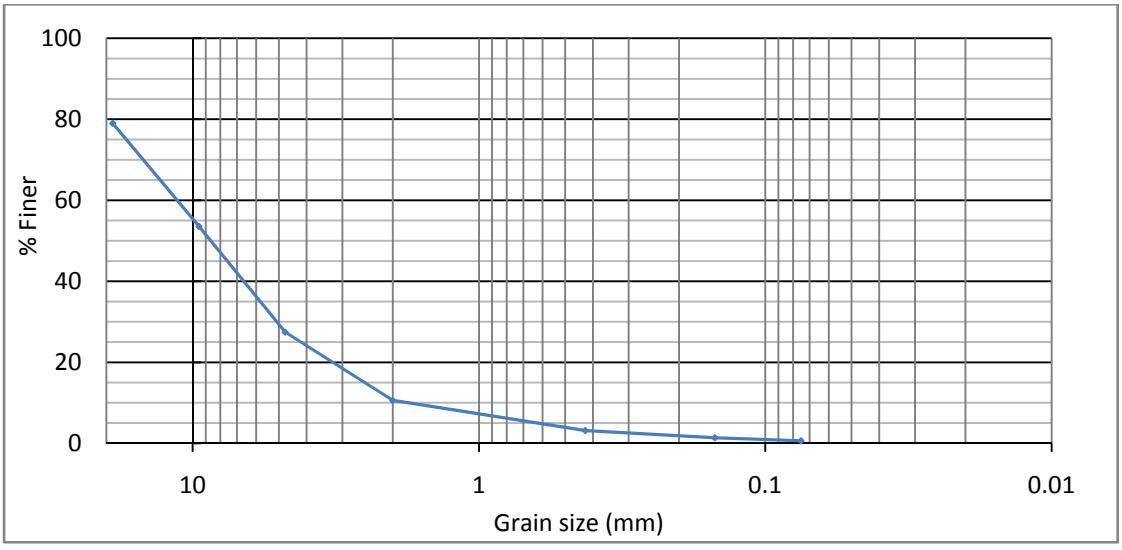

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 27.4 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 72.6 %. The amount of material passing sieve no. 4 and sieve no. 200 is 27.4 % and 0.6 %, so the percent of sand is 26.8 %.

$D_{60} = 12.0$ $D_{30} = 4.8$ $D_{10} = 2.0$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 6.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.0$

$CBR = 28.09(D_{60})^{0.358} = 68$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 68 is good for base course.

Depth: 20 – 28 inches

Bag No: WT BU

Sample Weight (g): 626.8

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	496.4	12.5	2.0	98.0
4.75	532.2	571.2	39.0	6.2	91.8
2.00	464.5	599.2	134.7	21.5	70.3
0.425	370.2	563.0	192.8	30.8	39.5
0.150	415.5	514.5	99.0	15.8	23.7
0.075	327.8	389.5	61.7	9.8	13.9
Pan	378.0	464.0	86.0	13.7	
		Total	625.7		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	43	36	23	10.4	10.30	0.084	9.9
0.5	42	35	23	10.6	10.49	0.060	9.6
1	40	33	23	10.9	10.79	0.043	9.1
2	37	30	23	11.4	11.29	0.031	8.3
4	34	27	23	11.9	11.78	0.023	7.4
8	32	25	23	12.2	12.08	0.016	6.9
15	30	23	23	12.5	12.38	0.012	6.3
30	27	20	22	13.0	12.87	0.009	5.5
60	25	18	22	13.3	13.17	0.006	5.0
120	24	17	21	13.5	13.37	0.004	4.7
240	22	15	21	13.8	13.66	0.003	4.1
480	21	14	21	14.0	13.86	0.002	3.9
1440	20	13	21	14.2	14.06	0.001	3.6

Specific gravity: 2.7

Sample weight (g): 50

Zero correction (mm): 7

G_s correction factor (α): 0.99

Suspension constant (k): 0.01312

% passing no. 200 sieve: 13.9

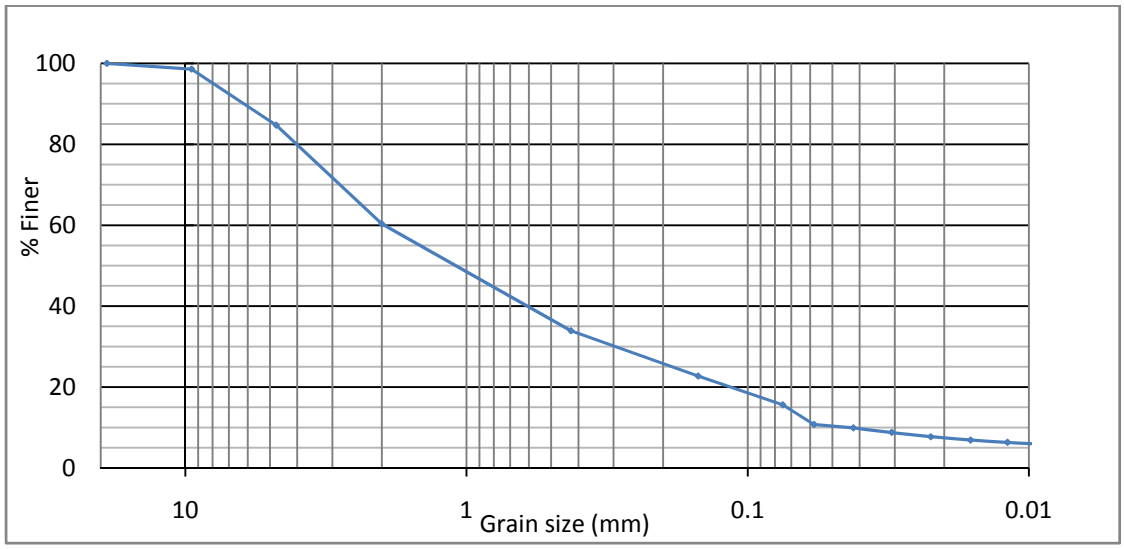

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 91.8 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 8.2 %. The amount of material passing sieve no. 4 and sieve no. 200 is 91.8 % and 13.9 %, so the percent of sand is 77.9 %.

D_{60} = 1.2 D_{30} = 0.23 D_{10} = 0.06

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 20$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.7$

$CBR = 28.09(D_{60})^{0.358} = 30$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 30 is good for subgrade.

Depth: 28 – 44 inches

Bag No: WT 1G

Sample Weight (g): 571.2

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	494.7	10.8	1.9	98.1
4.75	532.2	561.2	29.0	5.1	93.0
2.00	464.5	588.1	123.6	21.6	71.4
0.425	370.2	547.1	176.9	31.0	40.4
0.150	415.5	509.1	93.6	16.4	24.0
0.075	327.8	385.6	57.8	10.1	13.9
Pan	378.0	457.1	79.1	13.8	
		Total	570.8		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	49	42	23	9.4	9.31	0.080	11.6
0.5	45	38	23	10.1	10.00	0.059	10.5
1	43	36	23	10.4	10.30	0.042	9.9
2	39	32	23	11.1	10.99	0.031	8.8
4	35	28	23	11.7	11.58	0.022	7.7
8	33	26	23	12.0	11.88	0.016	7.2
15	32	25	23	12.2	12.08	0.012	6.9
30	30	23	22	12.5	12.38	0.008	6.3
60	29	22	22	12.7	12.57	0.006	6.1
120	28	21	21	12.9	12.77	0.004	5.8
240	27	20	21	13.0	12.87	0.003	5.5
480	26	19	21	13.2	13.07	0.002	5.2
1440	25	18	21	13.3	13.17	0.001	5.0

Specific gravity: 2.7

Sample weight (g): 50

Zero correction (mm): 7

G_s correction factor (α): 0.99

Suspension constant (k): 0.01312

% passing no. 200 sieve: 13.9

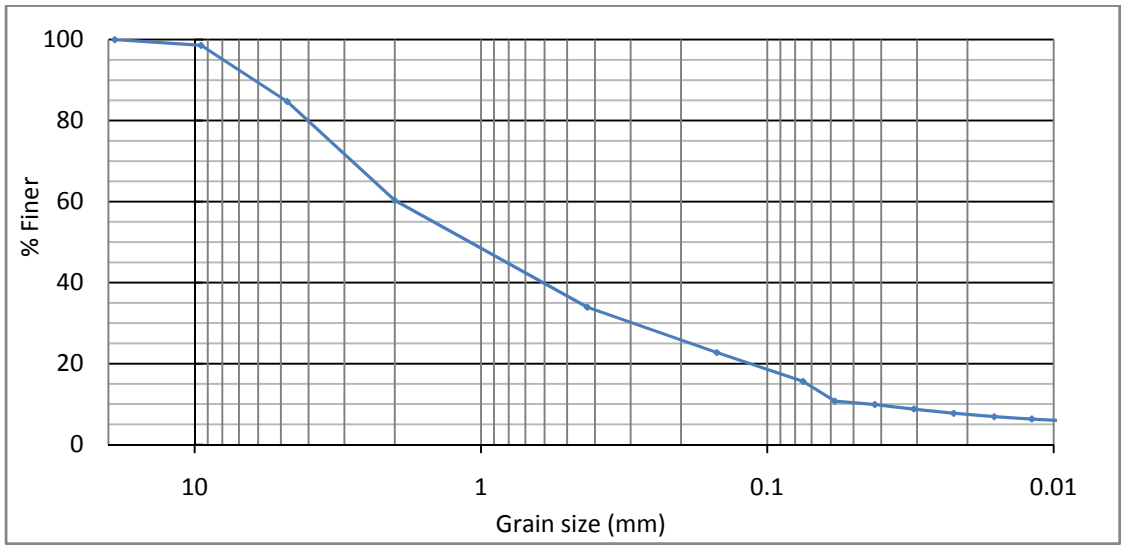

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 93.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 7.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 93.0 % and 13.9 %, so the percent of sand is 79.1 %.

$D_{60} = 1.15$ $D_{30} = 0.22$ $D_{10} = 0.055$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 20.9$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.8$

$CBR = 28.09(D_{60})^{0.358} = 29$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 29 is good for subgrade.

Depth: 44 – 64 inches

Bag No: WT FV

Sample Weight (g): 514.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	491.2	7.3	1.4	98.6
4.75	532.2	603.4	71.2	13.9	84.7
2.00	464.5	590.0	125.5	24.4	60.3
0.425	370.2	505.9	135.7	26.4	33.9
0.150	415.5	473.0	57.5	11.2	22.7
0.075	327.8	364.4	36.6	7.1	15.6
Pan	378.0	457.9	79.9	15.5	
		Total	513.7		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	47	40	23	9.7	9.60	0.081	12.4
0.5	46	39	23	9.9	9.80	0.058	12.0
1	43	36	23	10.4	10.30	0.042	11.1
2	39	32	23	11.1	10.99	0.031	9.9
4	35	28	23	11.7	11.58	0.022	8.7
8	32	25	23	12.2	12.08	0.016	7.7
15	30	23	23	12.5	12.38	0.012	7.1
30	28	21	22	12.9	12.77	0.009	6.5
60	27	20	22	13.0	12.87	0.006	6.2
120	25	18	21	13.3	13.17	0.004	5.6
240	25	18	21	13.3	13.17	0.003	5.6
480	25	18	21	13.3	13.17	0.002	5.6
1440	22	15	21	13.8	13.66	0.001	4.6

Specific gravity: 2.7

Sample weight (g): 50

Zero correction (mm): 7

G_s correction factor (α): 0.99

Suspension constant (k): 0.01312

% passing no. 200 sieve: 15.6

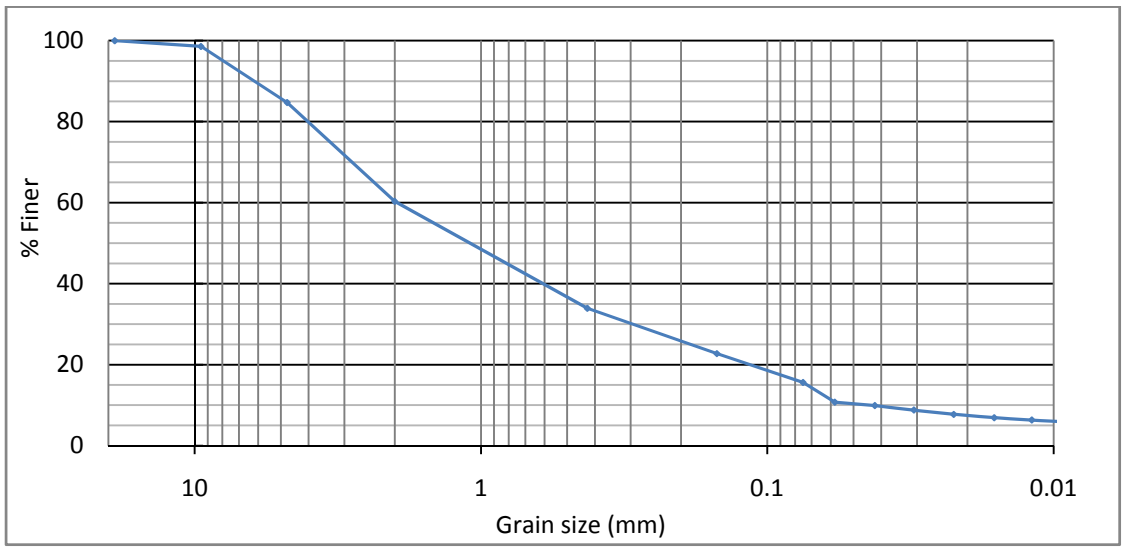

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 84.7 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 15.3 %. The amount of material passing sieve no. 4 and sieve no. 200 is 84.7 % and 15.6 %, so the percent of sand is 69.1 %.

D_{60} = 1.95 D_{30} = 0.3 D_{10} = 0.04

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 48.8$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.2$

$CBR = 28.09(D_{60})^{0.358} = 36$

The group symbol for the soil is SC and the group name is clayey sand with gravel. The CBR value of 36 is good for subgrade.

Raton Municipal Airport

Borehole 3

Location: Runway 07-25, 3000 ft. from SW threshold of Runway 25

Depth: 7 – 22 inches

Bag No: N 6

Sample Weight (g): 2117.8

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	1158.0	661.1	31.2	68.8
9.5	483.6	822.7	339.1	16.0	52.8
4.75	532.1	822.7	290.6	13.7	39.0
2.00	464.5	741.4	276.9	13.1	26.0
0.425	369.5	684.9	315.4	14.9	11.1
0.150	414.9	574.1	159.2	7.5	3.6
0.075	327.5	373.7	46.2	2.2	1.4
Pan	377.9	406.8	28.9	1.4	
		Total	2117.4		

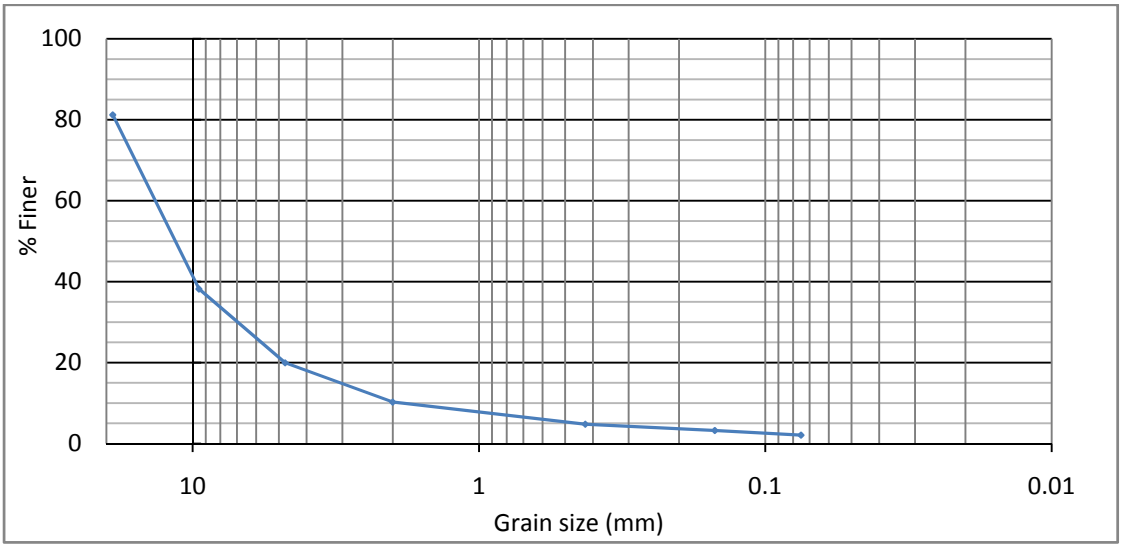

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 39.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 61.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 39.0 % and 1.4 %, so the percent of sand is 37.6 %.

$D_{60} = 14.0$ $D_{30} = 2.8$ $D_{10} = 0.4$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 36.8$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.5$

$CBR = 28.09(D_{60})^{0.358} = 72$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 72 is good for base course.

Depth: 22 – 47 inches

Bag No: Y 46

Sample Weight (g): 509.4

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	515.9	19.0	3.7	96.3
9.5	483.9	488.9	5.0	1.0	95.3
4.75	532.2	593.5	61.3	12.0	83.3
2.00	464.5	595.5	131.0	25.7	57.5
0.425	370.2	488.1	117.9	23.1	34.4
0.150	415.5	486.7	71.2	14.0	20.4
0.075	327.8	379.3	51.5	10.1	10.3
Pan	378.0	430.0	52.0	10.2	
		Total	508.9		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	48	43	23	9.2	9.11	0.078	8.8
0.5	43	38	23	10.1	10.00	0.058	7.8
1	40	35	23	10.6	10.49	0.042	7.1
2	37	32	23	11.1	10.99	0.030	6.5
4	35	30	23	11.4	11.29	0.022	6.1
8	32	27	23	11.9	11.78	0.016	5.5
15	29	24	23	12.4	12.28	0.012	4.9
30	28	23	22	12.5	12.38	0.008	4.7
60	26	21	22	12.9	12.77	0.006	4.3
120	25	20	21	13.0	12.87	0.004	4.1
240	23	18	21	13.3	13.17	0.003	3.7
480	22	17	21	13.5	13.37	0.002	3.5
1440	21	16	21	13.7	13.56	0.001	3.3

Specific gravity: 2.7

Sample weight (g): 50

Zero correction (mm): 4

G_s correction factor (α): 0.99

Suspension constant (k): 0.01297

% passing no. 200 sieve: 10.3

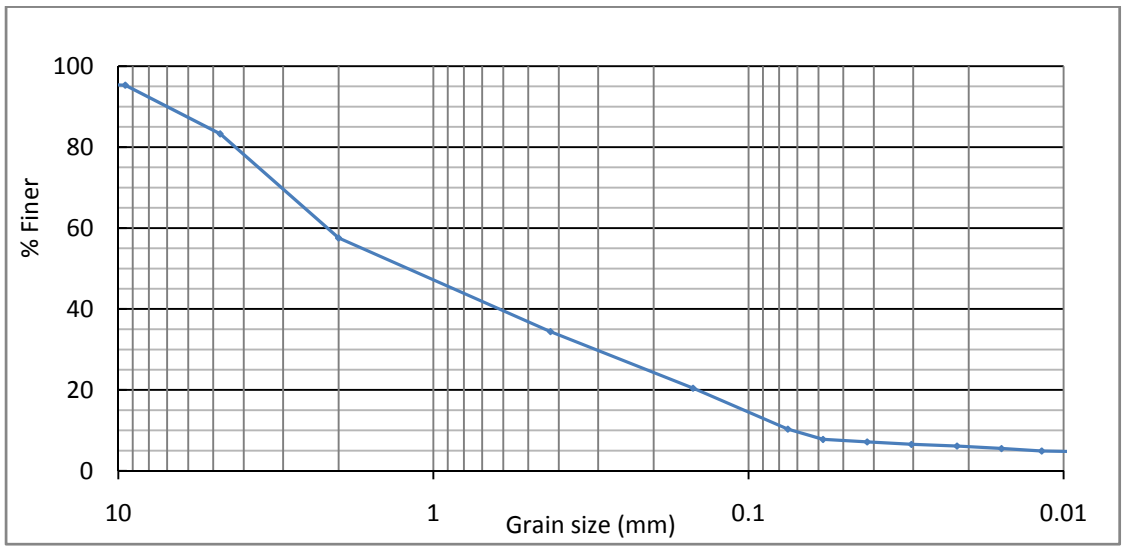

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 83.3 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 16.7 %. The amount of material passing sieve no. 4 and sieve no. 200 is 83.3 % and 10.3 %, so the percent of sand is 73.0 %.

D_{60} = 2.2 D_{30} = 0.3 D_{10} = 0.076

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 28.9$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.5$

$CBR = 28.09(D_{60})^{0.358} = 37$

The group symbol for the soil is SP-SM and the group name is poorly graded sand with silt and gravel. The CBR value of 37 is good for subgrade.

Table 3: Liquid Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Number of blows, N
M7	21.6	32.0	29.7	28.4	32
M8	21.5	36.0	32.7	29.5	26
M9	21.7	36.2	32.8	30.6	19

Table 4: Plastic Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Average, %
M10	21.2	28.1	27.0	19.0	18
M11	21.3	26.9	26.1	16.7	

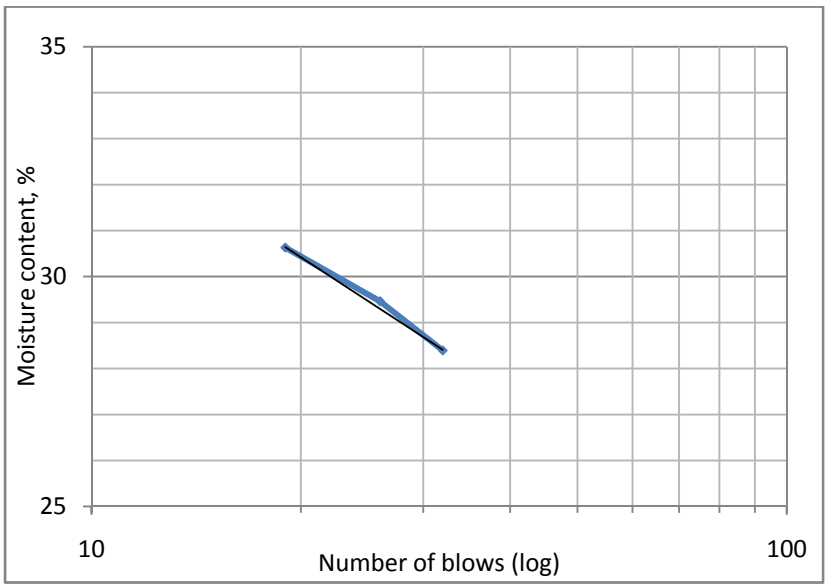

Figure 2: Liquid Limit

Liquid limit (LL): 29

Plastic limit (PL): 18

Plasticity index (PI): 11

ω - % passing no. 200 sieve

$$CBR = \frac{75}{1 + 0.728\,\omega\,PI} = 41$$

Depth: 47 – 70 inches

Bag No: N 62

Sample Weight (g): 592.8

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	608.2	111.3	18.8	81.2
9.5	483.6	738.7	255.1	43.0	38.2
4.75	532.1	640.3	108.2	18.3	19.9
2.00	464.5	522.0	57.5	9.7	10.2
0.425	369.5	401.9	32.4	5.5	4.8
0.150	414.9	424.1	9.2	1.6	3.2
0.075	327.5	334.3	6.8	1.1	2.1
Pan	377.9	389.5	11.6	2.0	
		Total	592.1		

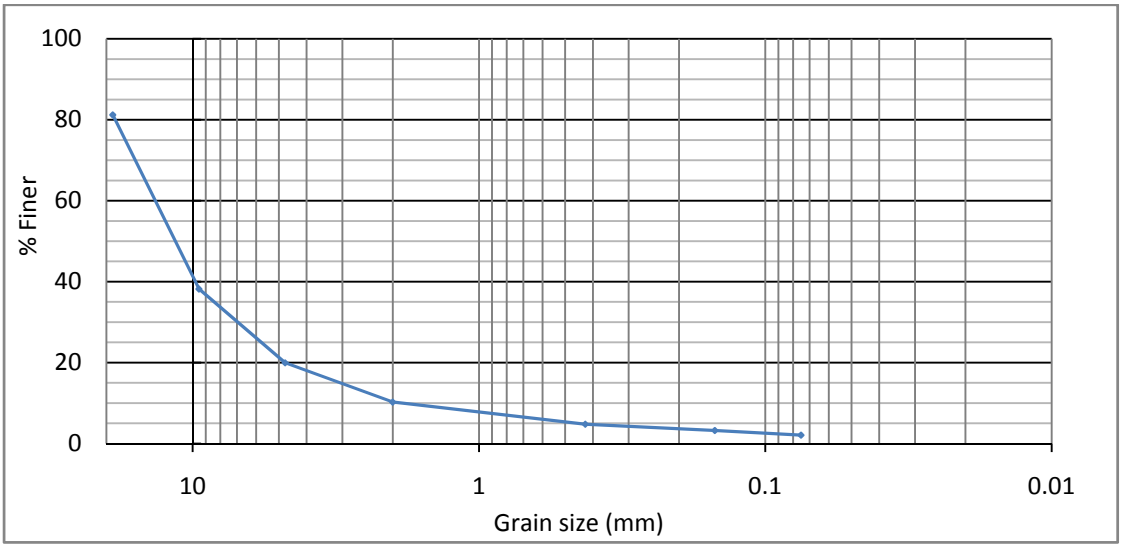

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 19.9 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 80.1 %. The amount of material passing sieve no. 4 and sieve no. 200 is 19.9 % and 2.1 %, so the percent of sand is 17.8 %.

$D_{60} = 14.0$ $D_{30} = 7.0$ $D_{10} = 2.0$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 7.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.8$

$CBR = 28.09(D_{60})^{0.358} = 72$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 72 is excellent for subgrade.

Raton Municipal Airport

Borehole 4

Location: Runway 07-25, 4000 ft. from SW threshold of Runway 25

Depth: 8 – 22 inches

Bag No: G 57

Sample Weight (g):1438.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	617.9	121.0	8.4	91.6
9.5	483.6	755.4	271.8	18.9	72.7
4.75	532.1	816.1	284.0	19.7	52.9
2.00	464.5	707.8	243.3	16.9	36.0
0.425	369.5	630.0	260.5	18.1	17.9
0.150	414.9	552.0	137.1	9.5	8.4
0.075	327.5	371.9	44.4	3.1	5.3
Pan	377.9	452.0	74.1	5.2	
		Total	1436.2		

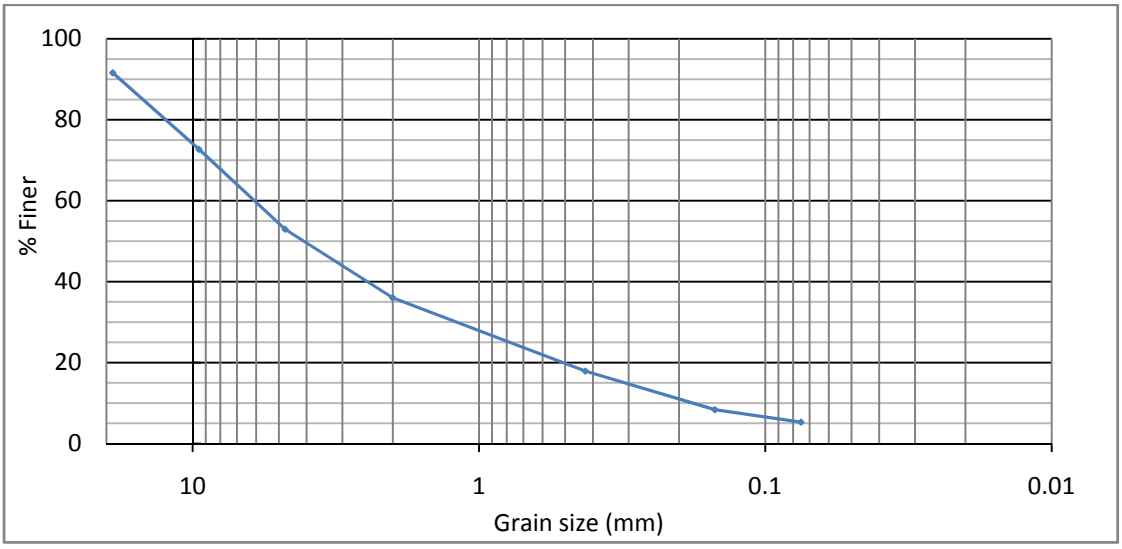

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 52.9 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 47.1 %. The amount of material passing sieve no. 4 and sieve no. 200 is 52.9 % and 5.3 %, so the percent of sand is 47.6 %.

$D_{60} = 6.1$ $D_{30} = 1.3$ $D_{10} = 0.2$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 33.9$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.5$

$CBR = 28.09(D_{60})^{0.358} = 54$

The group symbol for the soil is SW and the group name is well graded sand with gravel. The CBR value of 54 is good for base course.

Depth: 22 – 30 inches

Bag No: N 71

Sample Weight (g): 739.2

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	515.9	19.0	2.6	97.4
9.5	483.9	551.4	67.5	9.1	88.3
4.75	532.2	616.4	84.2	11.4	76.9
2.00	464.5	571.6	107.1	14.5	62.4
0.425	370.2	503.9	133.7	18.1	44.3
0.150	415.5	574.9	159.4	21.6	22.8
0.075	327.8	417.8	90.0	12.2	10.6
Pan	378.0	455.4	77.4	10.5	
		Total	738.3		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	50	45	23	8.9	8.81	0.078	9.4
0.5	45	40	23	9.7	9.60	0.057	8.4
1	40	35	23	10.6	10.49	0.043	7.3
2	35	30	23	11.4	11.29	0.031	6.3
4	32	27	23	11.9	11.78	0.023	5.7
8	30	25	23	12.2	12.08	0.016	5.2
15	27	22	23	12.7	12.57	0.012	4.6
30	24	19	22	13.2	13.07	0.009	4.0
60	23	18	22	13.3	13.17	0.006	3.8
120	22	17	21	13.5	13.37	0.004	3.6
240	20	15	21	13.8	13.66	0.003	3.1
480	19	14	21	14.0	13.86	0.002	2.9
1440	17	12	21	14.3	14.16	0.001	2.5

Specific gravity: 2.7

Sample weight (g): 50

Zero correction (mm): 5

G_s correction factor (α): 0.99

Suspension constant (k): 0.01312

% passing no. 200 sieve: 10.6

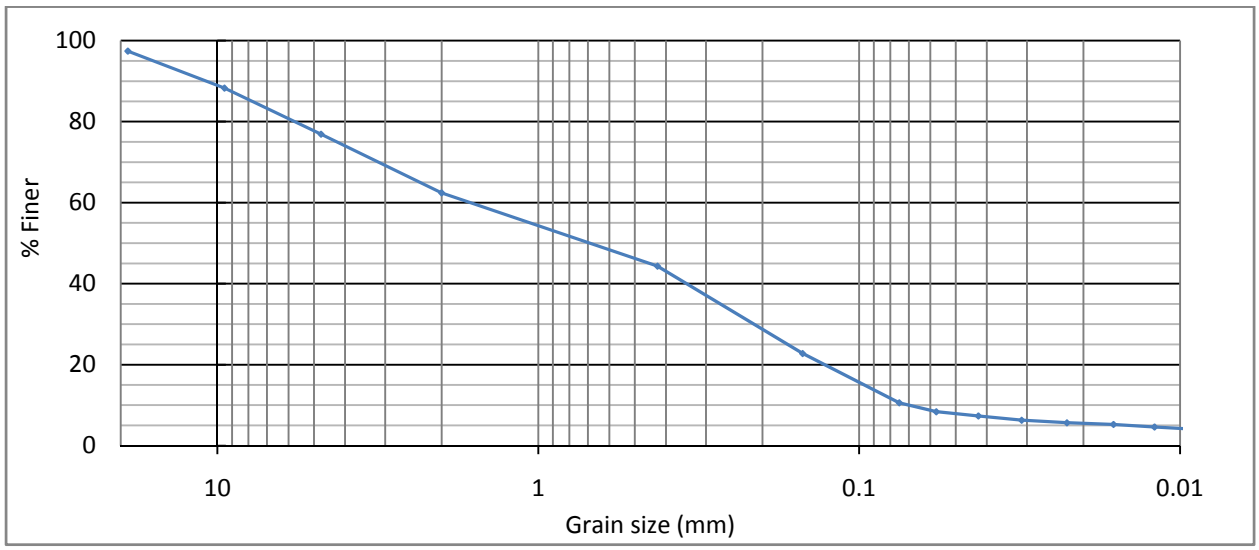

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 76.9 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 23.1 %. The amount of material passing sieve no. 4 and sieve no. 200 is 76.9 % and 10.6 %, so the percent of sand is 66.3 %.

D_{60} = 1.8 D_{30} = 0.22 D_{10} = 0.075

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 24$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.4$

$CBR = 28.09(D_{60})^{0.358} = 35$

The group symbol for the soil is SP-SM and the group name is poorly graded sand with silt and gravel. The CBR value of 35 is good for subgrade.

Depth: 30 – 45 inches

Bag No: N 38

Sample Weight (g): 537.4

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	534.7	37.8	7.0	93.0
9.5	483.6	644.5	160.9	29.9	63.0
4.75	532.1	647.9	115.8	21.5	41.5
2.00	464.5	534.3	69.8	13.0	28.5
0.425	369.5	422.4	52.9	9.8	18.6
0.150	414.9	454.6	39.7	7.4	11.3
0.075	327.5	353.7	26.2	4.9	6.4
Pan	377.9	411.2	33.3	6.2	
		Total	536.4		

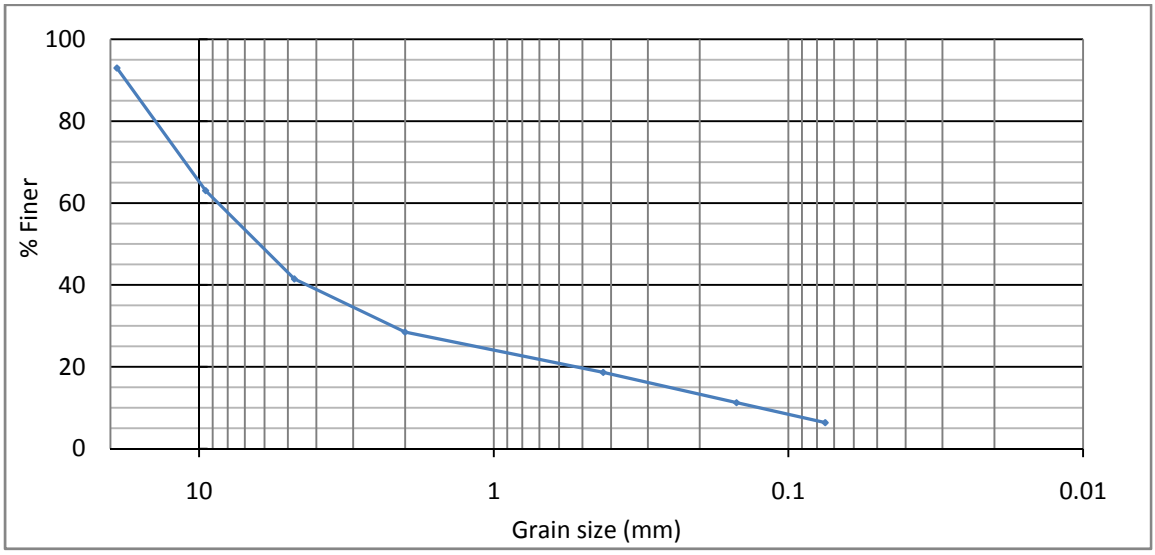

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 41.5 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 58.5 %. The amount of material passing sieve no. 4 and sieve no. 200 is 41.5 % and 6.4 %, so the percent of sand is 35.1 %.

$D_{60} = 8.6$ $D_{30} = 2.3$ $D_{10} = 0.1$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 66.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 4.7$

$CBR = 28.09(D_{60})^{0.358} = 61$

The group symbol for the soil is GP-GM and the group name is poorly graded gravel with silt and sand. The CBR value of 61 is excellent for subgrade.

Depth: 45 - 64 inches

Bag No: N 36

Sample Weight (g): 537.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	505.8	8.9	1.7	98.3
9.5	483.9	664.8	180.9	33.7	64.7
4.75	532.2	683.2	151.0	28.1	36.5
2.00	464.5	547.3	82.8	15.4	21.1
0.425	370.2	412.7	42.5	7.9	13.2
0.150	415.5	429.0	13.5	2.5	10.7
0.075	327.8	329.2	1.4	0.3	10.4
Pan	378.0	432.6	54.6	10.2	
		Total	535.6		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	48	43	23	9.2	9.20	0.080	9.0
0.5	45	40	23	9.7	9.70	0.058	8.4
1	42	37	23	10.2	10.20	0.042	7.7
2	38	33	23	10.9	10.90	0.031	6.9
4	33	28	23	11.7	11.70	0.023	5.8
8	31	26	23	12.0	12.00	0.016	5.4
15	29	24	23	12.4	12.40	0.012	5.0
30	27	22	22	12.7	12.70	0.009	4.6
60	25	20	22	13.0	13.00	0.006	4.2
120	24	19	21	13.2	13.20	0.004	4.0
240	23	18	21	13.3	13.30	0.003	3.8
480	22	17	21	13.5	13.50	0.002	3.6
1440	21	16	21	13.7	13.70	0.001	3.3

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 5

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 10.4

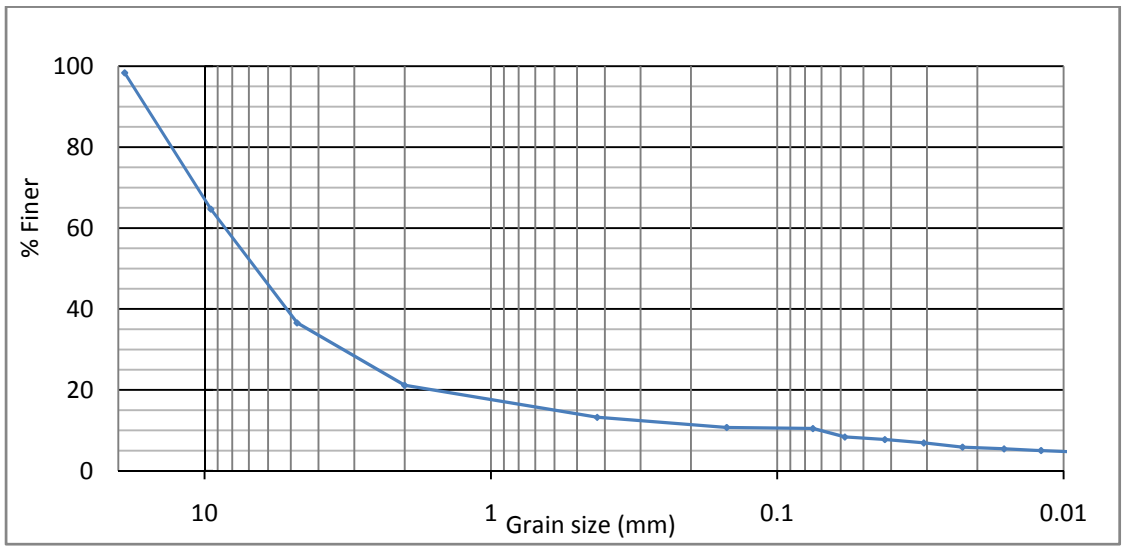

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 36.5 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 63.5 %. The amount of material passing sieve no. 4 and sieve no. 200 is 36.5 % and 10.4 %, so the percent of sand is 26.1 %.

$D_{60} = 8.5$ $D_{30} = 3.2$ $D_{10} = 0.08$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 106.3$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 15.1$

$CBR = 28.09(D_{60})^{0.358} = 60$

The group symbol for the soil is GP-GM and the group name is poorly graded gravel with silt and sand. The CBR value of 60 is excellent for subgrade.

Raton Municipal Airport

Borehole 5

Location: Runway 07-25, 5000 ft. from SW threshold of Runway 25

Depth: 7 – 13 inches

Bag No: WT 1Q

Sample Weight (g):1536.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	629	132.1	8.6	91.4
9.5	483.6	800.4	316.8	20.6	70.8
4.75	532.1	833.3	301.2	19.6	51.2
2.00	464.5	679.9	215.4	14.0	37.1
0.425	369.5	692.4	322.9	21.0	16.1
0.150	414.9	573.7	158.8	10.3	5.8
0.075	327.5	381.5	54.0	3.5	2.3
Pan	377.9	412.5	34.6	2.3	
		Total	1535.8		

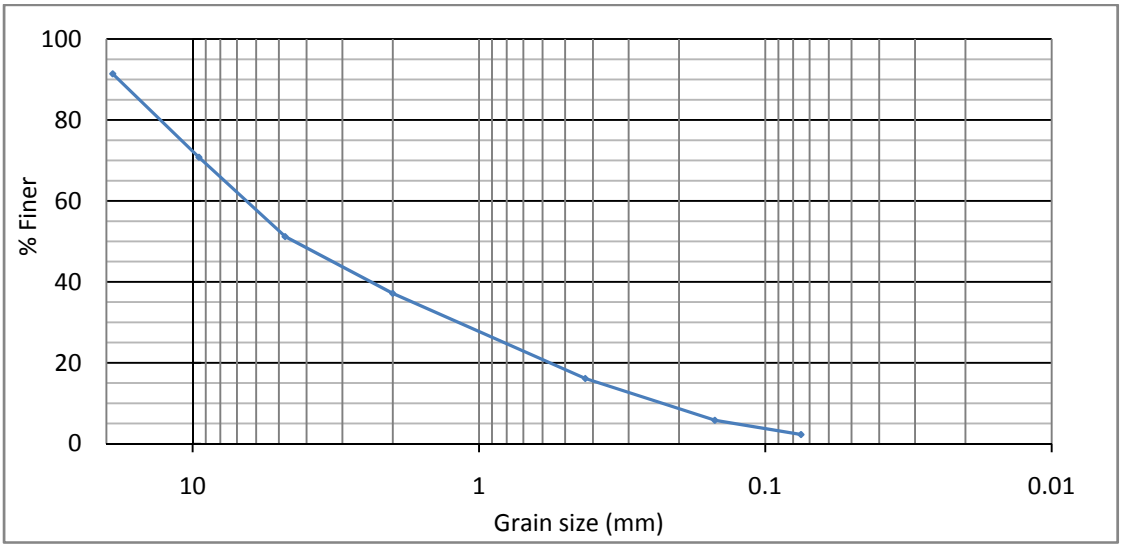

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 52.9 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 47.1 %. The amount of material passing sieve no. 4 and sieve no. 200 is 52.9 % and 5.3 %, so the percent of sand is 47.6 %.

$D_{60} = 6.1$ $D_{30} = 1.3$ $D_{10} = 0.2$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 33.9$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.5$

$CBR = 28.09(D_{60})^{0.358} = 54$

The group symbol for the soil is SW and the group name is well graded sand with gravel. The CBR value of 54 is good for base course.

Depth: 13 – 24 inches

Bag No: 138

Sample Weight (g): 415.2

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	509.9	13.0	3.1	96.9
9.5	483.6	507.9	24.3	5.9	91.0
4.75	532.1	565.2	33.1	8.0	83.0
2.00	464.5	569.7	105.2	25.3	57.7
0.425	369.5	484.2	114.7	27.6	30.1
0.150	414.9	479.2	64.3	15.5	14.6
0.075	327.5	361.3	33.8	8.1	6.5
Pan	377.9	404.7	26.8	6.5	
		Total	415.2		

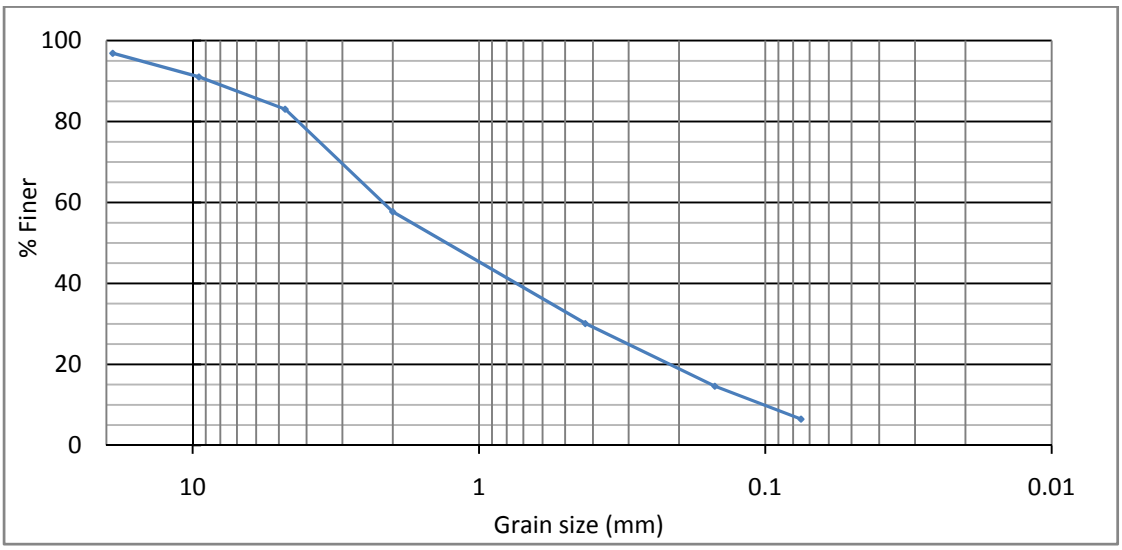

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 83.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 17.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 83.0 % and 6.5 %, so the percent of sand is 76.5 %.

$D_{60} = 2.2$ $D_{30} = 0.4$ $D_{10} = 0.1$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 22.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.8$

$CBR = 28.09(D_{60})^{0.358} = 37$

The group symbol for the soil is SP-SC and the group name is poorly graded sand with clay and gravel. The CBR value of 37 is good for subgrade.

Depth: 24 – 30 inches

Bag No: t22

Sample Weight (g): 545.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	505.1	8.2	1.5	98.5
9.5	483.6	535.5	51.9	9.5	89.0
4.75	532.1	628.9	96.8	17.8	71.2
2.00	464.5	615.3	150.8	27.7	43.6
0.425	369.5	481.9	112.4	20.6	22.9
0.150	414.9	471.1	56.2	10.3	12.6
0.075	327.5	359.9	32.4	5.9	6.7
Pan	377.9	413.8	35.9	6.6	
		Total	544.6		

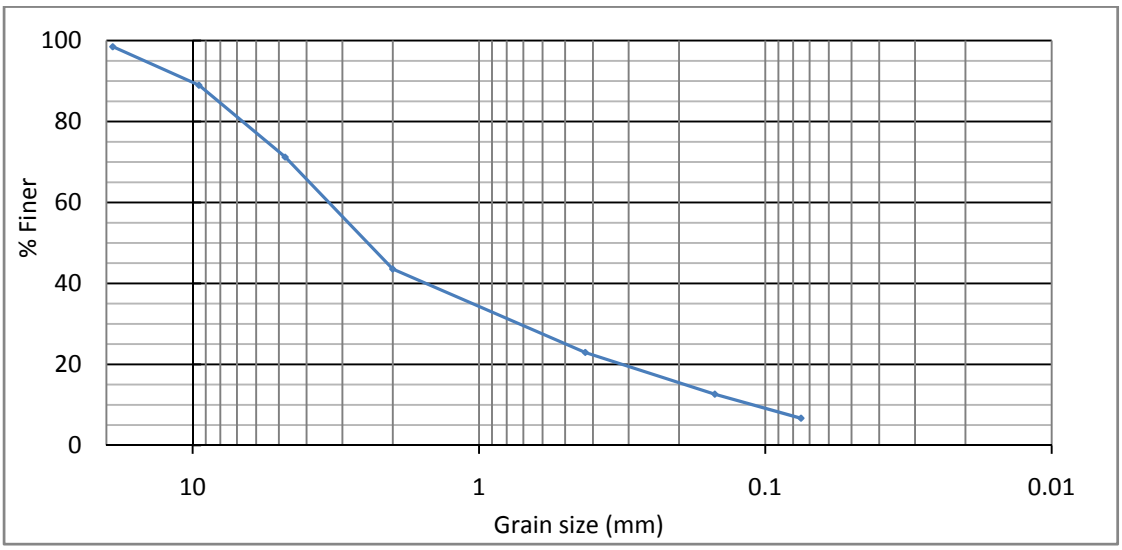

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 71.2 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 28.8 %. The amount of material passing sieve no. 4 and sieve no. 200 is 83.0 % and 6.7 %, so the percent of sand is 64.5 %.

$D_{60} = 3.4$ $D_{30} = 0.74$ $D_{10} = 0.13$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 26.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.2$

$CBR = 28.09(D_{60})^{0.358} = 43$

The group symbol for the soil is SP-SC and the group name is poorly graded sand with clay and gravel. The CBR value of 43 is good for subgrade.

Depth: 30 - 46 inches

Bag No: F 53

Sample Weight (g): 658.7

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	501.2	17.3	2.6	97.4
4.75	532.2	557.2	25.0	3.8	93.6
2.00	464.5	592.3	127.8	19.4	74.2
0.425	370.2	531.1	160.9	24.4	49.7
0.150	415.5	574.8	159.3	24.2	25.6
0.075	327.8	414.4	86.6	13.1	12.4
Pan	378.0	458.8	80.8	12.3	
		Total	657.7		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	40	37	23	10.2	10.20	0.084	9.2
0.5	38	35	23	10.6	10.60	0.061	8.7
1	37	34	23	10.7	10.70	0.043	8.4
2	35	32	23	11.1	11.10	0.031	7.9
4	33	30	23	11.4	11.40	0.022	7.5
8	32	29	23	11.5	11.50	0.016	7.2
15	30	27	23	11.9	11.90	0.012	6.7
30	29	26	22	12.0	12.00	0.008	6.5
60	28	25	22	12.2	12.20	0.006	6.2
120	27	24	21	12.4	12.40	0.004	6.0
240	25	22	21	12.7	12.70	0.003	5.5
480	24	21	21	12.9	12.90	0.002	5.2
1440	23	20	21	13.0	13.00	0.001	5.0

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 3

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 12.4

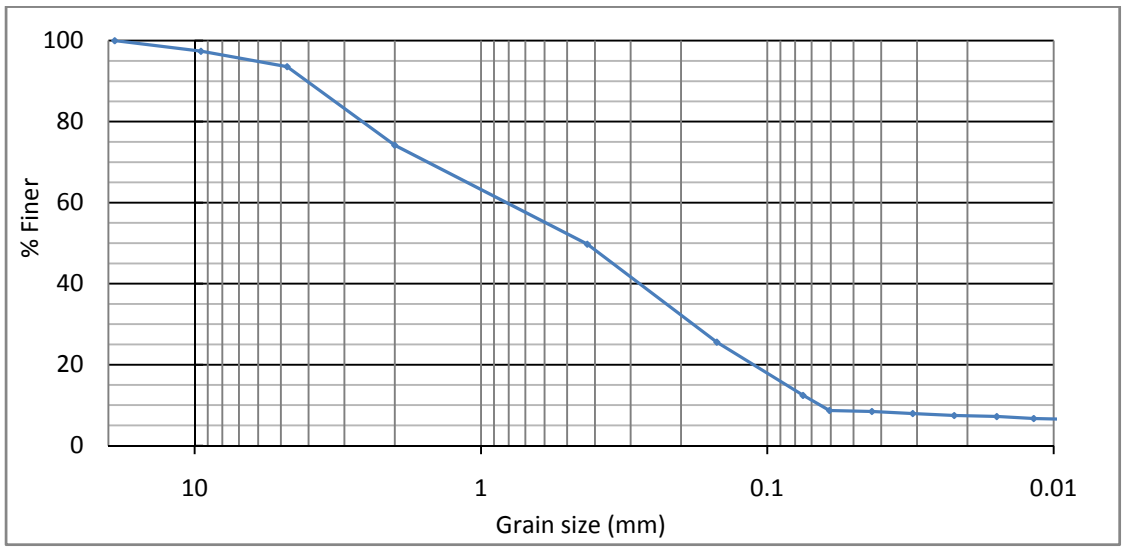

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 93.6 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 6.4 %. The amount of material passing sieve no. 4 and sieve no. 200 is 93.6 % and 12.4 %, so the percent of sand is 81.2 %.

$D_{60} = 0.85$ $D_{30} = 0.18$ $D_{10} = 0.073$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 11.6$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.5$

$CBR = 28.09(D_{60})^{0.358} = 26$

The group symbol for the soil is SM and the group name is silty sand. The CBR value of 26 is fair to good for subgrade.

Depth: 46 – 64 inches

Bag No: WT 1R

Sample Weight (g): 465.4

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	506.3	9.4	2.0	98.0
9.5	483.6	555.9	72.3	15.5	82.4
4.75	532.1	620.1	88.0	18.9	63.5
2.00	464.5	568.8	104.3	22.4	41.1
0.425	369.5	457.9	88.4	19.0	22.1
0.150	414.9	449.3	34.4	7.4	14.7
0.075	327.5	353.4	25.9	5.6	9.2
Pan	377.9	420.3	42.4	9.1	
		Total	465.1		

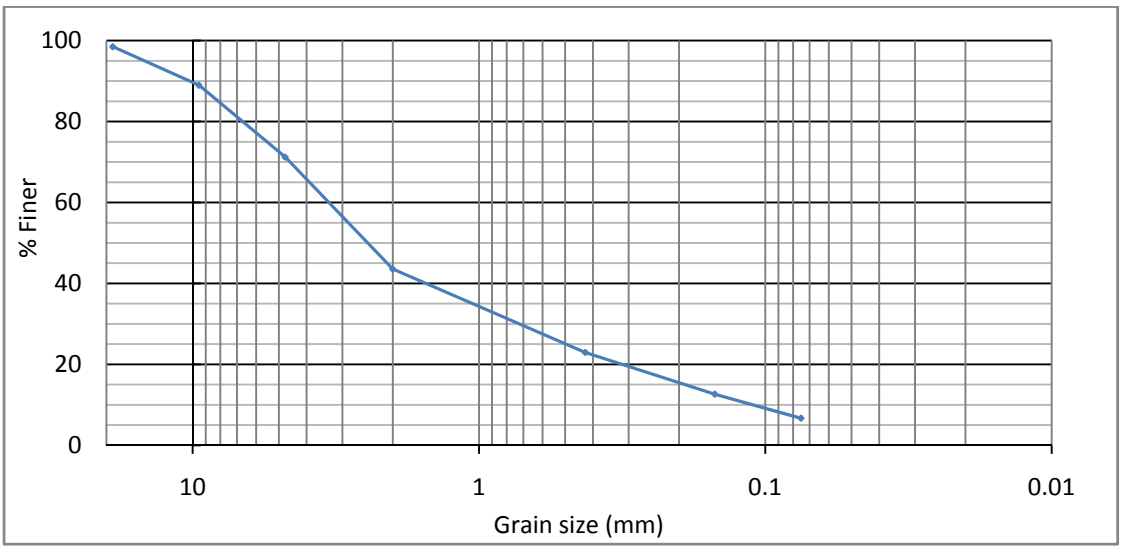

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 63.5 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 36.5 %. The amount of material passing sieve no. 4 and sieve no. 200 is 63.5 % and 9.2 %, so the percent of sand is 54.3 %.

$D_{60} = 4.1$ $D_{30} = 0.82$ $D_{10} = 0.083$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 49.4$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 2.0$

$CBR = 28.09(D_{60})^{0.358} = 46$

The group symbol for the soil is SW-SM and the group name is well graded sand with clay and gravel. The CBR value of 46 is good for subgrade.

Raton Municipal Airport

Borehole 6

Location: Taxiway B, 500 ft. from SW edge

Depth: 6 – 10 inches

Bag No: E 2

Sample Weight (g):740.5

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	509.1	12.2	1.6	98.4
9.5	483.6	678.5	194.9	26.3	72.0
4.75	532.1	665.2	133.1	18.0	54.1
2.00	464.5	571.8	107.3	14.5	39.6
0.425	369.5	550.3	180.8	24.4	15.2
0.150	414.9	487.6	72.7	9.8	5.3
0.075	327.5	346.8	19.3	2.6	2.7
Pan	377.9	397.3	19.4	2.6	
		Total	739.7		

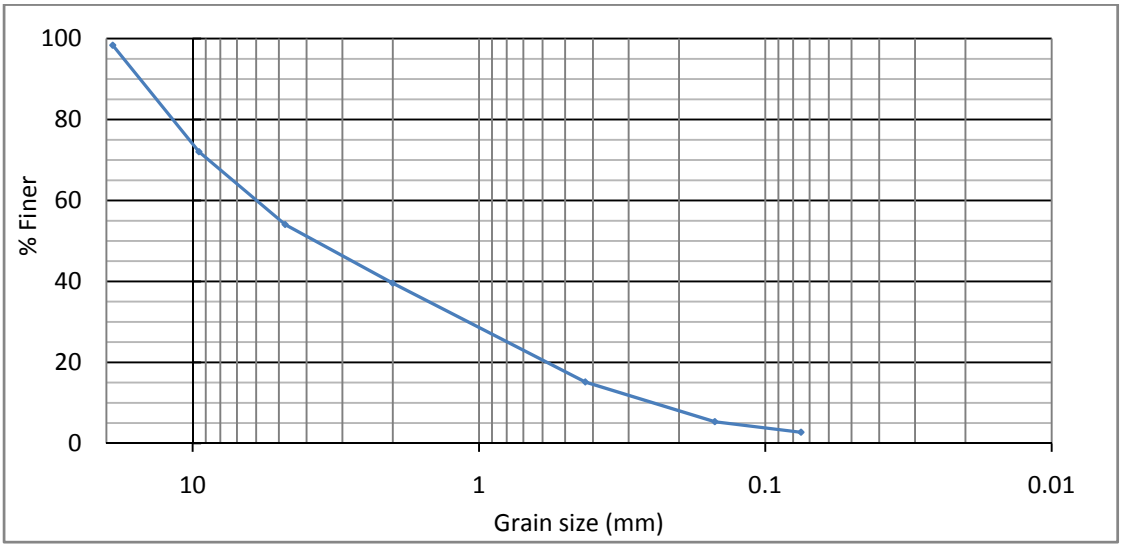

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 54.1 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 45.9 %. The amount of material passing sieve no. 4 and sieve no. 200 is 54.1 % and 2.7 %, so the percent of sand is 51.4 %.

$D_{60} = 6.0$ $D_{30} = 1.2$ $D_{10} = 0.28$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 21.4$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.9$

$CBR = 28.09(D_{60})^{0.358} = 53$

The group symbol for the soil is SW and the group name is well graded sand with gravel. The CBR value of 53 is fair for base course.

Depth: 10 – 21 inches

Bag No: D 20

Sample Weight (g):571.5

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	533.6	36.7	6.4	93.6
9.5	483.6	500.7	17.1	3.0	90.6
4.75	532.1	648.7	116.6	20.4	70.2
2.00	464.5	610.1	145.6	25.5	44.7
0.425	369.5	499.2	129.7	22.7	22.0
0.150	414.9	474.5	59.6	10.4	11.6
0.075	327.5	356.5	29.0	5.1	6.5
Pan	377.9	414.4	36.5	6.4	
		Total	570.8		

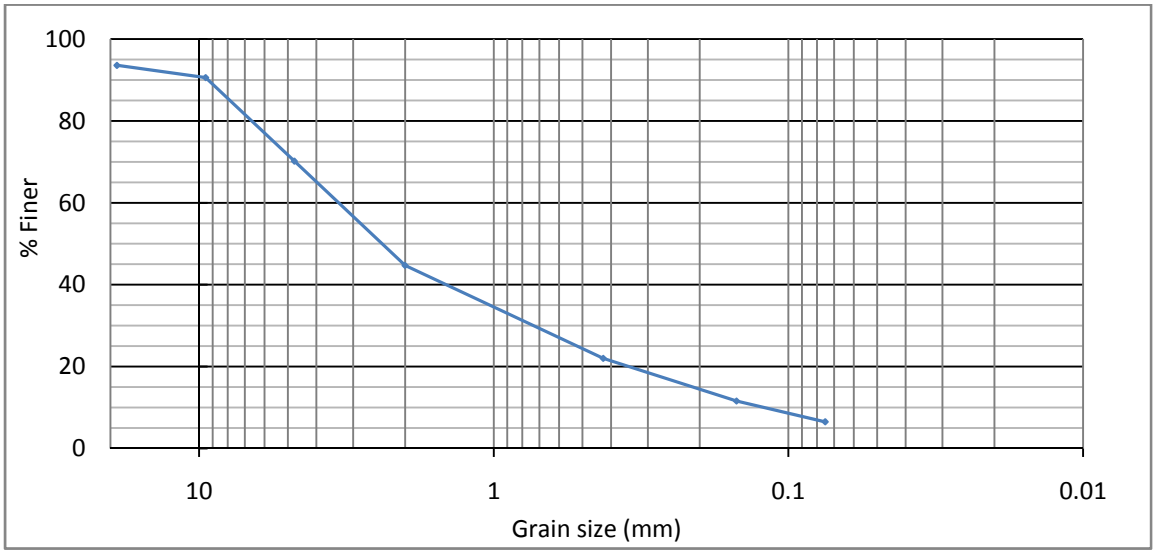

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 70.2 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 29.8 %. The amount of material passing sieve no. 4 and sieve no. 200 is 70.2 % and 6.5 %, so the percent of sand is 63.7 %.

$D_{60} = 3.3$ $D_{30} = 0.74$ $D_{10} = 0.14$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 23.6$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.2$

$CBR = 28.09(D_{60})^{0.358} = 43$

The group symbol for the soil is SW-SC and the group name is well graded sand with clay and gravel. The CBR value of 53 is good for subgrade.

Depth: 21 – 54 inches

Bag No: K 181

Sample Weight (g):572.2

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	576	79.1	13.8	86.2
9.5	483.6	566	82.4	14.4	71.8
4.75	532.1	576.6	44.5	7.8	64.0
2.00	464.5	528.8	64.3	11.2	52.8
0.425	369.5	515.4	145.9	25.5	27.3
0.150	414.9	534.6	119.7	20.9	6.3
0.075	327.5	350.3	22.8	4.0	2.4
Pan	377.9	390.5	12.6	2.2	
		Total	571.3		

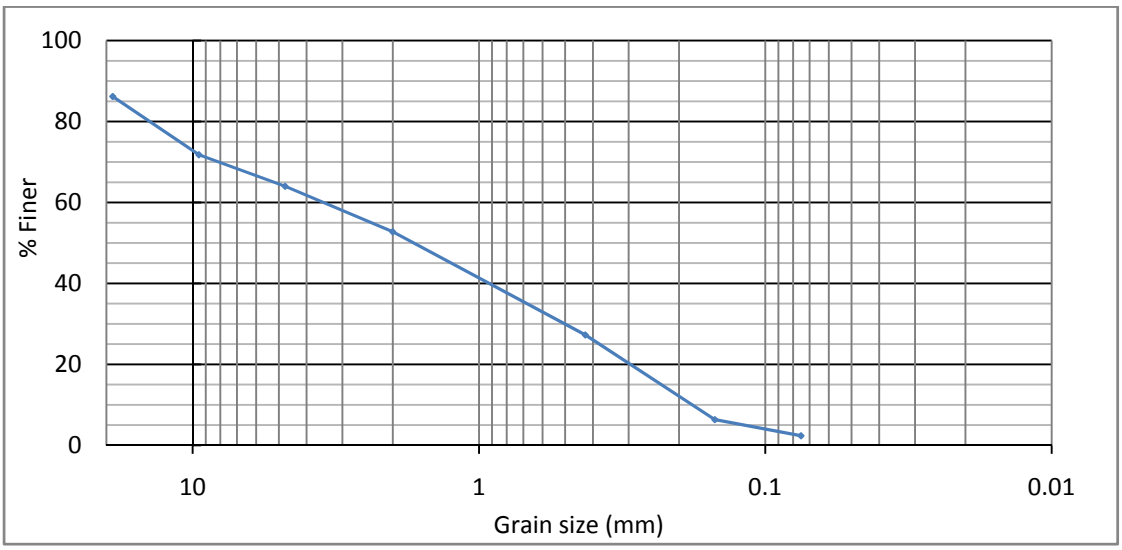

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 64.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 36.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 64.0 % and 2.4 %, so the percent of sand is 61.6 %.

$D_{60} = 3.3$ $D_{30} = 0.50$ $D_{10} = 0.19$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 17.4$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.4$

$CBR = 28.09(D_{60})^{0.358} = 43$

The group symbol for the soil is SP and the group name is poorly graded sand with gravel. The CBR value of 43 is good for subgrade.

Depth: 54 – 60 inches

Bag No: G 47

Sample Weight (g): 723.4

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	636.7	139.8	19.3	80.7
9.5	483.6	648.1	164.5	22.7	57.9
4.75	532.1	618.6	86.5	12.0	46.0
2.00	464.5	549.5	85.0	11.8	34.2
0.425	369.5	491.5	122.0	16.9	17.4
0.150	414.9	506.0	91.1	12.6	4.8
0.075	327.5	350.0	22.5	3.1	1.7
Pan	377.9	389.7	11.8	1.6	
		Total	723.2		

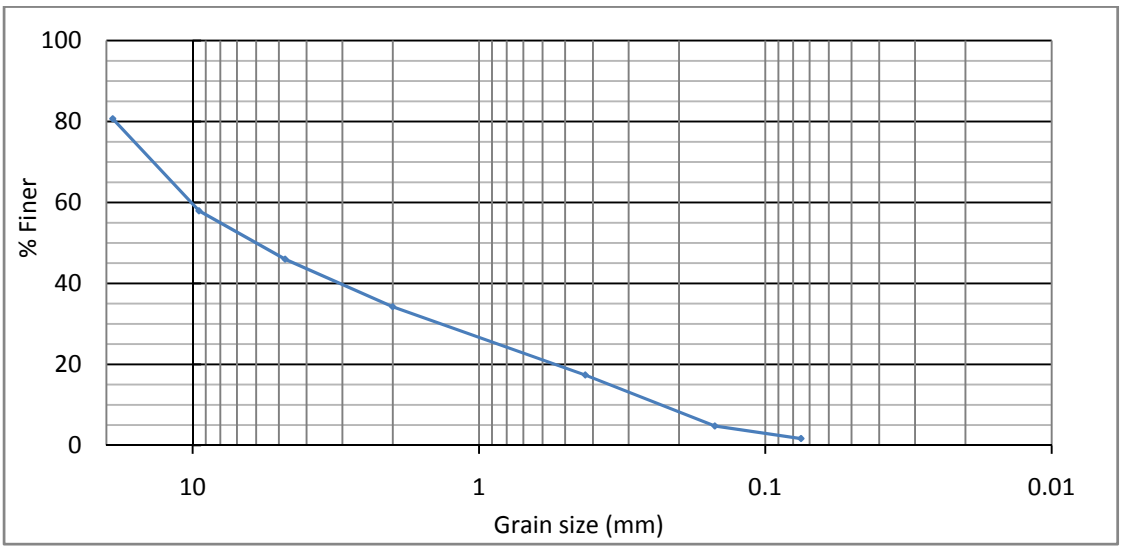

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 46.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 54.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 46.0 % and 1.7 %, so the percent of sand is 44.3 %.

$D_{60} = 10.1$ $D_{30} = 1.4$ $D_{10} = 0.23$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 43.9$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.84$

$CBR = 28.09(D_{60})^{0.358} = 64$

The group symbol for the soil is GP and the group name is poorly graded gravel with sand. The CBR value of 64 is excellent for subgrade.

Raton Municipal Airport

Borehole 7

Location: Taxiway B, 2200 ft. from SW edge

Depth: 6 – 10 inches

Bag No: W 100

Sample Weight (g):1607.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	558.4	61.5	3.8	96.2
9.5	483.6	901.6	418.0	26.0	70.2
4.75	532.1	852.0	319.9	19.9	50.3
2.00	464.5	757.6	293.1	18.2	32.0
0.425	369.5	745.3	375.8	23.4	8.6
0.150	414.9	508.0	93.1	5.8	2.8
0.075	327.5	349.4	21.9	1.4	1.5
Pan	377.9	400.0	22.1	1.4	
		Total	1605.4		

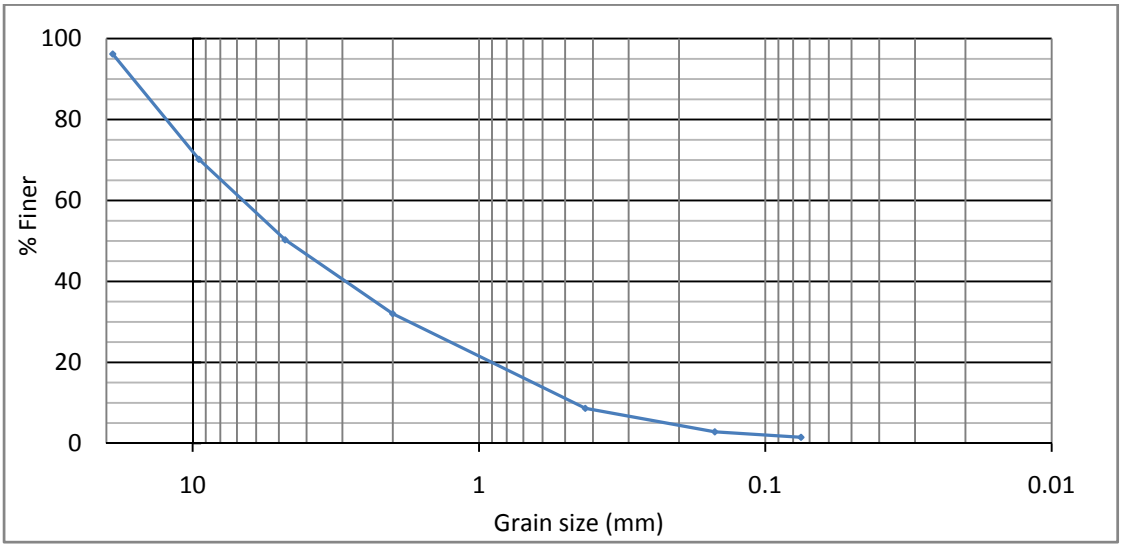

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 50.3 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 49.7 %. The amount of material passing sieve no. 4 and sieve no. 200 is 50.3 % and 1.5 %, so the percent of sand is 48.8 %.

$D_{60} = 6.8$ $D_{30} = 1.9$ $D_{10} = 0.48$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 14.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.1$

$CBR = 28.09(D_{60})^{0.358} = 56$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 56 is fair for base course.

Depth: 10 - 18 inches

Bag No: Z 82

Sample Weight (g): 524.5

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	483.9	0.0	0.0	100.0
4.75	532.2	552.9	20.7	3.9	96.1
2.00	464.5	578.5	114.0	21.7	74.3
0.425	370.2	522.4	152.2	29.0	45.3
0.150	415.5	507.8	92.3	17.6	27.7
0.075	327.8	385.3	57.5	11.0	16.7
Pan	378.0	464.7	86.7	16.5	
		Total	523.4		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	38	35	23	10.6	10.60	0.086	11.7
0.5	37	34	23	10.7	10.70	0.061	11.4
1	36	33	23	10.9	10.90	0.043	11.0
2	34	31	23	11.2	11.20	0.031	10.4
4	33	30	23	11.4	11.40	0.022	10.0
8	31	28	23	11.7	11.70	0.016	9.4
15	30	27	23	11.9	11.90	0.012	9.0
30	29	26	22	12.0	12.00	0.008	8.7
60	28	25	22	12.2	12.20	0.006	8.4
120	27	24	21	12.4	12.40	0.004	8.0
240	25	22	21	12.7	12.70	0.003	7.4
480	24	21	21	12.9	12.90	0.002	7.0
1440	23	20	21	13.0	13.00	0.001	6.7

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 3

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 16.7

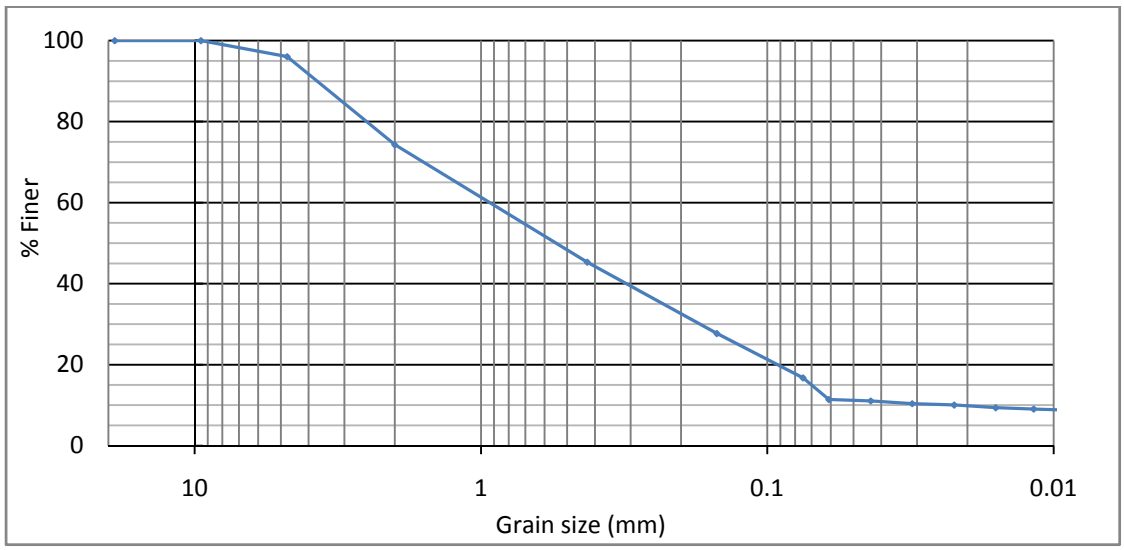

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 96.1 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 3.9 %. The amount of material passing sieve no. 4 and sieve no. 200 is 96.1 % and 16.7 %, so the percent of sand is 79.3 %.

$D_{60} = 0.92$ $D_{30} = 0.18$ $D_{10} = 0.022$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 41.8$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.6$

$CBR = 28.09(D_{60})^{0.358} = 27$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 26 is fair to good for subgrade.

Depth: 18 - 27 inches

Bag No: 89 C

Sample Weight (g): 564.9

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	485.1	1.2	0.2	99.8
4.75	532.2	545.9	13.7	2.4	97.4
2.00	464.5	522.9	58.4	10.3	87.0
0.425	370.2	529.8	159.6	28.2	58.8
0.150	415.5	559.6	144.1	25.5	33.3
0.075	327.8	408.8	81.0	14.3	19.0
Pan	378.0	484.9	106.9	18.9	
		Total	564.9		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	46	43	23	9.2	9.20	0.080	16.3
0.5	41	38	23	10.1	10.10	0.059	14.4
1	36	33	23	10.9	10.90	0.043	12.5
2	32	29	23	11.5	11.50	0.032	11.0
4	29	26	23	12.0	12.00	0.023	9.9
8	27	24	23	12.4	12.40	0.016	9.1
15	25	22	23	12.7	12.70	0.012	8.4
30	23	20	22	13.0	13.00	0.009	7.6
60	21	18	22	13.3	13.30	0.006	6.8
120	20	17	21	13.5	13.50	0.004	6.5
240	19	16	21	13.7	13.70	0.003	6.1
480	18	15	21	13.8	13.80	0.002	5.7
1440	17	14	21	14.0	14.00	0.001	5.3

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 3

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 19.0

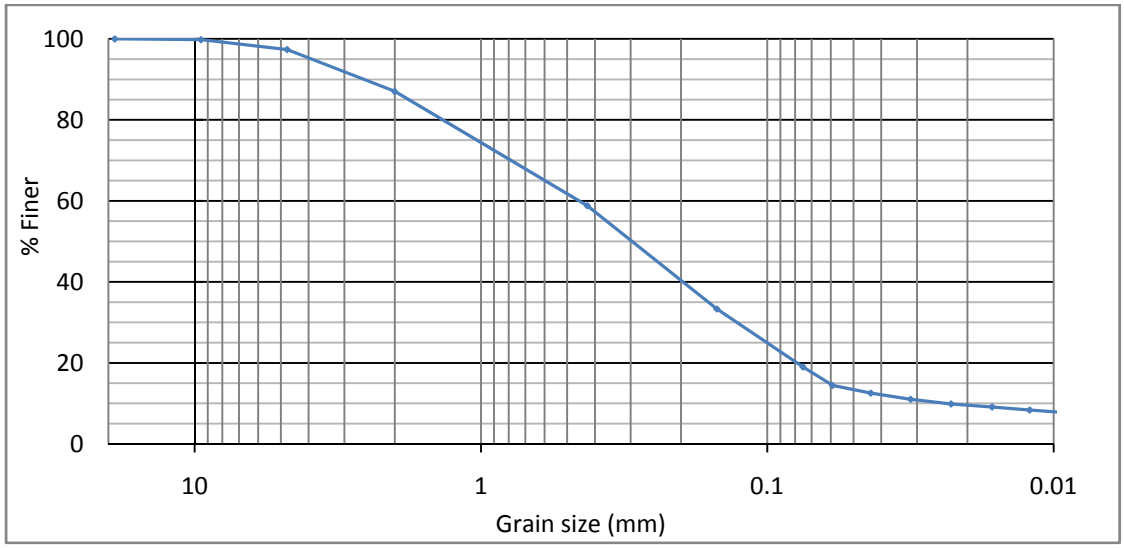

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 97.4 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 2.6 %. The amount of material passing sieve no. 4 and sieve no. 200 is 97.4 % and 19.0 %, so the percent of sand is 78.4 %.

D_{60} = 0.45 D_{30} = 0.14 D_{10} = 0.024

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 18.8$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.8$

$CBR = 28.09(D_{60})^{0.358} = 21$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 21 is fair to good for subgrade.

Depth: 27 – 36 inches

Bag No: N 54

Sample Weight (g):517.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.6	488.3	4.7	0.9	99.1
4.75	532.1	576.3	44.2	8.5	90.5
2.00	464.5	566.3	101.8	19.7	70.9
0.425	369.5	523.0	153.5	29.7	41.2
0.150	414.9	526.0	111.1	21.5	19.7
0.075	327.5	403.4	75.9	14.7	5.0
Pan	377.9	402.6	24.7	4.8	
		Tota	515.9		

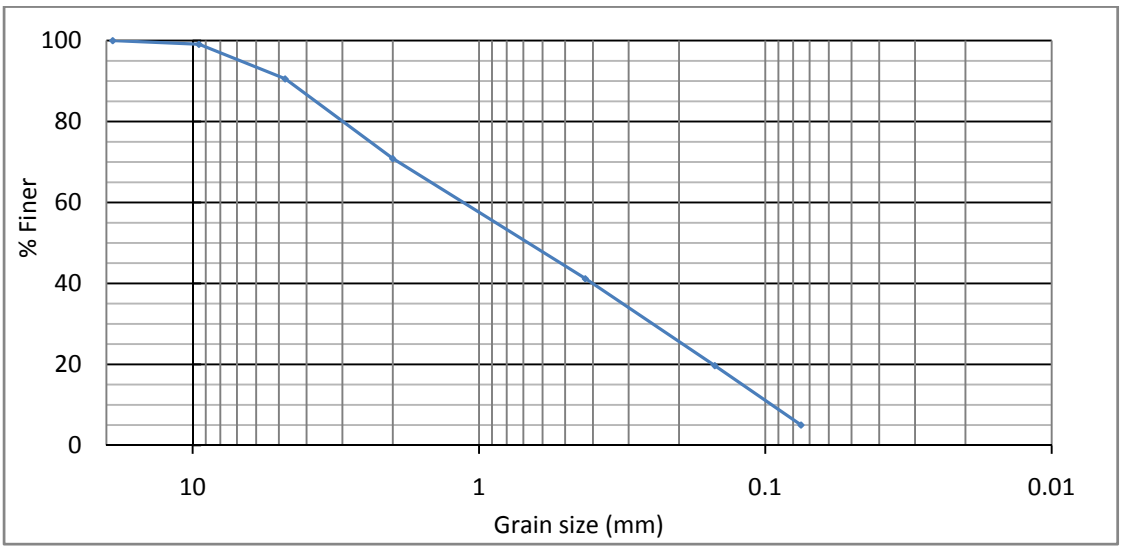

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 90.5 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 9.5 %. The amount of material passing sieve no. 4 and sieve no. 200 is 90.5 % and 5.0 %, so the percent of sand is 85.5 %.

$D_{60} = 1.2$ $D_{30} = 0.25$ $D_{10} = 0.095$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 12.6$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.55$

$CBR = 28.09(D_{60})^{0.358} = 30$

The group symbol for the soil is SP and the group name is poorly graded sand. The CBR value of 30 is good for subgrade.

Depth: 36 – 50 inches

Bag No: I 53

Sample Weight (g): 620.2

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.6	496.1	12.5	2.0	98.0
4.75	532.1	588.4	56.3	9.1	88.9
2.00	464.5	611.3	146.8	23.7	65.2
0.425	369.5	563.6	194.1	31.3	33.9
0.150	414.9	533.2	118.3	19.1	14.9
0.075	327.5	375.8	48.3	7.8	7.1
Pan	377.9	420.8	42.9	6.9	
		Total	619.2		

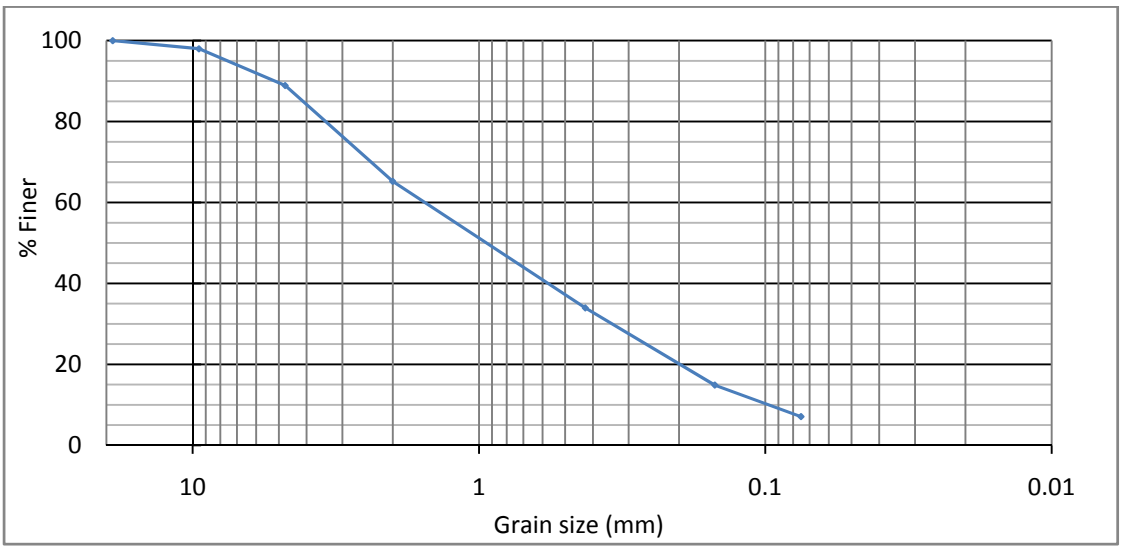

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 88.9 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 11.1 %. The amount of material passing sieve no. 4 and sieve no. 200 is 88.9 % and 7.1 %, so the percent of sand is 81.8 %.

$D_{60} = 1.8$ $D_{30} = 0.35$ $D_{10} = 0.096$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 18.8$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.71$

$CBR = 28.09(D_{60})^{0.358} = 35$

The group symbol for the soil is SP-SM and the group name is poorly graded sand with silt. The CBR value of 35 is good for subgrade.

Raton Municipal Airport

Borehole 8

Location: Taxiway B, 500 ft. east of runway 2-20 east edge

Depth: 6 – 10 inches

Bag No: K 462

Sample Weight (g):1939.3

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	535.2	38.3	2.0	98.0
9.5	483.6	1021.5	537.9	27.7	70.3
4.75	532.1	1028.3	496.2	25.6	44.7
2.00	464.5	853.4	388.9	20.1	24.6
0.425	369.5	694.9	325.4	16.8	7.9
0.150	414.9	501.2	86.3	4.5	3.4
0.075	327.5	355.4	27.9	1.4	2.0
Pan	377.9	414.7	36.8	1.9	
		Total	1937.7		

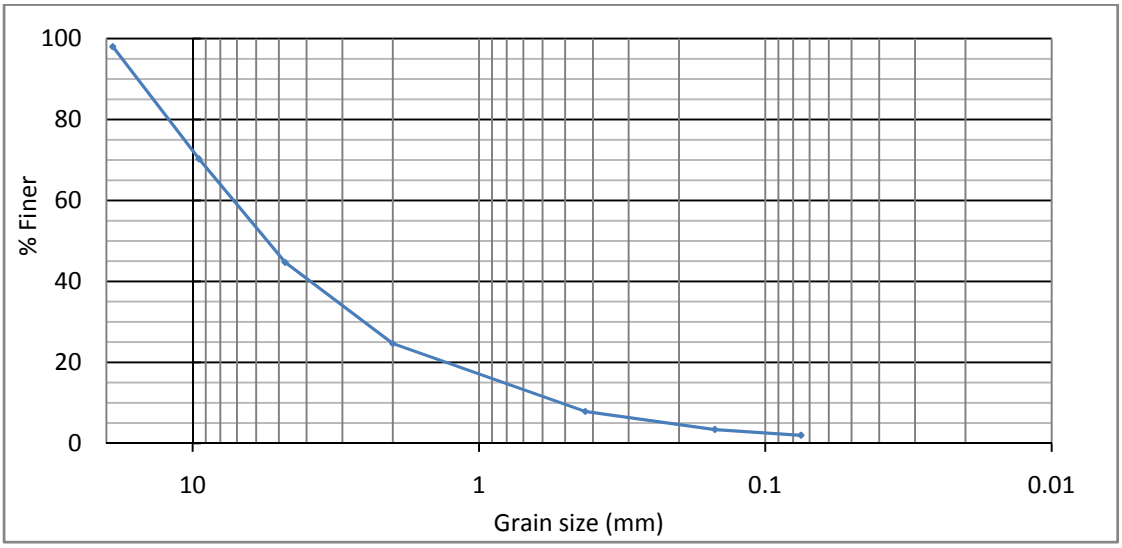

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 44.7 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 55.3 %. The amount of material passing sieve no. 4 and sieve no. 200 is 44.7 % and 2.0 %, so the percent of sand is 42.7 %.

$D_{60} = 7.1$ $D_{30} = 2.7$ $D_{10} = 0.5$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 14.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 2.05$

$CBR = 28.09(D_{60})^{0.358} = 57$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 57 is fair for base course.

Depth: 10 - 36 inches

Bag No: G 40

Sample Weight (g): 521.3

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	483.9	0.0	0.0	100.0
4.75	532.2	538.7	6.5	1.2	98.8
2.00	464.5	537.7	73.2	14.0	84.7
0.425	370.2	521.9	151.7	29.1	55.6
0.150	415.5	530.2	114.7	22.0	33.6
0.075	327.8	403.4	75.6	14.5	19.1
Pan	378.0	477.1	99.1	19.0	
		Total	520.8		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	46	39	23	9.9	9.90	0.083	14.9
0.5	41	34	23	10.7	10.70	0.061	13.0
1	36	29	23	11.5	11.50	0.045	11.1
2	32	25	23	12.2	12.20	0.033	9.6
4	29	22	23	12.7	12.70	0.023	8.4
8	27	20	23	13.0	13.00	0.017	7.6
15	25	18	23	13.3	13.30	0.012	6.9
30	23	16	22	13.7	13.70	0.009	6.1
60	21	14	22	14.0	14.00	0.006	5.3
120	20	13	21	14.2	14.20	0.005	5.0
240	19	12	21	14.3	14.30	0.003	4.6
480	18	11	21	14.5	14.50	0.002	4.2
1440	17	10	21	14.7	14.70	0.001	3.8

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 7

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 19.1

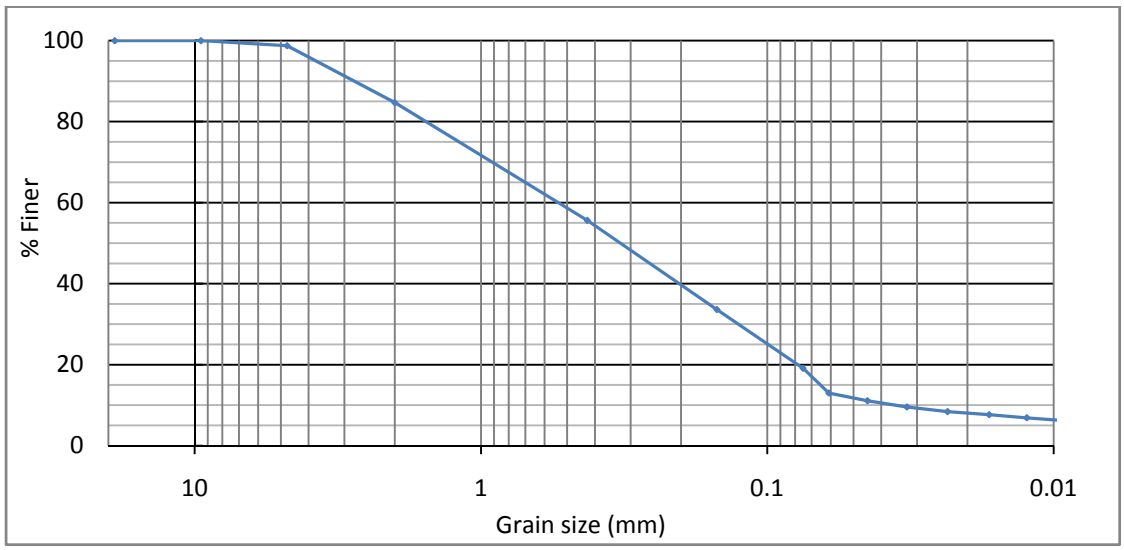

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 98.8 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 1.2 %. The amount of material passing sieve no. 4 and sieve no. 200 is 98.8 % and 19.1 %, so the percent of sand is 79.6 %.

$D_{60} = 0.55$ $D_{30} = 0.14$ $D_{10} = 0.035$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 15.7$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.0$

$CBR = 28.09(D_{60})^{0.358} = 23$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 23 is fair to good for subgrade.

Depth: 36 - 46 inches

Bag No: G 72

Sample Weight (g): 500.7

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	483.9	0.0	0.0	100.0
4.75	532.2	536.5	4.3	0.9	99.1
2.00	464.5	509.3	44.8	8.9	90.2
0.425	370.2	525.9	155.7	31.1	59.1
0.150	415.5	506.8	91.3	18.2	40.9
0.075	327.8	396.2	68.4	13.7	27.2
Pan	378.0	513.0	135.0	27.0	
		Total	499.5		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	46	39	23	9.9	9.90	0.083	21.2
0.5	45	38	23	10.1	10.10	0.059	20.7
1	41	34	23	10.7	10.70	0.043	18.5
2	36	29	23	11.5	11.50	0.032	15.8
4	32	25	23	12.2	12.20	0.023	13.6
8	30	23	23	12.5	12.50	0.016	12.5
15	27	20	23	13.0	13.00	0.012	10.9
30	25	18	22	13.3	13.30	0.009	9.8
60	24	17	22	13.5	13.50	0.006	9.2
120	23	16	21	13.7	13.70	0.004	8.7
240	23	16	21	13.7	13.70	0.003	8.7
480	22	15	21	13.8	13.80	0.002	8.2
1440	19	12	21	14.3	14.30	0.001	6.5

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 7

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 27.2

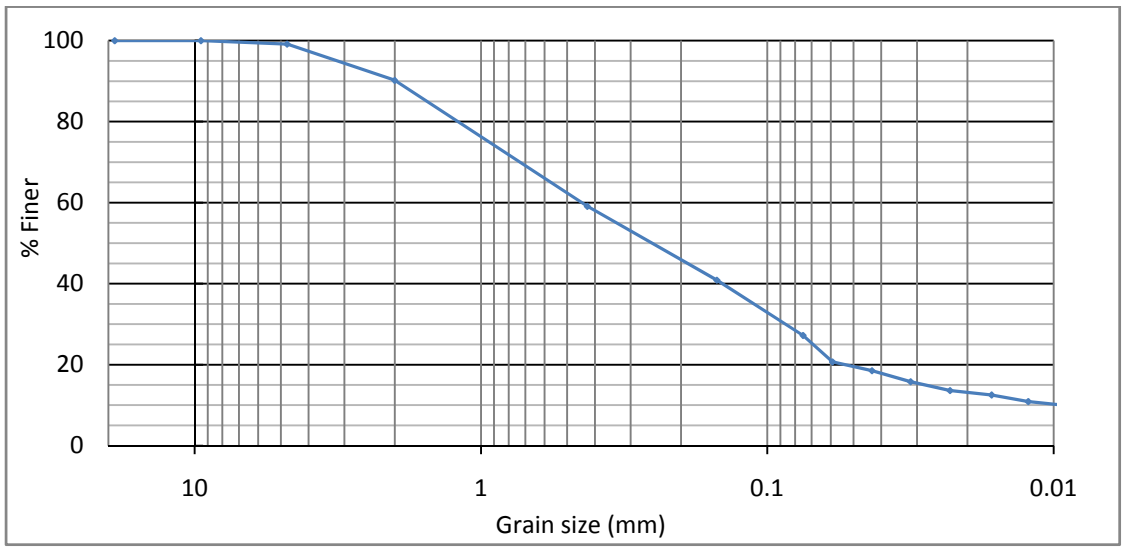

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 99.1 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 0.9 %. The amount of material passing sieve no. 4 and sieve no. 200 is 99.1 % and 27.2 %, so the percent of sand is 71.9 %.

$D_{60} = 0.46$ $D_{30} = 0.09$ $D_{10} = 0.011$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 41.8$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.5$

$CBR = 28.09(D_{60})^{0.358} = 21$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 21 is fair to good for subgrade.

Depth: 46 - 60 inches

Bag No: 12 D

Sample Weight (g): 410.8

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	487.6	3.7	0.9	99.1
4.75	532.2	538.2	6.0	1.5	97.6
2.00	464.5	499.2	34.7	8.4	89.2
0.425	370.2	495.6	125.4	30.5	58.7
0.150	415.5	486.1	70.6	17.2	41.5
0.075	327.8	373.8	46.0	11.2	30.3
Pan	378.0	498.1	120.1	29.2	
		Total	406.5		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	42	35	23	10.6	10.60	0.086	21.2
0.5	41	34	23	10.7	10.70	0.061	20.6
1	40	33	23	10.9	10.90	0.043	20.0
2	37	30	23	11.4	11.40	0.031	18.2
4	33	26	23	12.0	12.00	0.023	15.7
8	30	23	23	12.5	12.50	0.016	13.9
15	28	21	23	12.9	12.90	0.012	12.7
30	28	21	22	12.9	12.90	0.009	12.7
60	26	19	22	13.2	13.20	0.006	11.5
120	25	18	21	13.3	13.30	0.004	10.9
240	24	17	21	13.5	13.50	0.003	10.3
480	23	16	21	13.7	13.70	0.002	9.7
1440	20	13	21	14.2	14.20	0.001	7.9

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 7

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 30.3

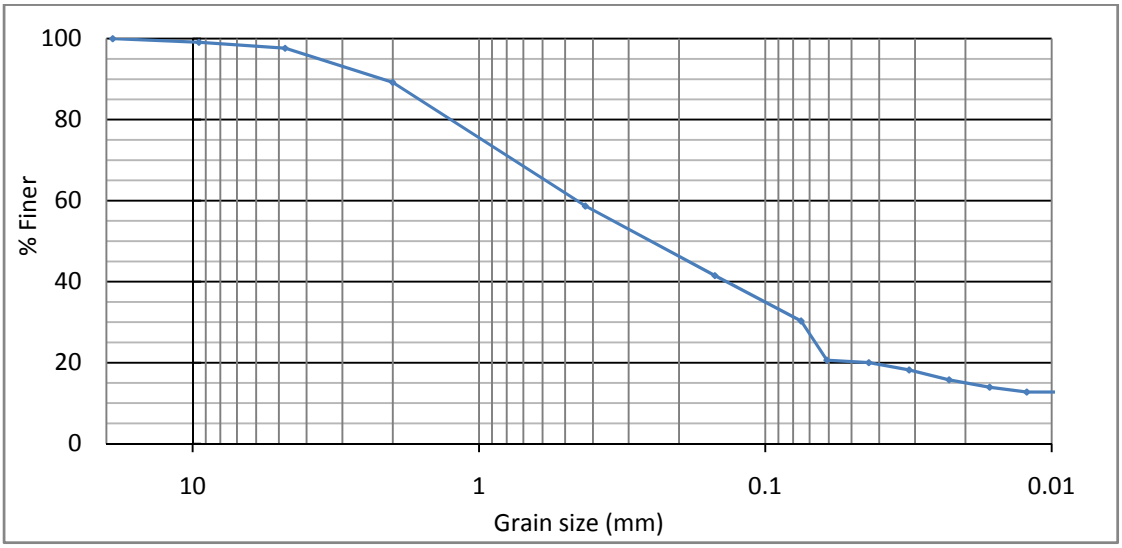

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 97.6 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal 2.4 %. The amount of material passing sieve no. 4 and sieve no. 200 is 97.6 % and 30.3 %, so the percent of sand is 67.4 %.

$D_{60} = 0.46$ $D_{30} = 0.078$ $D_{10} = 0.0025$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 184$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 5.3$

$CBR = 28.09(D_{60})^{0.358} = 21$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 21 is fair to good for subgrade.

Raton Municipal Airport

Borehole 9

Location: Runway 02-20, 1000 ft. north of runway 02 threshold

Depth: 8 – 15 inches

Bag No: G 98

Sample Weight (g):1538.4

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	936.3	439.4	28.6	71.4
9.5	483.6	856.1	372.5	24.2	47.2
4.75	532.1	801.7	269.6	17.5	29.7
2.00	464.5	659.9	195.4	12.7	17.0
0.425	369.5	511.7	142.2	9.2	7.8
0.150	414.9	475.8	60.9	4.0	3.8
0.075	327.5	350.7	23.2	1.5	2.3
Pan	377.9	411.1	33.2	2.2	
		Total	1536.4		

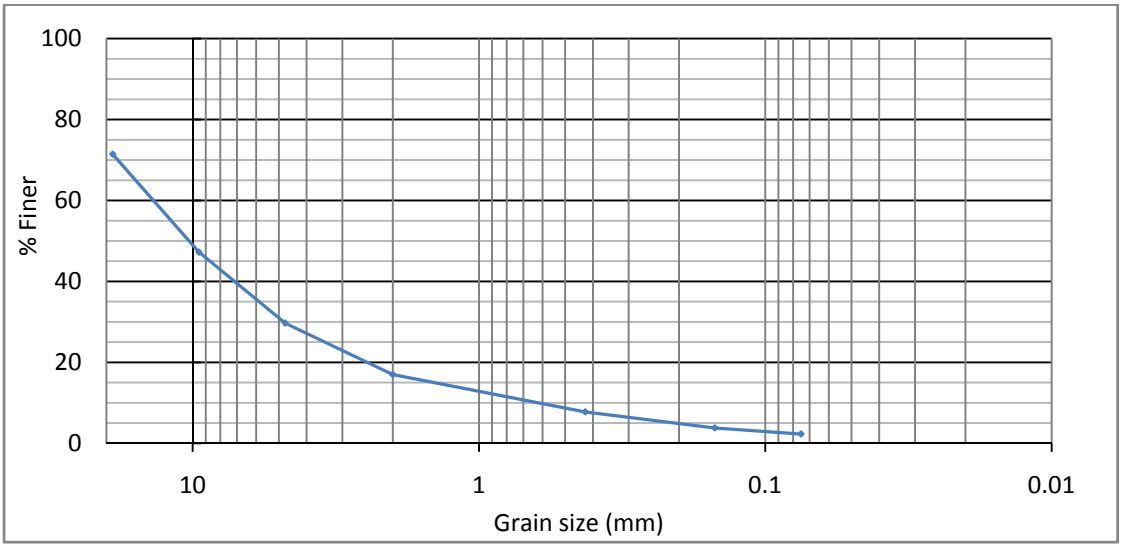

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 29.7 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 70.3 %. The amount of material passing sieve no. 4 and sieve no. 200 is 29.7 % and 2.3 %, so the percent of sand is 27.4 %.

$D_{60} = 14.0$ $D_{30} = 4.9$ $D_{10} = 0.64$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 21.9$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 2.68$

$CBR = 28.09(D_{60})^{0.358} = 72$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 72 is good for base course.

Depth: 15 – 33 inches

Bag No: N 44

Sample Weight (g):607.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	569.8	72.9	12.0	88.0
9.5	483.6	637.8	154.2	25.4	62.6
4.75	532.1	693.0	160.9	26.5	36.1
2.00	464.5	565.1	100.6	16.6	19.5
0.425	369.5	429.5	60.0	9.9	9.6
0.150	414.9	440.8	25.9	4.3	5.4
0.075	327.5	340.8	13.3	2.2	3.2
Pan	377.9	396.5	18.6	3.1	
		Total	606.4		

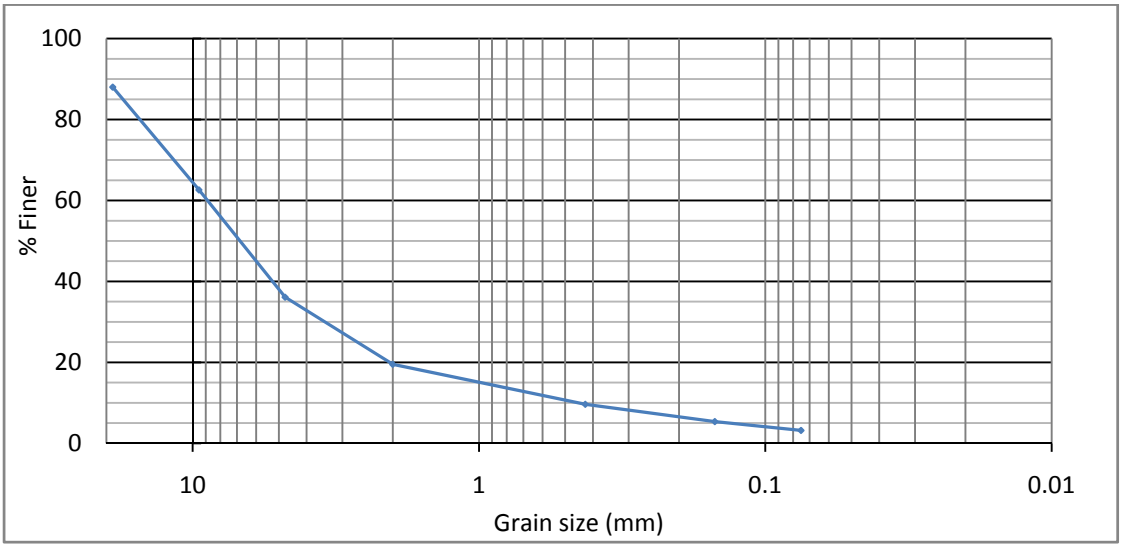

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 36.1 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 63.9 %. The amount of material passing sieve no. 4 and sieve no. 200 is 36.1 % and 3.2 %, so the percent of sand is 32.9 %.

$D_{60} = 8.9$ $D_{30} = 3.6$ $D_{10} = 0.44$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 20.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 3.31$

$CBR = 28.09(D_{60})^{0.358} = 61$

The group symbol for the soil is GP and the group name is poorly graded gravel with sand. The CBR value of 61 is excellent for subgrade.

Depth: 33 – 40 inches

Bag No: G 61

Sample Weight (g):675.5

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	553.9	57.0	8.4	91.6
9.5	483.6	654.5	170.9	25.3	66.3
4.75	532.1	660.6	128.5	19.0	47.2
2.00	464.5	576.6	112.1	16.6	30.6
0.425	369.5	464.0	94.5	14.0	16.7
0.150	414.9	457.5	42.6	6.3	10.3
0.075	327.5	354.6	27.1	4.0	6.3
Pan	377.9	419.2	41.3	6.1	
		Total	674.0		

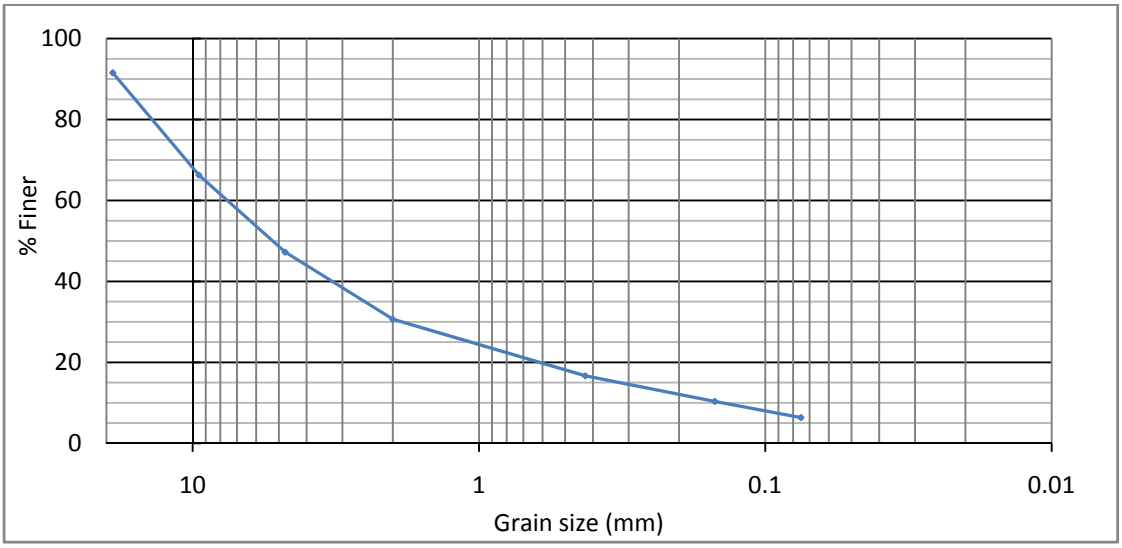

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 47.2 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 52.8 %. The amount of material passing sieve no. 4 and sieve no. 200 is 47.2 % and 6.3 %, so the percent of sand is 40.9 %.

$D_{60} = 7.5$ $D_{30} = 1.95$ $D_{10} = 0.16$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 46.9$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 3.17$

$CBR = 28.09(D_{60})^{0.358} = 58$

The group symbol for the soil is GP-GC and the group name is poorly graded gravel with clay and sand. The CBR value of 58 is excellent for subgrade.

Depth: 40 – 53 inches

Bag No: N 72

Sample Weight (g):522.3

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.6	672.3	188.7	36.1	63.9
4.75	532.1	712.2	180.1	34.5	29.4
2.00	464.5	534.4	69.9	13.4	16.0
0.425	369.5	412.0	42.5	8.1	7.9
0.150	414.9	429.6	14.7	2.8	5.1
0.075	327.5	333.9	6.4	1.2	3.8
Pan	377.9	397.4	19.5	3.7	
		Total	521.8		

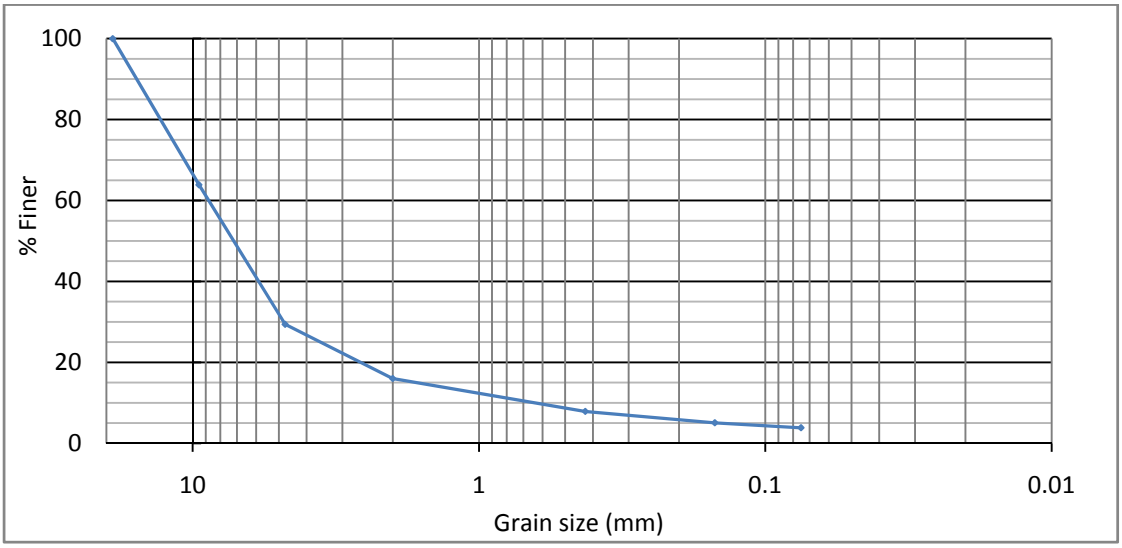

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 29.4 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 70.6 %. The amount of material passing sieve no. 4 and sieve no. 200 is 29.4 % and 3.8 %, so the percent of sand is 25.6 %.

$D_{60} = 8.9$ $D_{30} = 4.8$ $D_{10} = 0.6$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 14.8$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 4.32$

$CBR = 28.09(D_{60})^{0.358} = 61$

The group symbol for the soil is GP and the group name is poorly graded gravel with sand. The CBR value of 61 is excellent for subgrade.

Depth: 53 – 71 inches

Bag No: G 22

Sample Weight (g):553.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	503.0	6.1	1.1	98.9
9.5	483.6	631.2	147.6	26.7	72.2
4.75	532.1	666.2	134.1	24.2	48.0
2.00	464.5	565.9	101.4	18.3	29.6
0.425	369.5	451.7	82.2	14.9	14.8
0.150	414.9	438.5	23.6	4.3	10.5
0.075	327.5	342.3	14.8	2.7	7.8
Pan	377.9	420.3	42.4	7.7	
		Total	552.2		

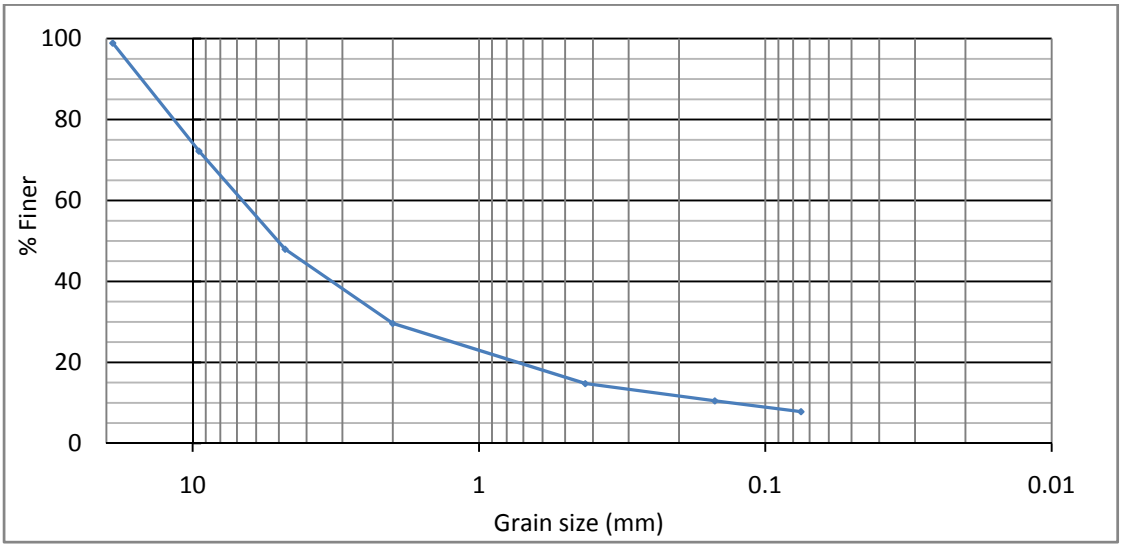

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 48.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 52.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 48.0 % and 7.8 %, so the percent of sand is 40.1 %.

$D_{60} = 6.8$ $D_{30} = 2.1$ $D_{10} = 0.16$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 42.5$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 4.05$

$CBR = 28.09(D_{60})^{0.358} = 56$

The group symbol for the soil is GP-GC and the group name is poorly graded gravel with clay and sand. The CBR value of 58 is excellent for subgrade.

Raton Municipal Airport

Borehole 10

Location: Runway 02-20, 2000 ft. north of runway 02 threshold

Depth: 8 – 14 inches

Bag No: B 11

Sample Weight (g):1332.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	761.1	264.2	19.8	80.2
9.5	483.6	858.9	375.3	28.2	52.0
4.75	532.1	836.2	304.1	22.8	29.2
2.00	464.5	653.1	188.6	14.2	15.0
0.425	369.5	488.8	119.3	9.0	6.0
0.150	414.9	456.8	41.9	3.1	2.9
0.075	327.5	343.9	16.4	1.2	1.7
Pan	377.9	399.8	21.9	1.6	
		Total	1331.7		

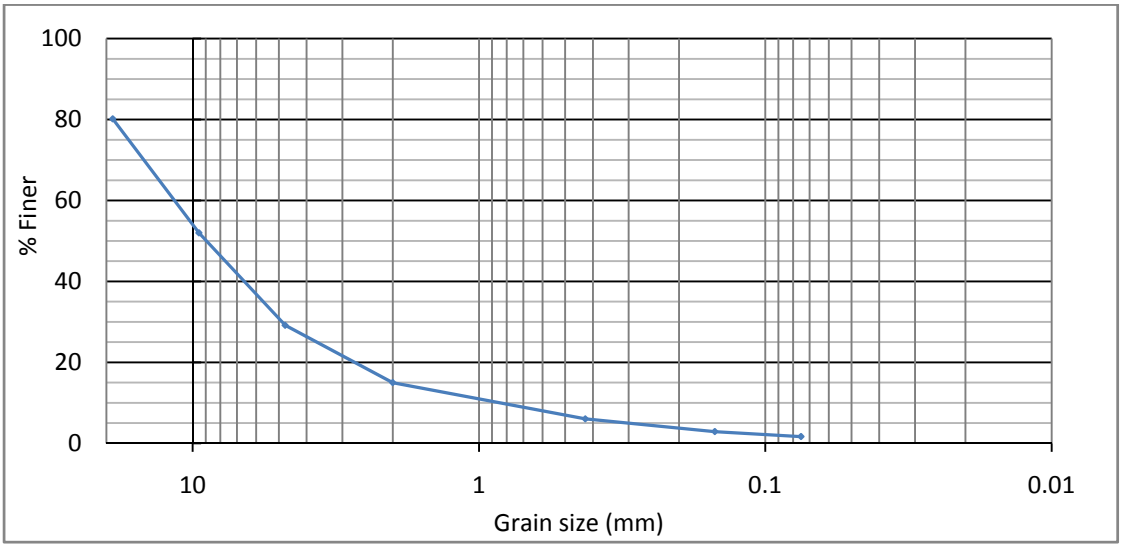

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 29.2 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 70.8 %. The amount of material passing sieve no. 4 and sieve no. 200 is 29.2 % and 1.7 %, so the percent of sand is 27.5 %.

$D_{60} = 12.0$ $D_{30} = 5.0$ $D_{10} = 0.9$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 13.3$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 2.3$

$CBR = 28.09(D_{60})^{0.358} = 68$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 68 is good for base course.

Depth: 14 – 28 inches

Bag No: V 45

Sample Weight (g):721.7

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	554.2	57.3	7.9	92.1
9.5	483.6	634.6	151.0	20.9	71.1
4.75	532.1	668.9	136.8	19.0	52.2
2.00	464.5	575.9	111.4	15.4	36.7
0.425	369.5	474.4	104.9	14.5	22.2
0.150	414.9	491.7	76.8	10.6	11.6
0.075	327.5	361.8	34.3	4.8	6.8
Pan	377.9	426.4	48.5	6.7	
		Total	721.0		

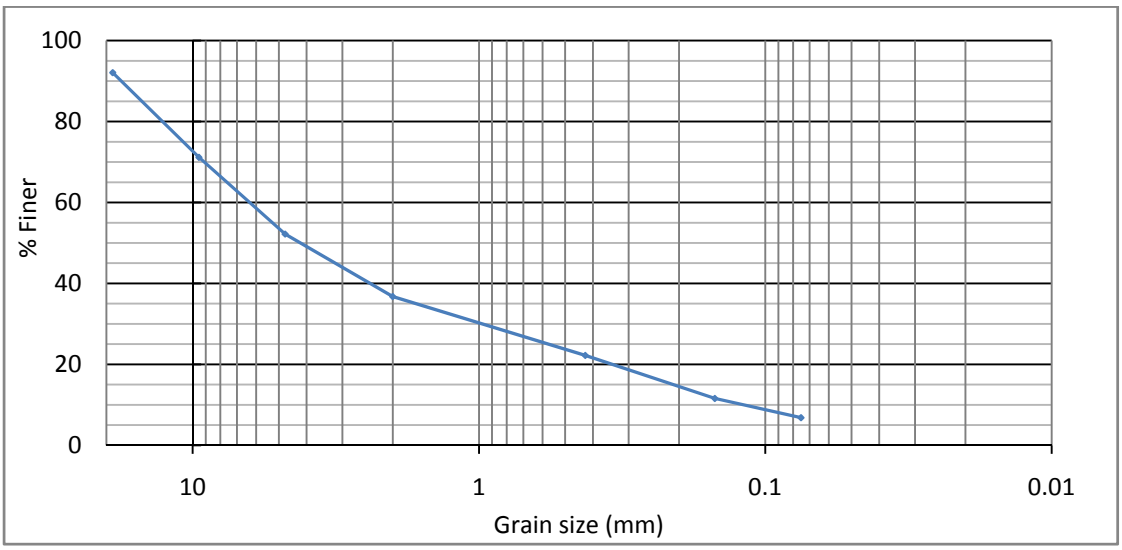

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 52.2 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 47.8 %. The amount of material passing sieve no. 4 and sieve no. 200 is 52.2 % and 6.8 %, so the percent of sand is 45.4 %.

$D_{60} = 6.3$ $D_{30} = 0.98$ $D_{10} = 0.14$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 45.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.09$

$CBR = 28.09(D_{60})^{0.358} = 54$

The group symbol for the soil is GW-GC and the group name is well graded gravel with clay and sand. The CBR value of 54 is good for subgrade.

Depth: 28 – 42 inches

Bag No: G 60

Sample Weight (g):588.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	521.6	24.7	4.2	95.8
9.5	483.6	645.1	161.5	27.5	68.3
4.75	532.1	624.9	92.8	15.8	52.6
2.00	464.5	549.3	84.8	14.4	38.1
0.425	369.5	446.1	76.6	13.0	25.1
0.150	414.9	485.4	70.5	12.0	13.1
0.075	327.5	366.8	39.3	6.7	6.4
Pan	377.9	414.0	36.1	6.1	
		Total	586.3		

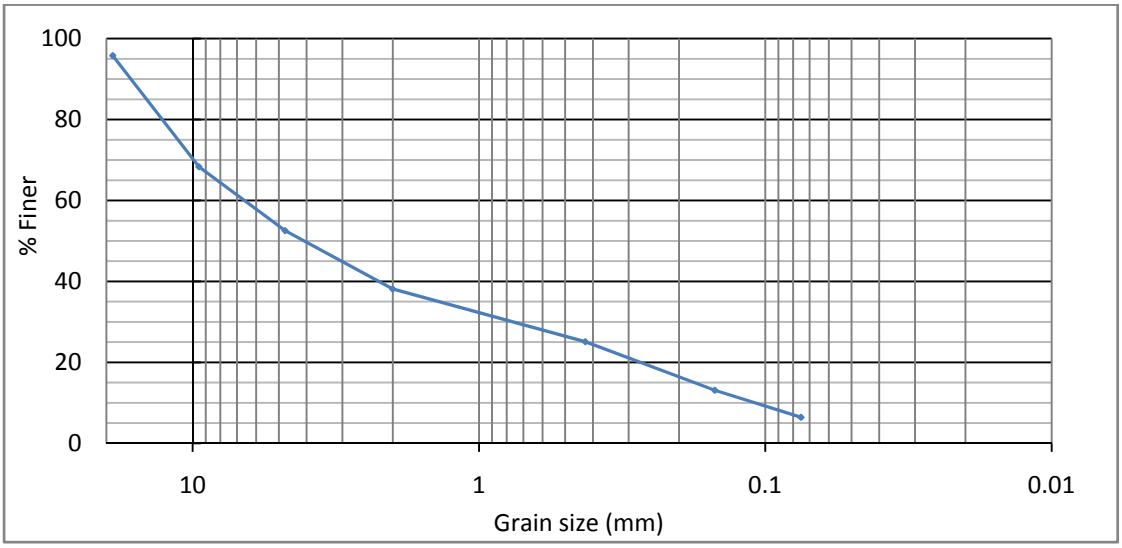

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 52.6 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 47.4 %. The amount of material passing sieve no. 4 and sieve no. 200 is 52.6 % and 6.4 %, so the percent of sand is 45.4 %.

$D_{60} = 6.5$ $D_{30} = 0.76$ $D_{10} = 0.12$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 54.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.74$

$CBR = 28.09(D_{60})^{0.358} = 55$

The group symbol for the soil is GP-GC and the group name is poorly graded gravel with clay and sand. The CBR value of 54 is good for subgrade.

Depth: 42 – 51 inches

Bag No: 85 D

Sample Weight (g):663.7

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	527.7	30.8	4.6	95.4
9.5	483.6	670.9	187.3	28.2	67.1
4.75	532.1	678.8	146.7	22.1	45.0
2.00	464.5	551.8	87.3	13.2	31.9
0.425	369.5	444.6	75.1	11.3	20.6
0.150	414.9	469.1	54.2	8.2	12.4
0.075	327.5	362.6	35.1	5.3	7.1
Pan	377.9	424.3	46.4	7.0	
		Total	662.9		

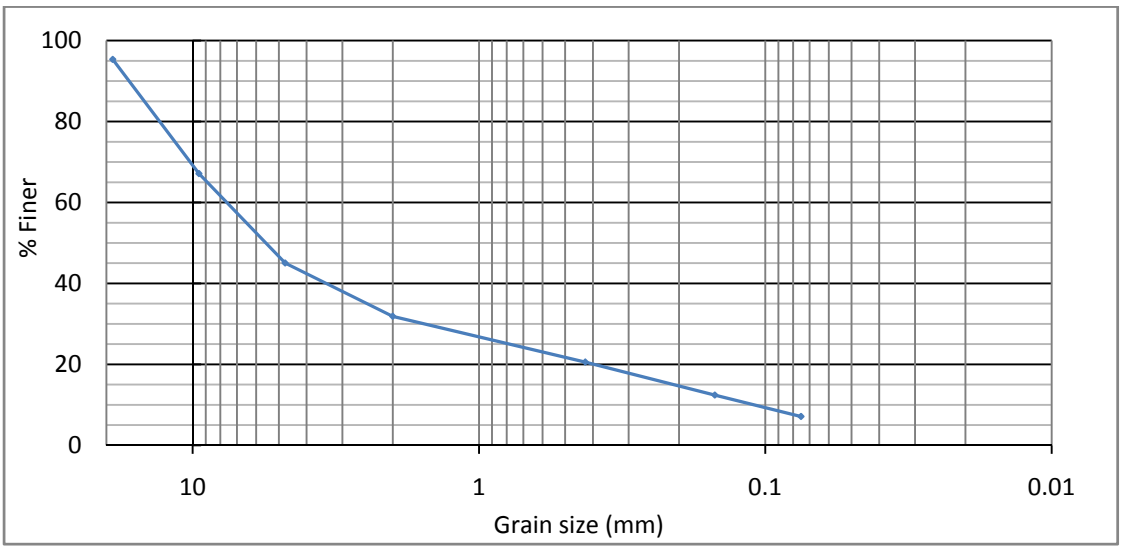

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 45.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 55.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 45.0 % and 7.1 %, so the percent of sand is 37.9 %.

$D_{60} = 7.6$ $D_{30} = 1.8$ $D_{10} = 0.12$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 63.3$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 3.6$

$CBR = 28.09(D_{60})^{0.358} = 58$

The group symbol for the soil is GP-GC and the group name is poorly graded gravel with clay and sand. The CBR value of 58 is good for subgrade.

Depth: 51 – 60 inches

Bag No: V 41

Sample Weight (g):663.5

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	637.1	140.2	21.1	78.9
9.5	483.6	706.0	222.4	33.5	45.4
4.75	532.1	640.6	108.5	16.4	29.0
2.00	464.5	538.6	74.1	11.2	17.8
0.425	369.5	425.0	55.5	8.4	9.5
0.150	414.9	439.8	24.9	3.8	5.7
0.075	327.5	342.0	14.5	2.2	3.5
Pan	377.9	399.5	21.6	3.3	
		Total	661.7		

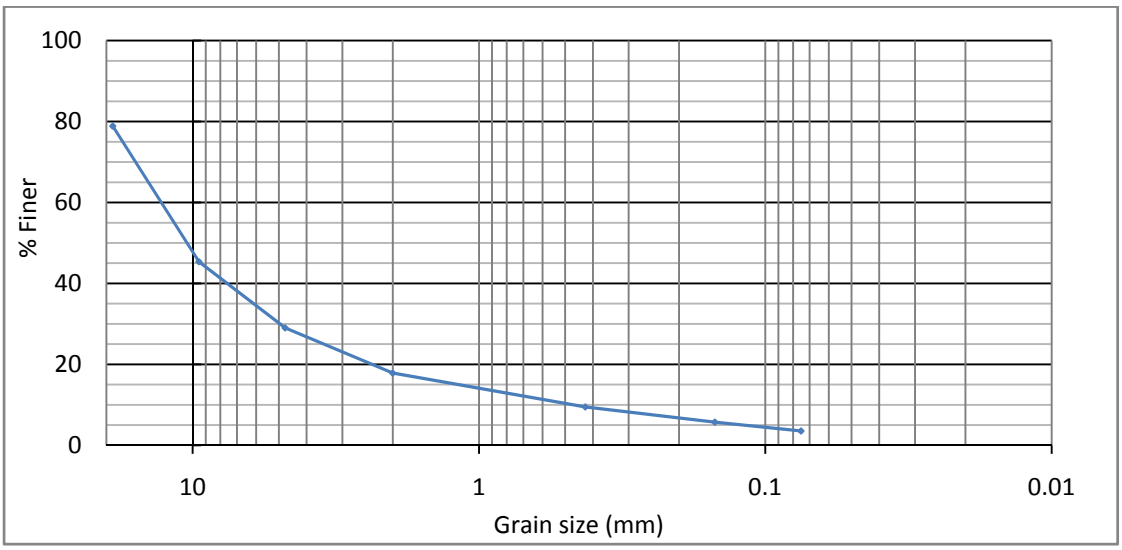

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 29.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 71.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 29.0 % and 3.5 %, so the percent of sand is 25.5 %.

$D_{60} = 13.0$ $D_{30} = 5.0$ $D_{10} = 0.45$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 28.9$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 4.3$

$CBR = 28.09(D_{60})^{0.358} = 70$

The group symbol for the soil is GP and the group name is poorly graded gravel with sand. The CBR value of 70 is excellent for subgrade.

Raton Municipal Airport

Borehole 11

Location: Runway 02-20, 3000 ft. north of runway 02 threshold

Depth: 5 – 11 inches

Bag No: L 54

Sample Weight (g):2051.6

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	828.6	331.7	16.2	83.8
9.5	483.6	1018.5	534.9	26.1	57.8
4.75	532.1	1007.2	475.1	23.2	34.6
2.00	464.5	788.3	323.8	15.8	18.8
0.425	369.5	603.9	234.4	11.4	7.4
0.150	414.9	498.5	83.6	4.1	3.3
0.075	327.5	355.3	27.8	1.4	2.0
Pan	377.9	416.4	38.5	1.9	
		Total	2049.8		

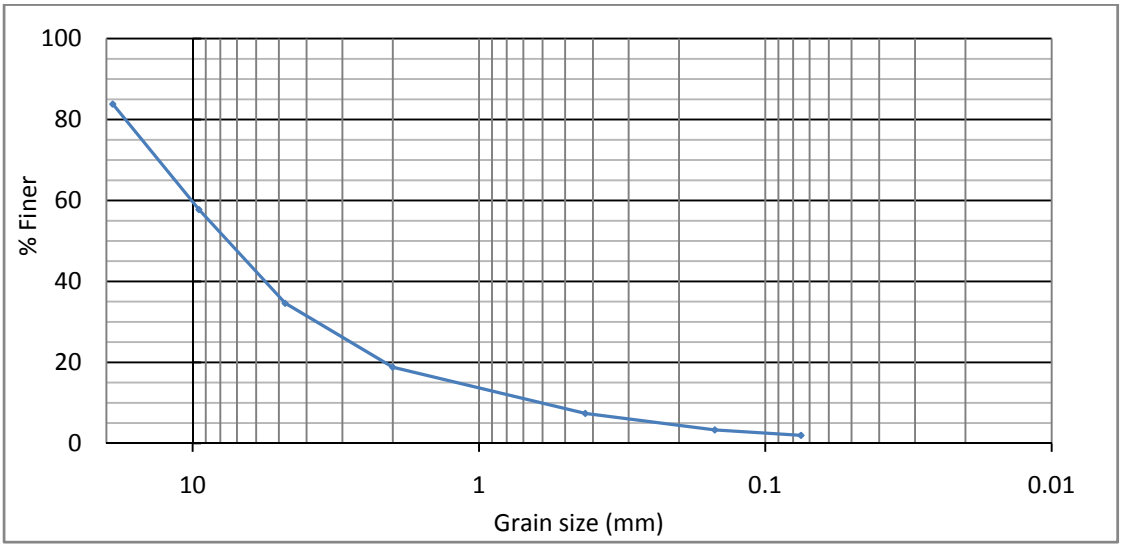

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 34.6 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 65.4 %. The amount of material passing sieve no. 4 and sieve no. 200 is 34.6 % and 2.0 %, so the percent of sand is 32.6 %.

$D_{60} = 10.0$ $D_{30} = 3.8$ $D_{10} = 0.6$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 16.7$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 2.4$

$CBR = 28.09(D_{60})^{0.358} = 64$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 64 is good for base course.

Depth: 11 - 30 inches

Bag No: WT 205

Sample Weight (g): 628.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	548.7	64.8	10.3	89.7
4.75	532.2	577.9	45.7	7.3	82.4
2.00	464.5	566.2	101.7	16.2	66.2
0.425	370.2	526.4	156.2	24.9	41.3
0.150	415.5	551.3	135.8	21.6	19.7
0.075	327.8	381.1	53.3	8.5	11.2
Pan	378.0	447.8	69.8	11.1	
		Total	627.3		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	45	40	23	9.7	9.70	0.082	9.0
0.5	42	37	23	10.2	10.20	0.059	8.3
1	39	34	23	10.7	10.70	0.043	7.6
2	35	30	23	11.4	11.40	0.031	6.7
4	33	28	23	11.7	11.70	0.023	6.3
8	31	26	23	12.0	12.00	0.016	5.8
15	29	24	23	12.4	12.40	0.012	5.4
30	28	23	22	12.5	12.50	0.009	5.2
60	26	21	22	12.9	12.90	0.006	4.7
120	24	19	21	13.2	13.20	0.004	4.3
240	23	18	21	13.3	13.30	0.003	4.0
480	21	16	21	13.7	13.70	0.002	3.6
1440	20	15	21	13.8	13.80	0.001	3.4

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 5

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 11.2

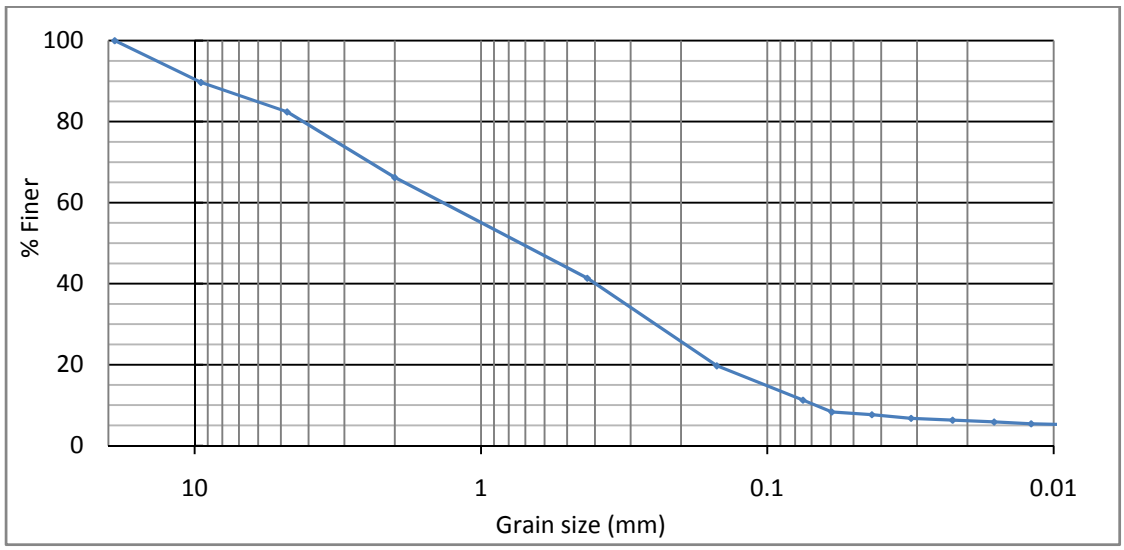

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 82.4 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal 17.6 %. The amount of material passing sieve no. 4 and sieve no. 200 is 82.4 % and 11.2 %, so the percent of sand is 11.2 %.

D_{60} = 1.40 D_{30} = 0.26 D_{10} = 0.074

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 18.9$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.7$

$CBR = 28.09(D_{60})^{0.358} = 32$

The group symbol for the soil is SP-SC and the group name is poorly graded sand with clay and gravel. The CBR value of 32 is fair to good for subgrade.

Depth: 30 - 43 inches

Bag No: 80 B

Sample Weight (g): 538.2

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	499.9	16.0	3.0	97.0
4.75	532.2	539.4	7.2	1.3	95.7
2.00	464.5	511.9	47.4	8.8	86.9
0.425	370.2	471.2	101.0	18.8	68.1
0.150	415.5	613.6	198.1	36.8	31.3
0.075	327.8	429.1	101.3	18.8	12.5
Pan	378.0	444.4	66.4	12.3	
		Total	537.4		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	48	45	23	8.9	8.90	0.079	11.2
0.5	45	42	23	9.4	9.40	0.057	10.5
1	42	39	23	9.9	9.90	0.041	9.7
2	38	35	23	10.6	10.60	0.030	8.7
4	34	31	23	11.2	11.20	0.022	7.7
8	32	29	23	11.5	11.50	0.016	7.2
15	30	27	23	11.9	11.90	0.012	6.7
30	28	25	22	12.2	12.20	0.008	6.2
60	26	23	22	12.5	12.50	0.006	5.7
120	25	22	21	12.7	12.70	0.004	5.5
240	24	21	21	12.9	12.90	0.003	5.2
480	23	20	21	13.0	13.00	0.002	5.0
1440	21	18	21	13.3	13.30	0.001	4.5

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 3

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 12.5

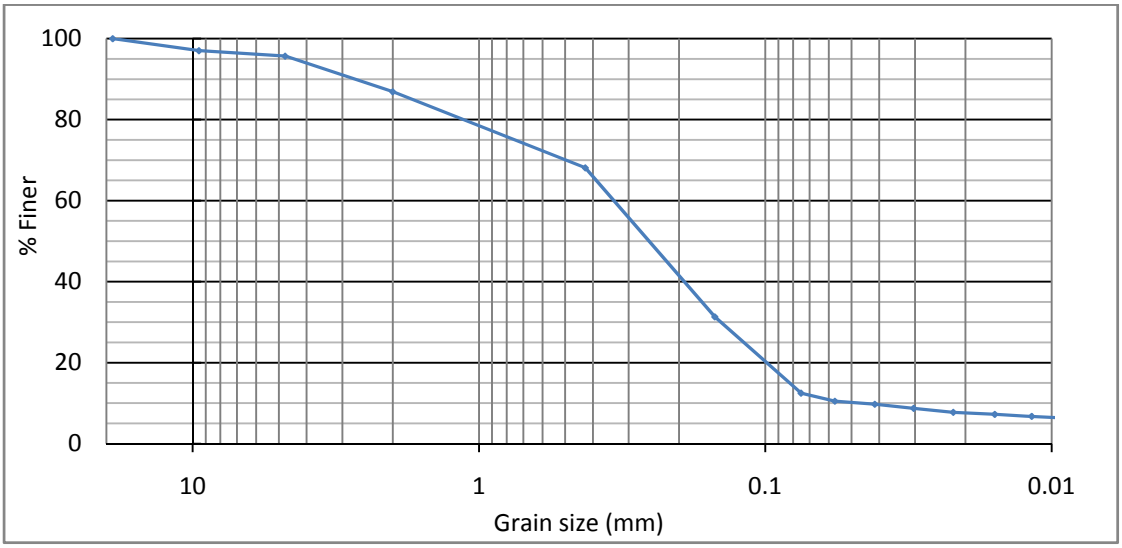

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 95.7 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal 4.3 %. The amount of material passing sieve no. 4 and sieve no. 200 is 95.7 % and 12.5 %, so the percent of sand is 83.2 %.

$D_{60} = 0.24$ $D_{30} = 0.15$ $D_{10} = 0.05$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 4.8$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.9$

$CBR = 28.09(D_{60})^{0.358} = 17$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 17 is fair for subgrade.

Depth: 43 – 68 inches

Bag No: t 37

Sample Weight (g): 707.5

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	483.9	0.0	0.0	100.0
4.75	532.2	534.6	2.4	0.3	99.7
2.00	464.5	521.7	57.2	8.1	91.6
0.425	370.2	567.2	197.0	27.8	63.7
0.150	415.5	630.7	215.2	30.4	33.3
0.075	327.8	446.5	118.7	16.8	16.5
Pan	378.0	489.3	111.3	15.7	
		Total	701.8		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	48	45	23	8.9	8.90	0.079	14.9
0.5	46	43	23	9.2	9.20	0.056	14.2
1	43	40	23	9.7	9.70	0.041	13.2
2	40	37	23	10.2	10.20	0.030	12.2
4	38	35	23	10.6	10.60	0.021	11.6
8	36	33	23	10.9	10.90	0.015	10.9
15	34	31	23	11.2	11.20	0.011	10.3
30	34	31	22	11.2	11.20	0.008	10.3
60	33	30	22	11.4	11.40	0.006	9.9
120	32	29	21	11.5	11.50	0.004	9.6
240	30	27	21	11.9	11.90	0.003	8.9
480	28	25	21	12.2	12.20	0.002	8.3
1440	27	24	21	12.4	12.40	0.001	7.9

Specific gravity: 2.65 | G_s correction factor (α): 1.0

Sample weight (g): 50 | Suspension constant (k): 0.01317

Zero correction (mm): 3 | % passing no. 200 sieve: 16.5

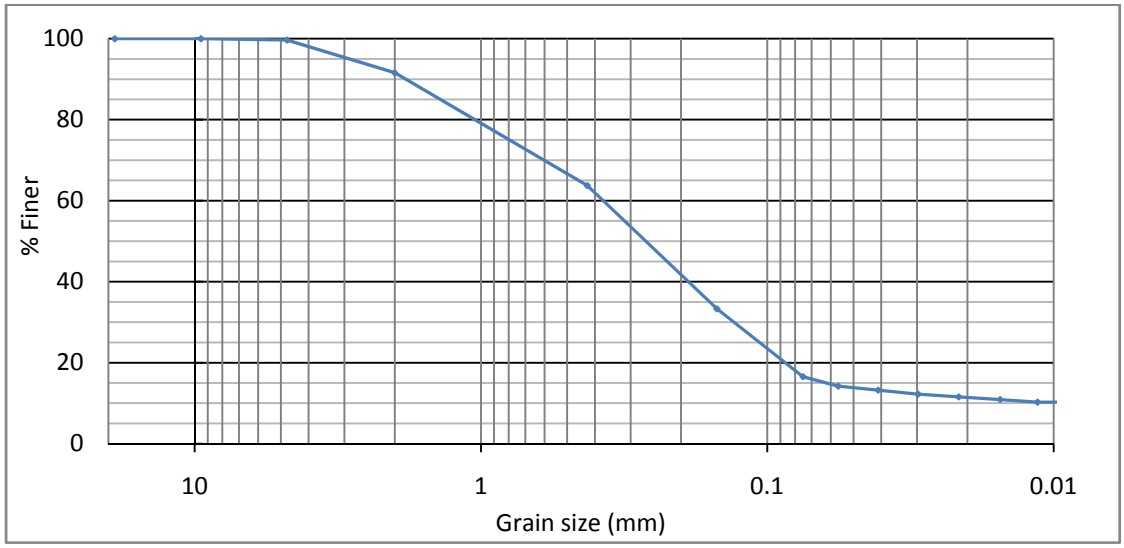

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 99.7 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 0.3 %. The amount of material passing sieve no. 4 and sieve no. 200 is 99.7 % and 16.5 %, so the percent of sand is 83.1 %.

D_{60} = 0.38 D_{30} = 0.13 D_{10} = 0.007

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 54.3$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 6.4$

$CBR = 28.09(D_{60})^{0.358} = 20$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 20 is fair for subgrade.

Table 3: Liquid Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Number of blows, N
M7	21.6	29.4	27.3	36.8	17
M8	21.5	30.8	28.5	32.9	31
M9	21.7	30.0	28.1	29.7	35

Table 4: Plastic Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Average, %
M20	21.2	32.1	30.8	13.5	14
M21	21.3	29.7	28.7	13.5	

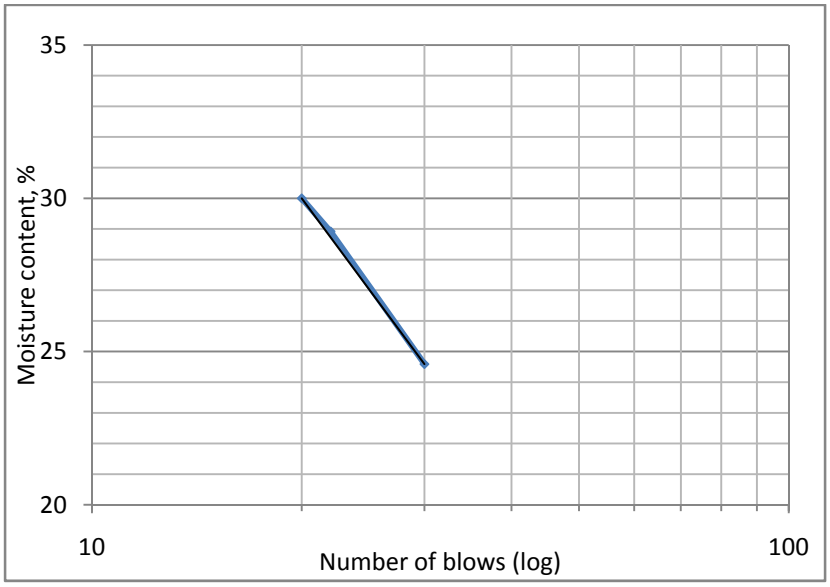

Figure 2: Liquid Limit

Liquid limit (LL): 28

Plastic limit (PL): 14

Plasticity index (PI): 14

ω - % passing no. 200 sieve

$$CBR = \frac{75}{1 + 0.728\,\omega\,PI} = 28$$

Raton Municipal Airport

Borehole 12

Location: Runway 02-20, 4000 ft. north of runway 02 threshold

Depth: 7 – 15 inches

Bag No: WT GA

Sample Weight (g):2228.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	972	475.1	21.3	78.7
9.5	483.6	995.3	511.7	23.0	55.7
4.75	532.1	993.7	461.6	20.7	35.0
2.00	464.5	836.5	372.0	16.7	18.3
0.425	369.5	638.5	269.0	12.1	6.2
0.150	414.9	493.3	78.4	3.5	2.7
0.075	327.5	348.1	20.6	0.9	1.8
Pan	377.9	416.1	38.2	1.7	
		Total	2226.6		

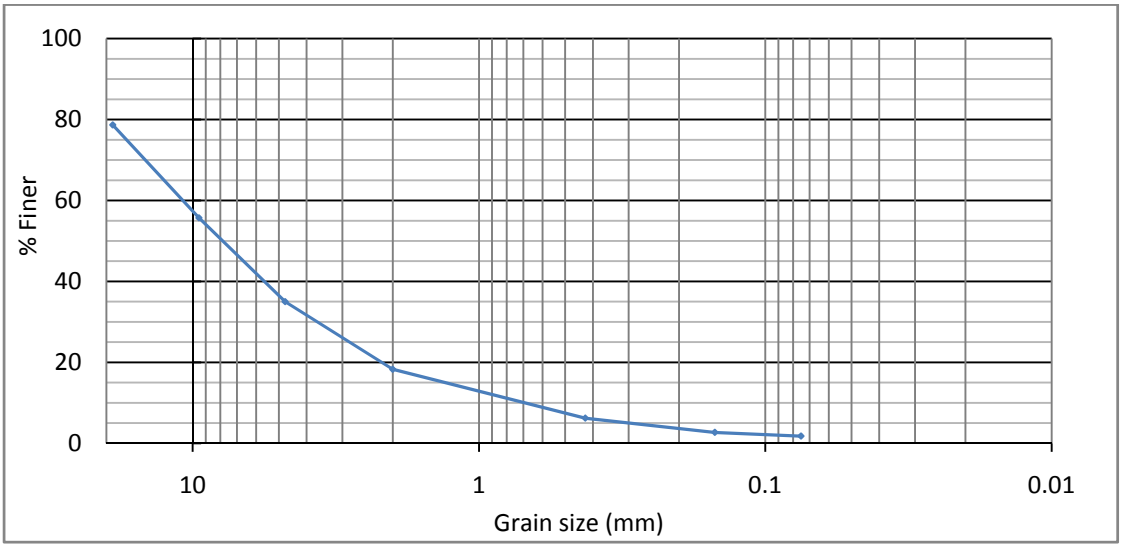

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 35.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 65.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 35.0 % and 1.8 %, so the percent of sand is 33.2 %.

$D_{60} = 11.0$ $D_{30} = 3.8$ $D_{10} = 0.7$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 15.7$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.9$

$CBR = 28.09(D_{60})^{0.358} = 66$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 66 is good for base course.

Depth: 15– 32 inches

Bag No: WT 1U

Sample Weight (g):857.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	751.1	254.2	29.7	70.3
9.5	483.6	769.8	286.2	33.4	36.9
4.75	532.1	668.8	136.7	16.0	21.0
2.00	464.5	528.9	64.4	7.5	13.5
0.425	369.5	423.7	54.2	6.3	7.2
0.150	414.9	439.6	24.7	2.9	4.3
0.075	327.5	342.2	14.7	1.7	2.6
Pan	377.9	399.0	21.1	2.5	
		Total	856.2		

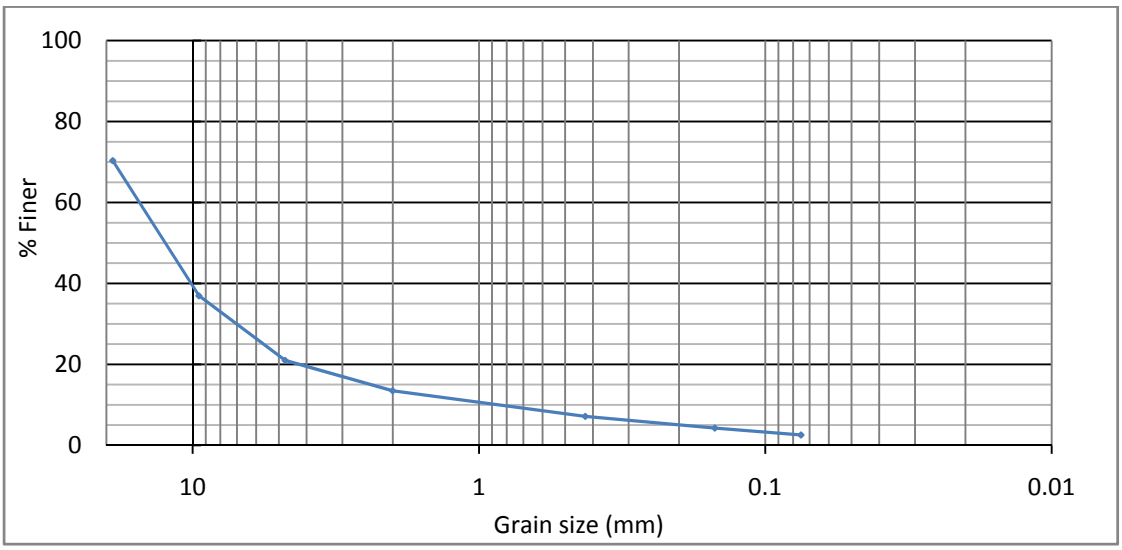

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 21.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 79.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 21.0 % and 2.6 %, so the percent of sand is 18.4 %.

$D_{60} = 17.0$ $D_{30} = 6.0$ $D_{10} = 0.19$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 91.9$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 11.4$

$CBR = 28.09(D_{60})^{0.358} = 77$

The group symbol for the soil is GP and the group name is poorly graded gravel with sand. The CBR value of 77 is excellent for subgrade.

Depth: 32 – 62 inches

Bag No: WT 1K

Sample Weight (g): 636.9

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	586.1	89.2	14.0	86.0
9.5	483.9	601.5	117.6	18.5	67.5
4.75	532.2	599.2	67.0	10.5	57.0
2.00	464.5	553.5	89.0	14.0	43.0
0.425	370.2	552.4	182.2	28.6	14.4
0.150	415.5	441.2	25.7	4.0	10.4
0.075	327.8	335.3	7.5	1.2	9.2
Pan	378.0	435.5	57.5	9.0	
		Total	635.7		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	46	43	23	9.2	9.20	0.080	7.9
0.5	44	41	23	9.6	9.60	0.058	7.6
1	39	36	23	10.4	10.40	0.042	6.6
2	35	32	23	11.1	11.10	0.031	5.9
4	31	28	23	11.7	11.70	0.023	5.2
8	28	25	23	12.2	12.20	0.016	4.6
15	26	23	23	12.5	12.50	0.012	4.2
30	25	22	22	12.7	12.70	0.009	4.1
60	23	20	22	13.0	13.00	0.006	3.7
120	21	18	21	13.3	13.30	0.004	3.3
240	21	18	21	13.3	13.30	0.003	3.3
480	19	16	21	13.7	13.70	0.002	2.9
1440	18	15	21	13.8	13.80	0.001	2.8

Specific gravity: 2.65 | G_s correction factor (α): 1.0

Sample weight (g): 50 | Suspension constant (k): 0.01317

Zero correction (mm): 3 | % passing no. 200 sieve: 9.2

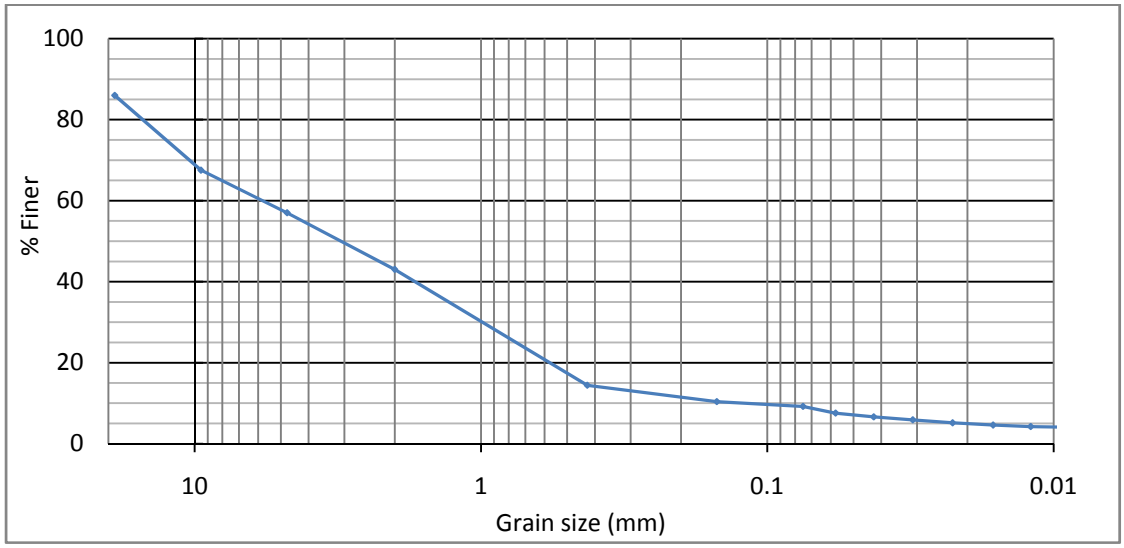

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 57.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 43.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 57.0 % and 9.2 %, so the percent of sand is 47.8 %.

$D_{60} = 6.0$ $D_{30} = 1.0$ $D_{10} = 0.1$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 60.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.7$

$CBR = 28.09(D_{60})^{0.358} = 53$

The group symbol for the soil is SW-SM and the group name is well graded sand with silt and gravel. The CBR value of 53 is good for subgrade.

Table 3: Liquid Limit Data

Can No.	Weight of can, $W_{1\ (g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Number of blows, N
M7	21.6	29.4	27.3	36.8	17
M8	21.5	30.8	28.5	32.9	31
M9	21.7	30.0	28.1	29.7	35

Table 4: Plastic Limit Data

Can No.	Weight of can, $W_{1\ (g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Average, %
M20	21.2	32.1	30.8	13.5	14
M21	21.3	29.7	28.7	13.5	

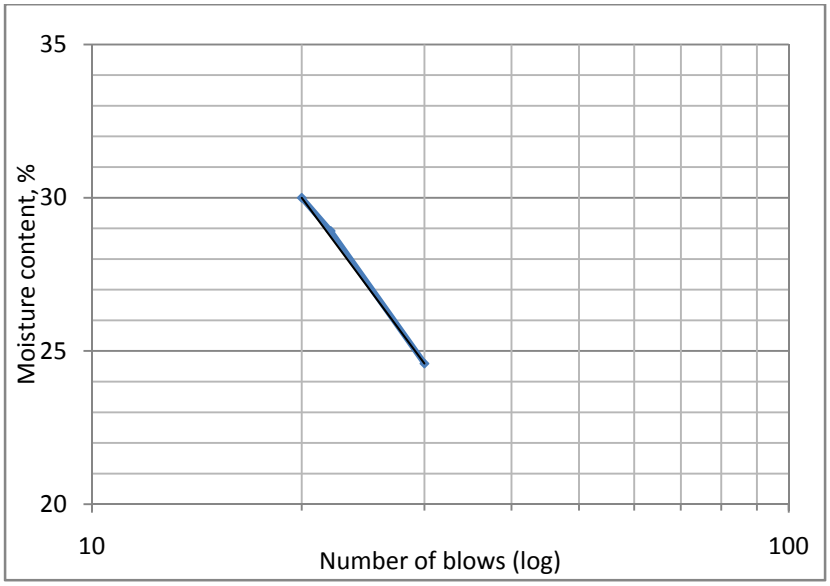

Figure 2: Liquid Limit

Liquid limit (LL): 28

Plastic limit (PL): 14

Plasticity index (PI): 14

ω - % passing no. 200 sieve

$$CBR = \frac{75}{1 + 0.728\,\omega\,PI} = 28$$

Raton Municipal Airport

Borehole 13

Location: Runway 02-20, 5000 ft. north of runway 02 threshold

Depth: 6 – 15 inches

Bag No: G 53

Sample Weight (g):1556.5

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	840.9	344.0	22.1	77.9
9.5	483.6	768	284.4	18.3	59.6
4.75	532.1	802.2	270.1	17.4	42.3
2.00	464.5	695.3	230.8	14.8	27.4
0.425	369.5	653.6	284.1	18.3	9.2
0.150	414.9	515.4	100.5	6.5	2.7
0.075	327.5	350.9	23.4	1.5	1.2
Pan	377.9	394.9	17.0	1.1	
		Total	1554.3		

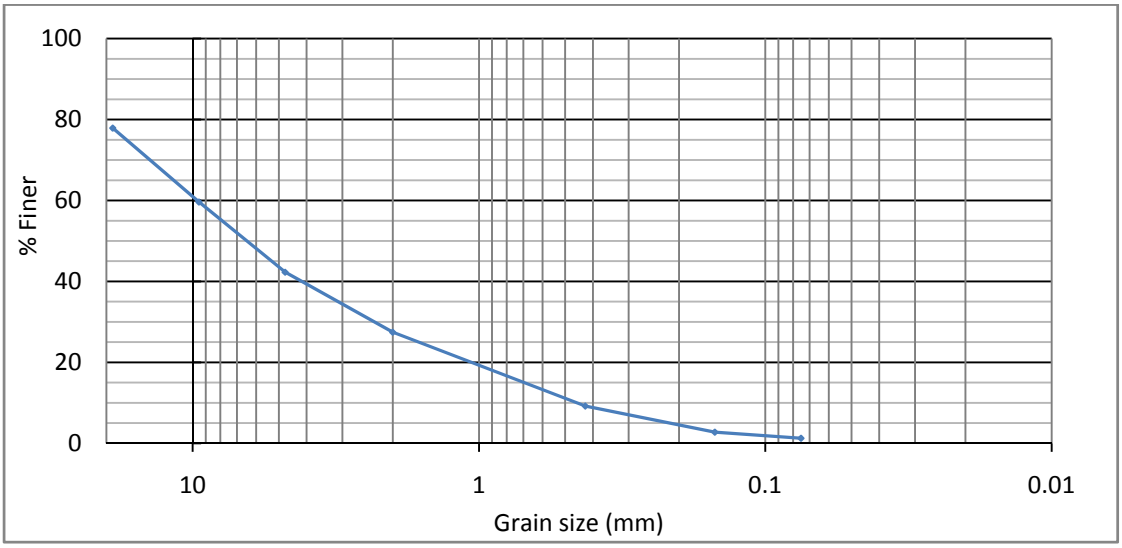

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 42.3 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 57.7 %. The amount of material passing sieve no. 4 and sieve no. 200 is 42.3 % and 1.2 %, so the percent of sand is 41.1 %.

$D_{60} = 9.5$ $D_{30} = 2.3$ $D_{10} = 0.46$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 20.7$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.2$

$CBR = 28.09(D_{60})^{0.358} = 63$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 63 is good for base course.

Depth: 15– 36 inches

Bag No: WT 2A

Sample Weight (g):638.3

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	541.1	44.2	6.9	93.1
9.5	483.6	815.9	332.3	52.1	41.0
4.75	532.2	657.8	125.6	19.7	21.3
2.00	464.5	514.6	50.1	7.8	13.5
0.425	369.5	406.2	36.7	5.7	7.7
0.150	415.0	433.5	18.5	2.9	4.8
0.075	327.6	339.7	12.1	1.9	2.9
Pan	378.0	395.7	17.7	2.8	
		Total	637.2		

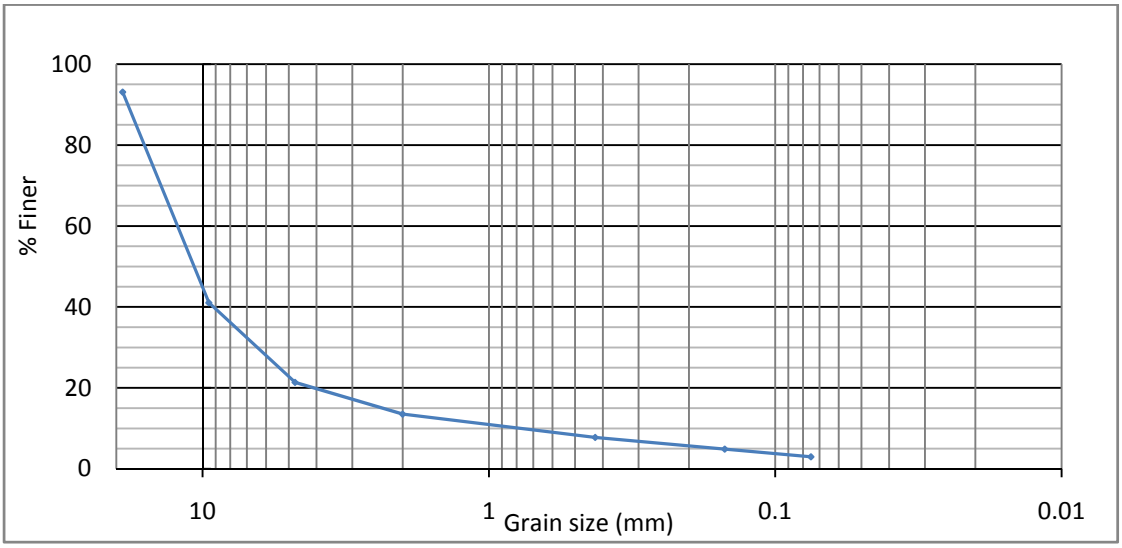

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 21.3 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 78.7 %. The amount of material passing sieve no. 4 and sieve no. 200 is 21.3 % and 2.9 %, so the percent of sand is 18.4 %.

$D_{60} = 11.5$ $D_{30} = 6.5$ $D_{10} = 0.8$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 14.4$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 4.6$

$CBR = 28.09(D_{60})^{0.358} = 50$

The group symbol for the soil is GP and the group name is poorly graded gravel with sand. The CBR value of 50 is good for subgrade.

Table 2: Liquid Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Number of blows, N
M17	21.6	31.6	28.6	42.9	35
M18	21.4	29.7	27.2	43.1	22
M19	21.4	31.6	28.5	43.7	17

Table 3: Plastic Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Average, %
M20	21.6	30.2	28.8	19.4	20
M21	21.6	28.1	27.0	20.4	

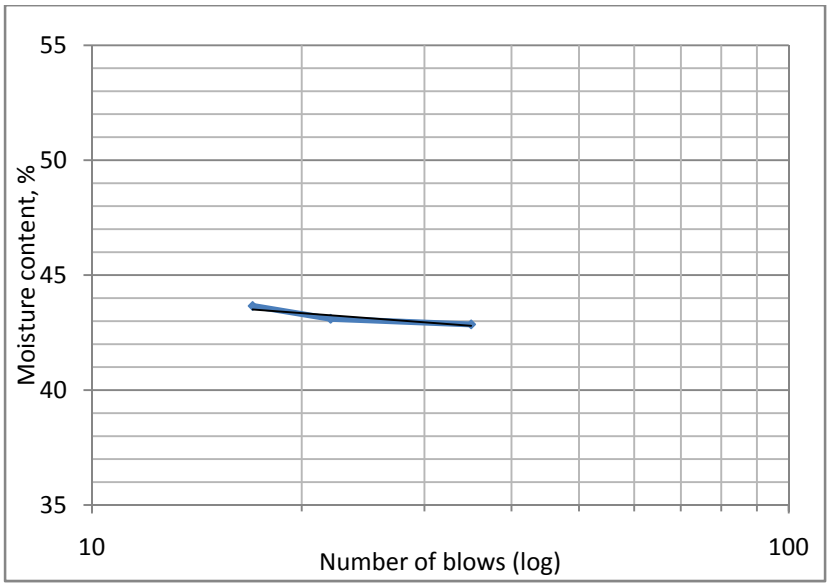

Figure 2: Liquid Limit

Liquid limit (LL): 43

Plastic limit (PL): 20

Plasticity index (PI): 23

ω - % passing no. 200 sieve

$$CBR = \frac{75}{1 + 0.728\,\omega\,PI} = 50$$

Depth: 36– 56 inches

Bag No: U 21

Sample Weight (g):601.3

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	527.1	30.2	5.0	95.0
9.5	483.6	625.5	141.9	23.6	71.4
4.75	532.2	652.6	120.4	20.0	51.4
2.00	464.5	581.8	117.3	19.5	31.8
0.425	369.5	463.1	93.6	15.6	16.3
0.150	415.0	442.0	27.0	4.5	11.8
0.075	327.6	347.7	20.1	3.3	8.4
Pan	378.0	428.6	50.6	8.4	
		Total	601.1		

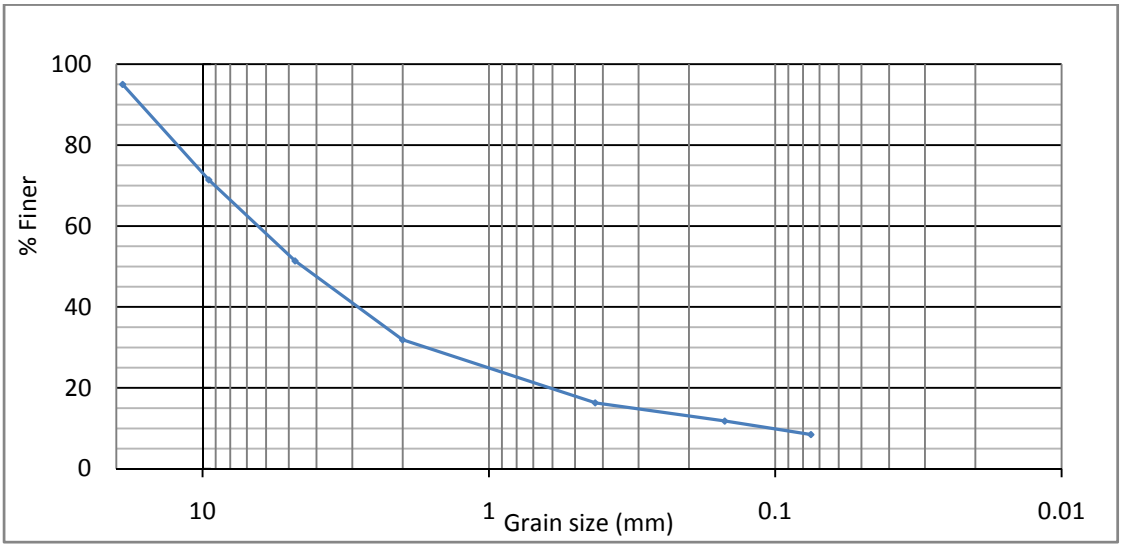

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 51.4 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 48.6 %. The amount of material passing sieve no. 4 and sieve no. 200 is 51.4 % and 8.4 %, so the percent of sand is 42.9 %.

$D_{60} = 6.5$ $D_{30} = 1.9$ $D_{10} = 0.1$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 54.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 4.4$

$CBR = 28.09(D_{60})^{0.358} = 33$

The group symbol for the soil is GP-GC and the group name is poorly graded gravel with clay and sand. The CBR value of 33 is good for subgrade.

Table 2: Liquid Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Number of blows, N
2	21.5	30.2	27.6	42.6	18
3	21.3	31.9	28.9	39.5	24
4	21.6	32.6	29.7	35.8	29

Table 3: Plastic Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Average, %
5	21.3	31.2	29.7	17.9	18
6	21.3	32.6	30.8	18.9	

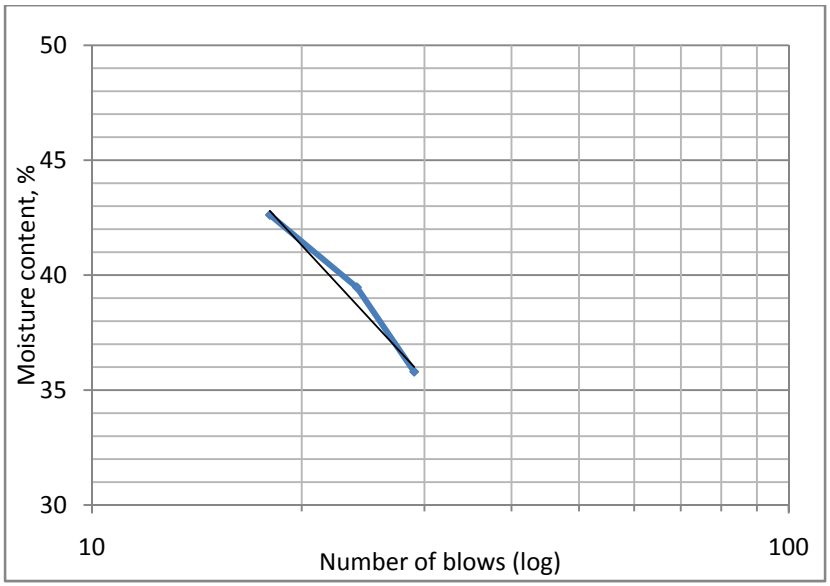

Figure 2: Liquid Limit

Liquid limit (LL): 39

Plastic limit (PL): 18

Plasticity index (PI): 21

ω - % passing no. 200 sieve

$$CBR = \frac{75}{1 + 0.728\,\omega\,PI} = 33$$

Depth: 56– 67 inches

Bag No: T 58

Sample Weight (g):522.4

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	528	31.1	6.0	94.0
9.5	483.6	690.5	206.9	39.6	54.4
4.75	532.1	642.4	110.3	21.1	33.3
2.00	464.5	533.8	69.3	13.3	20.1
0.425	369.5	414.0	44.5	8.5	11.5
0.150	414.9	430.3	15.4	2.9	8.6
0.075	327.5	337.4	9.9	1.9	6.7
Pan	377.9	412.0	34.1	6.5	
		Total	521.5		

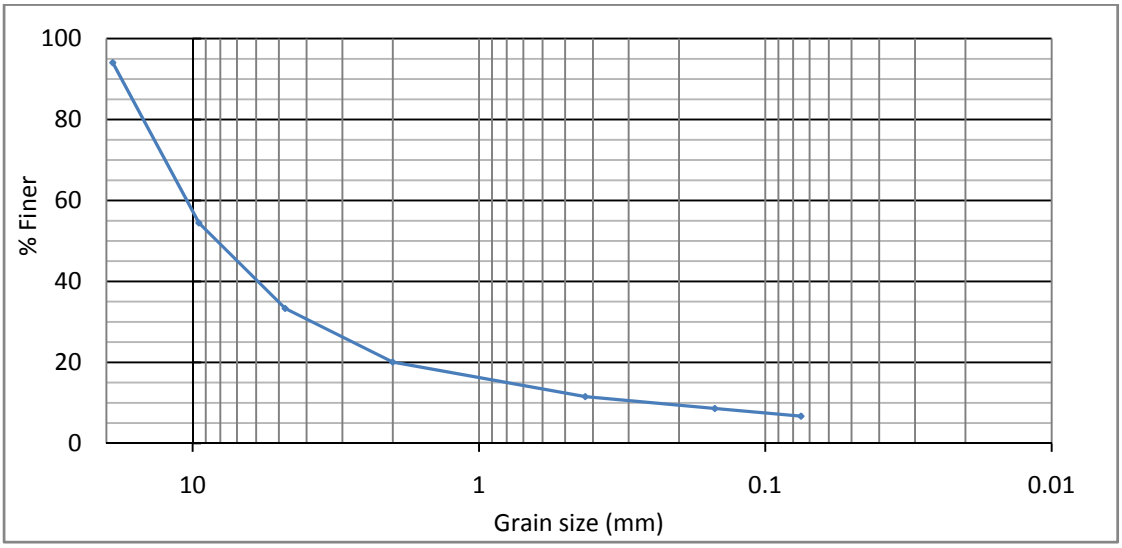

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 33.3 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 66.7 %. The amount of material passing sieve no. 4 and sieve no. 200 is 33.3 % and 6.7 %, so the percent of sand is 26.6 %.

$D_{60} = 11.0$ $D_{30} = 3.9$ $D_{10} = 0.24$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 45.8$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 5.8$

$CBR = 28.09(D_{60})^{0.358} = 66$

The group symbol for the soil is GP-GC and the group name is poorly graded gravel with clay and sand. The CBR value of 66 is good for subgrade.

Raton Municipal Airport

Borehole 14

Location: Runway 02-20, 6000 ft. north of runway 02 threshold

Depth: 7 – 12 inches

Bag No: 100 A

Sample Weight (g):2183.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	961.7	464.8	21.3	78.7
9.5	483.6	1020.6	537.0	24.6	54.1
4.75	532.1	911.9	379.8	17.4	36.7
2.00	464.5	748.1	283.6	13.0	23.7
0.425	369.5	682.1	312.6	14.3	9.4
0.150	414.9	533.1	118.2	5.4	4.0
0.075	327.5	365.5	38.0	1.7	2.2
Pan	377.9	423.2	45.3	2.1	
		Total	2179.3		

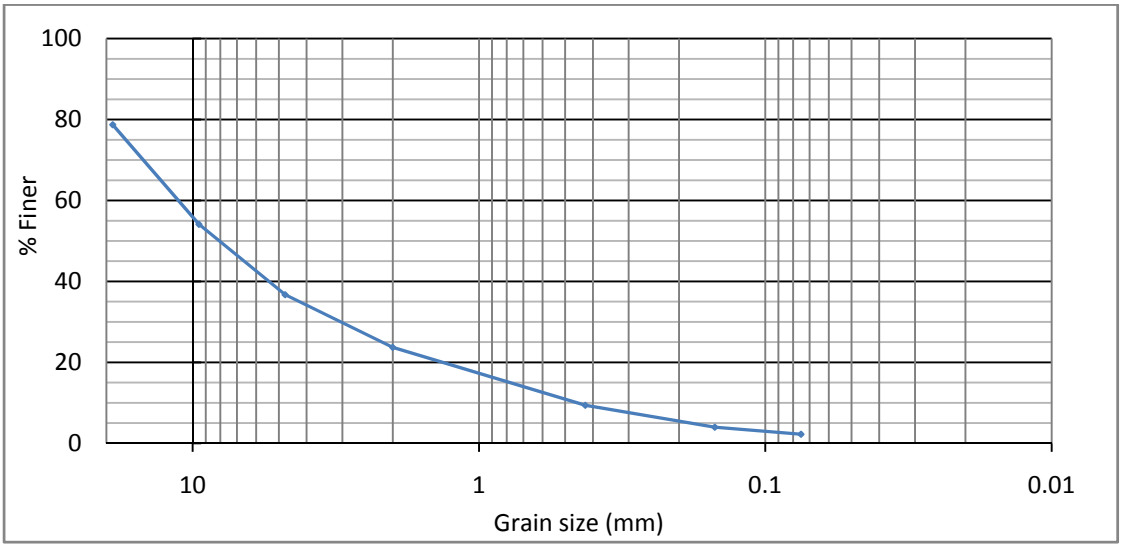

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 36.7 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 63.3 %. The amount of material passing sieve no. 4 and sieve no. 200 is 36.7 % and 2.2 %, so the percent of sand is 34.5 %.

$D_{60} = 11.0$ $D_{30} = 3.0$ $D_{10} = 0.42$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 26.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.9$

$CBR = 28.09(D_{60})^{0.358} = 66$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 66 is good for base course.

Depth: 12 – 18 inches

Bag No: WT FE

Sample Weight (g):652.7

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	627.4	130.5	20.0	80.0
9.5	483.6	637.9	154.3	23.6	56.4
4.75	532.1	663.3	131.2	20.1	36.3
2.00	464.5	557.8	93.3	14.3	22.0
0.425	369.5	443.4	73.9	11.3	10.6
0.150	414.9	446.1	31.2	4.8	5.9
0.075	327.5	344.2	16.7	2.6	3.3
Pan	377.9	398.7	20.8	3.2	
		Total	651.9		

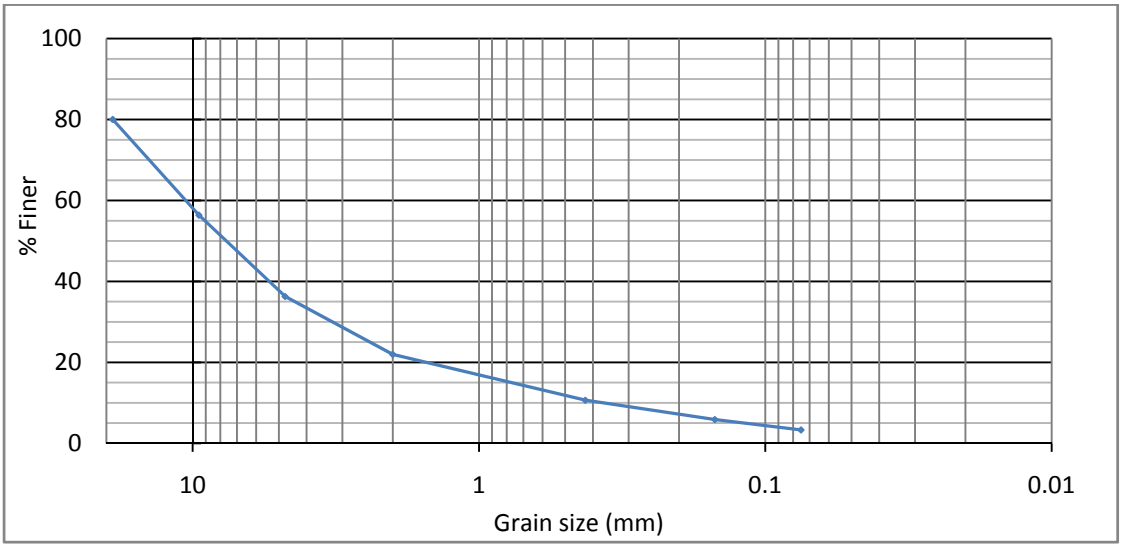

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 36.3 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 63.7 %. The amount of material passing sieve no. 4 and sieve no. 200 is 36.3 % and 3.3 %, so the percent of sand is 33.0 %.

D_{60} = 10.6 D_{30} = 3.2 D_{10} = 0.39

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 27.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 2.5$

$CBR = 28.09(D_{60})^{0.358} = 65$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 63 is excellent for subgrade.

Depth: 18 – 33 inches

Bag No: U 93

Sample Weight (g):652.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	675.6	178.7	27.4	72.6
9.5	483.6	710.6	227.0	34.8	37.8
4.75	532.2	644.8	112.6	17.3	20.5
2.00	464.5	517.8	53.3	8.2	12.3
0.425	369.5	402.4	32.9	5.0	7.3
0.150	415.0	429.1	14.1	2.2	5.1
0.075	327.6	334.0	6.4	1.0	4.1
Pan	378.0	404.1	26.1	4.0	
		Total	651.1		

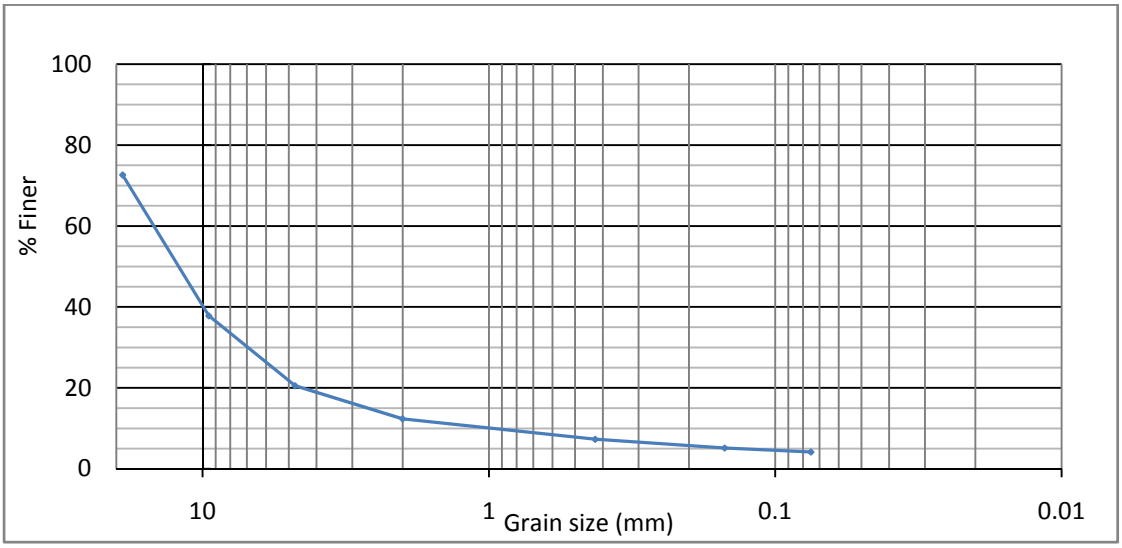

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 20.5 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 79.5 %. The amount of material passing sieve no. 4 and sieve no. 200 is 20.5 % and 4.1 %, so the percent of sand is 16.4 %.

$D_{60} = 16.0$ $D_{30} = 7.0$ $D_{10} = 1.0$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 16.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 3.1$

$CBR = 28.09(D_{60})^{0.358} = 52$

The group symbol for the soil is GP and the group name is poorly graded gravel with sand. The CBR value of 52 is good for subgrade.

Table 2: Liquid Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Number of blows, N
M5	21.1	34.2	30.7	36.5	16
M16	21.7	31.9	29.3	34.2	21
M17	21.6	31.5	29.1	32.0	30

Table 3: Plastic Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Average, %
M18	21.5	31.6	30.0	18.8	19
M19	21.4	30.5	29.1	18.2	

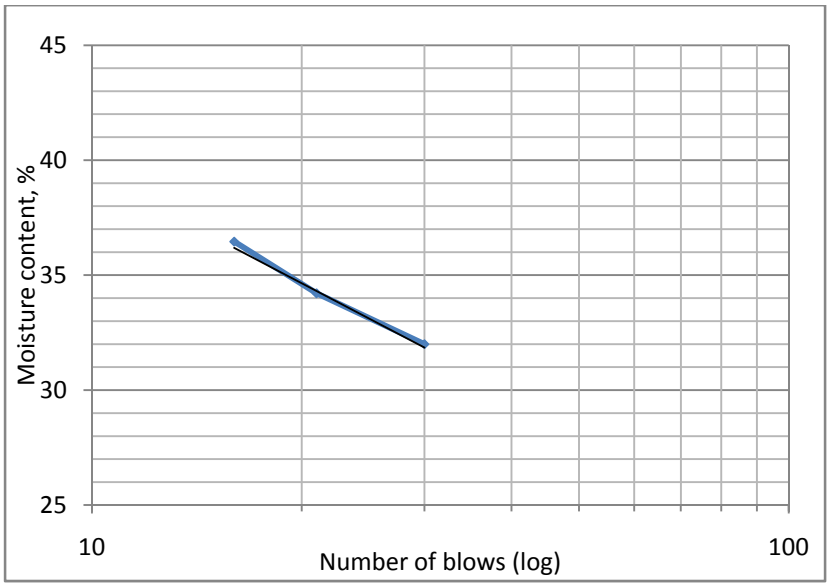

Figure 2: Liquid Limit

Liquid limit (LL): 33

Plastic limit (PL): 19

Plasticity index (PI): 14

ω - % passing no. 200 sieve

$$CBR = \frac{75}{1 + 0.728\,\omega\,PI} = 52$$

Depth: 33 – 48 inches

Bag No: U 57

Sample Weight (g):608.8

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	610.7	113.8	18.7	81.3
9.5	483.6	689.4	205.8	33.8	47.5
4.75	532.1	674.2	142.1	23.3	24.2
2.00	464.5	520.7	56.2	9.2	14.9
0.425	369.5	401.3	31.8	5.2	9.7
0.150	414.9	436.7	21.8	3.6	6.1
0.075	327.5	340.4	12.9	2.1	4.0
Pan	377.9	401.6	23.7	3.9	
		Total	608.1		

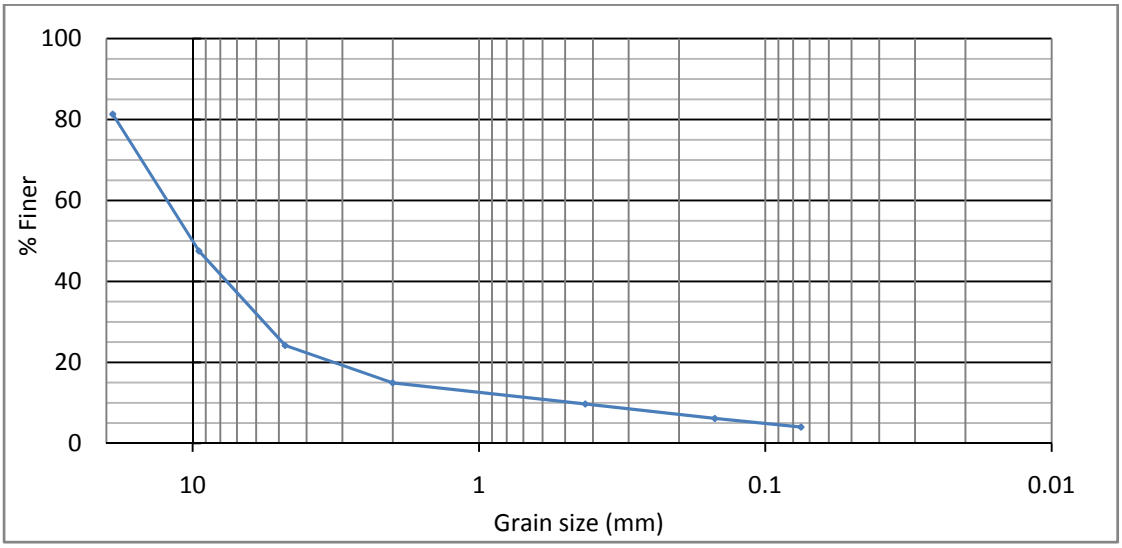

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 24.2 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 75.8 %. The amount of material passing sieve no. 4 and sieve no. 200 is 24.2 % and 4.0 %, so the percent of sand is 20.2 %.

$D_{60} = 12.0$ $D_{30} = 5.5$ $D_{10} = 0.44$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 27.3$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 5.7$

$CBR = 28.09(D_{60})^{0.358} = 68$

The group symbol for the soil is GP and the group name is poorly graded gravel with sand. The CBR value of 68 is excellent for subgrade.

Depth: 48 – 55 inches

Bag No: R 72

Sample Weight (g):654.9

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	650.2	153.3	23.4	76.6
9.5	483.6	631.2	147.6	22.5	54.1
4.75	532.2	617.1	84.9	13.0	41.1
2.00	464.5	545.5	81.0	12.4	28.7
0.425	369.5	441.2	71.7	10.9	17.8
0.150	415.0	466.8	51.8	7.9	9.9
0.075	327.6	351.5	23.9	3.6	6.2
Pan	378.0	417.5	39.5	6.0	
		Total	653.7		
19	496.9	650.2	153.3	23.4	76.6

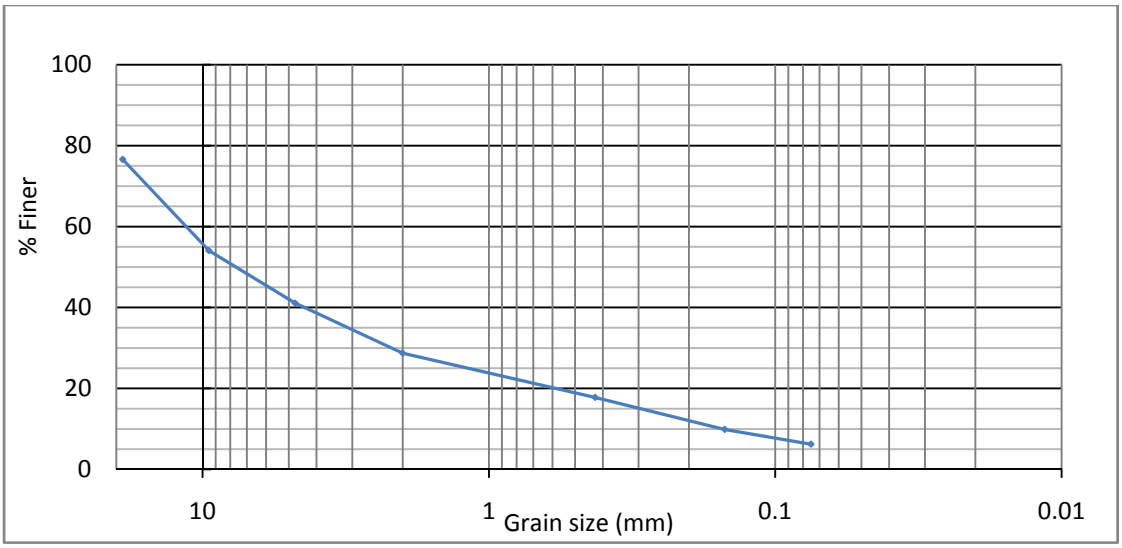

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 41.1 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 58.9 %. The amount of material passing sieve no. 4 and sieve no. 200 is 41.1 % and 6.2 %, so the percent of sand is 34.9 %.

$D_{60} = 12.0$ $D_{30} = 2.2$ $D_{10} = 0.2$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 66.7$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 2.2$

$CBR = 28.09(D_{60})^{0.358} = 41$

The group symbol for the soil is GW-GC and the group name is well graded gravel with clay and sand. The CBR value of 41 is good for subgrade.

Table 2: Liquid Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Number of blows, N
M1	21.3	31.1	28.6	34.2	35
M2	21.6	32.4	29.6	35.0	29
M3	21.8	31.5	28.8	38.6	17

Table 3: Plastic Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Average, %
M4	21.4	33.6	31.8	17.3	18
M5	21.6	30.0	28.7	18.3	

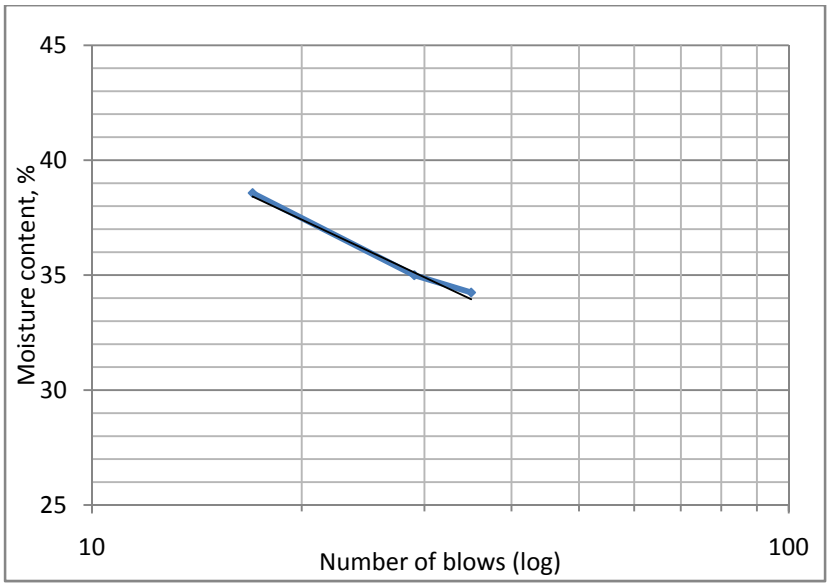

Figure 2: Liquid Limit

Liquid limit (LL): 36

Plastic limit (PL): 18

Plasticity index (PI): 18

ω - % passing no. 200 sieve

$$CBR = \frac{75}{1 + 0.728\,\omega\,PI} = 41$$

Raton Municipal Airport

Borehole 15

Location: Taxiway A, 500 ft. south of north pavement edge of Taxiway A

Depth: 6 – 14 inches

Bag No: D 14

Sample Weight (g):1328.2

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	729	232.1	17.5	82.5
9.5	483.6	868.6	385.0	29.0	53.5
4.75	532.1	759.5	227.4	17.1	36.4
2.00	464.5	625.3	160.8	12.1	24.3
0.425	369.5	526.4	156.9	11.8	12.5
0.150	414.9	505.9	91.0	6.9	5.6
0.075	327.5	360.8	33.3	2.5	3.1
Pan	377.9	418.0	40.1	3.0	
		Total	1326.6		

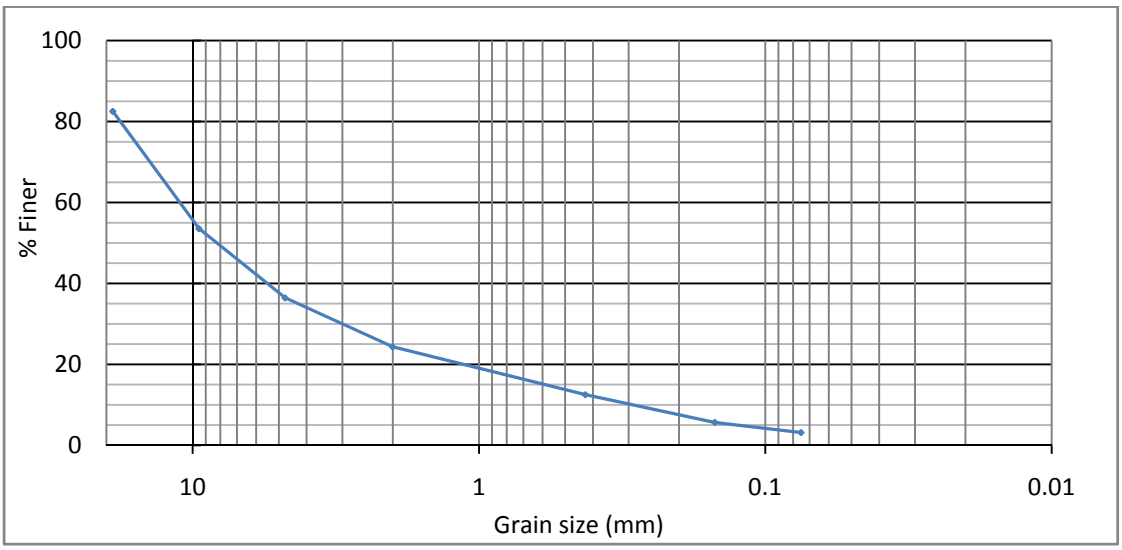

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 36.4 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 63.6 %. The amount of material passing sieve no. 4 and sieve no. 200 is 36.4 % and 3.1 %, so the percent of sand is 41.1 %.

$D_{60} = 11.0$ $D_{30} = 3.0$ $D_{10} = 0.3$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 36.7$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 2.7$

$CBR = 28.09(D_{60})^{0.358} = 66$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 66 is good for base course.

Depth: 14 – 21 inches

Bag No: V 27

Sample Weight (g): 533.5

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	488.2	4.3	0.8	99.2
4.75	532.2	545.4	13.2	2.5	96.7
2.00	464.5	519.5	55.0	10.3	86.4
0.425	370.2	551.0	180.8	33.9	52.5
0.150	415.5	515.5	100.0	18.7	33.8
0.075	327.8	382.2	54.4	10.2	23.6
Pan	378.0	502.8	124.8	23.4	
		Total	532.5		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	50	45	23	8.9	8.90	0.079	21.2
0.5	47	42	23	9.4	9.40	0.057	19.8
1	44	39	23	9.9	9.90	0.041	18.4
2	40	35	23	10.6	10.60	0.030	16.5
4	38	33	23	10.9	10.90	0.022	15.6
8	34	29	23	11.5	11.50	0.016	13.7
15	33	28	23	11.7	11.70	0.012	13.2
30	30	25	22	12.2	12.20	0.008	11.8
60	28	23	22	12.5	12.50	0.006	10.8
120	27	22	21	12.7	12.70	0.004	10.4
240	26	21	21	12.9	12.90	0.003	9.9
480	25	20	21	13.0	13.00	0.002	9.4
1440	23	18	21	13.3	13.30	0.001	8.5

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 5

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 23.6

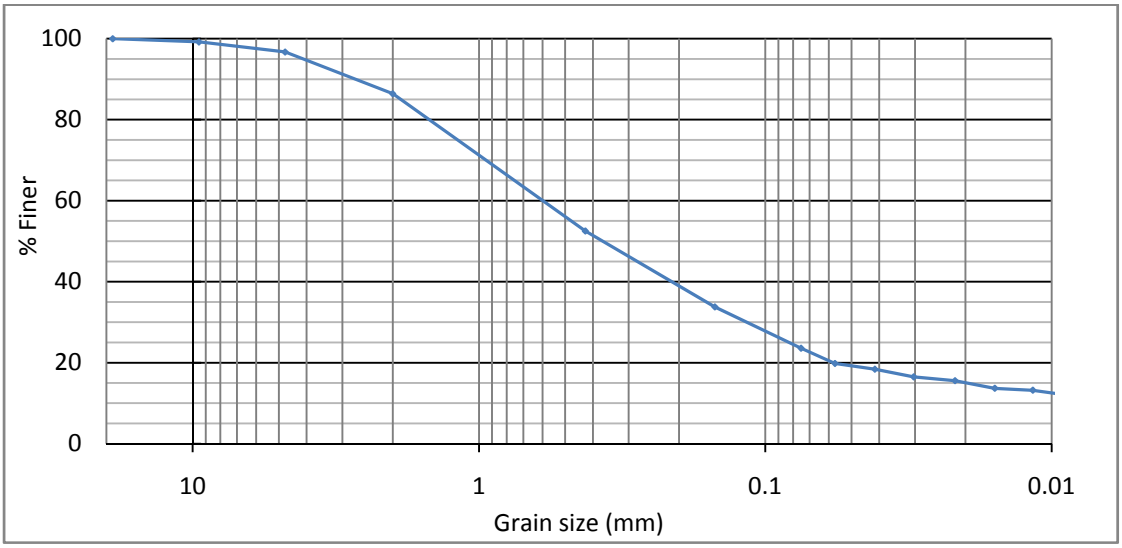

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 96.7 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 3.3 %. The amount of material passing sieve no. 4 and sieve no. 200 is 96.7 % and 23.6 %, so the percent of sand is 73.1 %.

D_{60} = 0.6 D_{30} = 0.12 D_{10} = 0 .0035

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 171$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 6.9$

$CBR = 28.09(D_{60})^{0.358} = 29$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 29 is fair for subgrade.

Table 3: Liquid Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Number of blows, N
M3	21.7	30.4	28.0	38.1	19
M1	21.3	33.7	30.3	37.8	23
M2	21.6	29.0	27.0	37.0	27

Table 4: Plastic Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Average, %
M4	21.4	30.0	28.5	21.1	20
M5	21.6	29.1	27.9	19.0	

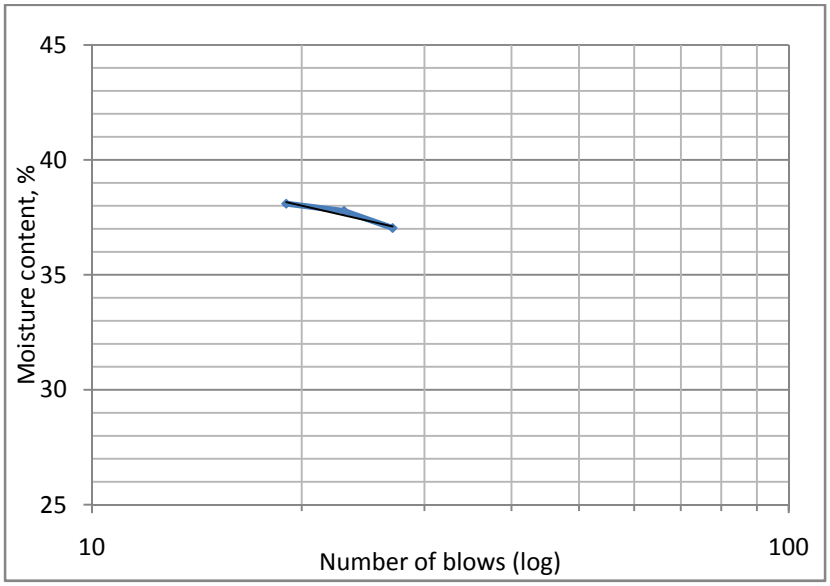

Figure 2: Liquid Limit

Liquid limit (LL): 37

Plastic limit (PL): 20

Plasticity index (PI): 17

ω - % passing no. 200 sieve

$$CBR = \frac{75}{1 + 0.728\,\omega\,PI} = 29$$

Depth: 21 – 28 inches

Bag No: V 2

Sample Weight (g): 582.5

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	552.4	68.5	11.8	88.2
4.75	532.2	556.2	24.0	4.1	84.1
2.00	464.5	544.2	79.7	13.7	70.4
0.425	370.2	520.2	150.0	25.8	44.7
0.150	415.5	508.9	93.4	16.0	28.7
0.075	327.8	398.1	70.3	12.1	16.6
Pan	378.0	473.5	95.5	16.4	
		Total	581.4		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	49	46	23	8.8	8.80	0.078	15.3
0.5	46	43	23	9.2	9.20	0.056	14.3
1	42	39	23	9.9	9.90	0.041	12.9
2	38	35	23	10.6	10.60	0.030	11.6
4	34	31	23	11.2	11.20	0.022	10.3
8	31	28	23	11.7	11.70	0.016	9.3
15	29	26	23	12.0	12.00	0.012	8.6
30	27	24	22	12.4	12.40	0.008	8.0
60	26	23	22	12.5	12.50	0.006	7.6
120	24	21	21	12.9	12.90	0.004	7.0
240	22	19	21	13.2	13.20	0.003	6.3
480	21	18	21	13.3	13.30	0.002	6.0
1440	18	15	21	13.8	13.80	0.001	5.0

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 3

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 16.6

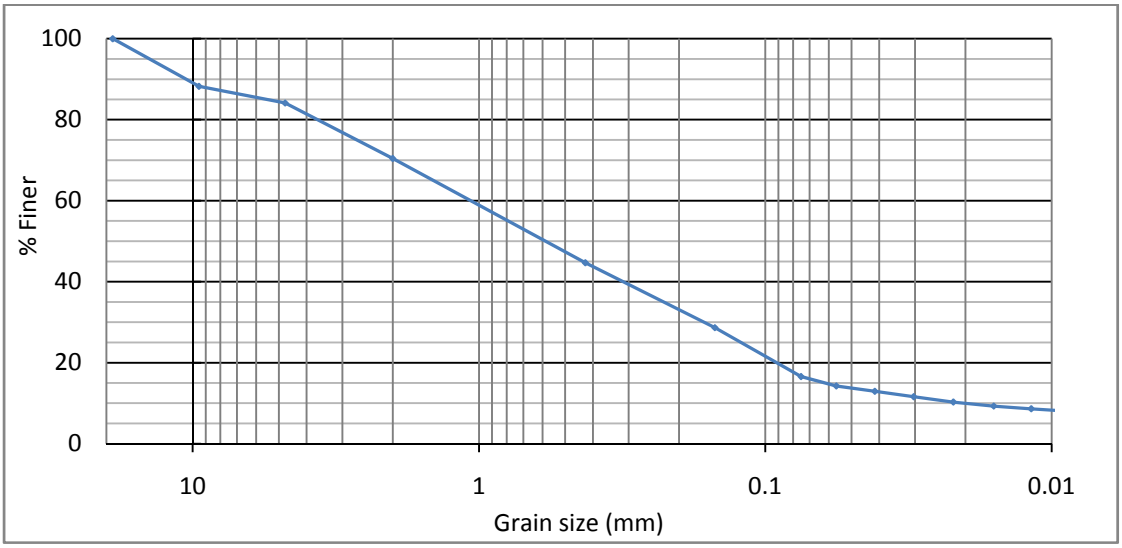

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 84.1 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 15.9 %. The amount of material passing sieve no. 4 and sieve no. 200 is 84.1 % and 16.6 %, so the percent of sand is 67.5 %.

D_{60} = 1.1 D_{30} = 0.18 D_{10} = 0.02

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 55$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.5$

$CBR = 28.09(D_{60})^{0.358} = 29$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 29 is fair for subgrade.

Depth: 28 – 46 inches

Bag No: A 91

Sample Weight (g): 440.5

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	483.9	0.0	0.0	100.0
4.75	532.2	532.6	0.4	0.1	99.9
2.00	464.5	493.6	29.1	6.6	93.3
0.425	370.2	532.3	162.1	36.8	56.5
0.150	415.5	494.8	79.3	18.0	38.5
0.075	327.8	378.5	50.7	11.5	27.0
Pan	378.0	496.1	118.1	26.8	
		Total	439.7		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	43	38	23	10.1	10.10	0.084	20.5
0.5	42	37	23	10.2	10.20	0.059	20.0
1	41	36	23	10.4	10.40	0.042	19.4
2	37	32	23	11.1	11.10	0.031	17.3
4	34	29	23	11.5	11.50	0.022	15.7
8	32	27	23	11.9	11.90	0.016	14.6
15	29	24	23	12.4	12.40	0.012	13.0
30	29	24	22	12.4	12.40	0.008	13.0
60	27	22	22	12.7	12.70	0.006	11.9
120	26	21	21	12.9	12.90	0.004	11.3
240	24	19	21	13.2	13.20	0.003	10.3
480	23	18	21	13.3	13.30	0.002	9.7
1440	22	17	21	13.5	13.50	0.001	9.2

Specific gravity: 2.65 | G_s correction factor (α): 1.0

Sample weight (g): 50 | Suspension constant (k): 0.01317

Zero correction (mm): 5 | % passing no. 200 sieve: 27.0

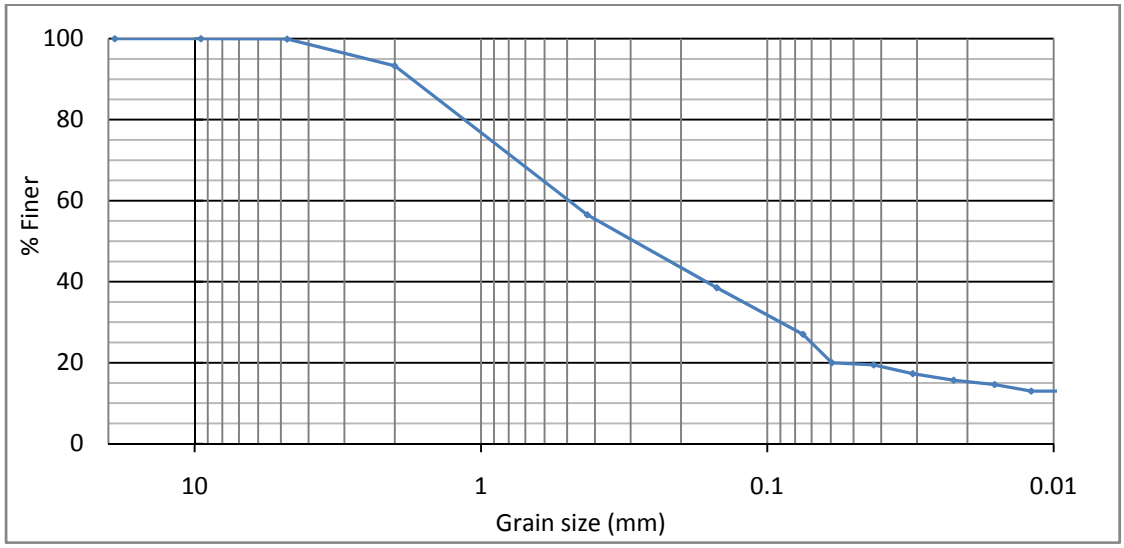

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 99.9 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 0.01 %. The amount of material passing sieve no. 4 and sieve no. 200 is 99.9 % and 27.0 %, so the percent of sand is 72.9 %.

D_{60} = 0.5 D_{30} = 0.09 D_{10} = 0.0025

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 200$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 6.5$

$CBR = 28.09(D_{60})^{0.358} = 22$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 22 is fair for subgrade.

Depth: 46 – 58 inches

Bag No: U 89

Sample Weight (g):540.7

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	510	13.1	2.4	97.6
9.5	483.6	547.6	64.0	11.8	85.7
4.75	532.1	577.4	45.3	8.4	77.4
2.00	464.5	540.6	76.1	14.1	63.3
0.425	369.5	513.5	144.0	26.6	36.7
0.150	414.9	524.0	109.1	20.2	16.5
0.075	327.5	365.5	38.0	7.0	9.5
Pan	377.9	427.8	49.9	9.2	
		Total	539.5		

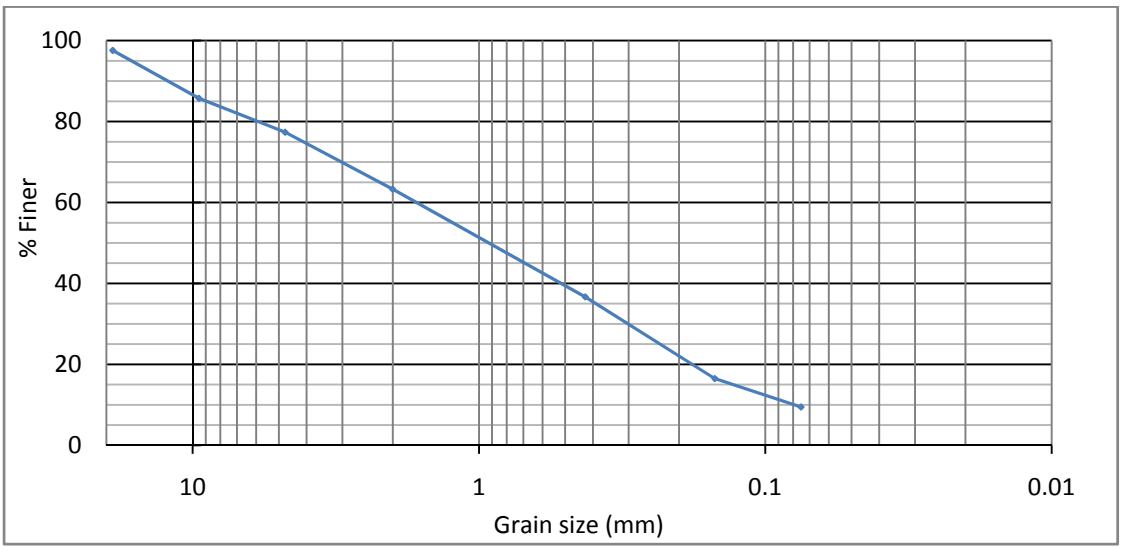

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 77.4 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 22.6 %. The amount of material passing sieve no. 4 and sieve no. 200 is 77.4 % and 9.5 %, so the percent of sand is 41.1 %.

$D_{60} = 1.8$ $D_{30} = 0.3$ $D_{10} = 0.076$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 23.7$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.66$

$CBR = 28.09(D_{60})^{0.358} = 35$

The group symbol for the soil is SP-SC and the group name is poorly graded sand with clay and gravel. The CBR value of 35 is good for subgrade.

Raton Municipal Airport

Borehole 16

Location: Taxiway A, 1800 ft. south of north pavement edge of Taxiway A

Depth: 6 – 13 inches

Bag No: N 18

Sample Weight (g):2301.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	1313.2	816.3	35.5	64.5
9.5	483.6	830.4	346.8	15.1	49.5
4.75	532.1	842.1	310.0	13.5	36.0
2.00	464.5	744.8	280.3	12.2	23.8
0.425	369.5	645.5	276.0	12.0	11.8
0.150	414.9	565.2	150.3	6.5	5.3
0.075	327.5	383.7	56.2	2.4	2.8
Pan	377.9	441.6	63.7	2.8	
		Total	2299.6		

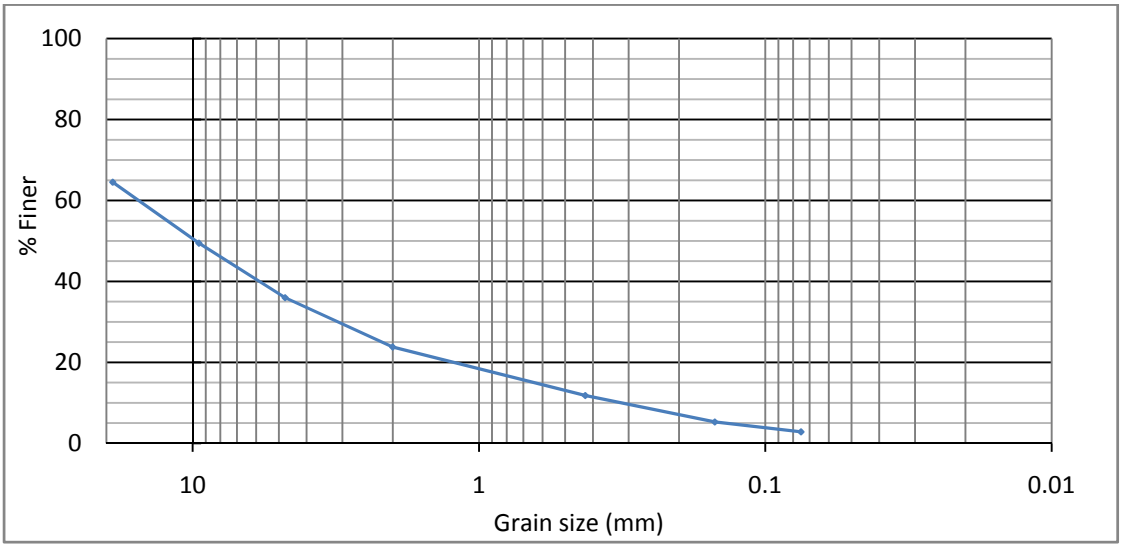

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 36.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 64.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 36.0 % and 2.8 %, so the percent of sand is 33.2 %.

$D_{60} = 17.5$ $D_{30} = 3.0$ $D_{10} = 0.31$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 56.5$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.7$

$CBR = 28.09(D_{60})^{0.358} = 78$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 78 is good for base course.

Depth: 13 – 27 inches

Bag No: P 609

Sample Weight (g): 516.7

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	510.1	13.2	2.6	97.4
9.5	483.9	490.2	6.3	1.2	96.2
4.75	532.2	539.0	6.8	1.3	94.9
2.00	464.5	495.6	31.1	6.0	88.9
0.425	370.2	513.4	143.2	27.7	61.2
0.150	415.5	550.8	135.3	26.2	35.0
0.075	327.8	398.3	70.5	13.6	21.3
Pan	378.0	486.8	108.8	21.1	
		Total	515.2		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	42	38	23	10.2	10.20	0.084	16.2
0.5	40	36	23	10.6	10.60	0.061	15.4
1	38	34	23	10.9	10.90	0.043	14.5
2	36	32	23	11.2	11.20	0.031	13.7
4	34	30	23	11.5	11.50	0.022	12.8
8	32	28	23	11.9	11.90	0.016	12.0
15	31	27	23	12.0	12.00	0.012	11.5
30	29	25	22	12.4	12.40	0.008	10.7
60	27	23	22	12.7	12.70	0.006	9.8
120	26	22	21	12.9	12.90	0.004	9.4
240	25	21	21	13.0	13.00	0.003	9.0
480	24	20	21	13.2	13.20	0.002	8.5
1440	23	19	21	13.3	13.30	0.001	8.1

Specific gravity: 2.65 | G_s correction factor (α): 1.0

Sample weight (g): 50 | Suspension constant (k): 0.01317

Zero correction (mm): 4 | % passing no. 200 sieve: 21.3

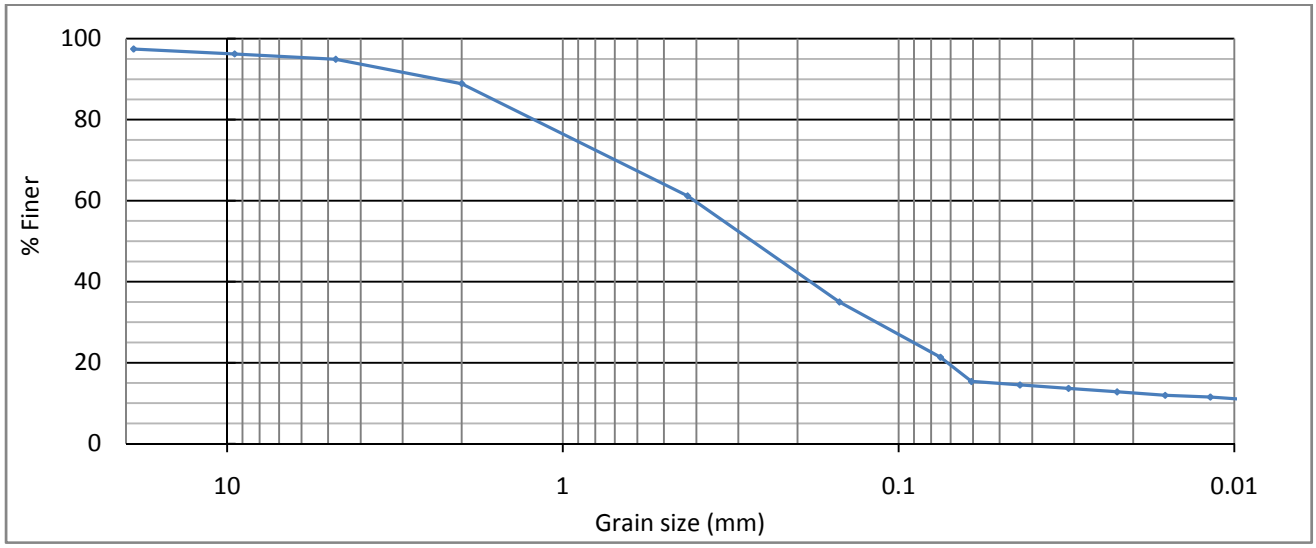

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 94.9 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 5.1 %. The amount of material passing sieve no. 4 and sieve no. 200 is 94.9 % and 21.3 %, so the percent of sand is 73.6 %.

D_{60} = 0.4 D_{30} = 0.12 D_{10} = 0.007

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 57.1$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 5.1$

$CBR = 28.09(D_{60})^{0.358} = 20$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 20 is fair for subgrade.

Depth: 27 – 39 inches

Bag No: R 5

Sample Weight (g):693.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	513.6	16.7	2.4	97.6
9.5	483.6	599.2	115.6	16.7	80.9
4.75	532.1	617.6	85.5	12.4	68.5
2.00	464.5	581.7	117.2	17.0	51.5
0.425	369.5	478.4	108.9	15.8	35.8
0.150	414.9	534.4	119.5	17.3	18.5
0.075	327.5	386.3	58.8	8.5	10.0
Pan	377.9	445.6	67.7	9.8	
		Total	689.9		

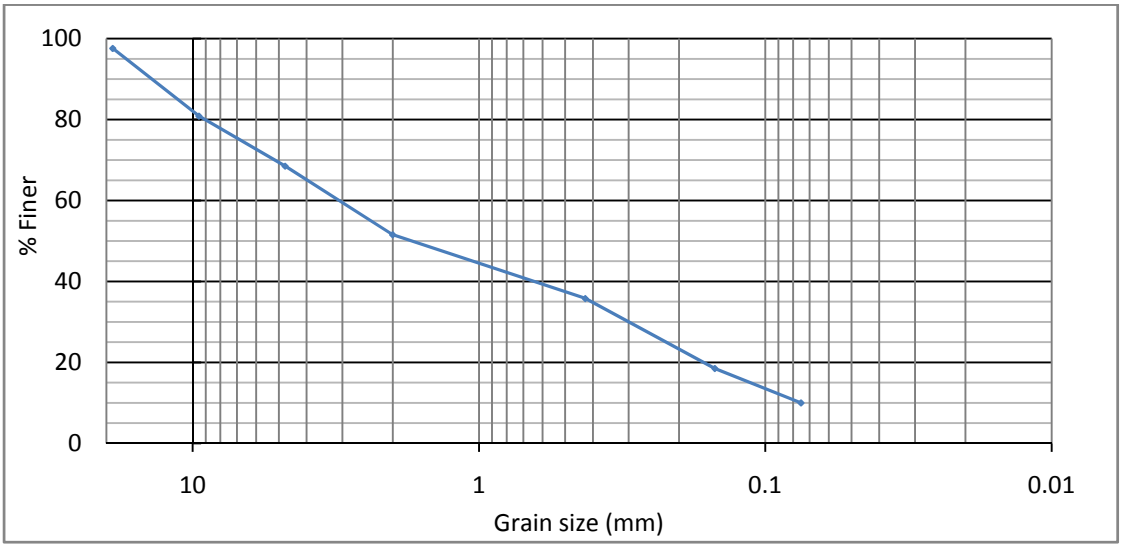

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 68.5 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 31.5 %. The amount of material passing sieve no. 4 and sieve no. 200 is 68.5 % and 10.0 %, so the percent of sand is 58.5 %.

$D_{60} = 3.0$ $D_{30} = 0.3$ $D_{10} = 0.075$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 40.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.4$

$CBR = 28.09(D_{60})^{0.358} = 42$

The group symbol for the soil is SP-SC and the group name is poorly graded sand with clay and gravel. The CBR value of 42 is good for subgrade.

Depth: 39 – 63 inches

Bag No: R 41

Sample Weight (g): 498.4

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	483.9	0.0	0.0	100.0
4.75	531.9	531.9	0.0	0.0	100.0
2.00	464.5	494.8	30.3	6.1	93.9
0.425	370.2	544.8	174.6	35.0	58.9
0.150	415.5	498.6	83.1	16.7	42.2
0.075	327.8	393.6	65.8	13.2	29.0
Pan	378.0	522.0	144.0	28.9	
		Total	497.8		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	50	46	23	8.8	8.80	0.078	26.7
0.5	48	44	23	9.1	9.10	0.056	25.5
1	43	39	23	9.9	9.90	0.041	22.6
2	39	35	23	10.6	10.60	0.030	20.3
4	34	30	23	11.4	11.40	0.022	17.4
8	31	27	23	11.9	11.90	0.016	15.7
15	28	24	23	12.4	12.40	0.012	13.9
30	27	23	22	12.5	12.50	0.009	13.3
60	25	21	22	12.9	12.90	0.006	12.2
120	23	19	21	13.2	13.20	0.004	11.0
240	22	18	21	13.3	13.30	0.003	10.4
480	21	17	21	13.5	13.50	0.002	9.9
1440	20	16	21	13.7	13.70	0.001	9.3

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 4

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 29.0

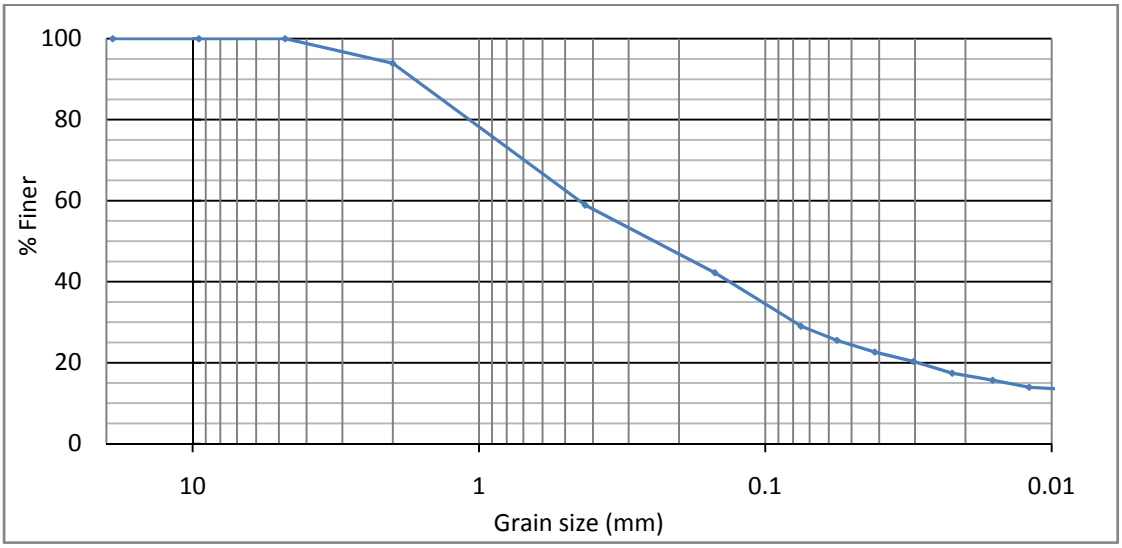

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 100.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 0.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 100.0 % and 29.0 %, so the percent of sand is 71.0 %.

D_{60} = 0.44 D_{30} = 0.08 D_{10} = 0 .0025

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 176$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 5.8$

$CBR = 28.09(D_{60})^{0.358} = 21$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 21 is fair for subgrade.

Table 3: Liquid Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Number of blows, N
M3	21.7	30.8	28.4	35.8	32
M1	21.6	30.5	28.1	36.9	24
M2	21.8	30.9	28.3	40.0	15

Table 4: Plastic Limit Data

Can No.	Weight of can, $W_{1\,(g)}$	Weight of can + wet soil, W_2 (g)	Weight of can + dry soil, W_3 (g)	Moisture content, ω (%)	Average, %
M4	21.3	29.7	28.3	20.0	19
M5	21.3	29.0	27.8	18.5	

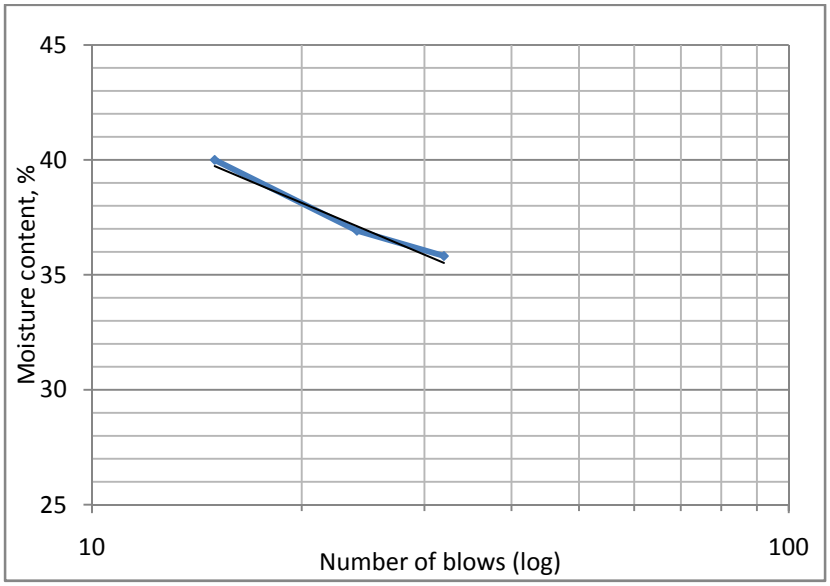

Figure 2: Liquid Limit

Liquid limit (LL): 37

Plastic limit (PL): 19

Plasticity index (PI): 18

ω - % passing no. 200 sieve

$$CBR = \frac{75}{1 + 0.728\,\omega\,PI} = 21$$

Raton Municipal Airport

Borehole 17

Location: Taxiway A, 3200 ft. south of north pavement edge of Taxiway A

Depth: 6 – 12 inches

Bag No: 81 A

Sample Weight (g):2693.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	921.2	424.3	15.8	84.2
9.5	483.6	802.1	318.5	11.8	72.4
4.75	532.1	1004.4	472.3	17.5	54.9
2.00	464.5	979.4	514.9	19.1	35.8
0.425	369.5	899.4	529.9	19.7	16.1
0.150	414.9	676.8	261.9	9.7	6.4
0.075	327.5	410.7	83.2	3.1	3.3
Pan	377.9	464.9	87.0	3.2	
		Total	2692.0		

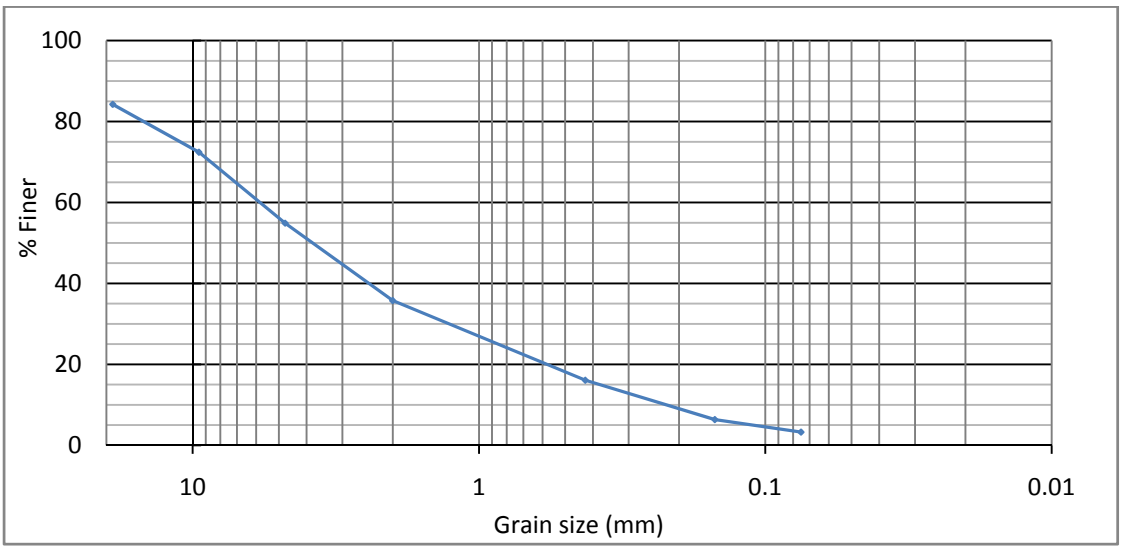

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 54.9 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 45.1 %. The amount of material passing sieve no. 4 and sieve no. 200 is 54.9 % and 3.3 %, so the percent of sand is 51.6 %.

$D_{60} = 6.0$ $D_{30} = 1.3$ $D_{10} = 0.23$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 26.1$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.2$

$CBR = 28.09(D_{60})^{0.358} = 53$

The group symbol for the soil is SW and the group name is well graded sand with gravel. The CBR value of 53 is good for base course.

Depth: 12 – 20 inches

Bag No: N 7

Sample Weight (g):633.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	543.7	46.8	7.4	92.6
9.5	483.6	666.6	183.0	28.9	63.7
4.75	532.1	649.8	117.7	18.6	45.1
2.00	464.5	535.5	71.0	11.2	33.9
0.425	369.5	439.0	69.5	11.0	22.9
0.150	414.9	478.5	63.6	10.0	12.9
0.075	327.5	361.7	34.2	5.4	7.5
Pan	377.9	424.9	47.0	7.4	
		Total	632.8		

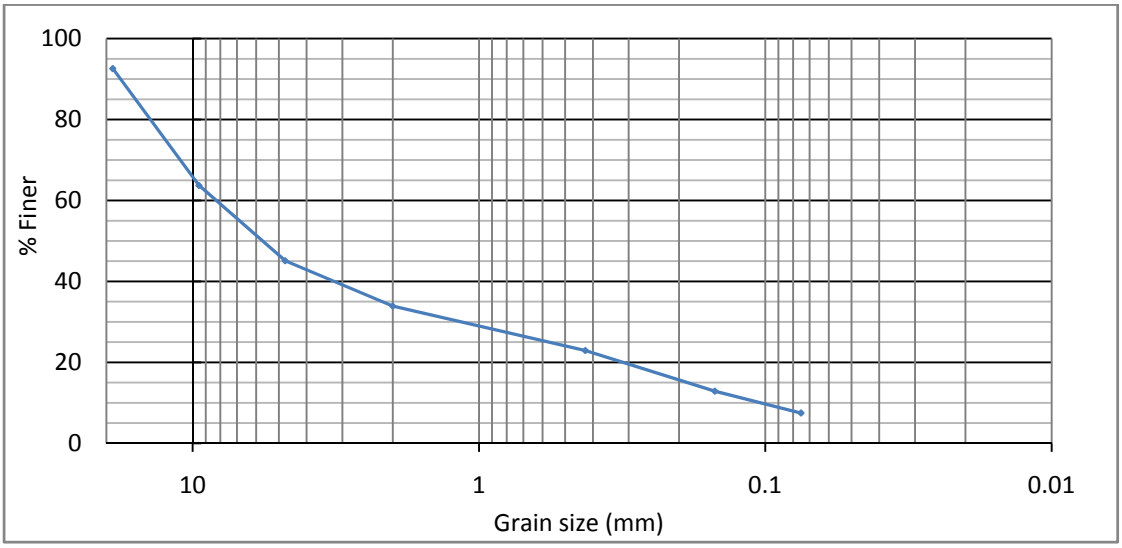

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 45.1 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 54.9 %. The amount of material passing sieve no. 4 and sieve no. 200 is 45.1 % and 7.5 %, so the percent of sand is 37.6 %.

$D_{60} = 8.2$ $D_{30} = 1.3$ $D_{10} = 0.1$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 82.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 2.1$

$CBR = 28.09(D_{60})^{0.358} = 60$

The group symbol for the soil is GW-GC and the group name is well graded gravel with clay and sand. The CBR value of 60 is good for subgrade.

Depth: 20 – 64 inches

Bag No: 88 A

Sample Weight (g):634.7

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	527.9	31.0	4.9	95.1
9.5	483.6	681.3	197.7	31.1	64.0
4.75	532.1	667.1	135.0	21.3	42.7
2.00	464.5	568.3	103.8	16.4	26.3
0.425	369.5	449.5	80.0	12.6	13.7
0.150	414.9	443.2	28.3	4.5	9.3
0.075	327.5	346.9	19.4	3.1	6.2
Pan	377.9	415.6	37.7	5.9	
		Total	632.9		

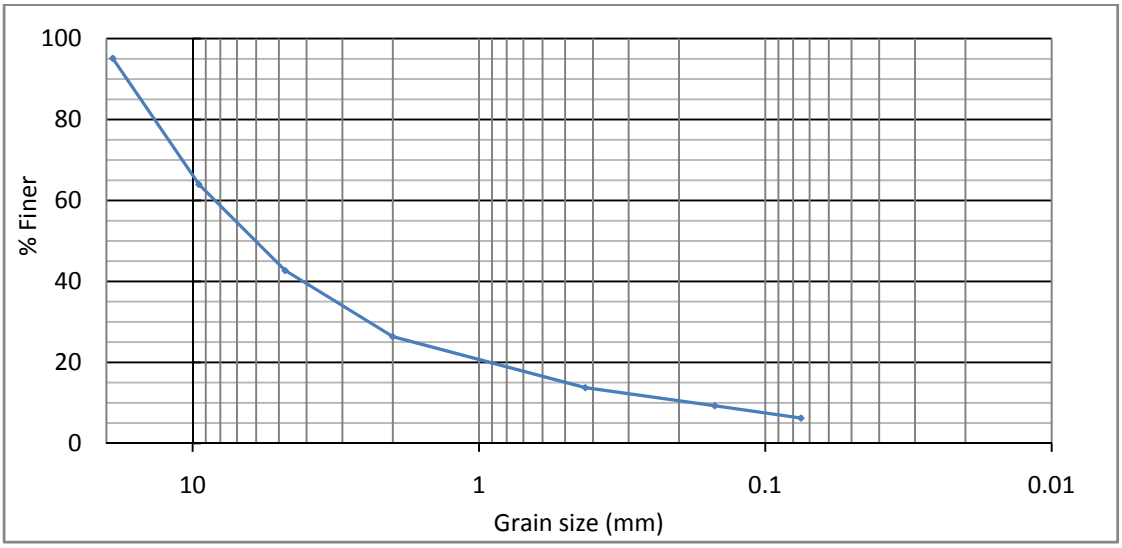

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 42.7 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 57.3 %. The amount of material passing sieve no. 4 and sieve no. 200 is 42.7 % and 6.2 %, so the percent of sand is 36.5 %.

$D_{60} = 8.4$ $D_{30} = 2.6$ $D_{10} = 0.2$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 42.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 4.0$

$CBR = 28.09(D_{60})^{0.358} = 60$

The group symbol for the soil is GP-GC and the group name is poorly graded gravel with sand. The CBR value of 60 is good for subgrade.

Raton Municipal Airport

Borehole 18

Location: Taxiway A, 5300 ft. south of north pavement edge of Taxiway A

Depth: 7 – 15 inches

Bag No: R 63

Sample Weight (g):1351.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	790.3	293.4	21.7	78.3
9.5	483.6	787.8	304.2	22.5	55.8
4.75	532.1	740.0	207.9	15.4	40.4
2.00	464.5	619.1	154.6	11.4	28.9
0.425	369.5	575.5	206.0	15.2	13.7
0.150	414.9	520.9	106.0	7.8	5.8
0.075	327.5	364.9	37.4	2.8	3.1
Pan	377.9	417.9	40.0	3.0	
		Total	1349.5		

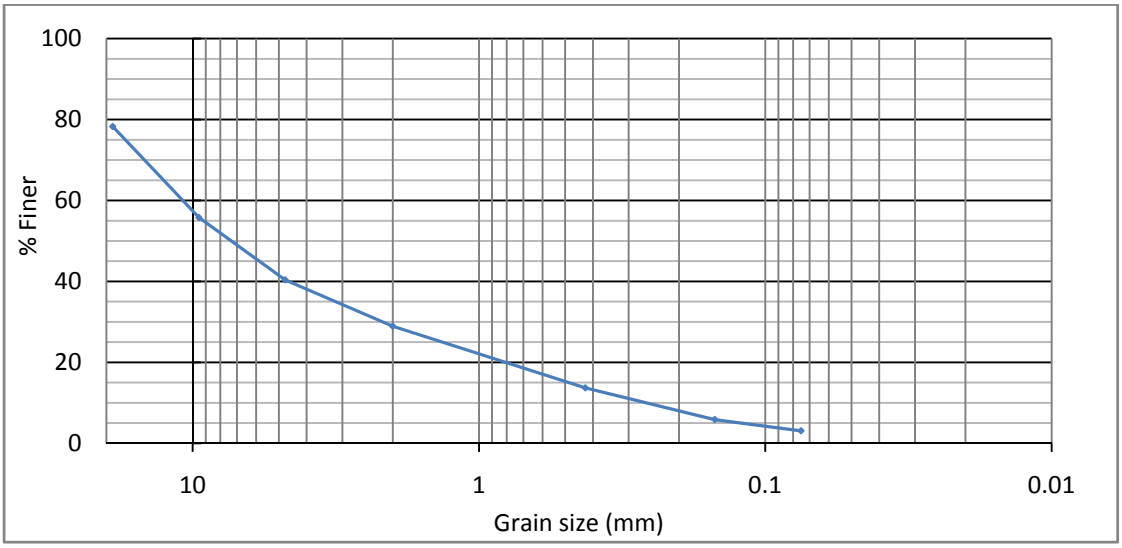

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 40.4 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 59.6 %. The amount of material passing sieve no. 4 and sieve no. 200 is 40.4 % and 3.1 %, so the percent of sand is 37.3 %.

$D_{60} = 11.0$ $D_{30} = 2.2$ $D_{10} = 0.28$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 39.3$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.6$

$CBR = 28.09(D_{60})^{0.358} = 66$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 66 is good for base course.

Depth: 15 – 40 inches

Bag No: WT 82

Sample Weight (g): 513.6

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	483.9	0.0	0.0	100.0
4.75	531.9	532.3	0.4	0.1	99.9
2.00	464.5	504.6	40.1	7.8	92.1
0.425	370.2	574.0	203.8	39.7	52.4
0.150	415.5	499.3	83.8	16.3	36.1
0.075	327.8	388.3	60.5	11.8	24.3
Pan	378.0	502.1	124.1	24.2	
		Total	512.7		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	50	46	23	8.8	8.80	0.078	22.4
0.5	48	44	23	9.1	9.10	0.056	21.4
1	43	39	23	9.9	9.90	0.041	19.0
2	39	35	23	10.6	10.60	0.030	17.0
4	34	30	23	11.4	11.40	0.022	14.6
8	31	27	23	11.9	11.90	0.016	13.1
15	28	24	23	12.4	12.40	0.012	11.7
30	27	23	22	12.5	12.50	0.009	11.2
60	25	21	22	12.9	12.90	0.006	10.2
120	23	19	21	13.2	13.20	0.004	9.2
240	22	18	21	13.3	13.30	0.003	8.8
480	21	17	21	13.5	13.50	0.002	8.3
1440	20	16	21	13.7	13.70	0.001	7.8

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 4

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 24.3

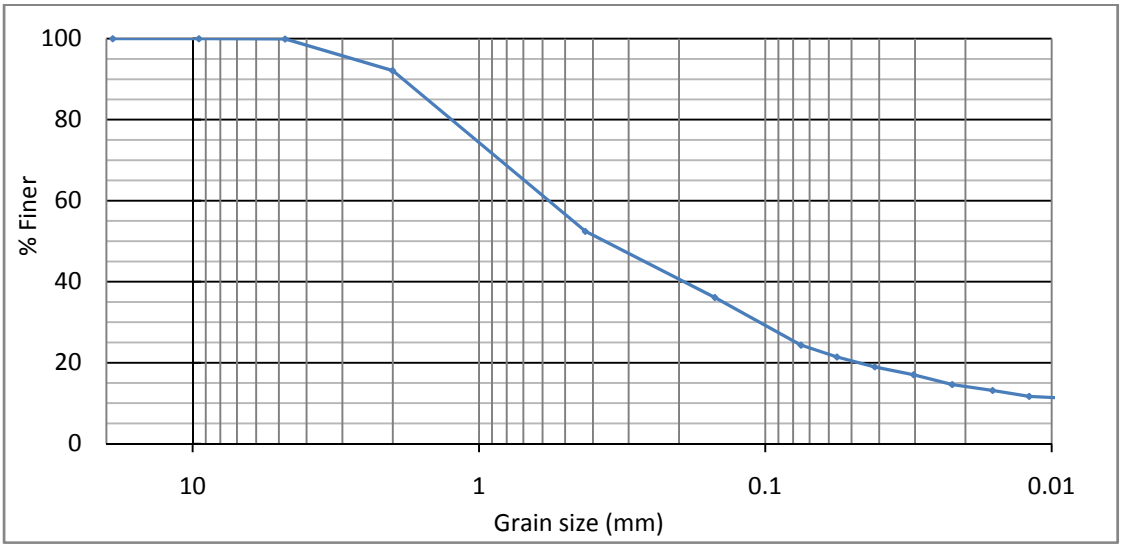

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 99.9 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 0.1 %. The amount of material passing sieve no. 4 and sieve no. 200 is 99.9 % and 24.3 %, so the percent of sand is 75.6 %.

$D_{60} = 0.57$ $D_{30} = 0.11$ $D_{10} = 0.005$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 114$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 4.2$

$CBR = 28.09(D_{60})^{0.358} = 23$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 23 is fair for subgrade.

Depth: 40 – 57 inches

Bag No: K 352

Sample Weight (g): 565.0

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	494.5	10.6	1.9	98.1
4.75	531.9	531.9	0.0	0.0	98.1
2.00	464.5	486.9	22.4	4.0	94.2
0.425	370.2	583.7	213.5	37.8	56.4
0.150	415.5	516.9	101.4	17.9	38.4
0.075	327.8	395.6	67.8	12.0	26.4
Pan	378.0	526.1	148.1	26.2	
		Total	563.8		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	45	40	23	9.7	9.70	0.082	21.1
0.5	42	37	23	10.2	10.20	0.059	19.6
1	39	34	23	10.7	10.70	0.043	18.0
2	35	30	23	11.4	11.40	0.031	15.9
4	33	28	23	11.7	11.70	0.023	14.8
8	31	26	23	12.0	12.00	0.016	13.7
15	29	24	23	12.4	12.40	0.012	12.7
30	28	23	22	12.5	12.50	0.009	12.2
60	26	21	22	12.9	12.90	0.006	11.1
120	24	19	21	13.2	13.20	0.004	10.0
240	23	18	21	13.3	13.30	0.003	9.5
480	21	16	21	13.7	13.70	0.002	8.5
1440	20	15	21	13.8	13.80	0.001	7.9

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 5

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 26.4

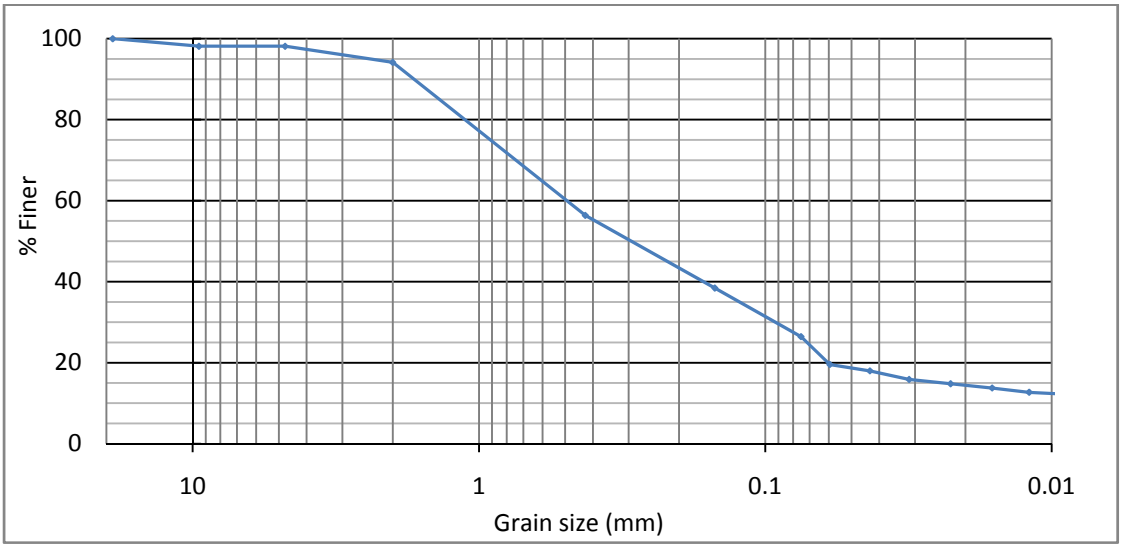

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 98.1 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 1.9 %. The amount of material passing sieve no. 4 and sieve no. 200 is 98.1 % and 26.4 %, so the percent of sand is 71.7 %.

$D_{60} = 0.5$ $D_{30} = 0.1$ $D_{10} = 0.0035$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 143$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 5.2$

$CBR = 28.09(D_{60})^{0.358} = 22$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 22 is fair for subgrade.

Depth: 57 – 67 inches

Bag No: U 24

Sample Weight (g): 602.2

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	551.6	54.7	9.1	90.9
9.5	483.9	506.8	22.9	3.8	87.1
4.75	531.9	585.6	53.7	8.9	78.2
2.00	464.5	590.9	126.4	21.0	57.2
0.425	370.2	533.8	163.6	27.2	30.0
0.150	415.5	498.0	82.5	13.7	16.3
0.075	327.8	365.2	37.4	6.2	10.1
Pan	378.0	437.9	59.9	9.9	
		Total	601.1		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	46	39	23	9.9	9.90	0.083	7.9
0.5	45	38	23	10.1	10.10	0.059	7.7
1	41	34	23	10.7	10.70	0.043	6.9
2	36	29	23	11.5	11.50	0.032	5.9
4	32	25	23	12.2	12.20	0.023	5.1
8	30	23	23	12.5	12.50	0.016	4.7
15	27	20	23	13.0	13.00	0.012	4.1
30	25	18	22	13.3	13.30	0.009	3.6
60	24	17	22	13.5	13.50	0.006	3.4
120	23	16	21	13.7	13.70	0.004	3.2
240	23	16	21	13.7	13.70	0.003	3.2
480	22	15	21	13.8	13.80	0.002	3.0
1440	19	12	21	14.3	14.30	0.001	2.4

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 7

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 10.1

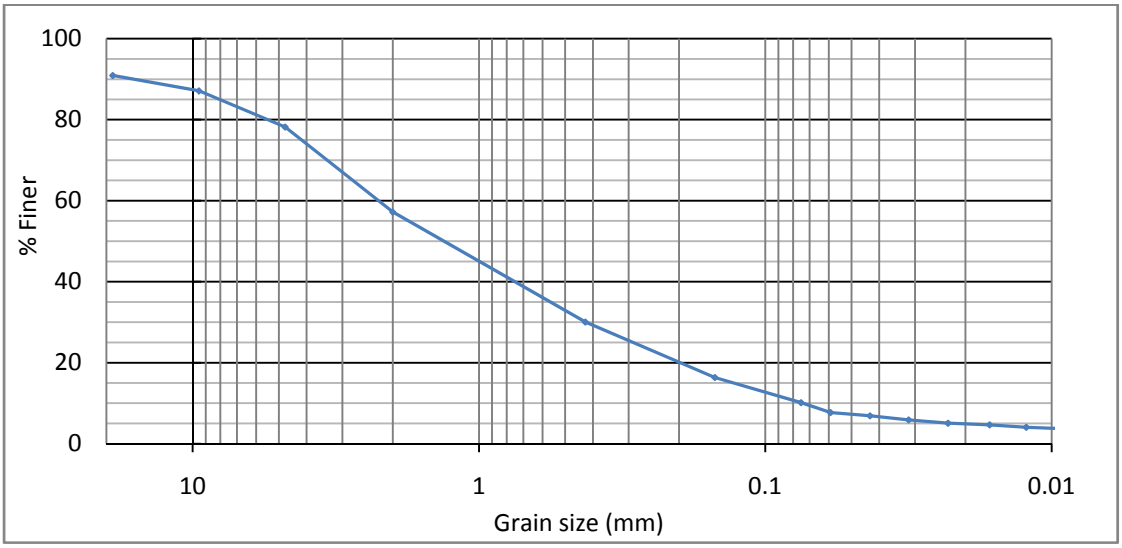

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 78.2 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 21.8 %. The amount of material passing sieve no. 4 and sieve no. 200 is 78.2 % and 10.1 %, so the percent of sand is 68.1 %.

$D_{60} = 2.2$ $D_{30} = 0.42$ $D_{10} = 0.074$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 29.7$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.1$

$CBR = 28.09(D_{60})^{0.358} = 37$

The group symbol for the soil is SW-SC and the group name is well graded sand with clay and gravel. The CBR value of 37 is good for subgrade.

Raton Municipal Airport

Borehole 19

Location: Apron, 220 ft. north of pavement south end

Depth: 2 – 13 inches

Bag No: 10 C

Sample Weight (g):1208.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	789	292.1	24.2	75.8
9.5	483.6	704.9	221.3	18.3	57.5
4.75	532.1	735.8	203.7	16.9	40.6
2.00	464.5	638.2	173.7	14.4	26.3
0.425	369.5	607.2	237.7	19.7	6.6
0.150	414.9	480.3	65.4	5.4	1.2
0.075	327.5	335.2	7.7	0.6	0.5
Pan	377.9	382.6	4.7	0.4	
		Total	1206.3		

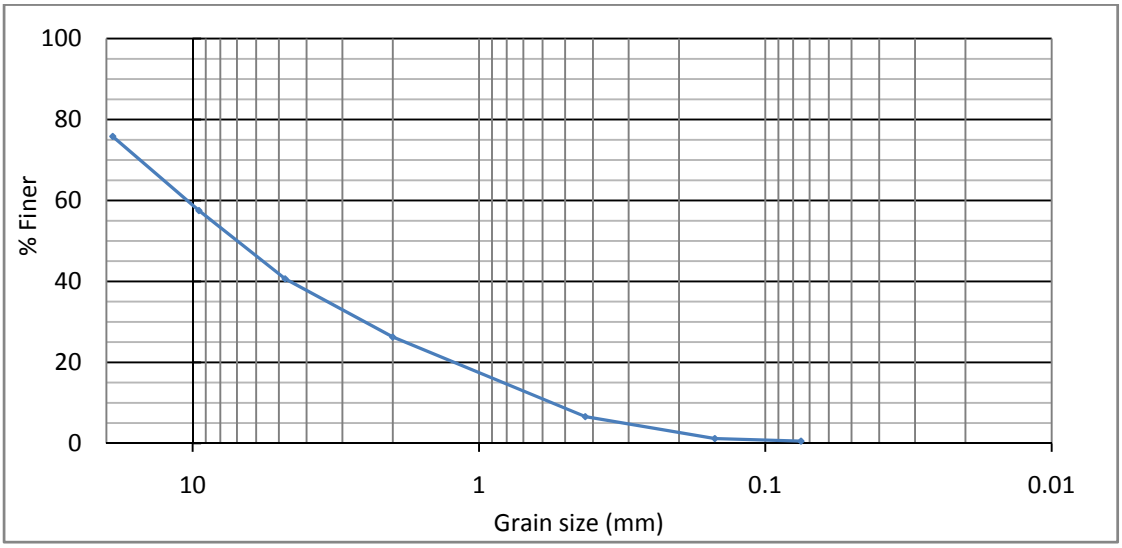

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 40.6 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 59.4 %. The amount of material passing sieve no. 4 and sieve no. 200 is 40.6 % and 0.5 %, so the percent of sand is 40.1 %.

$D_{60} = 11.0$ $D_{30} = 2.8$ $D_{10} = 0.55$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 20.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.3$

$CBR = 28.09(D_{60})^{0.358} = 66$

The group symbol for the soil is GW and the group name is well graded gravel with sand. The CBR value of 66 is good for base course.

Depth: 13 – 23 inches

Bag No: V 661

Sample Weight (g):908.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	641.8	144.9	16.0	84.0
9.5	483.6	724.9	241.3	26.6	57.5
4.75	532.1	731.8	199.7	22.0	35.5
2.00	464.5	595.1	130.6	14.4	21.1
0.425	369.5	445.0	75.5	8.3	12.8
0.150	414.9	466.7	51.8	5.7	7.1
0.075	327.5	351.8	24.3	2.7	4.4
Pan	377.9	416.1	38.2	4.2	
		Total	906.3		

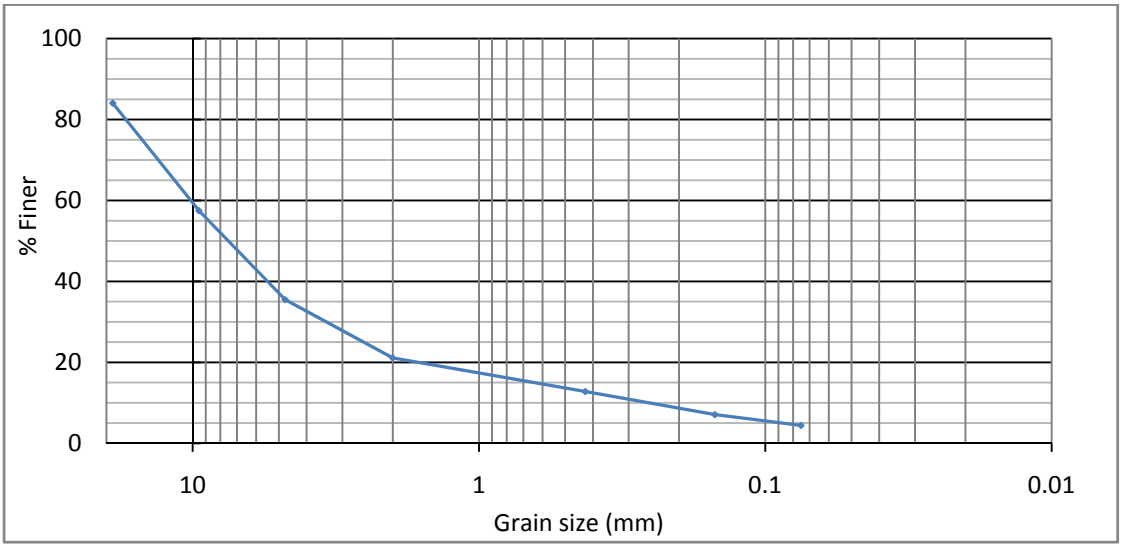

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 35.5 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 64.5 %. The amount of material passing sieve no. 4 and sieve no. 200 is 35.5 % and 4.4 %, so the percent of sand is 31.1 %.

$D_{60} = 10.0$ $D_{30} = 3.5$ $D_{10} = 0.27$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 37.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 4.5$

$CBR = 28.09(D_{60})^{0.358} = 64$

The group symbol for the soil is GP and the group name is poorly graded gravel with sand. The CBR value of 64 is good for subgrade.

Depth: 23 – 52 inches

Bag No: P 120

Sample Weight (g):761.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	509.2	12.3	1.6	98.4
9.5	483.6	798.5	314.9	41.4	57.0
4.75	532.1	736.3	204.2	26.8	30.2
2.00	464.5	566.1	101.6	13.3	16.8
0.425	369.5	431.7	62.2	8.2	8.7
0.150	414.9	441.8	26.9	3.5	5.1
0.075	327.5	341.4	13.9	1.8	3.3
Pan	377.9	401.7	23.8	3.1	
		Total	759.8		

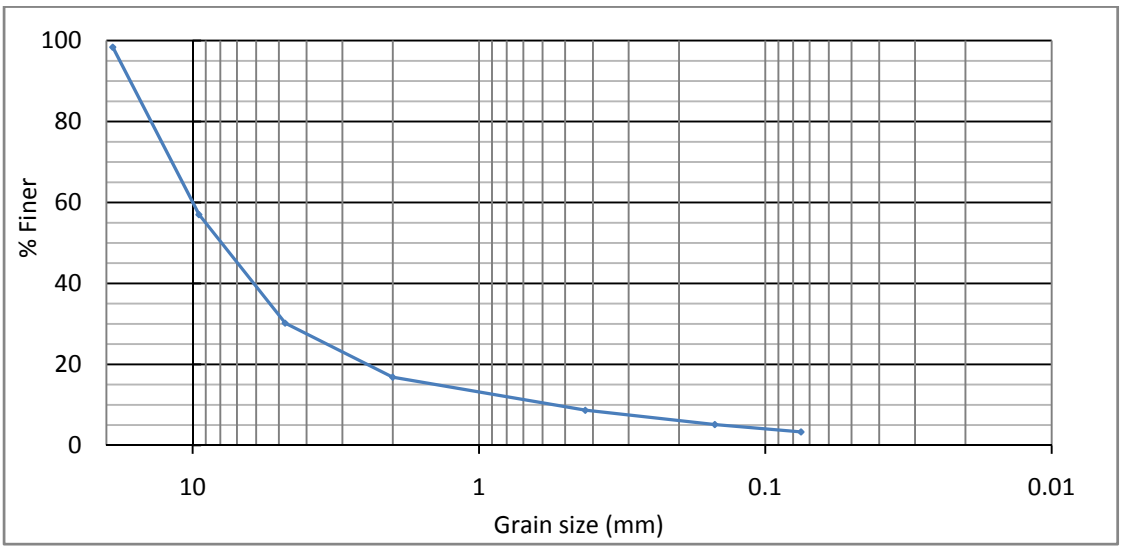

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 30.2 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 69.8 %. The amount of material passing sieve no. 4 and sieve no. 200 is 30.2 % and 3.3 %, so the percent of sand is 26.9 %.

$D_{60} = 10.0$ $D_{30} = 4.8$ $D_{10} = 0.55$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 18.2$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 4.2$

$CBR = 28.09(D_{60})^{0.358} = 64$

The group symbol for the soil is GP and the group name is poorly graded gravel with sand. The CBR value of 64 is good for subgrade.

Depth: 52 – 59 inches

Bag No: R 96

Sample Weight (g):784.1

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	577.8	80.9	10.3	89.7
9.5	483.6	597.9	114.3	14.6	75.1
4.75	532.1	653.6	121.5	15.5	59.6
2.00	464.5	578.7	114.2	14.6	45.0
0.425	369.5	493.9	124.4	15.9	29.2
0.150	414.9	539.2	124.3	15.9	13.3
0.075	327.5	383.4	55.9	7.1	6.2
Pan	377.9	425.4	47.5	6.1	
		Total	783.0		

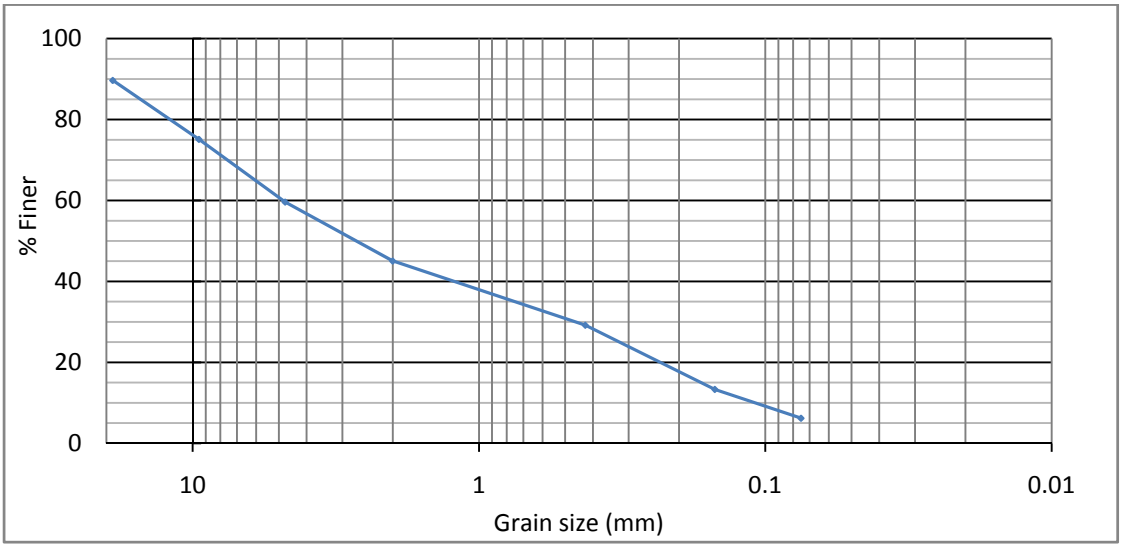

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 59.6 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 40.4 %. The amount of material passing sieve no. 4 and sieve no. 200 is 59.6 % and 6.2 %, so the percent of sand is 53.4 %.

$D_{60} = 4.8$ $D_{30} = 0.46$ $D_{10} = 0.12$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 40.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.37$

$CBR = 28.09(D_{60})^{0.358} = 49$

The group symbol for the soil is SP-SC and the group name is poorly graded sand with clay and gravel. The CBR value of 49 is good for subgrade.

Raton Municipal Airport

Borehole 20

Location: Apron, 65 ft. north of pavement south end

Depth: 3 – 12 inches

Bag No: 64 D

Sample Weight (g):527.8

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	578.4	81.5	15.4	84.6
9.5	483.6	527.3	43.7	8.3	76.3
4.75	532.1	627.5	95.4	18.1	58.2
2.00	464.5	568.3	103.8	19.7	38.5
0.425	369.5	503.7	134.2	25.4	13.1
0.150	414.9	463.2	48.3	9.2	4.0
0.075	327.5	340.5	13.0	2.5	1.5
Pan	377.9	385.6	7.7	1.5	
		Total	527.6		

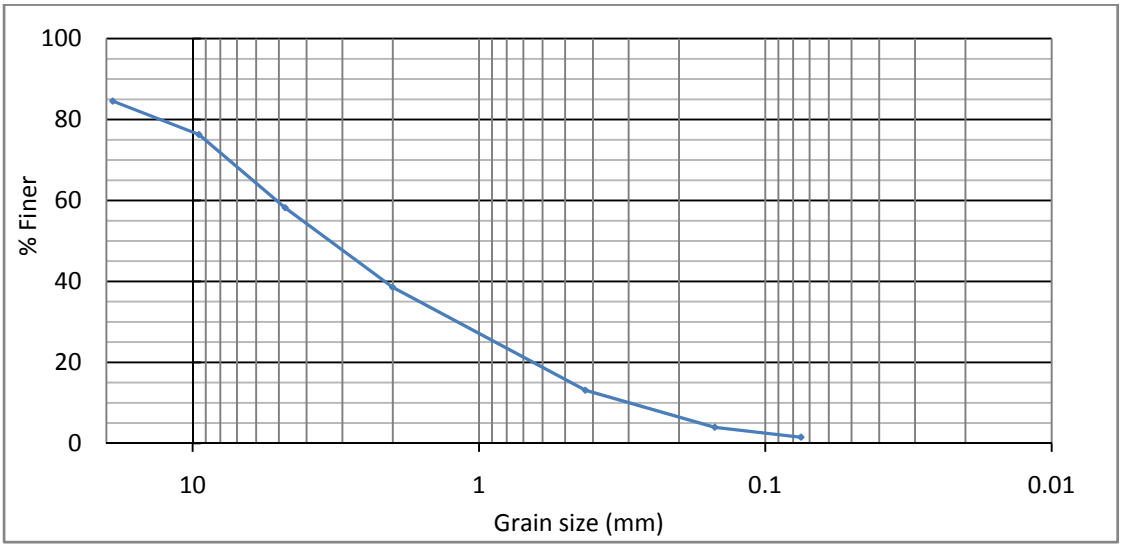

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 58.2 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 41.8 %. The amount of material passing sieve no. 4 and sieve no. 200 is 58.2 % and 1.5 %, so the percent of sand is 56.7 %.

$D_{60} = 5.2$ $D_{30} = 1.3$ $D_{10} = 0.3$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 17.3$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 1.1$

$CBR = 28.09(D_{60})^{0.358} = 51$

The group symbol for the soil is SW and the group name is well graded sand with gravel. The CBR value of 51 is good for base course.

Depth: 12 – 17 inches

Bag No: N/S

Sample Weight (g):415.2

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	509.9	13.0	3.1	96.9
9.5	483.6	507.9	24.3	5.9	91.0
4.75	532.1	565.2	33.1	8.0	83.0
2.00	464.5	569.7	105.2	25.3	57.7
0.425	369.5	484.2	114.7	27.6	30.1
0.150	414.9	479.2	64.3	15.5	14.6
0.075	327.5	361.3	33.8	8.1	6.5
Pan	377.9	404.7	26.8	6.5	
		Total	415.2		

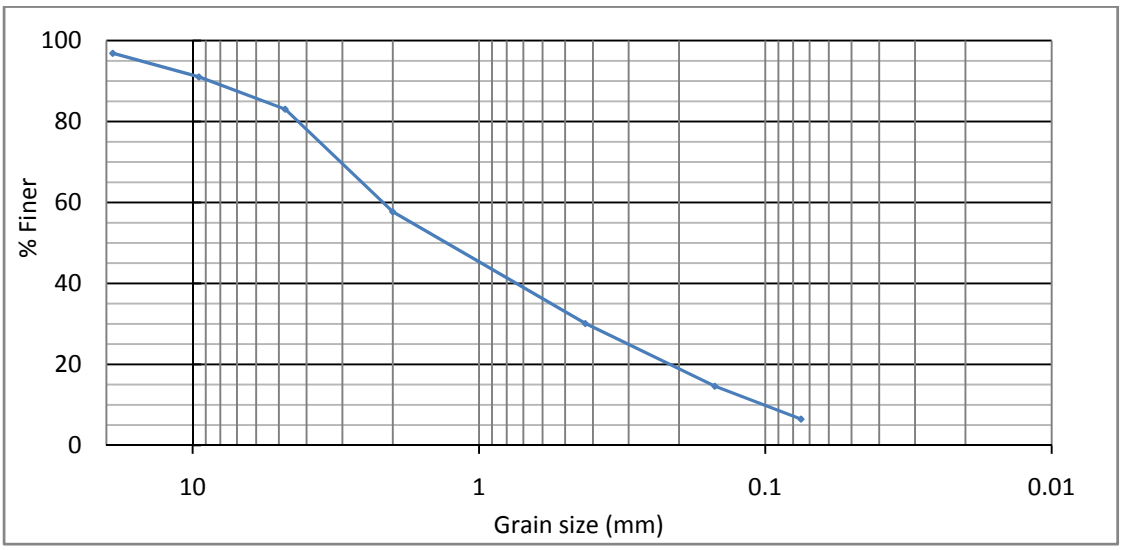

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 83.0 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 17.0 %. The amount of material passing sieve no. 4 and sieve no. 200 is 83.0 % and 6.5 %, so the percent of sand is 76.6 %.

$D_{60} = 2.2$ $D_{30} = 0.4$ $D_{10} = 0.1$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 22.0$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.8$

$CBR = 28.09(D_{60})^{0.358} = 37$

The group symbol for the soil is SP-SC and the group name is poorly graded sand with clay and gravel. The CBR value of 37 is good for subgrade.

Depth: 17 – 44 inches

Bag No: S 27

Sample Weight (g):413.7

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.6	506	22.4	5.4	94.6
4.75	532.1	573.4	41.3	10.0	84.6
2.00	464.5	561.6	97.1	23.5	61.1
0.425	369.5	464.8	95.3	23.0	38.1
0.150	414.9	494.1	79.2	19.1	19.0
0.075	327.5	372.1	44.6	10.8	8.2
Pan	377.9	411.5	33.6	8.1	
		Total	413.5		

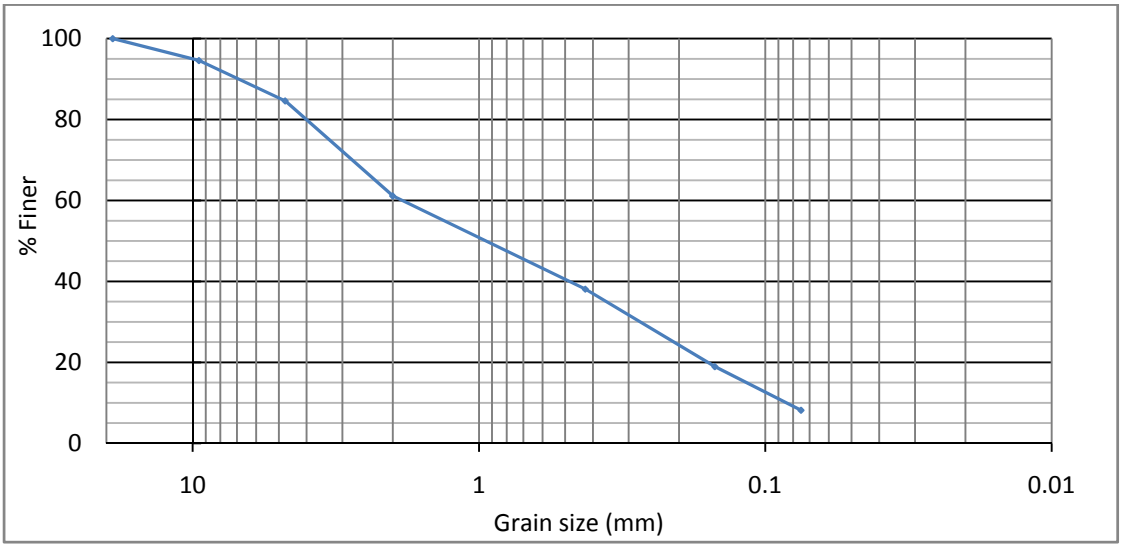

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 84.6 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 15.4 %. The amount of material passing sieve no. 4 and sieve no. 200 is 84.6 % and 8.2 %, so the percent of sand is 76.4 %.

$D_{60} = 1.8$ $D_{30} = 0.29$ $D_{10} = 0.083$

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 21.7$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.56$

$CBR = 28.09(D_{60})^{0.358} = 35$

The group symbol for the soil is SP-SC and the group name is poorly graded sand with clay and gravel. The CBR value of 49 is good for subgrade.

Depth: 44 – 56 inches

Bag No: V 57

Sample Weight (g):489.6

Table 1: Sieve Analysis Data

Sieve Size, mm	Sieve Wt., g	Sieve Wt. with Soil, g	Soil Wt. g	% Retained	Cumulative % Passing
19	496.9	496.9	0.0	0.0	100.0
9.5	483.9	483.9	0.0	0.0	100.0
4.75	531.9	543.8	11.9	2.4	97.6
2.00	464.5	549.7	85.2	17.4	80.2
0.425	370.2	506.5	136.3	27.8	52.3
0.150	415.5	514.9	99.4	20.3	32.0
0.075	327.8	413.6	85.8	17.5	14.5
Pan	378.0	448.1	70.1	14.3	
		Total	488.7		

Table 2: Hydrometer Analysis Data

Elapsed Time	Hydrometer Reading		T	Effective Depth (cm)		Particle Diameter	% Finer
(min)	Orig.	R_a	(°C)	$R_{a(Corr)}$	Corrected	(mm)	(%)
0.25	36	29	23	11.5	11.50	0.089	8.4
0.5	35	28	23	11.7	11.70	0.064	8.1
1	34	27	23	11.9	11.90	0.045	7.8
2	32	25	23	12.2	12.20	0.033	7.3
4	30	23	23	12.5	12.50	0.023	6.7
8	27	20	23	13.0	13.00	0.017	5.8
15	25	18	23	13.3	13.30	0.012	5.2
30	24	17	22	13.5	13.50	0.009	4.9
60	21	14	22	14.0	14.00	0.006	4.1
120	21	14	21	14.0	14.00	0.004	4.1
240	18	11	21	14.5	14.50	0.003	3.2
480	17	10	21	14.7	14.70	0.002	2.9
1440	16	9	21	14.8	14.80	0.001	2.6

Specific gravity: 2.65

Sample weight (g): 50

Zero correction (mm): 7

G_s correction factor (α): 1.0

Suspension constant (k): 0.01317

% passing no. 200 sieve: 14.5

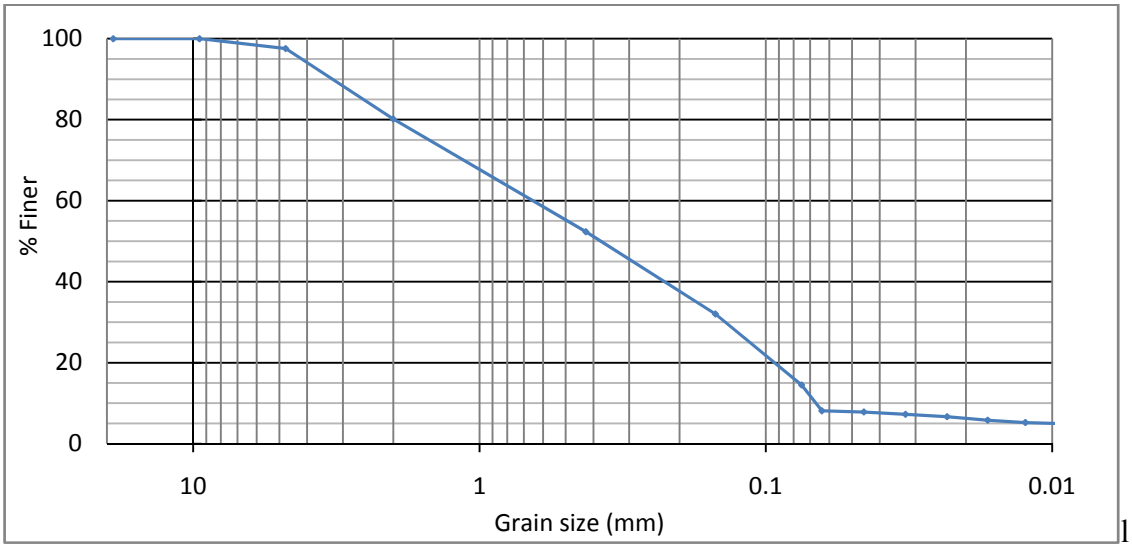

Figure 1: Gradation Curve

Since more than 50 % is retained on sieve no. 200, it is coarse-grained soil. 97.6 % is passing sieve no. 4, so the retained amount is the % of gravel which is equal to 2.4 %. The amount of material passing sieve no. 4 and sieve no. 200 is 97.6 % and 14.5 %, so the percent of sand is 83.1 %.

D_{60} = 0.65 D_{30} = 0.15 D_{10} = 0 .067

Coefficient of uniformity, $C_u = D_{60} / D_{10} = 9.7$

Coefficient of curvature, $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})} = 0.5$

$CBR = 28.09(D_{60})^{0.358} = 24$

The group symbol for the soil is SC and the group name is clayey sand. The CBR value of 24 is fair for subgrade.

APPENDIX B:

U.S. Department of Transportation
Federal Aviation Administration
Advisory Circular No. 150/5370-2G
Operational Safety on Airports During Construction, December 13, 2017

U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: Operational Safety on Airports During Construction	**Date:** 12/13/2017 **Initiated By:** AAS-100	**AC No:** 150/5370-2G **Change:**

1 **Purpose.**

This AC sets forth guidelines for operational safety on airports during construction.

2 **Cancellation.**

This AC cancels AC 150/5370-2F, *Operational Safety on Airports during Construction*, dated September 29, 2011.

3 **Application.**

This AC assists airport operators in complying with Title 14 Code of Federal Regulations (CFR) Part 139, *Certification of Airports*. For those certificated airports, this AC provides one way, but not the only way, of meeting those requirements. The use of this AC is mandatory for those airport construction projects receiving funds under the Airport Improvement Program (AIP). See Grant Assurance No. 34, *Policies, Standards, and Specifications*. While we do not require non-certificated airports without grant agreements or airports using Passenger Facility Charge (PFC) Program funds for construction projects to adhere to these guidelines, we recommend that they do so to help these airports maintain operational safety during construction.

4 **Related Documents.**

ACs and Orders referenced in the text of this AC do not include a revision letter, as they refer to the latest version. Appendix A contains a list of reading material on airport construction, design, and potential safety hazards during construction, as well as instructions for obtaining these documents.

5 **Principal Changes.**

The AC incorporates the following principal changes:

1. Notification about impacts to both airport owned and FAA-owned NAVAIDs was added. See paragraph 2.13.5.3, NAVAIDs.

2. Guidance for the use of orange construction signs was added. See paragraph 2.18.4.2, Temporary Signs.
3. Open trenches or excavations may be permitted in the taxiway safety area while the taxiway is open to aircraft operations, subject to restrictions. See paragraph 2.22.3.4, Excavations.
4. Guidance for temporary shortened runways and displaced thresholds has been enhanced. See Figure 2-1 and Figure 2-2.
5. Figures have been improved and a new Appendix F on the placement of orange construction signs has been added.

Hyperlinks (allowing the reader to access documents located on the internet and to maneuver within this document) are provided throughout this document and are identified with underlined text. When navigating within this document, return to the previously viewed page by pressing the "ALT" and " ←" keys simultaneously.

Figures in this document are schematic representations and are not to scale.

6 **Use of Metrics.**

Throughout this AC, U.S. customary units are used followed with "soft" (rounded) conversion to metric units. The U.S. customary units govern.

7 **Where to Find this AC.**

You can view a list of all ACs at http://www.faa.gov/regulations_policies/advisory_circulars/. You can view the Federal Aviation Regulations at http://www.faa.gov/regulations_policies/faa_regulations/.

8 **Feedback on this AC.**

If you have suggestions for improving this AC, you may use the Advisory Circular Feedback form at the end of this AC.

John R. Dermody
Director of Airport Safety and Standards

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CHAPTER 1. PLANNING AN AIRFIELD CONSTRUCTION PROJECT

1.1 Overview.

Airports are complex environments, and procedures and conditions associated with construction activities often affect aircraft operations and can jeopardize operational safety. Safety considerations are paramount and may make operational impacts unavoidable. However, careful planning, scheduling, and coordination of construction activities can minimize disruption of normal aircraft operations and avoid situations that compromise the airport's operational safety. The airport operator must understand how construction activities and aircraft operations affect one another to be able to develop an effective plan to complete the project. While the guidance in this AC is primarily used for construction operations, the concepts, methods and procedures described may also enhance the day-to-day airport maintenance operations, such as lighting maintenance and snow removal operations.

1.2 Plan for Safety.

Safety, maintaining aircraft operations, and construction costs are all interrelated. Since safety must not be compromised, the airport operator must strike a balance between maintaining aircraft operations and construction costs. This balance will vary widely depending on the operational needs and resources of the airport and will require early coordination with airport users and the FAA. As the project design progresses, the necessary construction locations, activities, and associated costs will be identified and their impact to airport operations must be assessed. Adjustments are made to the proposed construction activities, often by phasing the project, and/or to airport operations to maintain operational safety. This planning effort will ultimately result in a project Construction Safety and Phasing Plan (CSPP). The development of the CSPP takes place through the following five steps:

1.2.1 Identify Affected Areas.

The airport operator must determine the geographic areas on the airport affected by the construction project. Some, such as a runway extension, will be defined by the project. Others may be variable, such as the location of haul routes and material stockpiles.

1.2.2 Describe Current Operations.

Identify the normal airport operations in each affected area for each phase of the project. This becomes the baseline from which the impact on operations by construction activities can be measured. This should include a narrative of the typical users and aircraft operating within the affected areas. It should also include information related to airport operations: the Aircraft Approach Category (AAC) and Airplane Design Group (ADG) of the airplanes that operate on each runway; the ADG and Taxiway Design Group (TDG)[1] for each affected taxiway; designated approach visibility minimums;

[1] Find Taxiway Design Group information in AC 150/5300-13, *Airport Design.*

available approach and departure procedures; most demanding aircraft; declared distances; available air traffic control services; airport Surface Movement Guidance and Control System (SMGCS) plan; and others. The applicable seasons, days and times for certain operations should also be identified as applicable.

1.2.3 Allow for Temporary Changes to Operations.

To the extent practical, current airport operations should be maintained during the construction. In consultation with airport users, Aircraft Rescue and Fire Fighting (ARFF) personnel, and FAA Air Traffic Organization (ATO) personnel, the airport operator should identify and prioritize the airport's most important operations. The construction activities should be planned, through project phasing if necessary, to safely accommodate these operations. When the construction activities cannot be adjusted to safely maintain current operations, regardless of their importance, then the operations must be revised accordingly. Allowable changes include temporary revisions to approach procedures, restricting certain aircraft to specific runways and taxiways, suspension of certain operations, decreased weights for some aircraft due to shortened runways, and other changes. An example of a table showing temporary operations versus current operations is shown in Appendix E.

1.2.4 Take Required Measures to Revise Operations.

Once the level and type of aircraft operations to be maintained are identified, the airport operator must determine the measures required to safely conduct the planned operations during the construction. These measures will result in associated costs, which can be broadly interpreted to include not only direct construction costs, but also loss of revenue from impacted operations. Analysis of costs may indicate a need to reevaluate allowable changes to operations. As aircraft operations and allowable changes will vary widely among airports, this AC presents general guidance on those subjects.

1.2.5 Manage Safety Risk.

The FAA is committed to incorporating proactive safety risk management (SRM) tools into its decision-making processes. FAA Order 5200.11, *FAA Airports (ARP) Safety Management System (SMS)*, requires the FAA to conduct a Safety Assessment for certain triggering actions. Certain airport projects may require the airport operator to provide a Project Proposal Summary to help the FAA determine whether a Safety Assessment is required prior to FAA approval of the CSPP. The airport operator must coordinate with the appropriate FAA Airports Regional or District Office early in the development of the CSPP to determine the need for a Safety Risk Assessment. If the FAA requires an assessment, the airport operator must at a minimum:

1. Notify the appropriate FAA Airports Regional or District Office during the project "scope development" phase of any project requiring a CSPP.
2. Provide documents identified by the FAA as necessary to conduct SRM.
3. Participate in the SRM process for airport projects.
4. Provide a representative to participate on the SRM panel.

5. Ensure that all applicable SRM identified risks elements are recorded and mitigated within the CSPP.

1.3 **Develop a Construction Safety and Phasing Plan (CSPP).**

Development of an effective CSPP will require familiarity with many other documents referenced throughout this AC. See Appendix A for a list of related reading material.

1.3.1 List Requirements.

A CSPP must be developed for each on-airfield construction project funded by the Airport Improvement Program (AIP) or located on an airport certificated under Part 139. For on-airfield construction projects at Part 139 airports funded without AIP funds, the preparation of a CSPP represents an acceptable method the certificate holder may use to meet Part 139 requirements during airfield construction activity. As per FAA Order 5200.11, projects that require Safety Assessments do not include construction, rehabilitation, or change of any facility that is entirely outside the air operations area, does not involve any expansion of the facility envelope and does not involve construction equipment, haul routes or placement of material in locations that require access to the air operations area, increase the facility envelope, or impact line-of-sight. Such facilities may include passenger terminals and parking or other structures. However, extraordinary circumstances may trigger the need for a Safety Assessment and a CSPP. The CSPP is subject to subsequent review and approval under the FAA's Safety Risk Management procedures (see paragraph 1.2.5).

1.3.2 Prepare a Safety Plan Compliance Document (SPCD).

The Safety Plan Compliance Document (SPCD) details how the contractor will comply with the CSPP. Also, it will not be possible to determine all safety plan details (for example specific hazard equipment and lighting, contractor's points of contact, construction equipment heights) during the development of the CSPP. The successful contractor must define such details by preparing an SPCD that the airport operator reviews for approval prior to issuance of a notice-to-proceed. The SPCD is a subset of the CSPP, similar to how a shop drawing review is a subset to the technical specifications.

1.3.3 Assume Responsibility for the CSPP.

The airport operator is responsible for establishing and enforcing the CSPP. The airport operator may use the services of an engineering consultant to help develop the CSPP. However, writing the CSPP cannot be delegated to the construction contractor. Only those details the airport operator determines cannot be addressed before contract award are developed by the contractor and submitted for approval as the SPCD. The SPCD does not restate nor propose differences to provisions already addressed in the CSPP.

1.4 Who Is Responsible for Safety During Construction?

1.4.1 Establish a Safety Culture.

Everyone has a role in operational safety on airports during construction: the airport operator, the airport's consultants, the construction contractor and subcontractors, airport users, airport tenants, ARFF personnel, Air Traffic personnel, including Technical Operations personnel, FAA Airports Division personnel, and others, such as military personnel at any airport supporting military operations (e.g. national guard or a joint use facility). Close communication and coordination between all affected parties is the key to maintaining safe operations. Such communication and coordination should start at the project scoping meeting and continue through the completion of the project. The airport operator and contractor should conduct onsite safety inspections throughout the project and immediately remedy any deficiencies, whether caused by negligence, oversight, or project scope change.

1.4.2 Assess Airport Operator's Responsibilities.

An airport operator has overall responsibility for all activities on an airport, including construction. This includes the predesign, design, preconstruction, construction, and inspection phases. Additional information on the responsibilities listed below can be found throughout this AC. The airport operator must:

1.4.2.1 Develop a CSPP that complies with the safety guidelines of Chapter 2, Construction Safety and Phasing Plans, and Chapter 3, Guidelines for Writing a CSPP. The airport operator may develop the CSPP internally or have a consultant develop the CSPP for approval by the airport operator. For tenant sponsored projects, approve a CSPP developed by the tenant or its consultant.

1.4.2.2 Require, review and approve the SPCD by the contractor that indicates how it will comply with the CSPP and provides details that cannot be determined before contract award.

1.4.2.3 Convene a preconstruction meeting with the construction contractor, consultant, airport employees and, if appropriate, tenant sponsor and other tenants to review and discuss project safety before beginning construction activity. The appropriate FAA representatives should be invited to attend the meeting. See AC 150/5370-12, *Quality Management for Federally Funded Airport Construction Projects.* (Note "FAA" refers to the Airports Regional or District Office, the Air Traffic Organization, Flight Standards Service, and other offices that support airport operations, flight regulations, and construction/environmental policies.)

1.4.2.4 Ensure contact information is accurate for each representative/point of contact identified in the CSPP and SPCD.

1.4.2.5 Hold weekly or, if necessary, daily safety meetings with all affected parties to coordinate activities.

1.4.2.6 Notify users, ARFF personnel, and FAA ATO personnel of construction and conditions that may adversely affect the operational safety of the airport via Notices to Airmen (NOTAM) and other methods, as appropriate. Convene a meeting for review and discussion if necessary.

1.4.2.7 Ensure construction personnel know applicable airport procedures and changes to those procedures that may affect their work.

1.4.2.8 Ensure that all temporary construction signs are located per the scheduled list for each phase of the project.

1.4.2.9 Ensure construction contractors and subcontractors undergo training required by the CSPP and SPCD.

1.4.2.10 Ensure vehicle and pedestrian operations addressed in the CSPP and SPCD are coordinated with airport tenants, the airport traffic control tower (ATCT), and construction contractors.

1.4.2.11 At certificated airports, ensure each CSPP and SPCD is consistent with Part 139.

1.4.2.12 Conduct inspections sufficiently frequently to ensure construction contractors and tenants comply with the CSPP and SPCD and that there are no altered construction activities that could create potential safety hazards.

1.4.2.13 Take immediate action to resolve safety deficiencies.

1.4.2.14 At airports subject to 49 CFR Part 1542, *Airport Security*, ensure construction access complies with the security requirements of that regulation.

1.4.2.15 Notify appropriate parties when conditions exist that invoke provisions of the CSPP and SPCD (for example, implementation of low-visibility operations).

1.4.2.16 Ensure prompt submittal of a Notice of Proposed Construction or Alteration (Form 7460-1) for conducting an aeronautical study of potential obstructions such as tall equipment (cranes, concrete pumps, other), stock piles, and haul routes. A separate form may be filed for each potential obstruction, or one form may be filed describing the entire construction area and maximum equipment height. In the latter case, a separate form must be filed for any object beyond or higher than the originally evaluated area/height. The FAA encourages online submittal of forms for expediency at https://oeaaa.faa.gov/oeaaa/external/portal.jsp. The appropriate FAA Airports Regional or District Office can provide assistance in determining which objects require an aeronautical study.

1.4.2.17 Ensure prompt transmission of the Airport Sponsor Strategic Event Submission, FAA Form 6000-26, located at https://oeaaa.faa.gov/oeaaa/external/content/AIRPORT_SPONSOR_STRATEGIC_EVENT_SUBMISSION_FORM.pdf, to assure proper coordination for NAS Strategic Interruption per Service Level Agreement with ATO.

1.4.2.18 Promptly notify the FAA Airports Regional or District Office of any proposed changes to the CSPP prior to implementation of the change. Changes to the CSPP require review and approval by the airport operator and the FAA. The FAA Airports Regional or District office will determine if further coordination within the FAA is needed. Coordinate with appropriate local and other federal government agencies, such as Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), Transportation Security Administration (TSA), and the state environmental agency.

1.4.3 Define Construction Contractor's Responsibilities.

The contractor is responsible for complying with the CSPP and SPCD. The contractor must:

1.4.3.1 Submit a Safety Plan Compliance Document (SPCD) to the airport operator describing how it will comply with the requirements of the CSPP and supply any details that could not be determined before contract award. The SPCD must include a certification statement by the contractor, indicating an understanding of the operational safety requirements of the CSPP and the assertion of compliance with the approved CSPP and SPCD unless written approval is granted by the airport operator. Any construction practice proposed by the contractor that does not conform to the CSPP and SPCD may impact the airport's operational safety and will require a revision to the CSPP and SPCD and re-coordination with the airport operator and the FAA in advance.

1.4.3.2 Have available at all times copies of the CSPP and SPCD for reference by the airport operator and its representatives, and by subcontractors and contractor employees.

1.4.3.3 Ensure that construction personnel are familiar with safety procedures and regulations on the airport. Provide a point of contact who will coordinate an immediate response to correct any construction-related activity that may adversely affect the operational safety of the airport. Many projects will require 24-hour coverage.

1.4.3.4 Identify in the SPCD the contractor's on-site employees responsible for monitoring compliance with the CSPP and SPCD during construction. At least one of these employees must be on-site when active construction is taking place.

1.4.3.5 Conduct sufficient inspections to ensure construction personnel comply with the CSPP and SPCD and that there are no altered construction activities that could create potential safety hazards.

1.4.3.6 Restrict movement of construction vehicles and personnel to permitted construction areas by flagging, barricading, erecting temporary fencing, or providing escorts, as appropriate, and as specified in the CSPP and SPCD.

1.4.3.7 Ensure that no contractor employees, employees of subcontractors or suppliers, or other persons enter any part of the air operations area (AOA) from the construction site unless authorized.

1.4.3.8 Ensure prompt submittal through the airport operator of Form 7460-1 for the purpose of conducting an aeronautical study of contractor equipment such as tall equipment (cranes, concrete pumps, and other equipment), stock piles, and haul routes when different from cases previously filed by the airport operator. The FAA encourages online submittal of forms for expediency at https://oeaaa.faa.gov/oeaaa/external/portal.jsp.

1.4.3.9 Ensure that all necessary safety mitigations are understood by all parties involved, and any special requirements of each construction phase will be fulfilled per the approved timeframe.

1.4.3.10 Participate in pre-construction meetings to review construction limits, safety mitigations, NOTAMs, and understand all special airport operational needs during each phase of the project.

1.4.4 Define Tenant's Responsibilities.

If planning construction activities on leased property, Airport tenants, such as airline operators, fixed base operators, and FAA ATO/Technical Operations sponsoring construction are strongly encouraged to:

1. Develop, or have a consultant develop, a project specific CSPP and submit it to the airport operator. The airport operator may forgo a complete CSPP submittal and instead incorporate appropriate operational safety principles and measures addressed in the advisory circular within their tenant lease agreements.
2. In coordination with its contractor, develop an SPCD and submit it to the airport operator for approval issued prior to issuance of a Notice to Proceed.
3. Ensure that construction personnel are familiar with safety procedures and regulations on the airport during all phases of the construction.
4. Provide a point of contact of who will coordinate an immediate response to correct any construction-related activity that may adversely affect the operational safety of the airport.
5. Identify in the SPCD the contractor's on-site employees responsible for monitoring compliance with the CSPP and SPCD during construction. At least one of these employees must be on-site when active construction is taking place.
6. Ensure that no tenant or contractor employees, employees of subcontractors or suppliers, or any other persons enter any part of the AOA from the construction site unless authorized.
7. Restrict movement of construction vehicles to construction areas by flagging and barricading, erecting temporary fencing, or providing escorts, as appropriate, as specified in the CSPP and SPCD.
8. Ensure prompt submittal through the airport operator of Form 7460-1 for conducting an aeronautical study of contractor equipment such as tall equipment (cranes, concrete pumps, other), stock piles, and haul routes. The FAA encourages online submittal of forms for expediency at https://oeaaa.faa.gov/oeaaa/external/portal.jsp.
9. Participate in pre-construction meetings to review construction limits, safety mitigations, NOTAMs, and understand all special airport operational needs during each phase of the project.

CHAPTER 2. CONSTRUCTION SAFETY AND PHASING PLANS

2.1 Overview.

Aviation safety is the primary consideration at airports, especially during construction. The airport operator's CSPP and the contractor's Safety Plan Compliance Document (SPCD) are the primary tools to ensure safety compliance when coordinating construction activities with airport operations. These documents identify all aspects of the construction project that pose a potential safety hazard to airport operations and outline respective mitigation procedures for each hazard. They must provide information necessary for the Airport Operations department to conduct airfield inspections and expeditiously identify and correct unsafe conditions during construction. All aviation safety provisions included within the project drawings, contract specifications, and other related documents must also be reflected in the CSPP and SPCD.

2.2 Assume Responsibility.

Operational safety on the airport remains the airport operator's responsibility at all times. The airport operator must develop, certify, and submit for FAA approval each CSPP. It is the airport operator's responsibility to apply the requirements of the FAA approved CSPP. The airport operator must revise the CSPP when conditions warrant changes and must submit the revised CSPP to the FAA for approval. The airport operator must also require and approve a SPCD from the project contractor.

2.3 Submit the CSPP.

Construction Safety and Phasing Plans should be developed concurrently with the project design. Milestone versions of the CSPP should be submitted for review and approval as follows. While these milestones are not mandatory, early submission will help to avoid delays. Submittals are preferred in 8.5 × 11 inch or 11 × 17 inch format for compatibility with the FAA's Obstruction Evaluation / Airport Airspace Analysis (OE / AAA) process.

2.3.1 Submit an Outline/Draft.

By the time approximately 25% to 30% of the project design is completed, the principal elements of the CSPP should be established. Airport operators are encouraged to submit an outline or draft, detailing all CSPP provisions developed to date, to the FAA for review at this stage of the project design.

2.3.2 Submit a CSPP.

The CSPP should be formally submitted for FAA approval when the project design is 80 percent to 90 percent complete. Since provisions in the CSPP will influence contract costs, it is important to obtain FAA approval in time to include all such provisions in the procurement contract.

2.3.3 Submit an SPCD.

The contractor should submit the SPCD to the airport operator for approval to be issued prior to the Notice to Proceed.

2.3.4 Submit CSPP Revisions.

All revisions to a previously approved CSPP must be re-submitted to the FAA for review and approval/disapproval action.

2.4 Meet CSPP Requirements.

2.4.1 To the extent possible, the CSPP should address the following as outlined in Chapter 3, Guidelines for Writing a CSPP. Details that cannot be determined at this stage are to be included in the SPCD.

1. Coordination.
    a. Contractor progress meetings.
    b. Scope or schedule changes.
    c. FAA ATO coordination.
2. Phasing.
    a. Phase elements.
    b. Construction safety drawings.
3. Areas and operations affected by the construction activity.
    a. Identification of affected areas.
    b. Mitigation of effects.
4. Protection of navigation aids (NAVAIDs).
5. Contractor access.
    a. Location of stockpiled construction materials.
    b. Vehicle and pedestrian operations.
6. Wildlife management.
    a. Trash.
    b. Standing water.
    c. Tall grass and seeds.
    d. Poorly maintained fencing and gates.
    e. Disruption of existing wildlife habitat.
7. Foreign Object Debris (FOD) management.
8. Hazardous materials (HAZMAT) management.
9. Notification of construction activities.

a. Maintenance of a list of responsible representatives/ points of contact.

b. NOTAM.

c. Emergency notification procedures.

d. Coordination with ARFF Personnel.

e. Notification to the FAA.

10. Inspection requirements.

a. Daily (or more frequent) inspections.

b. Final inspections.

11. Underground utilities.

12. Penalties.

13. Special conditions.

14. Runway and taxiway visual aids. Marking, lighting, signs, and visual NAVAIDs.

a. General.

b. Markings.

c. Lighting and visual NAVAIDs.

d. Signs, temporary, including orange construction signs, and permanent signs.

15. Marking and signs for access routes.

16. Hazard marking and lighting.

a. Purpose.

b. Equipment.

17. Work zone lighting for nighttime construction (if applicable).

18. Protection of runway and taxiway safety areas, object free areas, obstacle free zones, and approach/departure surfaces.

a. Runway Safety Area (RSA).

b. Runway Object Free Area (ROFA).

c. Taxiway Safety Area (TSA). Provide details for any adjustments to Taxiway Safety Area width to allow continued operation of smaller aircraft. See paragraph 2.22.3.

d. Taxiway Object Free Area (TOFA). Provide details for any continued aircraft operations while construction occurs within the TOFA. See paragraph 2.22.4.

e. Obstacle Free Zone (OFZ).

f. Runway approach/departure surfaces.

19. Other limitations on construction.

a. Prohibitions.

b. Restrictions.

2.4.2 The Safety Plan Compliance Document (SPCD) should include a general statement by the construction contractor that he/she has read and will abide by the CSPP. In addition, the SPCD must include all supplemental information that could not be included in the CSPP prior to the contract award. The contractor statement should include the name of the contractor, the title of the project CSPP, the approval date of the CSPP, and a reference to any supplemental information (that is, "I, (Name of Contractor), have read the (Title of Project) CSPP, approved on (Date), and will abide by it as written and with the following additions as noted:"). The supplemental information in the SPCD should be written to match the format of the CSPP indicating each subject by corresponding CSPP subject number and title. If no supplemental information is necessary for any specific subject, the statement, "No supplemental information," should be written after the corresponding subject title. The SPCD should not duplicate information in the CSPP:

1. Coordination. Discuss details of proposed safety meetings with the airport operator and with contractor employees and subcontractors.
2. Phasing. Discuss proposed construction schedule elements, including:
   a. Duration of each phase.
   b. Daily start and finish of construction, including "night only" construction.
   c. Duration of construction activities during:
      i. Normal runway operations.
      ii. Closed runway operations.
      iii. Modified runway "Aircraft Reference Code" usage.
3. Areas and operations affected by the construction activity. These areas and operations should be identified in the CSPP and should not require an entry in the SPCD.
4. Protection of NAVAIDs. Discuss specific methods proposed to protect operating NAVAIDs.
5. Contractor access. Provide the following:
   a. Details on how the contractor will maintain the integrity of the airport security fence (gate guards, daily log of construction personnel, and other).
   b. Listing of individuals requiring driver training (for certificated airports and as requested).
   c. Radio communications.
      i. Types of radios and backup capabilities.
      ii. Who will be monitoring radios.
      iii. Who to contact if the ATCT cannot reach the contractor's designated person by radio.

d. Details on how the contractor will escort material delivery vehicles.

6. Wildlife management. Discuss the following:
   a. Methods and procedures to prevent wildlife attraction.
   b. Wildlife reporting procedures.
7. Foreign Object Debris (FOD) management. Discuss equipment and methods for control of FOD, including construction debris and dust.
8. Hazardous Materials (HAZMAT) management. Discuss equipment and methods for responding to hazardous spills.
9. Notification of construction activities. Provide the following:
   a. Contractor points of contact.
   b. Contractor emergency contact.
   c. Listing of tall or other requested equipment proposed for use on the airport and the timeframe for submitting 7460-1 forms not previously submitted by the airport operator.
   d. Batch plant details, including 7460-1 submittal.
10. Inspection requirements. Discuss daily (or more frequent) inspections and special inspection procedures.
11. Underground utilities. Discuss proposed methods of identifying and protecting underground utilities.
12. Penalties. Penalties should be identified in the CSPP and should not require an entry in the SPCD.
13. Special conditions. Discuss proposed actions for each special condition identified in the CSPP.
14. Runway and taxiway visual aids. Including marking, lighting, signs, and visual NAVAIDs. Discuss proposed visual aids including the following:
   a. Equipment and methods for covering signage and airfield lights.
   b. Equipment and methods for temporary closure markings (paint, fabric, other).
   c. Temporary orange construction signs.
   d. Types of temporary Visual Guidance Slope Indicators (VGSI).
15. Marking and signs for access routes. Discuss proposed methods of demarcating access routes for vehicle drivers.
16. Hazard marking and lighting. Discuss proposed equipment and methods for identifying excavation areas.
17. Work zone lighting for nighttime construction (if applicable). Discuss proposed equipment, locations, aiming, and shielding to prevent interference with air traffic control and aircraft operations.

18. Protection of runway and taxiway safety areas, object free areas, obstacle free zones, and approach/departure surfaces. Discuss proposed methods of identifying, demarcating, and protecting airport surfaces including:
    a. Equipment and methods for maintaining Taxiway Safety Area standards.
    b. Equipment and methods to ensure the safe passage of aircraft where Taxiway Safety Area or Taxiway Object Free Area standards cannot be maintained.
    c. Equipment and methods for separation of construction operations from aircraft operations, including details of barricades.
19. Other limitations on construction should be identified in the CSPP and should not require an entry in the SPCD.

2.5 **Coordination.**

Airport operators, or tenants responsible for design, bidding and conducting construction on their leased properties, should ensure at all project developmental stages, such as predesign, prebid, and preconstruction conferences, they capture the subject of airport operational safety during construction (see AC 150/5370-12, *Quality Management for Federally Funded Airport Construction Projects*). In addition, the following should be coordinated as required:

2.5.1 Progress Meetings.

Operational safety should be a standing agenda item for discussion during progress meetings throughout the project developmental stages.

2.5.2 Scope or Schedule Changes.

Changes in the scope or duration at any of the project stages may require revisions to the CSPP and review and approval by the airport operator and the FAA (see paragraph 1.4.2.17).

2.5.3 FAA ATO Coordination.

Early coordination with FAA ATO is highly recommended during the design phase and is required for scheduling Technical Operations shutdowns prior to construction. Coordination is critical to restarts of NAVAID services and to the establishment of any special procedures for the movement of aircraft. Formal agreements between the airport operator and appropriate FAA offices are recommended. All relocation or adjustments to NAVAIDs, or changes to final grades in critical areas, should be coordinated with FAA ATO and may require an FAA flight inspection prior to restarting the facility. Flight inspections must be coordinated and scheduled well in advance of the intended facility restart. Flight inspections may require a reimbursable agreement between the airport operator and FAA ATO. Reimbursable agreements should be coordinated a minimum of 12 months prior to the start of construction. (See paragraph 2.13.5.3.2 for required FAA notification regarding FAA-owned NAVAIDs.)

2.6 **Phasing.**

Once it has been determined what types and levels of airport operations will be maintained, the most efficient sequence of construction may not be feasible. In this case, the sequence of construction may be phased to gain maximum efficiency while allowing for the required operations. The development of the resulting construction phases should be coordinated with local Air Traffic personnel and airport users. The sequenced construction phases established in the CSPP must be incorporated into the project design and must be reflected in the contract drawings and specifications.

2.6.1 Phase Elements.

For each phase the CSPP should detail:

- Areas closed to aircraft operations.
- Duration of closures.
- Taxi routes and/or areas of reduced TSA and TOFA to reflect reduced ADG use.
- ARFF access routes.
- Construction staging, disposal, and cleanout areas.
- Construction access and haul routes.
- Impacts to NAVAIDs.
- Lighting, marking, and signing changes.
- Available runway length and/or reduced RSA and ROFA to reflect reduced ADG use.
- Declared distances (if applicable).
- Required hazard marking, lighting, and signing.
- Work zone lighting for nighttime construction (if applicable).
- Lead times for required notifications.

2.6.2 Construction Safety Drawings.

Drawings specifically indicating operational safety procedures and methods in affected areas (i.e., construction safety drawings) should be developed for each construction phase. Such drawings should be included in the CSPP as referenced attachments and should also be included in the contract drawing package.

2.7 **Areas and Operations Affected by Construction Activity.**

Runways and taxiways should remain in use by aircraft to the maximum extent possible without compromising safety. Pre-meetings with the FAA ATO will support operational simulations. See Appendix E for an example of a table showing temporary operations versus current operations. The tables in Appendix E can be useful for coordination among all interested parties, including FAA Lines of Business.

2.7.1 Identification of Affected Areas.

Identifying areas and operations affected by the construction helps to determine possible safety problems. The affected areas should be identified in the construction safety drawings for each construction phase. (See paragraph 2.6.2.) Of particular concern are:

2.7.1.1 **Closing, or Partial Closing, of Runways, Taxiways and Aprons, and Displaced Thresholds.**

When a runway is partially closed, a portion of the pavement is unavailable for any aircraft operation, meaning taxiing, landing, or takeoff in either direction on that pavement is prohibited. A displaced threshold, by contrast, is established to ensure obstacle clearance and adequate safety area for landing aircraft. The pavement prior to the displaced threshold is normally available for take-off in the direction of the displacement and for landing and takeoff in the opposite direction. Misunderstanding this difference, may result in issuance of an inaccurate NOTAM, and can lead to a hazardous condition.

2.7.1.1.1 Partially Closed Runways.

The temporarily closed portion of a partially closed runway will generally extend from the threshold to a taxiway that may be used for entering and exiting the runway. If the closed portion extends to a point between taxiways, pilots will have to back-taxi on the runway, which is an undesirable operation. See Figure 2-1 for a desirable configuration.

2.7.1.1.2 Displaced Thresholds.

Since the portion of the runway pavement between the permanent threshold and a standard displaced threshold is available for takeoff and for landing in the opposite direction, the temporary displaced threshold need not be located at an entrance/exit taxiway. See Figure 2-2.

2.7.1.2 Closing of aircraft rescue and fire fighting access routes.

2.7.1.3 Closing of access routes used by airport and airline support vehicles.

2.7.1.4 Interruption of utilities, including water supplies for fire fighting.

2.7.1.5 Approach/departure surfaces affected by heights of objects.

2.7.1.6 Construction areas, storage areas, and access routes near runways, taxiways, aprons, or helipads.

Figure 2-1. Temporary Partially Closed Runway

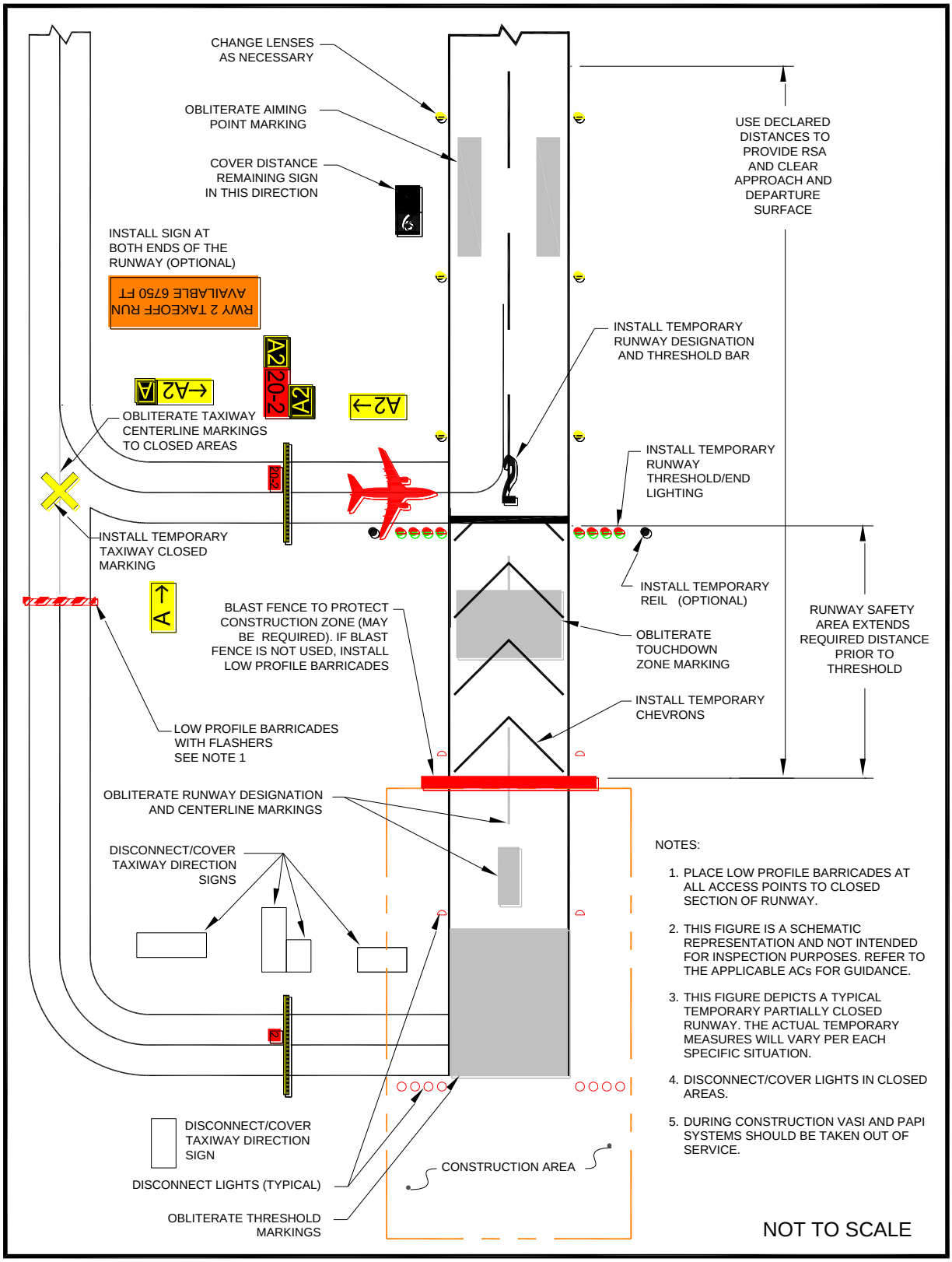
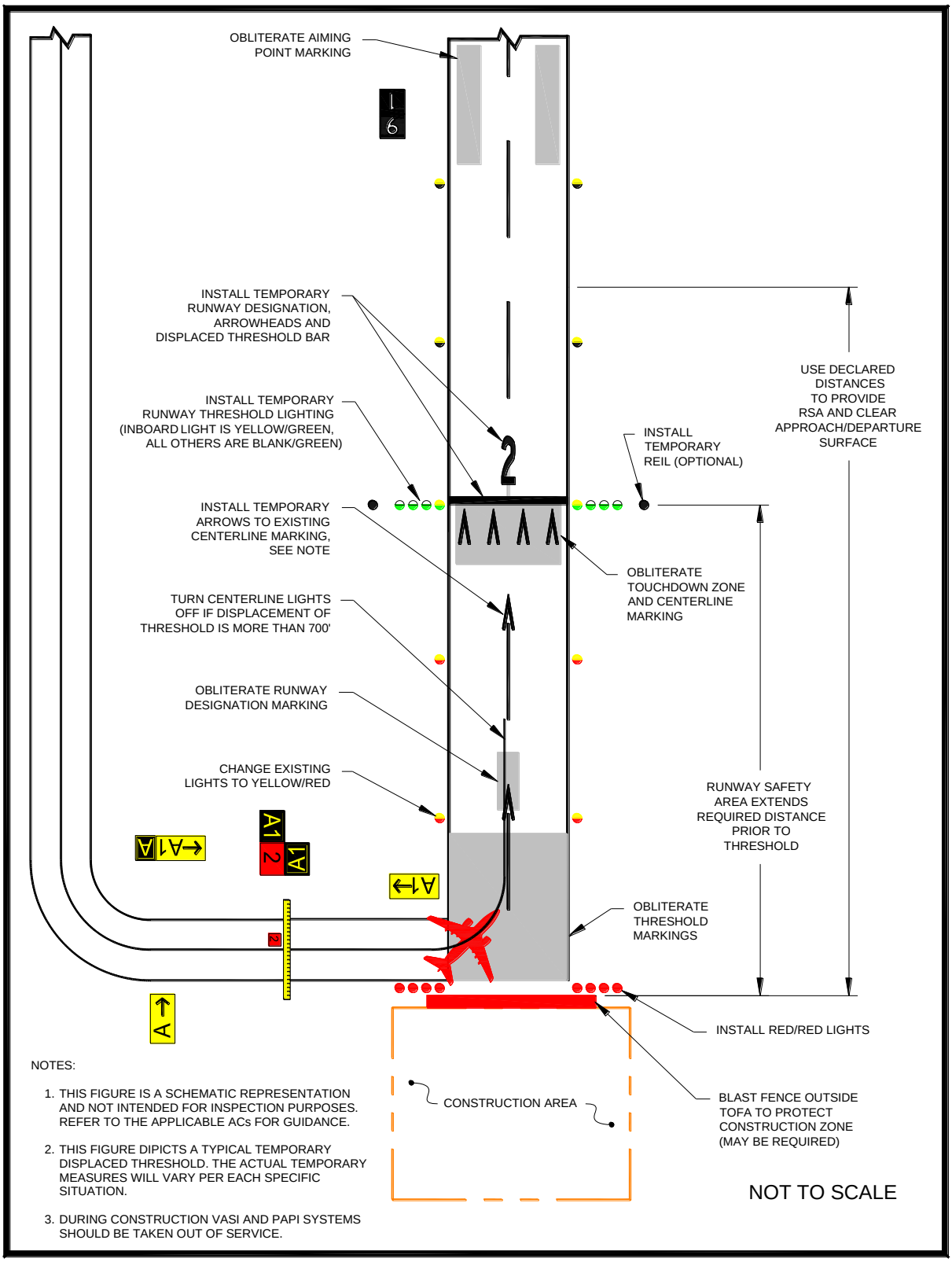


Figure 2-2. Temporary Displaced Threshold



Note: See paragraph 2.18.2.5.

2.7.2 Mitigation of Effects.

Establishment of specific procedures is necessary to maintain the safety and efficiency of airport operations. The CSPP must address:

2.7.2.1 Temporary changes to runway and/or taxi operations.

2.7.2.2 Detours for ARFF and other airport vehicles.

2.7.2.3 Maintenance of essential utilities.

2.7.2.4 Temporary changes to air traffic control procedures. Such changes must be coordinated with the ATO.

2.8 Navigation Aid (NAVAID) Protection.

Before commencing construction activity, parking vehicles, or storing construction equipment and materials near a NAVAID, coordinate with the appropriate FAA ATO/Technical Operations office to evaluate the effect of construction activity and the required distance and direction from the NAVAID. (See paragraph 2.13.5.3.) Construction activities, materials/equipment storage, and vehicle parking near electronic NAVAIDs require special consideration since they may interfere with signals essential to air navigation. If any NAVAID may be affected, the CSPP and SPCD must show an understanding of the "critical area" associated with each NAVAID and describe how it will be protected. Where applicable, the operational critical areas of NAVAIDs should be graphically delineated on the project drawings. Pay particular attention to stockpiling material, as well as to movement and parking of equipment that may interfere with line of sight from the ATCT or with electronic emissions. Interference from construction equipment and activities may require NAVAID shutdown or adjustment of instrument approach minimums for low visibility operations. This condition requires that a NOTAM be filed (see paragraph 2.13.2). Construction activities and materials/equipment storage near a NAVAID must not obstruct access to the equipment and instruments for maintenance. Submittal of a 7460-1 form is required for construction vehicles operating near FAA NAVAIDs. (See paragraph 2.13.5.3.)

2.9 Contractor Access.

The CSPP must detail the areas to which the contractor must have access, and explain how contractor personnel will access those areas. Specifically address:

2.9.1 Location of Stockpiled Construction Materials.

Stockpiled materials and equipment storage are not permitted within the RSA and OFZ, and if possible should not be permitted within the Object Free Area (OFA) of an operational runway. Stockpiling material in the OFA requires submittal of a 7460-1 form and justification provided to the appropriate FAA Airports Regional or District Office for approval. The airport operator must ensure that stockpiled materials and equipment adjacent to these areas are prominently marked and lighted during hours of restricted visibility or darkness. (See paragraph 2.18.2.) This includes determining and

verifying that materials are stabilized and stored at an approved location so as not to be a hazard to aircraft operations and to prevent attraction of wildlife and foreign object damage from blowing or tracked material. See paragraphs 2.10 and 2.11.

2.9.2 Vehicle and Pedestrian Operations.

The CSPP should include specific vehicle and pedestrian requirements. Vehicle and pedestrian access routes for airport construction projects must be controlled to prevent inadvertent or unauthorized entry of persons, vehicles, or animals onto the AOA. The airport operator should coordinate requirements for vehicle operations with airport tenants, contractors, and the FAA air traffic manager. In regard to vehicle and pedestrian operations, the CSPP should include the following, with associated training requirements:

2.9.2.1 **Construction Site Parking.**

Designate in advance vehicle parking areas for contractor employees to prevent any unauthorized entry of persons or vehicles onto the AOA. These areas should provide reasonable contractor employee access to the job site.

2.9.2.2 **Construction Equipment Parking.**

Contractor employees must park and service all construction vehicles in an area designated by the airport operator outside the OFZ and never in the safety area of an active runway or taxiway. Unless a complex setup procedure makes movement of specialized equipment infeasible, inactive equipment must not be parked on a closed taxiway or runway. If it is necessary to leave specialized equipment on a closed taxiway or runway at night, the equipment must be well lighted. Employees should also park construction vehicles outside the OFA when not in use by construction personnel (for example, overnight, on weekends, or during other periods when construction is not active). Parking areas must not obstruct the clear line of sight by the ATCT to any taxiways or runways under air traffic control nor obstruct any runway visual aids, signs, or navigation aids. The FAA must also study those areas to determine effects on airport design criteria, surfaces established by 14 CFR Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace (Part 77), and on NAVAIDs and Instrument Approach Procedures (IAP). See paragraph 2.13.1 for further information.

2.9.2.3 **Access and Haul Roads.**

Determine the construction contractor’s access to the construction sites and haul roads. Do not permit the construction contractor to use any access or haul roads other than those approved. Access routes used by contractor vehicles must be clearly marked to prevent inadvertent entry to areas open to airport operations. Pay special attention to ensure that if construction traffic is to share or cross any ARFF routes that ARFF right of way is not impeded at any time, and that construction traffic on haul

roads does not interfere with NAVAIDs or approach surfaces of operational runways. Address whether access gates will be blocked or inoperative or if a rally point will be blocked or inaccessible.

2.9.2.4 Marking and lighting of vehicles in accordance with AC 150/5210-5, *Painting, Marking, and Lighting of Vehicles Used on an Airport.*

2.9.2.5 Description of proper vehicle operations on various areas under normal, lost communications, and emergency conditions.

2.9.2.6 Required escorts.

2.9.2.7 **Training Requirements for Vehicle Drivers to Ensure Compliance with the Airport Operator's Vehicle Rules and Regulations.**

Specific training should be provided to vehicle operators, including those providing escorts. See AC 150/5210-20, *Ground Vehicle Operations on Airports*, for information on training and records maintenance requirements.

2.9.2.8 **Situational Awareness.**

Vehicle drivers must confirm by personal observation that no aircraft is approaching their position (either in the air or on the ground) when given clearance to cross a runway, taxiway, or any other area open to airport operations. In addition, it is the responsibility of the escort vehicle driver to verify the movement/position of all escorted vehicles at any given time. At non-towered airports, all aircraft movements and flight operations rely on aircraft operators to self-report their positions and intentions. However, there is no requirement for an aircraft to have radio communications. Because aircraft do not always broadcast their positions or intentions, visual checking, radio monitoring, and situational awareness of the surroundings is critical to safety.

2.9.2.9 **Two-Way Radio Communication Procedures.**

2.9.2.9.1 General.

The airport operator must ensure that tenant and construction contractor personnel engaged in activities involving unescorted operation on aircraft movement areas observe the proper procedures for communications, including using appropriate radio frequencies at airports with and without ATCT. When operating vehicles on or near open runways or taxiways, construction personnel must understand the critical importance of maintaining radio contact, as directed by the airport operator, with:

1. Airport operations
2. ATCT

3. Common Traffic Advisory Frequency (CTAF), which may include UNICOM, MULTICOM.
4. Automatic Terminal Information Service (ATIS). This frequency is useful for monitoring conditions on the airport. Local air traffic will broadcast information regarding construction related runway closures and "shortened" runways on the ATIS frequency.

2.9.2.9.2 Areas Requiring Two-Way Radio Communication with the ATCT.

Vehicular traffic crossing active movement areas must be controlled either by two-way radio with the ATCT, escort, flagman, signal light, or other means appropriate for the particular airport.

2.9.2.9.3 Frequencies to be Used.

The airport operator will specify the frequencies to be used by the contractor, which may include the CTAF for monitoring of aircraft operations. Frequencies may also be assigned by the airport operator for other communications, including any radio frequency in compliance with Federal Communications Commission requirements. At airports with an ATCT, the airport operator will specify the frequency assigned by the ATCT to be used between contractor vehicles and the ATCT.

2.9.2.9.4 Proper radio usage, including read back requirements.

2.9.2.9.5 Proper phraseology, including the International Phonetic Alphabet.

2.9.2.9.6 Light Gun Signals.

Even though radio communication is maintained, escort vehicle drivers must also familiarize themselves with ATCT light gun signals in the event of radio failure. See the FAA safety placard "Ground Vehicle Guide to Airport Signs and Markings." This safety placard may be downloaded through the Runway Safety Program Web site at http://www.faa.gov/airports/runway_safety/publications/ (see "Signs & Markings Vehicle Dashboard Sticker") or obtained from the FAA Airports Regional Office.

2.9.2.10 **Maintenance of the secured area of the airport, including:**

2.9.2.10.1 Fencing and Gates.

Airport operators and contractors must take care to maintain security during construction when access points are created in the security fencing to permit the passage of construction vehicles or personnel. Temporary gates should be equipped so they can be securely closed and locked to prevent access by animals and unauthorized people. Procedures should be in place to ensure that only authorized persons and vehicles have access to the AOA and to prohibit "piggybacking" behind another person or vehicle. The Department of Transportation (DOT) document DOT/FAA/AR-

00/52, *Recommended Security Guidelines for Airport Planning and Construction*, provides more specific information on fencing. A copy of this document can be obtained from the Airport Consultants Council, Airports Council International, or American Association of Airport Executives.

2.9.2.10.2 Badging Requirements.

Airports subject to 49 CFR Part 1542, *Airport Security*, must meet standards for access control, movement of ground vehicles, and identification of construction contractor and tenant personnel.

2.10 Wildlife Management.

The CSPP and SPCD must be in accordance with the airport operator's wildlife hazard management plan, if applicable. See AC 150/5200-33, *Hazardous Wildlife Attractants On or Near Airports,* and CertAlert 98-05, *Grasses Attractive to Hazardous Wildlife.* Construction contractors must carefully control and continuously remove waste or loose materials that might attract wildlife. Contractor personnel must be aware of and avoid construction activities that can create wildlife hazards on airports, such as:

2.10.1 Trash.

Food scraps must be collected from construction personnel activity.

2.10.2 Standing Water.

2.10.3 Tall Grass and Seeds.

Requirements for turf establishment can be at odds with requirements for wildlife control. Grass seed is attractive to birds. Lower quality seed mixtures can contain seeds of plants (such as clover) that attract larger wildlife. Seeding should comply with the guidance in AC 150/5370-10, *Standards for Specifying Construction of Airports,* Item T-901, Seeding. Contact the local office of the United Sates Department of Agriculture Soil Conservation Service or the State University Agricultural Extension Service (County Agent or equivalent) for assistance and recommendations. These agencies can also provide liming and fertilizer recommendations.

2.10.4 Poorly Maintained Fencing and Gates.

See paragraph 2.9.2.10.1.

2.10.5 Disruption of Existing Wildlife Habitat.

While this will frequently be unavoidable due to the nature of the project, the CSPP should specify under what circumstances (location, wildlife type) contractor personnel should immediately notify the airport operator of wildlife sightings.

2.11 Foreign Object Debris (FOD) Management.

Waste and loose materials, commonly referred to as FOD, are capable of causing damage to aircraft landing gears, propellers, and jet engines. Construction contractors must not leave or place FOD on or near active aircraft movement areas. Materials capable of creating FOD must be continuously removed during the construction project. Fencing (other than security fencing) or covers may be necessary to contain material that can be carried by wind into areas where aircraft operate. See AC 150/5210-24, *Foreign Object Debris (FOD) Management.*

2.12 Hazardous Materials (HAZMAT) Management.

Contractors operating construction vehicles and equipment on the airport must be prepared to expeditiously contain and clean-up spills resulting from fuel or hydraulic fluid leaks. Transport and handling of other hazardous materials on an airport also requires special procedures. See AC 150/5320-15, *Management of Airport Industrial Waste.*

2.13 Notification of Construction Activities.

The CSPP and SPCD must detail procedures for the immediate notification of airport users and the FAA of any conditions adversely affecting the operational safety of the airport. It must address the notification actions described below, as applicable.

2.13.1 List of Responsible Representatives/points of contact for all involved parties, and procedures for contacting each of them, including after hours.

2.13.2 NOTAMs.

Only the airport operator may initiate or cancel NOTAMs on airport conditions, and is the only entity that can close or open a runway. The airport operator must coordinate the issuance, maintenance, and cancellation of NOTAMs about airport conditions resulting from construction activities with tenants and the local air traffic facility (control tower, approach control, or air traffic control center), and must either enter the NOTAM into NOTAM Manager, or provide information on closed or hazardous conditions on airport movement areas to the FAA Flight Service Station (FSS) so it can issue a NOTAM. The airport operator must file and maintain a list of authorized representatives with the FSS. Refer to AC 150/5200-28, *Notices to Airmen (NOTAMs) for Airport Operators,* for a sample NOTAM form. Only the FAA may issue or cancel NOTAMs on shutdown or irregular operation of FAA owned facilities. Any person having reason to believe that a NOTAM is missing, incomplete, or inaccurate must notify the airport operator. See paragraph 2.7.1.1 about issuing NOTAMs for partially closed runways versus runways with displaced thresholds.

2.13.3 Emergency notification procedures for medical, fire fighting, and police response.

2.13.4 Coordination with ARFF.

The CSPP must detail procedures for coordinating through the airport sponsor with ARFF personnel, mutual aid providers, and other emergency services if construction requires:

1. The deactivation and subsequent reactivation of water lines or fire hydrants, or
2. The rerouting, blocking and restoration of emergency access routes, or
3. The use of hazardous materials on the airfield.

2.13.5 Notification to the FAA.

2.13.5.1 **Part 77.**

Any person proposing construction or alteration of objects that affect navigable airspace, as defined in Part 77, must notify the FAA. This includes construction equipment and proposed parking areas for this equipment (i.e., cranes, graders, other equipment) on airports. FAA Form 7460-1, *Notice of Proposed Construction or Alteration*, can be used for this purpose and submitted to the appropriate FAA Airports Regional or District Office. See Appendix A to download the form. Further guidance is available on the FAA web site at oeaaa.faa.gov.

2.13.5.2 **Part 157.**

With some exceptions, Title 14 CFR Part 157, *Notice of Construction, Alteration, Activation, and Deactivation of Airports*, requires that the airport operator notify the FAA in writing whenever a non-Federally funded project involves the construction of a new airport; the construction, realigning, altering, activating, or abandoning of a runway, landing strip, or associated taxiway; or the deactivation or abandoning of an entire airport. Notification involves submitting FAA Form 7480-1, *Notice of Landing Area Proposal*, to the nearest FAA Airports Regional or District Office. See Appendix A to download the form.

2.13.5.3 **NAVAIDs.**

For emergency (short-notice) notification about impacts to both airport owned and FAA owned NAVAIDs, contact: 866-432-2622.

2.13.5.3.1 Airport Owned/FAA Maintained.

If construction operations require a shutdown of 24 hours or greater in duration, or more than 4 hours daily on consecutive days, of a NAVAID owned by the airport but maintained by the FAA, provide a 45-day minimum notice to FAA ATO/Technical Operations prior to facility shutdown, using Strategic Event Coordination (SEC) Form 6000.26 contained within FAA Order 6000.15, *General Maintenance Handbook for National Airspace System (NAS) Facilities*.

2.13.5.3.2 FAA Owned.

1. The airport operator must notify the appropriate FAA ATO Service Area Planning and Requirements (P&R) Group a minimum of 45 days prior to implementing an event that causes impacts to NAVAIDs, using SEC Form 6000.26.
2. Coordinate work for an FAA owned NAVAID shutdown with the local FAA ATO/Technical Operations office, including any necessary reimbursable agreements and flight checks. Detail procedures that address unanticipated utility outages and cable cuts that could impact FAA NAVAIDs. Refer to active Service Level Agreement with ATO for specifics.

2.14 **Inspection Requirements.**

2.14.1 Daily Inspections.

Inspections should be conducted at least daily, but more frequently if necessary to ensure conformance with the CSPP. A sample checklist is provided in Appendix D, Construction Project Daily Safety Inspection Checklist. See also AC 150/5200-18, *Airport Safety Self-Inspection.* Airport operators holding a Part 139 certificate are required to conduct self-inspections during unusual conditions, such as construction activities, that may affect safe air carrier operations.

2.14.2 Interim Inspections.

Inspections should be conducted of all areas to be (re)opened to aircraft traffic to ensure the proper operation of lights and signs, for correct markings, and absence of FOD. The contractor should conduct an inspection of the work area with airport operations personnel. The contractor should ensure that all construction materials have been secured, all pavement surfaces have been swept clean, all transition ramps have been properly constructed, and that surfaces have been appropriately marked for aircraft to operate safely. Only if all items on the list meet with the airport operator's approval should the air traffic control tower be notified to open the area to aircraft operations. The contractor should be required to retain a suitable workforce and the necessary equipment at the work area for any last minute cleanup that may be requested by the airport operator prior to opening the area.

2.14.3 Final Inspections.

New runways and extended runway closures may require safety inspections at certificated airports prior to allowing air carrier service. Coordinate with the FAA Airport Certification Safety Inspector (ACSI) to determine if a final inspection will be necessary.

2.15 **Underground Utilities.**

The CSPP and/or SPCD must include procedures for locating and protecting existing underground utilities, cables, wires, pipelines, and other underground facilities in excavation areas. This may involve coordinating with public utilities and FAA ATO/Technical Operations. Note that "One Call" or "Miss Utility" services do not include FAA ATO/Technical Operations.

2.16 **Penalties.**

The CSPP should detail penalty provisions for noncompliance with airport rules and regulations and the safety plans (for example, if a vehicle is involved in a runway incursion). Such penalties typically include rescission of driving privileges or access to the AOA.

2.17 **Special Conditions.**

The CSPP must detail any special conditions that affect the operation of the airport and will require the activation of any special procedures (for example, low-visibility operations, snow removal, aircraft in distress, aircraft accident, security breach, Vehicle / Pedestrian Deviation (VPD) and other activities requiring construction suspension/resumption).

2.18 **Runway and Taxiway Visual Aids.**

This includes marking, lighting, signs, and visual NAVAIDs. The CSPP must ensure that areas where aircraft will be operating are clearly and visibly separated from construction areas, including closed runways. Throughout the duration of the construction project, verify that these areas remain clearly marked and visible at all times and that marking, lighting, signs, and visual NAVAIDs that are to continue to perform their functions during construction remain in place and operational. Visual NAVAIDs that are not serving their intended function during construction must be temporarily disabled, covered, or modified as necessary. The CSPP must address the following, as appropriate:

2.18.1 General.

Airport markings, lighting, signs, and visual NAVAIDs must be clearly visible to pilots, not misleading, confusing, or deceptive. All must be secured in place to prevent movement by prop wash, jet blast, wing vortices, and other wind currents and constructed of materials that will minimize damage to an aircraft in the event of inadvertent contact. Items used to secure such markings must be of a color similar to the marking.

2.18.2 Markings.

During the course of construction projects, temporary pavement markings are often required to allow for aircraft operations during or between work periods. During the design phase of the project, the designer should coordinate with the project manager,

airport operations, airport users, the FAA Airports project manager, and Airport Certification Safety Inspector for Part 139 airports to determine minimum temporary markings. The FAA Airports project manager will, wherever a runway is closed, coordinate with the appropriate FAA Flight Standards Office and disseminate findings to all parties. Where possible, the temporary markings on finish grade pavements should be placed to mirror the dimensions of the final markings. Markings must be in compliance with the standards of AC 150/5340-1, *Standards for Airport Markings*, except as noted herein. Runways and runway exit taxiways closed to aircraft operations are marked with a yellow X. The preferred visual aid to depict temporary runway closure is the lighted X signal placed on or near the runway designation numbers. (See paragraph 2.18.2.1.2.)

2.18.2.1 **Closed Runways and Taxiways.**

2.18.2.1.1 Permanently Closed Runways.

For runways, obliterate the threshold marking, runway designation marking, and touchdown zone markings, and place an X at each end and at 1,000-foot (300 m) intervals. For a multiple runway environment, if the lighted X on a designated number will be located in the RSA of an adjacent active runway, locate the lighted X farther down the closed runway to clear the RSA of the active runway. In addition, the closed runway numbers located in the RSA of an active runway must be marked with a flat yellow X.

2.18.2.1.2 Temporarily Closed Runways.

For runways that have been temporarily closed, place an X at each end of the runway directly on or as near as practicable to the runway designation numbers. For a multiple runway environment, if the lighted X on a designated number will be located in the RSA of an adjacent active runway, locate the lighted X farther down the closed runway to clear the RSA of the active runway. In addition, the closed runway numbers located in the RSA of an active runway must be marked with a flat yellow X. See Figure 2-3. See also paragraph 2.18.3.3.

2.18.2.1.3 Partially Closed Runways and Displaced Thresholds.

When threshold markings are needed to identify the temporary beginning of the runway that is available for landing, the markings must comply with AC 150/5340-1. An X is not used on a partially closed runway or a runway with a displaced threshold. See paragraph 2.7.1.1 for the difference between partially closed runways and runways with displaced thresholds. Because of the temporary nature of threshold displacement due to construction, it is not necessary to re-adjust the existing runway centerline markings to meet standard spacing for a runway with a visual approach. Some of the requirements below may be waived in the cases of low-activity airports and/or short duration changes that are measured in days rather than weeks. Consider whether the presence of an airport traffic

control tower allows for the development of special procedures. Contact the appropriate FAA Airports Regional or District Office for assistance.

Figure 2-3. Markings for a Temporarily Closed Runway

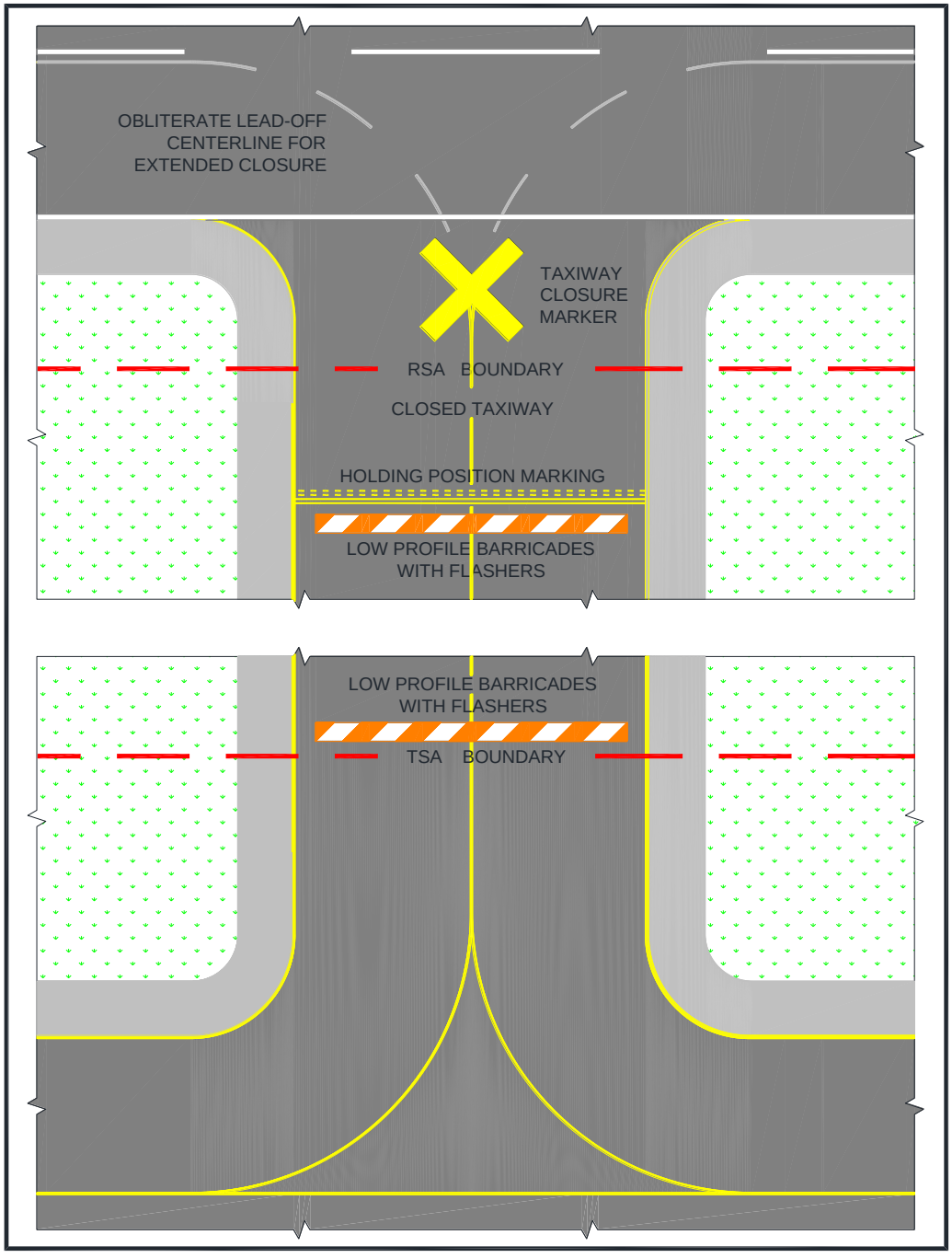
1. **Partially Closed Runways.** Pavement markings for temporary closed portions of the runway consist of a runway threshold bar, runway designation, and yellow chevrons to identify pavement areas that are unsuitable for takeoff or landing (see AC 150/5340-1). Obliterate or cover markings prior to the moved threshold. Existing touchdown zone markings beyond the moved threshold may remain in place. Obliterate aiming point markings. Issue appropriate NOTAMs regarding any nonstandard markings. See Figure 2-4.

2. **Displaced Thresholds.** Pavement markings for a displaced threshold consist of a runway threshold bar, runway designation, and white arrowheads with and without arrow shafts. These markings are required to identify the portion of the runway before the displaced threshold to provide centerline guidance for pilots during approaches, takeoffs, and landing rollouts from the opposite direction. See AC 150/5340-1. Obliterate markings prior to the displaced threshold. Existing touchdown zone markings beyond the displaced threshold may remain in place. Obliterate aiming point markings. Issue appropriate NOTAMs regarding any nonstandard markings. See Figure 2-2.

2.18.2.1.4 Taxiways.

1. **Permanently Closed Taxiways.** AC 150/5300-13 *Airport Design*, notes that it is preferable to remove the pavement, but for pavement that is to remain, place an X at the entrance to both ends of the closed section. Obliterate taxiway centerline markings, including runway leadoff lines, leading to the closed taxiway. See Figure 2-4.

Figure 2-4. Temporary Taxiway Closure



2. **Temporarily Closed Taxiways.** Place barricades outside the safety area of intersecting taxiways. For runway/taxiway intersections, place an X at the entrance to the closed taxiway from the runway. If the taxiway will be closed for an extended period, obliterate taxiway centerline markings, including runway leadoff lines and taxiway to taxiway turns, leading to the closed section. Always obliterate runway lead-off lines for high speed exits, regardless of the duration of the closure. If the centerline markings will be reused upon reopening the taxiway, it is preferable to paint over the marking. This will result in less damage to the pavement when the upper layer of paint is ultimately removed. See Figure 2-4.

2.18.2.1.5 Temporarily Closed Airport.

When the airport is closed temporarily, mark all the runways as closed.

2.18.2.2 If unable to paint temporary markings on the pavement, construct them from any of the following materials: fabric, colored plastic, painted sheets of plywood, or similar materials. They must be properly configured and appropriately secured to prevent movement by prop wash, jet blast, or other wind currents. Items used to secure such markings must be of a color similar to the marking.

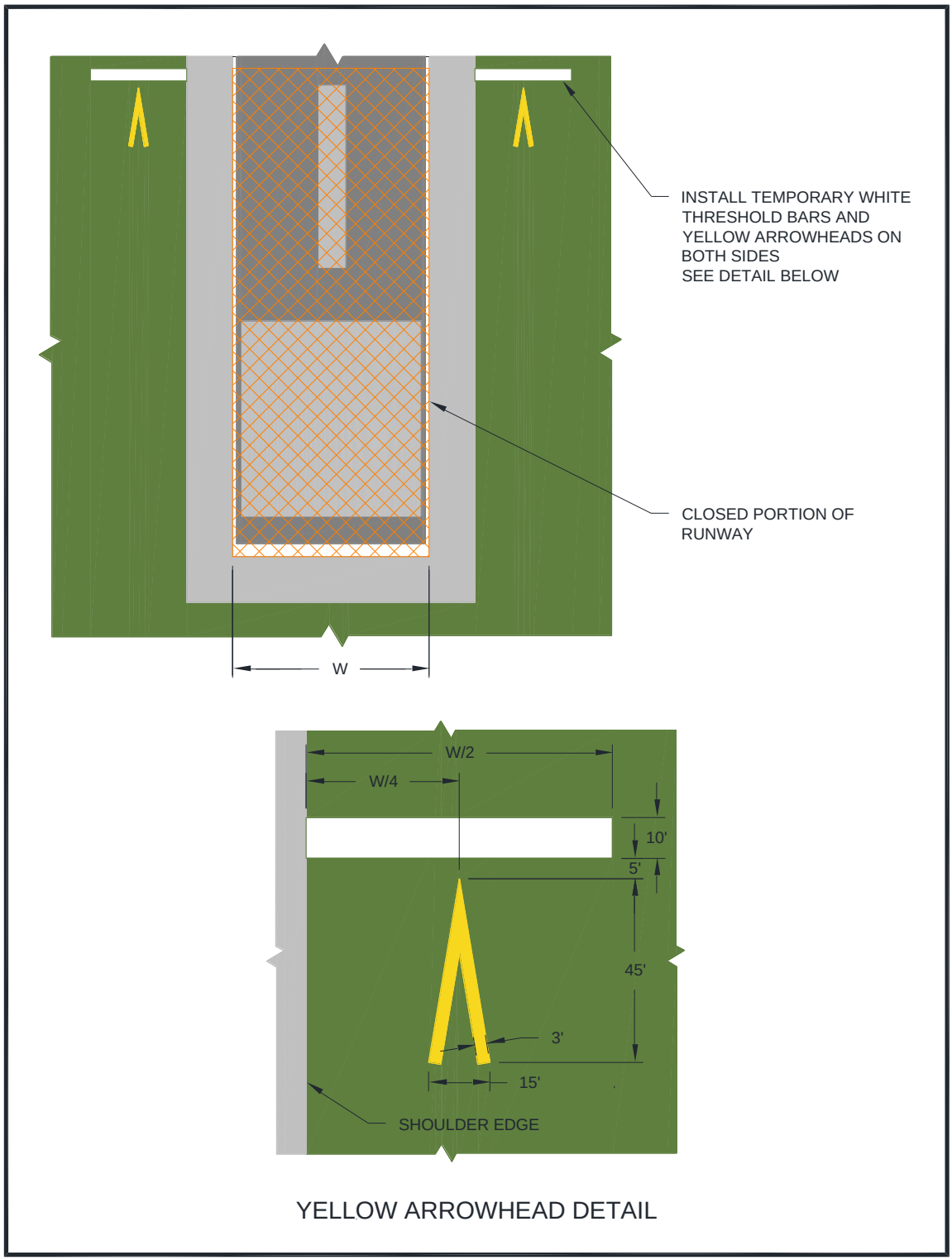
2.18.2.3 It may be necessary to remove or cover runway markings, including but not limited to, runway designation markings, threshold markings, centerline markings, edge stripes, touchdown zone markings and aiming point markings, depending on the length of construction and type of activity at the airport. When removing runway markings, apply the same treatment to areas between stripes or numbers, as the cleaned area will appear to pilots as a marking in the shape of the treated area.

2.18.2.4 If it is not possible to install threshold bars, chevrons, and arrows on the pavement, "temporary outboard white threshold bars and yellow arrowheads", see Figure 2-5, may be used. Locate them outside of the runway pavement surface on both sides of the runway. The dimensions must be as shown in Figure 2-5. If the markings are not discernible on grass or snow, apply a black background with appropriate material over the ground to ensure they are clearly visible.

2.18.2.5 The application rate of paint to mark a short-term temporary runway and taxiway markings may deviate from the standard (see Item P-620, "Runway and Taxiway Painting," in AC 150/5370-10), but the dimensions must meet the existing standards. When applying temporary markings at night, it is recommended that the fast curing, Type II paint be used to help offset the higher humidity and cooler temperatures often experienced at night. Diluting the paint will substantially increase cure time and is not recommended. Glass beads are not recommended for temporary markings. Striated markings may also be used for certain temporary markings. AC

150/5340-1, *Standards for Airport Markings*, has additional guidance on temporary markings.

Figure 2-5. Temporary Outboard White Threshold Bars and Yellow Arrowheads



2.18.3 Lighting and Visual NAVAIDs.

This paragraph refers to standard runway and taxiway lighting systems. See below for hazard lighting. Lighting installation must be in conformance with AC 150/5340-30, *Design and Installation Details for Airport Visual Aids,* and fixture design in conformance with AC 150/5345-50, *Specification for Portable Runway and Taxiway Lights.* When disconnecting runway and taxiway lighting fixtures, disconnect the associated isolation transformers. See AC 150/5340-26, *Maintenance of Airport Visual Aid Facilities*, for disconnect procedures and safety precautions. Alternately, cover the light fixture in such a way as to prevent light leakage. Avoid removing the lamp from energized fixtures because an excessive number of isolation transformers with open secondaries may damage the regulators and/or increase the current above its normal value. Secure, identify, and place any above ground temporary wiring in conduit to prevent electrocution and fire ignition sources. Maintain mandatory hold signs to operate normally in any situation where pilots or vehicle drivers could mistakenly be in that location. At towered airports certificated under Part 139, holding position signs are required to be illuminated on open taxiways crossing to closed or inactive runways. If the holding position sign is installed on the runway circuit for the closed runway, install a jumper to the taxiway circuit to provide power to the holding position sign for nighttime operations. Where it is not possible to maintain power to signs that would normally be operational, install barricades to exclude aircraft. Figure 2-1, Figure 2-2, Figure 2-3, and Figure 2-4 illustrate temporary changes to lighting and visual NAVAIDs.

2.18.3.1 **Permanently Closed Runways and Taxiways.**

For runways and taxiways that have been permanently closed, disconnect the lighting circuits.

2.18.3.2 **Temporarily Closed Runways and New Runways Not Yet Open to Air Traffic.**

If available, use a lighted X, both at night and during the day, placed at each end of the runway on or near the runway designation numbers facing the approach. (Note that the lighted X must be illuminated at all times that it is on a runway.) The use of a lighted X is required if night work requires runway lighting to be on. See AC 150/5345-55, *Specification for L-893, Lighted Visual Aid to Indicate Temporary Runway Closure.* For runways that have been temporarily closed, but for an extended period, and for those with pilot controlled lighting, disconnect the lighting circuits or secure switches to prevent inadvertent activation. For runways that will be opened periodically, coordinate procedures with the FAA air traffic manager or, at airports without an ATCT, the airport operator. Activate stop bars if available. Figure 2-6 shows a lighted X by day. Figure 2-7 shows a lighted X at night.

Figure 2-6. Lighted X in Daytime

Figure 2-7. Lighted X at Night

2.18.3.3 **Partially Closed Runways and Displaced Thresholds.**

When a runway is partially closed, a portion of the pavement is unavailable for any aircraft operation, meaning taxiing and landing or taking off in either direction. A displaced threshold, by contrast, is put in place to ensure obstacle clearance by landing aircraft. The pavement prior to the displaced threshold is available for takeoff in the direction of the displacement, and for landing and takeoff in the opposite direction. Misunderstanding this difference and issuance of a subsequently inaccurate NOTAM can result in a hazardous situation. For both partially

closed runways and displaced thresholds, approach lighting systems at the affected end must be placed out of service.

2.18.3.3.1 Partially Closed Runways.

Disconnect edge and threshold lights on that part of the runway at and behind the threshold (that is, the portion of the runway that is closed). Alternately, cover the light fixtures in such a way as to prevent light leakage. See Figure 2-1.

2.18.3.3.2 Temporary Displaced Thresholds.

Edge lighting in the area of the displacement emits red light in the direction of approach and yellow light (white for visual runways) in the opposite direction. If the displacement is 700 feet or less, blank out centerline lights in the direction of approach or place the centerline lights out of service. If the displacement is over 700 feet, place the centerline lights out of service. See AC 150/5340-30 for details on lighting displaced thresholds. See Figure 2-2.

2.18.3.3.3 Temporary runway thresholds and runway ends must be lighted if the runway is lighted and it is the intended threshold for night landings or instrument meteorological conditions.

2.18.3.3.4 A temporary threshold on an unlighted runway may be marked by retroreflective, elevated markers in addition to markings noted in paragraph 2.18.2.1.3. Markers seen by aircraft on approach are green. Markers at the rollout end of the runway are red. At certificated airports, temporary elevated threshold markers must be mounted with a frangible fitting (see 14 CFR Part 139.309). At non-certificated airports, the temporary elevated threshold markings may either be mounted with a frangible fitting or be flexible. See AC 150/5345-39, *Specification for L-853, Runway and Taxiway Retroreflective Markers.*

2.18.3.3.5 Temporary threshold lights and runway end lights and related visual NAVAIDs are installed outboard of the edges of the full-strength pavement only when they cannot be installed on the pavement. They are installed with bases at grade level or as low as possible, but not more than 3 inch (7.6 cm) above ground. (The standard above ground height for airport lighting fixtures is 14 inches (35 cm)). When any portion of a base is above grade, place properly compacted fill around the base to minimize the rate of gradient change so aircraft can, in an emergency, cross at normal landing or takeoff speeds without incurring significant damage. See AC 150/5370-10.

2.18.3.3.6 Maintain threshold and edge lighting color and spacing standards as described in AC 150/5340-30. Battery powered, solar, or portable lights that meet the criteria in AC 150/5345-50 may be used. These systems are intended primarily for visual flight rules (VFR) aircraft operations but may

be used for instrument flight rules (IFR) aircraft operations, upon individual approval from the Flight Standards Division of the applicable FAA Regional Office.

2.18.3.3.7 When runway thresholds are temporarily displaced, reconfigure yellow lenses (caution zone), as necessary, and place the centerline lights out of service.

2.18.3.3.8 Relocate the Visual Glide Slope Indicator (VGSI), such as Visual Approach Slope Indicator (VASI) and Precision Approach Path Indicator (PAPI); other airport lights, such as Runway End Identifier Lights (REIL); and approach lights to identify the temporary threshold. Another option is to disable the VGSI or any equipment that would give misleading indications to pilots as to the new threshold location. Installation of temporary visual aids may be necessary to provide adequate guidance to pilots on approach to the affected runway. If the FAA owns and operates the VGSI, coordinate its installation or disabling with the local ATO/Technical Operations Office. Relocation of such visual aids will depend on the duration of the project and the benefits gained from the relocation, as this can result in great expense. See FAA JO 6850.2, *Visual Guidance Lighting Systems,* for installation criteria for FAA owned and operated NAVAIDs.

2.18.3.3.9 Issue a NOTAM to inform pilots of temporary lighting conditions.

2.18.3.4 **Temporarily Closed Taxiways.**

If possible, deactivate the taxiway lighting circuits. When deactivation is not possible (for example other taxiways on the same circuit are to remain open), cover the light fixture in a way as to prevent light leakage.

2.18.4 Signs.

To the extent possible, signs must be in conformance with AC 150/5345-44, *Specification for Runway and Taxiway Signs*, and AC 150/5340-18, *Standard for Airport Sign Systems.*

2.18.4.1 **Existing Signs.**

Runway exit signs are to be covered for closed runway exits. Outbound destination signs are to be covered for closed runways. Any time a sign does not serve its normal function or would provide conflicting information, it must be covered or removed to prevent misdirecting pilots. Note that information signs identifying a crossing taxiway continue to perform their normal function even if the crossing taxiway is closed. For long term construction projects, consider relocating signs, especially runway distance remaining signs.

2.18.4.2 **Temporary Signs.**

Orange construction signs comprise a message in black on an orange background. Orange construction signs may help pilots be aware of changed conditions. The airport operator may choose to introduce these signs as part of a movement area construction project to increase situational awareness when needed. Locate signs outside the taxiway safety limits and ahead of construction areas so pilots can take timely action. Use temporary signs judiciously, striking a balance between the need for information and the increase in pilot workload. When there is a concern of pilot "information overload," the applicability of mandatory hold signs must take precedence over orange construction signs recommended during construction. Temporary signs must meet the standards for such signs in Engineering Brief 93, *Guidance for the Assembly and Installation of Temporary Orange Construction Signs.* Many criteria in AC 150/5345-44, *Specification for Runway and Taxiway Signs*, are referenced in the Engineering Brief. Permissible sign legends are:

1. CONSTRUCTION AHEAD,
2. CONSTRUCTION ON RAMP, and
3. RWY XX TAKEOFF RUN AVAILABLE XXX FT.

Phasing, supported by drawings and sign schedule, for the installation of orange construction signs must be included in the CSPP or SPCD.

2.18.4.2.1 Takeoff Run Available (TORA) signs.

Recommended: Where a runway has been shortened for takeoff, install orange TORA signs well before the hold lines, such as on a parallel taxiway prior to a turn to a runway hold position. See EB 93 for sign size and location.

2.18.4.2.2 Sign legends are shown in Figure F-1.

Note: See Figure E-1, Figure E-2, Figure E-3, Figure F-2, and Figure F-3 for examples of orange construction sign locations.

2.19 **Marking and Signs for Access Routes.**

The CSPP should indicate that pavement markings and signs for construction personnel will conform to AC 150/5340-18 and, to the extent practicable, with the Federal Highway Administration Manual on Uniform Traffic Control Devices (MUTCD) and/or State highway specifications. Signs adjacent to areas used by aircraft must comply with the frangibility requirements of AC 150/5220-23, *Frangible Connections*, which may require modification to size and height guidance in the MUTCD.

2.20 **Hazard Marking, Lighting and Signing.**

2.20.1 Hazard marking, lighting, and signing prevent pilots from entering areas closed to aircraft, and prevent construction personnel from entering areas open to aircraft. The CSPP must specify prominent, comprehensible warning indicators for any area affected by construction that is normally accessible to aircraft, personnel, or vehicles. Hazard marking and lighting must also be specified to identify open manholes, small areas under repair, stockpiled material, waste areas, and areas subject to jet blast. Also consider less obvious construction-related hazards and include markings to identify FAA, airport, and National Weather Service facilities cables and power lines; instrument landing system (ILS) critical areas; airport surfaces, such as RSA, OFA, and OFZ; and other sensitive areas to make it easier for contractor personnel to avoid these areas.

2.20.2 Equipment.

2.20.2.1 **Barricades.**

Low profile barricades, including traffic cones, (weighted or sturdily attached to the surface) are acceptable methods used to identify and define the limits of construction and hazardous areas on airports. Careful consideration must be given to selecting equipment that poses the least danger to aircraft but is sturdy enough to remain in place when subjected to typical winds, prop wash and jet blast. The spacing of barricades must be such that a breach is physically prevented barring a deliberate act. For example, if barricades are intended to exclude aircraft, gaps between barricades must be smaller than the wingspan of the smallest aircraft to be excluded; if barricades are intended to exclude vehicles, gaps between barricades must be smaller than the width of the excluded vehicles, generally 4 feet (1.2 meters). Provision must be made for ARFF access if necessary. If barricades are intended to exclude pedestrians, they must be continuously linked. Continuous linking may be accomplished through the use of ropes, securely attached to prevent FOD.

2.20.2.2 **Lights.**

Lights must be red, either steady burning or flashing, and must meet the luminance requirements of the State Highway Department. Batteries powering lights will last longer if lights flash. Lights must be mounted on barricades and spaced at no more than 10 feet (3 meters). Lights must be operated between sunset and sunrise and during periods of low visibility whenever the airport is open for operations. They may be operated by photocell, but this may require that the contractor turn them on manually during periods of low visibility during daytime hours.

2.20.2.3 **Supplement Barricades with Signs (for example) As Necessary.**

Examples are “No Entry” and “No Vehicles.” Be aware of the increased effects of wind and jet blast on barricades with attached signs.

2.20.2.4 **Air Operations Area – General.**

Barricades are not permitted in any active safety area or on the runway side of a runway hold line. Within a runway or taxiway object free area, and on aprons, use orange traffic cones, flashing or steady burning red lights as noted above, highly reflective collapsible barricades marked with diagonal, alternating orange and white stripes; and/or signs to separate all construction/maintenance areas from the movement area. Barricades may be supplemented with alternating orange and white flags at least 20 by 20 inch (50 by 50 cm) square and securely fastened to eliminate FOD. All barricades adjacent to any open runway or taxiway / taxilane safety area, or apron must be as low as possible to the ground, and no more than 18 inches high, exclusive of supplementary lights and flags. Barricades must be of low mass; easily collapsible upon contact with an aircraft or any of its components; and weighted or sturdily attached to the surface to prevent displacement from prop wash, jet blast, wing vortex, and other surface wind currents. If affixed to the surface, they must be frangible at grade level or as low as possible, but not to exceed 3 inch (7.6 cm) above the ground. Figure 2-8 and Figure 2-9 show sample barricades with proper coloring and flags.

Figure 2-8. Interlocking Barricades

Figure 2-9. Low Profile Barricades

2.20.2.5 **Air Operations Area – Runway/Taxiway Intersections.**

Use highly reflective barricades with lights to close taxiways leading to closed runways. Evaluate all operating factors when determining how to mark temporary closures that can last from 10 to 15 minutes to a much longer period of time. However, even for closures of relatively short duration, close all taxiway/runway intersections with barricades. The use of traffic cones is appropriate for short duration closures.

2.20.2.6 **Air Operations Area – Other.**

Beyond runway and taxiway object free areas and aprons, barricades intended for construction vehicles and personnel may be many different shapes and made from various materials, including railroad ties, sawhorses, jersey barriers, or barrels.

2.20.2.7 **Maintenance.**

The construction specifications must include a provision requiring the contractor to have a person on call 24 hours a day for emergency maintenance of airport hazard lighting and barricades. The contractor must file the contact person's information with the airport operator. Lighting should be checked for proper operation at least once per day, preferably at dusk.

2.21 Work Zone Lighting for Nighttime Construction.

Lighting equipment must adequately illuminate the work area if the construction is to be performed during nighttime hours. Refer to AC 150/5370-10 for minimum illumination levels for nighttime paving projects. Additionally, it is recommended that all support equipment, except haul trucks, be equipped with artificial illumination to safely

illuminate the area immediately surrounding their work areas. The lights should be positioned to provide the most natural color illumination and contrast with a minimum of shadows. The spacing must be determined by trial. Light towers should be positioned and adjusted to aim away from ATCT cabs and active runways to prevent blinding effects. Shielding may be necessary. Light towers should be removed from the construction site when the area is reopened to aircraft operations. Construction lighting units should be identified and generally located on the construction phasing plans in relationship to the ATCT and active runways and taxiways.

2.22 **Protection of Runway and Taxiway Safety Areas.**

Runway and taxiway safety areas, OFZs, OFAs, and approach surfaces are described in AC 150/5300-13. Protection of these areas includes limitations on the location and height of equipment and stockpiled material. An FAA airspace study may be required. Coordinate with the appropriate FAA Airports Regional or District Office if there is any doubt as to requirements or dimensions (see paragraph 2.13.5) as soon as the location and height of materials or equipment are known. The CSPP should include drawings showing all safety areas, object free areas, obstacle free zones and approach departure surfaces affected by construction.

2.22.1 Runway Safety Area (RSA).

A runway safety area is the defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway (see AC 150/5300-13). Construction activities within the existing RSA are subject to the following conditions:

2.22.1.1 No construction may occur within the existing RSA while the runway is open for aircraft operations. The RSA dimensions may be temporarily adjusted if the runway is restricted to aircraft operations requiring an RSA that is equal to the RSA width and length beyond the runway ends available during construction. (See AC 150/5300-13). The temporary use of declared distances and/or partial runway closures may provide the necessary RSA under certain circumstances. Coordinate with the appropriate FAA Airports Regional or District Office to have declared distances information published, and appropriate NOTAMs issued. See AC 150/5300-13 for guidance on the use of declared distances.

2.22.1.2 The airport operator must coordinate the adjustment of RSA dimensions as permitted above with the appropriate FAA Airports Regional or District Office and the local FAA air traffic manager and issue a NOTAM.

2.22.1.3 The CSPP and SPCD must provide procedures for ensuring adequate distance for protection from blasting operations, if required by operational considerations.

2.22.1.4 **Excavations.**

2.22.1.4.1 Open trenches or excavations are not permitted within the RSA while the runway is open. Backfill trenches before the runway is opened. If backfilling excavations before the runway must be opened is impracticable, cover the excavations appropriately. Covering for open trenches must be designed to allow the safe operation of the heaviest aircraft operating on the runway across the trench without damage to the aircraft.

2.22.1.4.2 Construction contractors must prominently mark open trenches and excavations at the construction site with red or orange flags, as approved by the airport operator, and light them with red lights during hours of restricted visibility or darkness.

2.22.1.5 **Erosion Control.**

Soil erosion must be controlled to maintain RSA standards, that is, the RSA must be cleared and graded and have no potentially hazardous ruts, humps, depressions, or other surface variations, and capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and fire fighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft.

2.22.2 Runway Object Free Area (ROFA).

Construction, including excavations, may be permitted in the ROFA. However, equipment must be removed from the ROFA when not in use, and material should not be stockpiled in the ROFA if not necessary. Stockpiling material in the OFA requires submittal of a 7460-1 form and justification provided to the appropriate FAA Airports Regional or District Office for approval.

2.22.3 Taxiway Safety Area (TSA).

2.22.3.1 A taxiway safety area is a defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway. (See AC 150/5300-13.) Since the width of the TSA is equal to the wingspan of the design aircraft, no construction may occur within the TSA while the taxiway is open for aircraft operations. The TSA dimensions may be temporarily adjusted if the taxiway is restricted to aircraft operations requiring a TSA that is equal to the TSA width available during construction. Give special consideration to TSA dimensions at taxiway turns and intersections. (see AC 150/5300-13).

2.22.3.2 The airport operator must coordinate the adjustment of the TSA width as permitted above with the appropriate FAA Airports Regional or District Office and the FAA air traffic manager and issue a NOTAM.

2.22.3.3 The CSPP and SPCD must provide procedures for ensuring adequate distance for protection from blasting operations.

2.22.3.4 **Excavations.**

1. Curves. Open trenches or excavations are not permitted within the TSA while the taxiway is open. Trenches should be backfilled before the taxiway is opened. If backfilling excavations before the taxiway must be opened is impracticable, cover the excavations appropriately. Covering for open trenches must be designed to allow the safe operation of the heaviest aircraft operating on the taxiway across the trench without damage to the aircraft.
2. Straight Sections. Open trenches or excavations are not permitted within the TSA while the taxiway is open for unrestricted aircraft operations. Trenches should be backfilled before the taxiway is opened. If backfilling excavations before the taxiway must be opened is impracticable, cover the excavations to allow the safe passage of ARFF equipment and of the heaviest aircraft operating on the taxiway across the trench without causing damage to the equipment or aircraft. In rare circumstances where the section of taxiway is indispensable for aircraft movement, open trenches or excavations may be permitted in the TSA while the taxiway is open to aircraft operations, subject to the following restrictions:
    a. Taxiing speed is limited to 10 mph.
    b. Appropriate NOTAMs are issued.
    c. Marking and lighting meeting the provisions of paragraphs 2.18 and 2.20 are implemented.
    d. Low mass, low-profile lighted barricades are installed.
    e. Appropriate temporary orange construction signs are installed.
3. Construction contractors must prominently mark open trenches and excavations at the construction site with red or orange flags, as approved by the airport operator, and light them with red lights during hours of restricted visibility or darkness.

2.22.3.5 **Erosion control.**

Soil erosion must be controlled to maintain TSA standards, that is, the TSA must be cleared and graded and have no potentially hazardous ruts, humps, depressions, or other surface variations, and capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and firefighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft.

2.22.4 Taxiway Object Free Area (TOFA).

Unlike the Runway Object Free Area, aircraft wings regularly penetrate the taxiway object free area during normal operations. Thus, the restrictions are more stringent. Except as provided below, no construction may occur within the taxiway object free area while the taxiway is open for aircraft operations.

2.22.4.1 The taxiway object free area dimensions may be temporarily adjusted if the taxiway is restricted to aircraft operations requiring a taxiway object free area that is equal to the taxiway object free area width available. Give special consideration to TOFA dimensions at taxiway turns and intersections.

2.22.4.2 Offset taxiway centerline and edge pavement markings (do not use glass beads) may be used as a temporary measure to provide the required taxiway object free area. Where offset taxiway pavement markings are provided, centerline lighting, centerline reflectors, or taxiway edge reflectors are required. Existing lighting that does not coincide with the temporary markings must be taken out of service.

2.22.4.3 Construction activity, including open excavations, may be accomplished without adjusting the width of the taxiway object free area, subject to the following restrictions:

2.22.4.3.1 Taxiing speed is limited to 10 mph.

2.22.4.3.2 NOTAMs issued advising taxiing pilots of hazard and recommending reduced taxiing speeds on the taxiway.

2.22.4.3.3 Marking and lighting meeting the provisions of paragraphs 2.18 and 2.20 are implemented.

2.22.4.3.4 If desired, appropriate orange construction signs are installed. See paragraph 2.18.4.2 and Appendix F.

2.22.4.3.5 Five-foot clearance is maintained between equipment and materials and any part of an aircraft (includes wingtip overhang). If such clearance can only be maintained if an aircraft does not have full use of the entire taxiway width (with its main landing gear at the edge of the usable pavement), then it will be necessary to move personnel and equipment for the passage of that aircraft.

2.22.4.3.6 Flaggers furnished by the contractor must be used to direct and control construction equipment and personnel to a pre-established setback distance for safe passage of aircraft, and airline and/or airport personnel. Flaggers must also be used to direct taxiing aircraft. Due to liability issues, the airport operator should require airlines to provide flaggers for directing taxiing aircraft.

2.22.5 Obstacle Free Zone (OFZ).

In general, personnel, material, and/or equipment may not penetrate the OFZ while the runway is open for aircraft operations. If a penetration to the OFZ is necessary, it may be possible to continue aircraft operations through operational restrictions. Coordinate with the FAA through the appropriate FAA Airports Regional or District Office.

2.22.6 Runway Approach/Departure Areas and Clearways.

All personnel, materials, and/or equipment must remain clear of the applicable threshold siting surfaces, as defined in AC 150/5300-13. Objects that do not penetrate these surfaces may still be obstructions to air navigation and may affect standard instrument approach procedures. Coordinate with the FAA through the appropriate FAA Airports Regional or District Office.

2.22.6.1 Construction activity in a runway approach/departure area may result in the need to partially close a runway or displace the existing runway threshold. Partial runway closure, displacement of the runway threshold, as well as closure of the complete runway and other portions of the movement area also require coordination through the airport operator with the appropriate FAA air traffic manager (FSS if non-towered) and ATO/Technical Operations (for affected NAVAIDS) and airport users.

2.22.6.2 **Caution About Partial Runway Closures.**

When filing a NOTAM for a partial runway closure, clearly state that the portion of pavement located prior to the threshold is not available for landing and departing traffic. In this case, the threshold has been moved for both landing and takeoff purposes (this is different than a displaced threshold). There may be situations where the portion of closed runway is available for taxiing only. If so, the NOTAM must reflect this condition).

2.22.6.3 **Caution About Displaced Thresholds.**

Implementation of a displaced threshold affects runway length available for aircraft landing over the displacement. Depending on the reason for the displacement (to provide obstruction clearance or RSA), such a displacement may also require an adjustment in the landing distance available and accelerate-stop distance available in the opposite direction. If project scope includes personnel, equipment, excavation, or other work within the existing RSA of any usable runway end, do not implement a displaced threshold unless arrivals and departures toward the construction activity are prohibited. Instead, implement a partial closure.

2.23 **Other Limitations on Construction.**

The CSPP must specify any other limitations on construction, including but not limited to:

2.23.1 Prohibitions.

2.23.1.1 No use of tall equipment (cranes, concrete pumps, and so on) unless a 7460-1 determination letter is issued for such equipment.

2.23.1.2 No use of open flame welding or torches unless fire safety precautions are provided and the airport operator has approved their use.

2.23.1.3 No use of electrical blasting caps on or within 1,000 feet (300 meters) of the airport property. See AC 150/5370-10.

2.23.2 Restrictions.

2.23.2.1 Construction suspension required during specific airport operations.

2.23.2.2 Areas that cannot be worked on simultaneously.

2.23.2.3 Day or night construction restrictions.

2.23.2.4 Seasonal construction restrictions.

2.23.2.5 Temporary signs not approved by the airport operator.

2.23.2.6 Grades changes that could result in unplanned effects on NAVAIDs.

CHAPTER 3. GUIDELINES FOR WRITING A CSPP

3.1 General Requirements.

The CSPP is a standalone document written to correspond with the subjects outlined in paragraph 2.4. The CSPP is organized by numbered sections corresponding to each subject listed in paragraph 2.4, and described in detail in paragraphs 2.5 - 2.23. Each section number and title in the CSPP matches the corresponding subject outlined in paragraph 2.4 (for example, 1. Coordination, 2. Phasing, 3. Areas and Operations Affected by the Construction Activity, and so on). With the exception of the project scope of work outlined in Section 2. Phasing, only subjects specific to operational safety during construction should be addressed.

3.2 Applicability of Subjects.

Each section should, to the extent practical, focus on the specific subject. Where an overlapping requirement spans several sections, the requirement should be explained in detail in the most applicable section. A reference to that section should be included in all other sections where the requirement may apply. For example, the requirement to protect existing underground FAA ILS cables during trenching operations could be considered FAA ATO coordination (Coordination, paragraph 2.5.3), an area and operation affected by the construction activity (Areas and Operations Affected by the Construction Activity, paragraph 2.7.1.4), a protection of a NAVAID (Protection of Navigational Aids (NAVAIDs), paragraph 2.8), or a notification to the FAA of construction activities (Notification of Construction Activities, paragraph 2.13.5.3.2). However, it is more specifically an underground utility requirement (Underground Utilities, paragraph 2.15). The procedure for protecting underground ILS cables during trenching operations should therefore be described in 2.4.2.11: "The contractor must coordinate with the local FAA System Support Center (SSC) to mark existing ILS cable routes along Runway 17-35. The ILS cables will be located by hand digging whenever the trenching operation moves within 10 feet of the cable markings." All other applicable sections should include a reference to 2.4.2.11: "ILS cables shall be identified and protected as described in 2.4.2.11" or "See 2.4.2.11 for ILS cable identification and protection requirements." Thus, the CSPP should be considered as a whole, with no need to duplicate responses to related issues.

3.3 Graphical Representations.

Construction safety drawings should be included in the CSPP as attachments. When other graphical representations will aid in supporting written statements, the drawings, diagrams, and/or photographs should also be attached to the CSPP. References should be made in the CSPP to each graphical attachment and may be made in multiple sections.

3.4 **Reference Documents.**

The CSPP must not incorporate a document by reference unless reproduction of the material in that document is prohibited. In that case, either copies of or a source for the referenced document must be provided to the contractor. Where this AC recommends references (e.g. as in paragraph 3.9) the intent is to include a reference to the corresponding section in the CSPP, not to this Advisory Circular.

3.5 **Restrictions.**

The CSPP should not be considered as a project design review document. The CSPP should also avoid mention of permanent ("as-built") features such as pavements, markings, signs, and lighting, except when such features are intended to aid in maintaining operational safety during the construction.

3.6 **Coordination.**

Include in this section a detailed description of conferences and meetings to be held both before and during the project. Include appropriate information from AC 150/5370-12. Discuss coordination procedures and schedules for each required FAA ATO Technical Operations shutdown and restart and all required flight inspections.

3.7 **Phasing.**

Include in this section a detailed scope of work description for the project as a whole and each phase of work covered by the CSPP. This includes all locations and durations of the work proposed. Attach drawings to graphically support the written scope of work. Detail in this section the sequenced phases of the proposed construction. Include a reference to paragraph 3.8, as appropriate.

3.8 **Areas and Operations Affected by Construction.**

Focus in this section on identifying the areas and operations affected by the construction. Describe corresponding mitigation that is not covered in detail elsewhere in the CSPP. Include references to paragraphs below as appropriate. Attach drawings as necessary to graphically describe affected areas and mechanisms proposed. See Appendix F for sample operational effects tables and figures.

3.9 **NAVAID Protection.**

List in this section all NAVAID facilities that will be affected by the construction. Identify NAVAID facilities that will be placed out of service at any time prior to or during construction activities. Identify individuals responsible for coordinating each shutdown and when each facility will be out of service. Include a reference to paragraph 3.6 for FAA ATO NAVAID shutdown, restart, and flight inspection coordination. Outline in detail procedures to protect each NAVAID facility remaining in service from interference by construction activities. Include a reference to paragraph 3.14 for the

issuance of NOTAMs as required. Include a reference to paragraph 3.16 for the protection of underground cables and piping serving NAVAIDs. If temporary visual aids are proposed to replace or supplement existing facilities, include a reference to paragraph 3.19. Attach drawings to graphically indicate the affected NAVAIDS and the corresponding critical areas.

3.10 **Contractor Access.**

This will necessarily be the most extensive section of the CSPP. Provide sufficient detail so that a contractor not experienced in working on airports will understand the unique restrictions such work will require. Due to this extent, it should be broken down into subsections as described below:

3.10.1 Location of Stockpiled Construction Materials.

Describe in this section specific locations for stockpiling material. Note any height restrictions on stockpiles. Include a reference to paragraph 3.21 for hazard marking and lighting devices used to identify stockpiles. Include a reference to paragraph 3.11 for provisions to prevent stockpile material from becoming wildlife attractants. Include a reference to paragraph 3.12 for provisions to prevent stockpile material from becoming FOD. Attach drawings to graphically indicate the stockpile locations.

3.10.2 Vehicle and Pedestrian Operations.

While there are many items to be addressed in this major subsection of the CSPP, all are concerned with one main issue: keeping people and vehicles from areas of the airport where they don't belong. This includes preventing unauthorized entry to the AOA and preventing the improper movement of pedestrians or vehicles on the airport. In this section, focus on mechanisms to prevent construction vehicles and workers traveling to and from the worksite from unauthorized entry into movement areas. Specify locations of parking for both employee vehicles and construction equipment, and routes for access and haul roads. In most cases, this will best be accomplished by attaching a drawing. Quote from AC 150/5210-5 specific requirements for contractor vehicles rather than referring to the AC as a whole, and include special requirements for identifying HAZMAT vehicles. Quote from, rather than incorporate by reference, AC 150/5210-20 as appropriate to address the airport's rules for ground vehicle operations, including its training program. Discuss the airport's recordkeeping system listing authorized vehicle operators.

3.10.3 Two-Way Radio Communications.

Include a special section to identify all individuals who are required to maintain communications with Air Traffic (AT) at airports with active towers, or monitor CTAF at airports without or with closed ATCT. Include training requirements for all individuals required to communicate with AT. Individuals required to monitor AT frequencies should also be identified. If construction employees are also required to communicate by radio with Airport Operations, this procedure should be described in detail. Usage of vehicle mounted radios and/or portable radios should be addressed. Communication procedures for the event of disabled radio communication (that is, light

signals, telephone numbers, others) must be included. All radio frequencies should by identified (Tower, Ground Control, CTAF, UNICOM, ATIS, and so on).

3.10.4 Airport Security.

Address security as it applies to vehicle and pedestrian operations. Discuss TSA requirements, security badging requirements, perimeter fence integrity, gate security, and other needs. Attach drawings to graphically indicate secured and/or Security Identification Display Areas (SIDA), perimeter fencing, and available access points.

3.11 **Wildlife Management.**

Discuss in this section wildlife management procedures. Describe the maintenance of existing wildlife mitigation devices, such as perimeter fences, and procedures to limit wildlife attractants. Include procedures to notify Airport Operations of wildlife encounters. Include a reference to paragraph 3.10 for security (wildlife) fence integrity maintenance as required.

3.12 **FOD Management.**

In this section, discuss methods to control and monitor FOD: worksite housekeeping, ground vehicle tire inspections, runway sweeps, and so on. Include a reference to paragraph 3.15 for inspection requirements as required.

3.13 **HAZMAT Management.**

Describe in this section HAZMAT management procedures: fuel deliveries, spill recovery procedures, Safety Data Sheet (SDS), Material Safety Data Sheet (MSDS) or Product Safety Data Sheet (PSDS) availability, and other considerations. Any specific airport HAZMAT restrictions should also be identified. Include a reference to paragraph 3.10 for HAZMAT vehicle identification requirements. Quote from, rather than incorporate by reference, AC 150/5320-15.

3.14 **Notification of Construction Activities.**

List in this section the names and telephone numbers of points of contact for all parties affected by the construction project. We recommend a single list that includes all telephone numbers required under this section. Include emergency notification procedures for all representatives of all parties potentially impacted by the construction. Identify individual representatives – and at least one alternate – for each party. List both on-duty and off-duty contact information for each individual, including individuals responsible for emergency maintenance of airport construction hazard lighting and barricades. Describe procedures to coordinate immediate response to events that might adversely affect the operational safety of the airport (such as interrupted NAVAID service). Explain requirements for and the procedures for the issuance of Notices to Airmen (NOTAMs), notification to FAA required by 14 CFR Part 77 and Part 157 and in the event of affected NAVAIDs. For NOTAMs, identify an individual, and at least one alternate, responsible for issuing and cancelling each specific type of Notice to

Airmen (NOTAM) required. Detail notification methods for police, fire fighting, and medical emergencies. This may include 911, but should also include direct phone numbers of local police departments and nearby hospitals. Identify the E911 address of the airport and the emergency access route via haul roads to the construction site. Require the contractor to have this information available to all workers. The local Poison Control number should be listed. Procedures regarding notification of Airport Operations and/or the ARFF Department of such emergencies should be identified, as applicable. If airport radio communications are identified as a means of emergency notification, include a reference to paragraph 3.10. Differentiate between emergency and nonemergency notification of ARFF personnel, the latter including activities that affect ARFF water supplies and access roads. Identify the primary ARFF contact person and at least one alternate. If notification is to be made through Airport Operations, then detail this procedure. Include a method of confirmation from the ARFF department.

3.15 **Inspection Requirements.**

Describe in this section inspection requirements to ensure airfield safety compliance. Include a requirement for routine inspections by the resident engineer (RE) or other airport operator's representative and the construction contractors. If the engineering consultants and/or contractors have a Safety Officer who will conduct such inspections, identify this individual. Describe procedures for special inspections, such as those required to reopen areas for aircraft operations. Part 139 requires daily airfield inspections at certificated airports, but these may need to be more frequent when construction is in progress. Discuss the role of such inspections on areas under construction. Include a requirement to immediately remedy any deficiencies, whether caused by negligence, oversight, or project scope change.

3.16 **Underground Utilities.**

Explain how existing underground utilities will be located and protected. Identify each utility owner and include contact information for each company/agency in the master list. Address emergency response procedures for damaged or disrupted utilities. Include a reference to paragraph 3.14 for notification of utility owners of accidental utility disruption as required.

3.17 **Penalties.**

Describe in this section specific penalties imposed for noncompliance with airport rules and regulations, including the CSPP: SIDA violations, VPD, and others.

3.18 **Special Conditions.**

Identify any special conditions that may trigger specific safety mitigation actions outlined in this CSPP: low visibility operations, snow removal, aircraft in distress, aircraft accident, security breach, VPD, and other activities requiring construction suspension/resumption. Include a reference to paragraph 3.10 for compliance with airport safety and security measures and for radio communications as required. Include

a reference to paragraph 3.14 for emergency notification of all involved parties, including police/security, ARFF, and medical services.

3.19 **Runway and Taxiway Visual Aids.**

Include marking, lighting, signs, and visual NAVAIDS. Detail temporary runway and taxiway marking, lighting, signs, and visual NAVAIDs required for the construction. Discuss existing marking, lighting, signs, and visual NAVAIDs that are temporarily, altered, obliterated, or shut down. Consider non-federal facilities and address requirements for reimbursable agreements necessary for alteration of FAA facilities and for necessary flight checks. Identify temporary TORA signs or runway distance remaining signs if appropriate. Identify required temporary visual NAVAIDs such as REIL or PAPI. Quote from, rather than incorporate by reference, AC 150/5340-1, *Standards for Airport Markings;* AC 150/5340-18, *Standards for Airport Sign Systems;* and AC 150/5340-30, as required. Attach drawings to graphically indicate proposed marking, lighting, signs, and visual NAVAIDs.

3.20 **Marking and Signs for Access Routes.**

Detail plans for marking and signs for vehicle access routes. To the extent possible, signs should be in conformance with the Federal Highway Administration MUTCD and/or State highway specifications, not hand lettered. Detail any modifications to the guidance in the MUTCD necessary to meet frangibility/height requirements.

3.21 **Hazard Marking and Lighting.**

Specify all marking and lighting equipment, including when and where each type of device is to be used. Specify maximum gaps between barricades and the maximum spacing of hazard lighting. Identify one individual and at least one alternate responsible for maintenance of hazard marking and lighting equipment in the master telephone list. Include a reference to paragraph 3.14. Attach drawings to graphically indicate the placement of hazard marking and lighting equipment.

3.22 **Work Zone Lighting for Nighttime Construction.**

If work is to be conducted at night, specify all lighting equipment, including when and where each type of device is to be used. Indicate the direction lights are to be aimed and any directions that aiming of lights is prohibited. Specify any shielding necessary in instances where aiming is not sufficient to prevent interference with air traffic control and aircraft operations. Attach drawings to graphically indicate the placement and aiming of lighting equipment. Where the plan only indicates directions that aiming of lights is prohibited, the placement and positioning of portable lights must be proposed by the Contractor and approved by the airport operator’s representative each time lights are relocated or repositioned.

3.23 **Protection of Runway and Taxiway Safety Areas.**

This section should focus exclusively on procedures for protecting all safety areas, including those altered by the construction: methods of demarcation, limit of access, movement within safety areas, stockpiling and trenching restrictions, and so on. Reference AC 150/5300-13, as required. Include a reference to paragraph 3.10 for procedures regarding vehicle and personnel movement within safety areas. Include a reference to paragraph 3.10 for material stockpile restrictions as required. Detail requirements for trenching, excavations, and backfill. Include a reference to paragraph 3.21 for hazard marking and lighting devices used to identify open excavations as required. If runway and taxiway closures are proposed to protect safety areas, or if temporary displaced thresholds and/or revised declared distances are used to provide the required Runway Safety Area, include a reference to paragraphs 3.14 and 3.19. Detail procedures for protecting the runway OFZ, runway OFA, taxiway OFA and runway approach surfaces including those altered by the construction: methods of demarcation, limit of cranes, storage of equipment, and so on. Quote from, rather than incorporate by reference, AC 150/5300-13, as required. Include a reference to paragraph 3.24 for height (i.e., crane) restrictions as required. One way to address the height of equipment that will move during the project is to establish a three-dimensional "box" within which equipment will be confined that can be studied as a single object. Attach drawings to graphically indicate the safety area, OFZ, and OFA boundaries.

3.24 **Other Limitations on Construction.**

This section should describe what limitations must be applied to each area of work and when each limitation will be applied: limitations due to airport operations, height (i.e., crane) restrictions, areas which cannot be worked at simultaneously, day/night work restrictions, winter construction, and other limitations. Include a reference to paragraph 3.7 for project phasing requirements based on construction limitations as required.

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APPENDIX A. RELATED READING MATERIAL

Obtain the latest version of the following free publications from the FAA on its Web site at http://www.faa.gov/airports/.

Table A-1. FAA Publications

Number	Title and Description
AC 150/5200-28	*Notices to Airmen (NOTAMs) for Airport Operators* Guidance for using the NOTAM System in airport reporting.
AC 150/5200-30	*Airport Field Condition Assessments and Winter Operations Safety* Guidance for airport owners/operators on the development of an acceptable airport snow and ice control program and on appropriate field condition reporting procedures.
AC 150/5200-33	*Hazardous Wildlife Attractants On or Near Airports* Guidance on locating certain land uses that might attract hazardous wildlife to public-use airports.
AC 150/5210-5	*Painting, Marking, and Lighting of Vehicles Used on an Airport* Guidance, specifications, and standards for painting, marking, and lighting vehicles operating in the airport air operations areas.
AC 150/5210-20	*Ground Vehicle Operations to include Taxiing or Towing an Aircraft on Airports* Guidance to airport operators on developing ground vehicle operation training programs.
AC 150/5300-13	*Airport Design* FAA standards and recommendations for airport design. Establishes approach visibility minimums as an airport design parameter, and contains the Object Free area and the obstacle free-zone criteria.
AC 150/5210-24	*Airport Foreign Object Debris (FOD) Management* Guidance for developing and managing an airport foreign object debris (FOD) program

Number	Title and Description
AC 150/5320-15	*Management of Airport Industrial Waste* Basic information on the characteristics, management, and regulations of industrial wastes generated at airports. Guidance for developing a Storm Water Pollution Prevention Plan (SWPPP) that applies best management practices to eliminate, prevent, or reduce pollutants in storm water runoff with particular airport industrial activities.
AC 150/5340-1	*Standards for Airport Markings* FAA standards for the siting and installation of signs on airport runways and taxiways.
AC 150/5340-18	*Standards for Airport Sign Systems* FAA standards for the siting and installation of signs on airport runways and taxiways.
AC 150/5345-28	*Precision Approach Path Indicator (PAPI) Systems* FAA standards for PAPI systems, which provide pilots with visual glide slope guidance during approach for landing.
AC 150/5340-30	*Design and Installation Details for Airport Visual Aids* Guidance and recommendations on the installation of airport visual aids.
AC 150/5345-39	*Specification for L-853, Runway and Taxiway Retroreflective Markers*
AC 150/5345-44	*Specification for Runway and Taxiway Signs* FAA specifications for unlighted and lighted signs for taxiways and runways.
AC 150/5345-53	*Airport Lighting Equipment Certification Program* Details on the Airport Lighting Equipment Certification Program (ALECP).
AC 150/5345-50	*Specification for Portable Runway and Taxiway Lights* FAA standards for portable runway and taxiway lights and runway end identifier lights for temporary use to permit continued aircraft operations while all or part of a runway lighting system is inoperative.
AC 150/5345-55	*Specification for L-893, Lighted Visual Aid to Indicate Temporary Runway Closure*

Number	Title and Description
AC 150/5370-10	*Standards for Specifying Construction of Airports* Standards for construction of airports, including earthwork, drainage, paving, turfing, lighting, and incidental construction.
AC 150/5370-12	*Quality Management for Federally Funded Airport Construction Projects*
EB 93	*Guidance for the Assembly and Installation of Temporary Orange Construction Signs*
FAA Order 5200.11	FAA Airports (ARP) Safety Management System (SMS) Basics for implementing SMS within ARP. Includes roles and responsibilities of ARP management and staff as well as other FAA lines of business that contribute to the ARP SMS.
FAA Certalert 98-05	*Grasses Attractive to Hazardous Wildlife* Guidance on grass management and seed selection.
FAA Form 7460-1	Notice of Proposed Construction or Alteration
FAA Form 7480-1	Notice of Landing Area Proposal
FAA Form 6000.26	National NAS Strategic Interruption Service Level Agreement, Strategic Events Coordination, Airport Sponsor Form

Obtain the latest version of the following free publications from the Electronic Code of Federal Regulations at http://www.ecfr.gov/.

Table A-2. Code of Federal Regulation

Number	Title
Title 14 CFR Part 77	Safe, Efficient Use and Preservation of the Navigable Airspace
Title 14 CFR Part 139	Certification of Airports
Title 49 CFR Part 1542	Airport Security

Obtain the latest version of the Manual on Uniform Traffic Control Devices from the Federal Highway Administration at http://mutcd.fhwa.dot.gov/.

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APPENDIX B. TERMS AND ACRONYMS

Table B-1. Terms and Acronyms

Term	Definition
Form 7460-1	Notice of Proposed Construction or Alteration. For on-airport projects, the form submitted to the FAA regional or airports division office as formal written notification of any kind of construction or alteration of objects that affect navigable airspace, as defined in 14 CFR Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*. (See guidance available on the FAA web site at https://oeaaa.faa.gov.) The form may be downloaded at http://www.faa.gov/airports/resources/forms/, or filed electronically at: https://oeaaa.faa.gov.
Form 7480-1	Notice of Landing Area Proposal. Form submitted to the FAA Airports Regional Division Office or Airports District Office as formal written notification whenever a project without an airport layout plan on file with the FAA involves the construction of a new airport; the construction, realigning, altering, activating, or abandoning of a runway, landing strip, or associated taxiway; or the deactivation or abandoning of an entire airport The form may be downloaded at http://www.faa.gov/airports/resources/forms/.
Form 6000-26	Airport Sponsor Strategic Event Submission Form
AC	Advisory Circular
ACSI	Airport Certification Safety Inspector
ADG	Airplane Design Group
AIP	Airport Improvement Program
ALECP	Airport Lighting Equipment Certification Program
ANG	Air National Guard
AOA	Air Operations Area, as defined in 14 CFR Part 107. Means a portion of an airport, specified in the airport security program, in which security measures are carried out. This area includes aircraft movement areas, aircraft parking areas, loading ramps, and safety areas, and any adjacent areas (such as general aviation areas) that are not separated by adequate security systems, measures, or procedures. This area does not include the secured area of the airport terminal building.
ARFF	Aircraft Rescue and Fire Fighting
ARP	FAA Office of Airports
ASDA	Accelerate-Stop Distance Available
AT	Air Traffic
ATCT	Airport Traffic Control Tower
ATIS	Automatic Terminal Information Service
ATO	Air Traffic Organization
Certificated Airport	An airport that has been issued an Airport Operating Certificate by the FAA under

Term	Definition
	the authority of 14 CFR Part 139, *Certification of Airports*.
CFR	Code of Federal Regulations
Construction	The presence of construction-related personnel, equipment, and materials in any location that could infringe upon the movement of aircraft.
CSPP	Construction Safety and Phasing Plan. The overall plan for safety and phasing of a construction project developed by the airport operator, or developed by the airport operator's consultant and approved by the airport operator. It is included in the invitation for bids and becomes part of the project specifications.
CTAF	Common Traffic Advisory Frequency
Displaced Threshold	A threshold that is located at a point on the runway other than the designated beginning of the runway. The portion of pavement behind a displaced threshold is available for takeoffs in either direction or landing from the opposite direction.
DOT	Department of Transportation
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FOD	Foreign Object Debris/Damage
FSS	Flight Service Station
GA	General Aviation
HAZMAT	Hazardous Materials
HMA	Hot Mix Asphalt
IAP	Instrument Approach Procedures
IFR	Instrument Flight Rules
ILS	Instrument Landing System
LDA	Landing Distance Available
LOC	Localizer antenna array
Movement Area	The runways, taxiways, and other areas of an airport that are used for taxiing or hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading aprons and aircraft parking areas (reference 14 CFR Part 139).
MSDS	Material Safety Data Sheet
MUTCD	Manual on Uniform Traffic Control Devices
NAVAID	Navigation Aid
NAVAID Critical Area	An area of defined shape and size associated with a NAVAID that must remain clear and graded to avoid interference with the electronic signal.
Non-Movement Area	The area inside the airport security fence exclusive of the Movement Area. It is important to note that the non-movement area includes pavement traversed by aircraft.

Term	Definition
NOTAM	Notices to Airmen
Obstruction	Any object/obstacle exceeding the obstruction standards specified by 14 CFR Part 77, subpart C.
OCC	Operations Control Center
OE / AAA	Obstruction Evaluation / Airport Airspace Analysis
OFA	Object Free Area. An area on the ground centered on the runway, taxiway, or taxi lane centerline provided to enhance safety of aircraft operations by having the area free of objects except for those objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes. (See AC 150/5300-13 for additional guidance on OFA standards and wingtip clearance criteria.)
OFZ	Obstacle Free Zone. The airspace below 150 ft (45 m) above the established airport elevation and along the runway and extended runway centerline that is required to be clear of all objects, except for frangible visual NAVAIDs that need to be located in the OFZ because of their function, in order to provide clearance protection for aircraft landing or taking off from the runway and for missed approaches. The OFZ is subdivided as follows: Runway OFZ, Inner Approach OFZ, Inner Transitional OFZ, and Precision OFZ. Refer to AC 150/5300-13 for guidance on OFZ.
OSHA	Occupational Safety and Health Administration
OTS	Out of Service
P&R	Planning and Requirements Group
NPI	NAS Planning & Integration
PAPI	Precision Approach Path Indicator
PFC	Passenger Facility Charge
PLASI	Pulse Light Approach Slope Indicator
Project Proposal Summary	A clear and concise description of the proposed project or change that is the object of Safety Risk Management.
RA	Reimbursable Agreement
RE	Resident Engineer
REIL	Runway End Identifier Lights
RNAV	Area Navigation
ROFA	Runway Object Free Area
RSA	Runway Safety Area. A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway, in accordance with AC 150/5300-13.
SDS	Safety Data Sheet
SIDA	Security Identification Display Area
SMS	Safety Management System

Term	Definition
SPCD	Safety Plan Compliance Document. Details developed and submitted by a contractor to the airport operator for approval providing details on how the performance of a construction project will comply with the CSPP.
SRM	Safety Risk Management
SSC	System Support Center
Taxiway Safety Area	A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway, in accordance with AC 150/5300-13.
TDG	Taxiway Design Group
Temporary	Any condition that is not intended to be permanent.
Temporary Runway End	The beginning of that portion of the runway available for landing and taking off in one direction, and for landing in the other direction. Note the difference from a displaced threshold.
Threshold	The beginning of that portion of the runway available for landing. In some instances, the landing threshold may be displaced.
TODA	Takeoff Distance Available
TOFA	Taxiway Object Free Area
TORA	Takeoff Run Available. The length of the runway less any length of runway unavailable and/or unsuitable for takeoff run computations. See AC 150/5300-13 for guidance on declared distances.
TSA	Taxiway Safety Area, or Transportation Security Administration
UNICOM	A radio communications system of a type used at small airports.
VASI	Visual Approach Slope Indicator
VGSI	Visual Glide Slope Indicator. A device that provides a visual glide slope indicator to landing pilots. These systems include precision approach path indicator (PAPI), visual approach slope indicator (VASI), and pulse light approach slope indicator (PLASI).
VFR	Visual Flight Rules
VOR	Very High Frequency Omnidirectional Radio Range
VPD	Vehicle / Pedestrian Deviation

APPENDIX C. SAFETY AND PHASING PLAN CHECKLIST

This appendix is keyed to Chapter 2. In the electronic version of this AC, clicking on the paragraph designation in the Reference column will access the applicable paragraph. There may be instances where the CSPP requires provisions that are not covered by the list in this appendix.

This checklist is intended as an aid, not a required submittal.

Table C-1. CSPP Checklist

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
General Considerations					
Requirements for predesign, prebid, and preconstruction conferences to introduce the subject of airport operational safety during construction are specified.	2.5				
Operational safety is a standing agenda item for construction progress meetings.	2.5				
Scheduling of the construction phases is properly addressed.	2.6				
Any formal agreements are established.	2.5.3				
Areas and Operations Affected by Construction Activity					
Drawings showing affected areas are included.	2.7.1				
Closed or partially closed runways, taxiways, and aprons are depicted on drawings.	2.7.1.1				
Access routes used by ARFF vehicles affected by the project are addressed.	2.7.1.2				
Access routes used by airport and airline support vehicles affected by the project are addressed.	2.7.1.3				
Underground utilities, including water supplies for firefighting and drainage.	2.7.1.4				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Approach/departure surfaces affected by heights of temporary objects are addressed.	2.7.1.5				
Construction areas, storage areas, and access routes near runways, taxiways, aprons, or helipads are properly depicted on drawings.	2.7.1				
Temporary changes to taxi operations are addressed.	2.7.2.1				
Detours for ARFF and other airport vehicles are identified.	2.7.2.2				
Maintenance of essential utilities and underground infrastructure is addressed.	2.7.2.3				
Temporary changes to air traffic control procedures are addressed.	2.7.2.4				
NAVAIDs					
Critical areas for NAVAIDs are depicted on drawings.	2.8				
Effects of construction activity on the performance of NAVAIDS, including unanticipated power outages, are addressed.	2.8				
Protection of NAVAID facilities is addressed.	2.8				
The required distance and direction from each NAVAID to any construction activity is depicted on drawings.	2.8				
Procedures for coordination with FAA ATO/Technical Operations, including identification of points of contact, are included.	2.8, 2.13.1, 2.13.5.3.1, 2.18.1				
Contractor Access					
The CSPP addresses areas to which contractor will have access and how	2.9				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
the areas will be accessed.					
The application of 49 CFR Part 1542 Airport Security, where appropriate, is addressed.	2.9				
The location of stockpiled construction materials is depicted on drawings.	2.9.1				
The requirement for stockpiles in the ROFA to be approved by FAA is included.	2.9.1				
Requirements for proper stockpiling of materials are included.	2.9.1				
Construction site parking is addressed.	2.9.2.1				
Construction equipment parking is addressed.	2.9.2.2				
Access and haul roads are addressed.	2.9.2.3				
A requirement for marking and lighting of vehicles to comply with AC 150/5210-5, *Painting, Marking and Lighting of Vehicles Used on an Airport,* is included.	2.9.2.4				
Proper vehicle operations, including requirements for escorts, are described.	2.9.2.5, 2.9.2.6				
Training requirements for vehicle drivers are addressed.	2.9.2.7				
Two-way radio communications procedures are described.	2.9.2.9				
Maintenance of the secured area of the airport is addressed.	2.9.2.10				
Wildlife Management					
The airport operator's wildlife management procedures are addressed.	2.10				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Foreign Object Debris Management					
The airport operator's FOD management procedures are addressed.	2.11				
Hazardous Materials Management					
The airport operator's hazardous materials management procedures are addressed.	2.12				
Notification of Construction Activities					
Procedures for the immediate notification of airport user and local FAA of any conditions adversely affecting the operational safety of the airport are detailed.	2.13				
Maintenance of a list by the airport operator of the responsible representatives/points of contact for all involved parties and procedures for contacting them 24 hours a day, seven days a week is specified.	2.13.1				
A list of local ATO/Technical Operations personnel is included.	2.13.1				
A list of ATCT managers on duty is included.	2.13.1				
A list of authorized representatives to the OCC is included.	2.13.2				
Procedures for coordinating, issuing, maintaining and cancelling by the airport operator of NOTAMS about airport conditions resulting from construction are included.	2.8, 2.13.2, 2.18.3.3.9				
Provision of information on closed or hazardous conditions on airport movement areas by the airport operator to the OCC is specified.	2.13.2				
Emergency notification procedures for medical, fire fighting, and police	2.13.3				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
response are addressed.					
Coordination with ARFF personnel for non-emergency issues is addressed.	2.13.4				
Notification to the FAA under 14 CFR parts 77 and 157 is addressed.	2.13.5				
Reimbursable agreements for flight checks and/or design and construction for FAA owned NAVAIDs are addressed.	2.13.5.3.2				
Inspection Requirements					
Daily and interim inspections by both the airport operator and contractor are specified.	2.14.1, 2.14.2				
Final inspections at certificated airports are specified when required.	2.14.3				
Underground Utilities					
Procedures for protecting existing underground facilities in excavation areas are described.	2.15				
Penalties					
Penalty provisions for noncompliance with airport rules and regulations and the safety plans are detailed.	2.16				
Special Conditions					
Any special conditions that affect the operation of the airport or require the activation of any special procedures are addressed.	2.17				
Runway and Taxiway Visual Aids - Marking, Lighting, Signs, and Visual NAVAIDs					
The proper securing of temporary airport markings, lighting, signs, and visual NAVAIDs is addressed.	2.18.1				
Frangibility of airport markings, lighting, signs, and visual NAVAIDs is specified.	2.18.1, 2.18.3, 2.18.4.2, 2.20.2.4				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
The requirement for markings to be in compliance with AC 150/5340-1, *Standards for Airport Markings*, is specified.	2.18.2				
Detailed specifications for materials and methods for temporary markings are provided.	2.18.2				
The requirement for lighting to conform to AC 150/5340-30, *Design and Installation Details for Airport Visual Aids;* AC 150/5345-50, *Specification for Portable Runway and Taxiway Lights;* and AC 150/5345-53, *Airport Lighting Certification Program*, is specified.	2.18.3				
The use of a lighted X is specified where appropriate.	2.18.2.1.2, 2.18.3.2				
The requirement for signs to conform to AC 150/5345-44, *Specification for Runway and Taxiway Signs;* AC 50/5340-18, *Standards for Airport Sign Systems;* and AC 150/5345-53, *Airport Lighting Certification Program*, is specified.	2.18.4				
Marking and Signs For Access Routes					
The CSPP specifies that pavement markings and signs intended for construction personnel should conform to AC 150/5340-18 and, to the extent practicable, with the MUTCD and/or State highway specifications.	2.18.4.2				
Hazard Marking and Lighting					
Prominent, comprehensible warning indicators for any area affected by construction that is normally accessible to aircraft, personnel, or vehicles are specified.	2.20.1				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Hazard marking and lighting are specified to identify open manholes, small areas under repair, stockpiled material, and waste areas.	2.20.1				
The CSPP considers less obvious construction-related hazards.	2.20.1				
Equipment that poses the least danger to aircraft but is sturdy enough to remain in place when subjected to typical winds, prop wash and jet blast is specified.	2.20.2.1				
The spacing of barricades is specified such that a breach is physically prevented barring a deliberate act.	2.20.2.1				
Red lights meeting the luminance requirements of the State Highway Department are specified.	2.20.2.2				
Barricades, temporary markers, and other objects placed and left in areas adjacent to any open runway, taxiway, taxi lane, or apron are specified to be as low as possible to the ground, and no more than 18 inch high.	2.20.2.3				
Barricades are specified to indicate construction locations in which no part of an aircraft may enter.	2.20.2.3				
Highly reflective barriers with lights are specified to barricade taxiways leading to closed runways.	2.20.2.5				
Markings for temporary closures are specified.	2.20.2.5				
The provision of a contractor's representative on call 24 hours a day for emergency maintenance of airport hazard lighting and barricades is specified.	2.20.2.7				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Work Zone Lighting for Nighttime Construction					
If work is to be conducted at night, the CSPP identifies construction lighting units and their general locations and aiming in relationship to the ATCT and active runways and taxiways.	2.21				
Protection of Runway and Taxiway Safety Areas					
The CSPP clearly states that no construction may occur within a safety area while the associated runway or taxiway is open for aircraft operations.	2.22.1.1, 2.22.3.1				
The CSPP specifies that the airport operator coordinates the adjustment of RSA or TSA dimensions with the ATCT and the appropriate FAA Airports Regional or District Office and issues a local NOTAM.	2.22.1.2, 2.22.3.2				
Procedures for ensuring adequate distance for protection from blasting operations, if required by operational considerations, are detailed.	2.22.3.3				
The CSPP specifies that open trenches or excavations are not permitted within a safety area while the associated runway or taxiway is open, subject to approved exceptions.	2.22.1.4				
Appropriate covering of excavations in the RSA or TSA that cannot be backfilled before the associated runway or taxiway is open is detailed.	2.22.1.4				
The CSPP includes provisions for prominent marking of open trenches and excavations at the construction site.	2.22.1.4				
Grading and soil erosion control to maintain RSA/TSA standards are	2.22.3.5				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
addressed.					
The CSPP specifies that equipment is to be removed from the ROFA when not in use.	2.22.2				
The CSPP clearly states that no construction may occur within a taxiway safety area while the taxiway is open for aircraft operations.	2.22.3				
Appropriate details are specified for any construction work to be accomplished in a taxiway object free area.	2.22.4				
Measures to ensure that personnel, material, and/or equipment do not penetrate the OFZ or threshold siting surfaces while the runway is open for aircraft operations are included.	2.22.4.3.6				
Provisions for protection of runway approach/departure areas and clearways are included.	2.22.6				
Other Limitations on Construction					
The CSPP prohibits the use of open flame welding or torches unless adequate fire safety precautions are provided and the airport operator has approved their use.	2.23.1.2				
The CSPP prohibits the use of electrical blasting caps on or within 1,000 ft (300 m) of the airport property.	2.23.1.3				

APPENDIX D. CONSTRUCTION PROJECT DAILY SAFETY INSPECTION CHECKLIST

The situations identified below are potentially hazardous conditions that may occur during airport construction projects. Safety area encroachments, unauthorized and improper ground vehicle operations, and unmarked or uncovered holes and trenches near aircraft operating surfaces pose the most prevalent threats to airport operational safety during airport construction projects. The list below is one tool that the airport operator or contractor may use to aid in identifying and correcting potentially hazardous conditions. It should be customized as appropriate for each project including information such as the date, time and name of the person conducting the inspection.

Table D-1. Potentially Hazardous Conditions

Item	Action Required (Describe)	No Action Required (Check)
Excavation adjacent to runways, taxiways, and aprons improperly backfilled.		
Mounds of earth, construction materials, temporary structures, and other obstacles near any open runway, taxiway, or taxi lane; in the related Object Free area and aircraft approach or departure areas/zones; or obstructing any sign or marking.		
Runway resurfacing projects resulting in lips exceeding 3 inch (7.6 cm) from pavement edges and ends.		
Heavy equipment (stationary or mobile) operating or idle near AOA, in runway approaches and departures areas, or in OFZ.		
Equipment or material near NAVAIDs that may degrade or impair radiated signals and/or the monitoring of navigation and visual aids. Unauthorized or improper vehicle operations in localizer or glide slope critical areas, resulting in electronic interference and/or facility shutdown.		
Tall and especially relatively low visibility units (that is, equipment with slim profiles) — cranes, drills, and similar objects — located in critical areas, such as OFZ and		

Item	Action Required (Describe)	No Action Required (Check)
approach zones.		
Improperly positioned or malfunctioning lights or unlighted airport hazards, such as holes or excavations, on any apron, open taxiway, or open taxi lane or in a related safety, approach, or departure area.		
Obstacles, loose pavement, trash, and other debris on or near AOA. Construction debris (gravel, sand, mud, paving materials) on airport pavements may result in aircraft propeller, turbine engine, or tire damage. Also, loose materials may blow about, potentially causing personal injury or equipment damage.		
Inappropriate or poorly maintained fencing during construction intended to deter human and animal intrusions into the AOA. Fencing and other markings that are inadequate to separate construction areas from open AOA create aviation hazards.		
Improper or inadequate marking or lighting of runways (especially thresholds that have been displaced or runways that have been closed) and taxiways that could cause pilot confusion and provide a potential for a runway incursion. Inadequate or improper methods of marking, barricading, and lighting of temporarily closed portions of AOA create aviation hazards.		
Wildlife attractants — such as trash (food scraps not collected from construction personnel activity), grass seeds, tall grass, or standing water — on or near airports.		
Obliterated or faded temporary markings on active operational areas.		
Misleading or malfunctioning obstruction lights. Unlighted or unmarked obstructions in the approach to any open runway pose aviation hazards.		

Item	Action Required (Describe)	No Action Required (Check)
Failure to issue, update, or cancel NOTAMs about airport or runway closures or other construction related airport conditions.		
Failure to mark and identify utilities or power cables. Damage to utilities and power cables during construction activity can result in the loss of runway / taxiway lighting; loss of navigation, visual, or approach aids; disruption of weather reporting services; and/or loss of communications.		
Restrictions on ARFF access from fire stations to the runway / taxiway system or airport buildings.		
Lack of radio communications with construction vehicles in airport movement areas.		
Objects, regardless of whether they are marked or flagged, or activities anywhere on or near an airport that could be distracting, confusing, or alarming to pilots during aircraft operations.		
Water, snow, dirt, debris, or other contaminants that temporarily obscure or derogate the visibility of runway/taxiway marking, lighting, and pavement edges. Any condition or factor that obscures or diminishes the visibility of areas under construction.		
Spillage from vehicles (gasoline, diesel fuel, oil) on active pavement areas, such as runways, taxiways, aprons, and airport roadways.		
Failure to maintain drainage system integrity during construction (for example, no temporary drainage provided when working on a drainage system).		

Item	Action Required (Describe)	No Action Required (Check)
Failure to provide for proper electrical lockout and tagging procedures. At larger airports with multiple maintenance shifts/workers, construction contractors should make provisions for coordinating work on circuits.		
Failure to control dust. Consider limiting the amount of area from which the contractor is allowed to strip turf.		
Exposed wiring that creates an electrocution or fire ignition hazard. Identify and secure wiring, and place it in conduit or bury it.		
Site burning, which can cause possible obscuration.		
Construction work taking place outside of designated work areas and out of phase.		

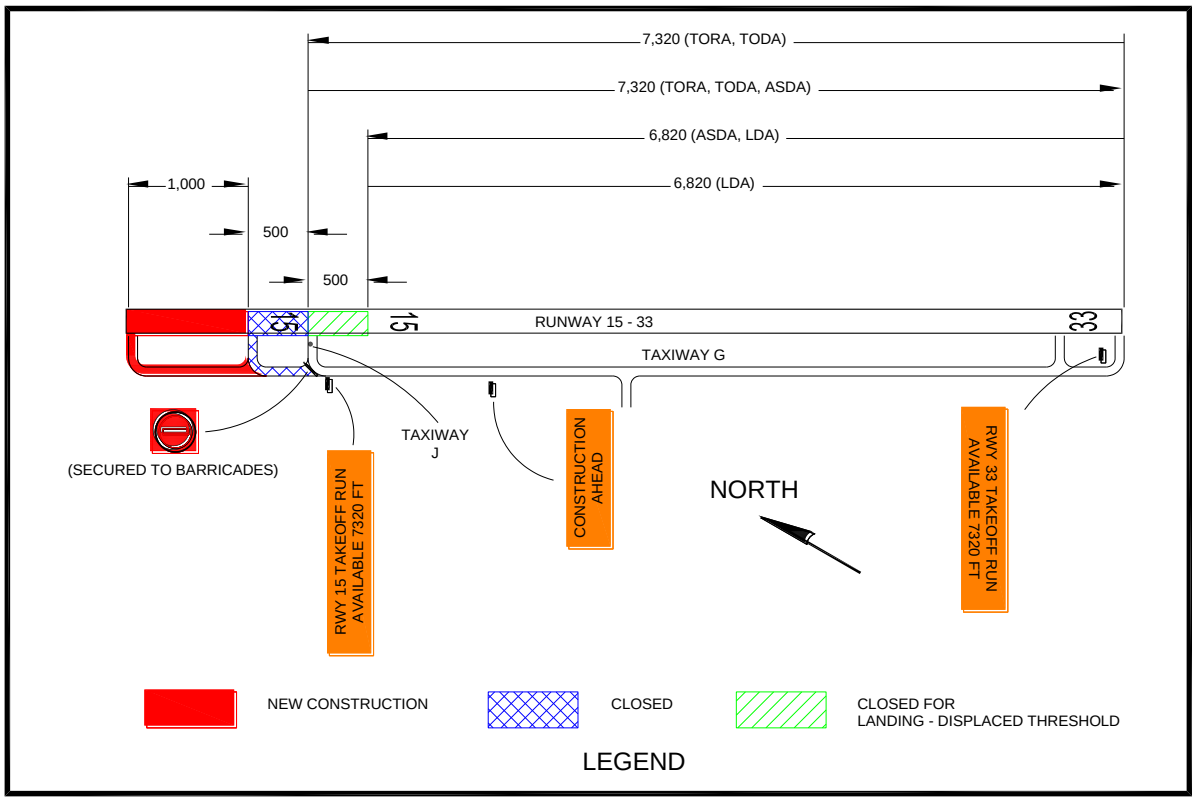
APPENDIX E. SAMPLE OPERATIONAL EFFECTS TABLE

E.1 Project Description.

Runway 15-33 is currently 7820 feet long, with a 500 foot stopway on the north end. This project will remove the stopway and extend the runway 1000 feet to the north and 500 feet to the south. Finally, the existing portion of the runway will be repaved. The runway 33 glide slope will be relocated. The new runway 33 localizer has already been installed by FAA Technical Operations and only needs to be switched on. Runway 15 is currently served only by a localizer, which will remain in operation as it will be beyond the future RSA. Appropriate NOTAMS will be issued throughout the project.

E.1.1 During Phase I, the runway 15 threshold will be displaced 1000 feet to keep construction equipment below the approach surface. The start of runway 15 takeoff and the departure end of runway 33 will also be moved 500 feet to protect workers from jet blast. Declared distances for runway 33 will be adjusted to provide the required RSA and applicable departure surface. Excavation near Taxiway G will require its ADG to be reduced from IV to III. See Figure E-1.

Figure E-1. Phase I Example

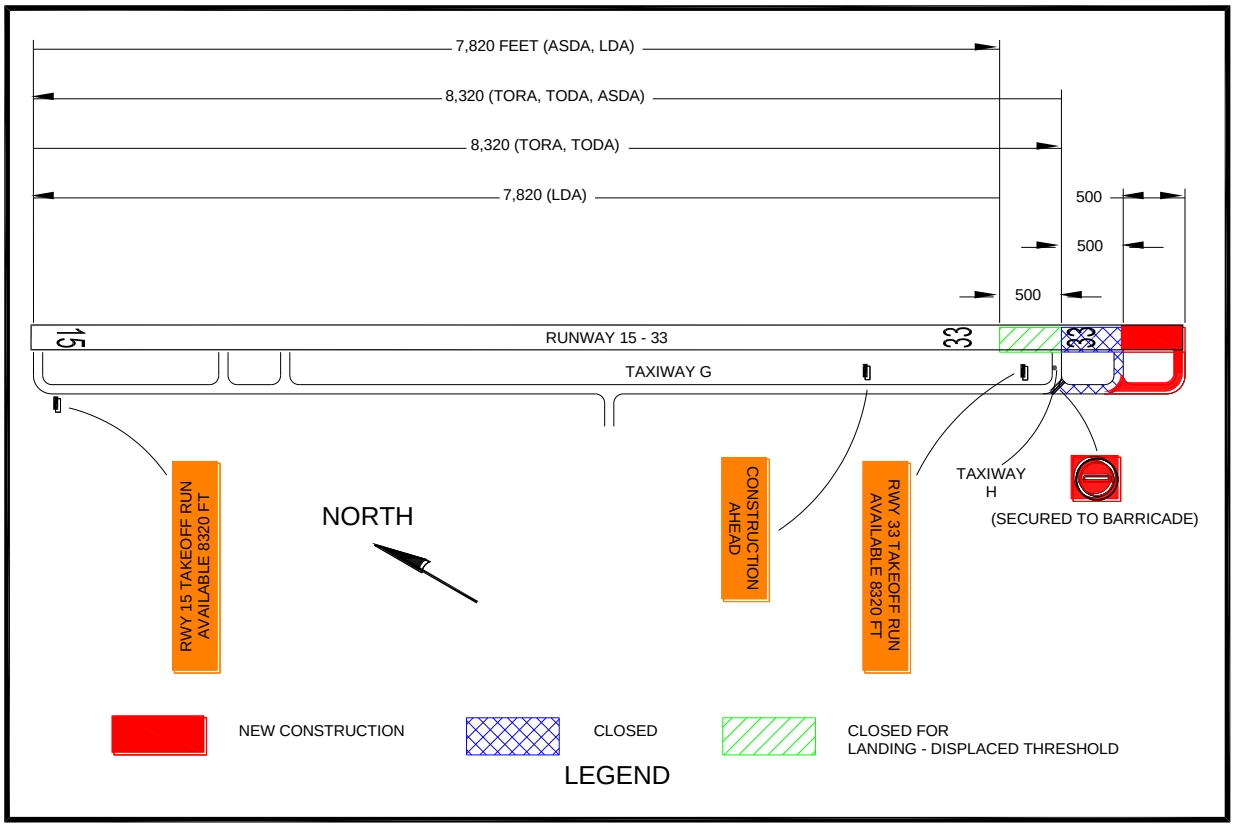


Note 1: Where hold signs are installed on both sides of a taxiway, install the TORA sign on the left side of the taxiway before the final turn to the runway intersection.

Note 2: Based on the declared distances for Runway 33 departures, the maximum equipment height in the construction area is 12.5 feet (500/40 = 12.5).

E.2 During Phase II, the runway 33 threshold will be displaced 1000 feet to keep construction equipment below the approach surface. The start of runway 33 takeoff and the departure end of runway 15 will also be moved 500 feet to protect workers from jet blast. Declared distances for runway 15 will be adjusted to provide the required RSA and applicable departure surface. See Figure E-2.

Figure E-2. Phase II Example



Note 1: Where hold signs are installed on both sides of a taxiway, install the TORA sign on the left side of the taxiway before the final turn to the runway intersection.

Note 2: Based on the declared distances for Runway 15 departures, the maximum equipment height in the construction area is 12.5 feet (500/40 = 12.5).

E.3 During Phase III, the existing portion of the runway will be repaved with Hot Mix Asphalt (HMA) and the runway 33 glide slope will be relocated. Construction will be accomplished between the hours of 8:00 pm and 5:00 am, during which the runway will be closed to operations.

Figure E-3. Phase III Example

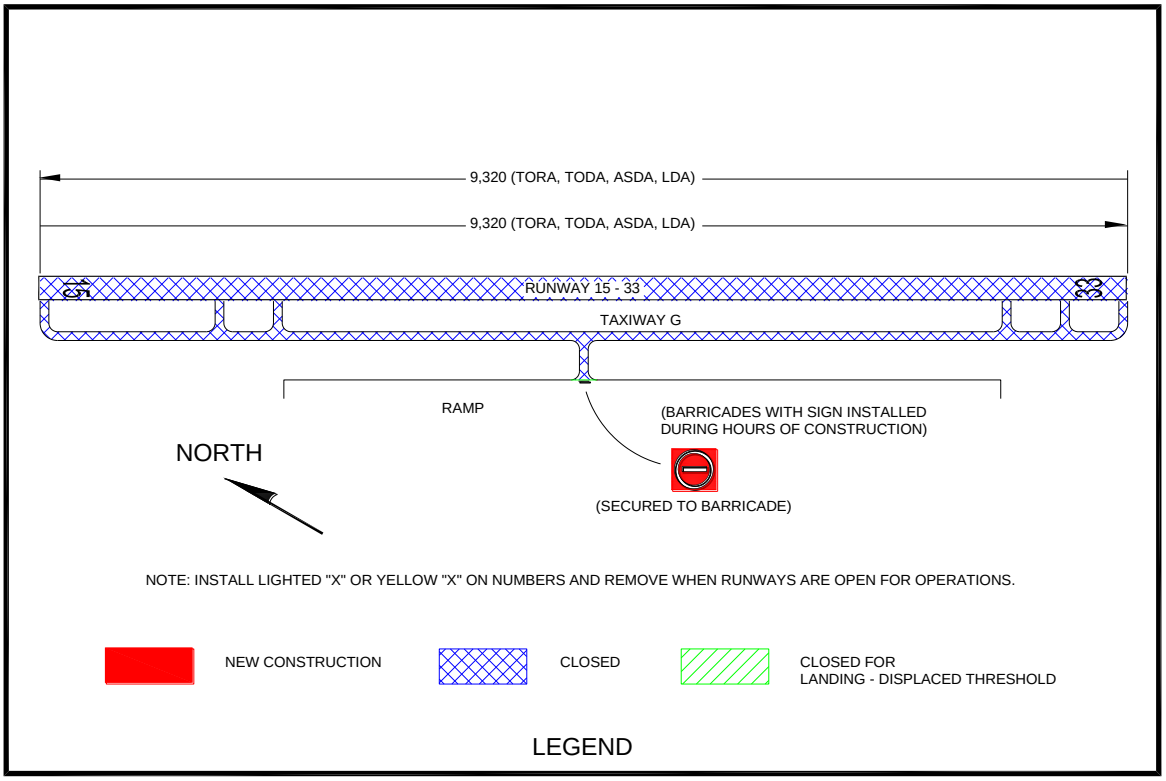


Table E-1. Operational Effects Table

Project	**Runway 15-33 Extension and Repaving**			
Phase	**Normal (Existing)**	**Phase I: Extend Runway 15 End**	**Phase II: Extend Runway 33 End**	**Phase III: Repave Runway**
Scope of Work	N/A	Extend Runway 15-33 1,000 ft on north end with Hot Mix Asphaltic Concrete (HMA).	Extend Runway 15-33 500 ft on south end with Hot Mix Asphaltic Concrete (HMA).	Repave existing runway with HMA Relocate Runway 33 Glide Slope
Effects of Construction Operations	N/A	Existing North 500 ft closed	Existing South 500 ft closed	Runway closed between 8:00 pm and 5:00 am Edge lighting out of service
Construction Phase	N/A	Phase I (Anticipated)	Phase II (Anticipated)	Phase III (Anticipated)
Runway 15 Average Aircraft Operations	Carrier: 52 /day GA: 26 /day Military: 11 /day	Carrier: 40 /day GA: 26 /day Military: 0 /day	Carrier: 45 /day GA: 26 /day Military: 5 /day	Carrier: 45 / day GA: 20 / day Military: 0 /day
Runway 33 Average Aircraft Operations	Carrier: 40 /day GA: 18 /day Military: 10 /day	Carrier: 30 /day GA: 18 /day Military: 0 /day	Carrier: 25 /day GA: 18 /day Military: 5 /day	Carrier: 20 /day GA: 5 /day Military: 0 /day
Runway 15-33 Aircraft Category	C-IV	C-IV	C-IV	C-IV
Runway 15 Approach Visibility Minimums	1 mile	1 mile	1 mile	1 mile
Runway 33 Approach Visibility Minimums	¾ mile	¾ mile	¾ mile	1 mile

Note: Proper coordination with Flight Procedures group is necessary to maintain instrument approach procedures during construction.

Project		Runway 15-33 Extension and Repaving			
Phase		Normal (Existing)	Phase I: Extend Runway 15 End	Phase II: Extend Runway 33 End	Phase III: Repave Runway
Runway 15 Declared Distances	TORA	7,820	7,320	8,320	9,320
	TODA	7,820	7,320	8,320	9,320
	ASDA	7,820	7,320	7,820	9,320
	LDA	7,820	6,820	7,820	9,320
Runway 33 Declared Distances	TORA	7,820	7,320	8,320	9,320
	TODA	7,820	7,320	8,320	9,320
	ASDA	8,320	6,820	8,320	9,320
	LDA	7,820	6,820	7,820	9,320
Runway 15 Approach Procedures		LOC only	LOC only	LOC only	LOC only
		RNAV	RNAV	RNAV	RNAV
		VOR	VOR	VOR	VOR
Runway 33 Approach Procedures		ILS	ILS	ILS	LOC only
		RNAV	RNAV	RNAV	RNAV
		VOR	VOR	VOR	VOR
Runway 15 NAVAIDs		LOC	LOC	LOC	LOC
Runway 33 NAVAIDs		ILS, MALSR	ILS, MALSR	ILS, MALSR	LOC, MALSR
Taxiway G ADG		IV	III	IV	IV
Taxiway G TDG		4	4	4	4
ATCT (hours open)		24 hours	24 hours	24 hours	0500 - 2000
ARFF Index		D	D	D	D

Project	Runway 15-33 Extension and Repaving			
Phase	**Normal (Existing)**	**Phase I: Extend Runway 15 End**	**Phase II: Extend Runway 33 End**	**Phase III: Repave Runway**
Special Conditions	Air National Guard (ANG) military operations	All military aircraft relocated to alternate ANG Base	Some large military aircraft relocated to alternate ANG Base	All military aircraft relocated to alternate ANG Base
Information for NOTAMs		Refer above for applicable declared distances. Taxiway G limited to 118 ft wingspan	Refer above for applicable declared distances.	Refer above for applicable declared distances. Airport closed 2000 – 0500. Runway 15 glide slope OTS.

Note: This table is one example. It may be advantageous to develop a separate table for each project phase and/or to address the operational status of the associated NAVAIDs per construction phase.

Complete the following chart for each phase to determine the area that must be protected along the runway and taxiway edges:

Table E-2. Runway and Taxiway Edge Protection

Runway/Taxiway	Aircraft Approach Category* A, B, C, or D	Airplane Design Group* I, II, III, or IV	Safety Area Width in Feet Divided by 2*

*See AC 150/5300-13 to complete the chart for a specific runway/taxiway.

Complete the following chart for each phase to determine the area that must be protected before the runway threshold:

Table E-3. Protection Prior to Runway Threshold

Runway End Number	Airplane Design Group* I, II, III, or IV	Aircraft Approach Category* A, B, C, or D	Minimum Safety Area Prior to the Threshold*	Minimum Distance to Threshold Based on Required Approach Slope*	
			ft	ft	: 1
			ft	ft	: 1
			ft	ft	: 1
			ft	ft	: 1

*See AC 150/5300-13 to complete the chart for a specific runway.

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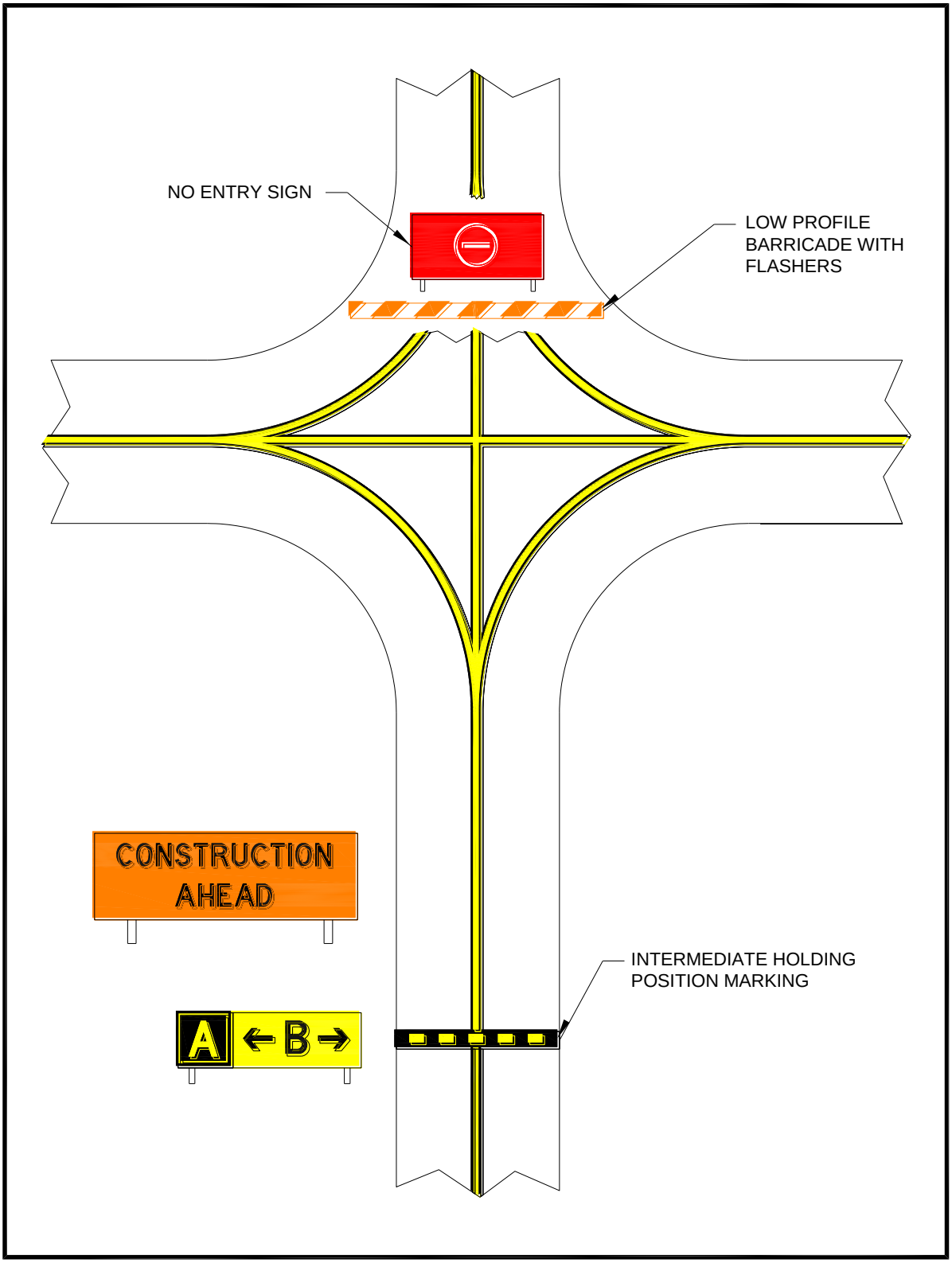
APPENDIX F. ORANGE CONSTRUCTION SIGNS

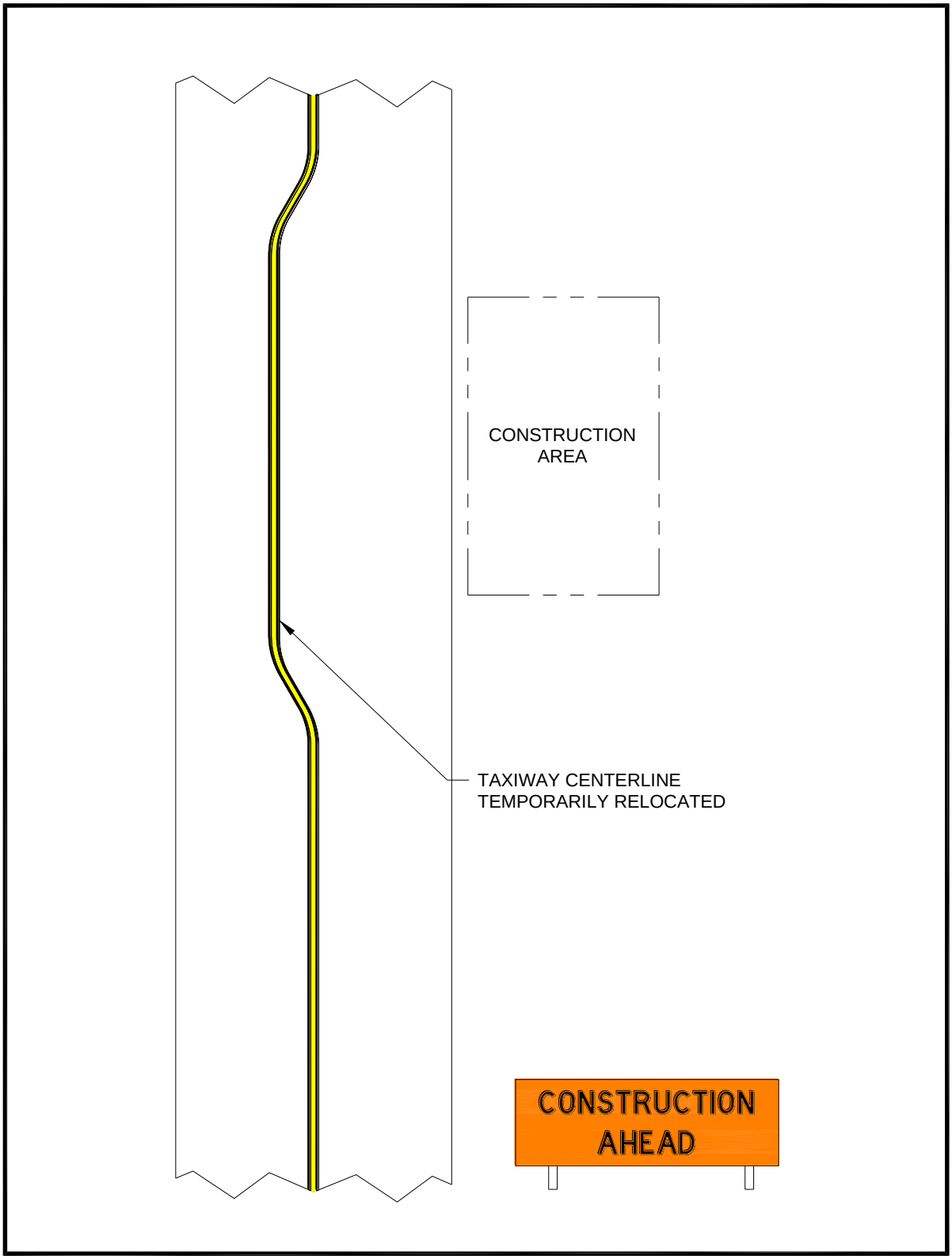
Figure F-1. Approved Sign Legends

Figure F-2. Orange Construction Sign Example 1



Note: For proper placement of signs, refer to EB 93.

Figure F-3. Orange Construction Sign Example 2



Note: For proper placement of signs, refer to EB 93.

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Advisory Circular Feedback

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by (1) mailing this form to Manager, Airport Engineering Division, Federal Aviation Administration ATTN: AAS-100, 800 Independence Avenue SW, Washington DC 20591 or (2) faxing it to the attention of the Office of Airport Safety and Standards at (202) 267-5383.

Subject: AC 150/5370-2G Date: _____

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph _____ on page _____.

☐ Recommend paragraph _____ on page _____ be changed as follows:

_____
_____
_____

☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

_____
_____
_____

☐ Other comments:

_____
_____
_____

☐ I would like to discuss the above. Please contact me at (phone number, email address).

_____

Submitted by: _____ Date: _____

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