

SECTION 01010

General Work

1.0 INTENT OF PLANS AND SPECIFICATIONS:

It is the intent of the Plans and Specifications to describe the complete work to be performed under the Contract. Except as provided on the Plans or in the Specifications, it is also the intent that the Contractor shall furnish all materials, supplies, tools, equipment, labor and incidentals necessary to complete the work.

2.0 CHANGES AND INCREASED OR DECREASED QUANTITIES OF WORK:

The Owner has the right to make such changes and alterations in the Plans or in the quantities of work as he may consider necessary or desirable, and such changes and alterations shall not be considered as a waiver of any condition of the Contract, nor shall they invalidate any provision thereof. The Contractor shall perform the work as increased or decreased, and no allowance will be made for anticipated profits.

Payment to the Contractor will be made for the actual quantities of work done and materials furnished at the unit prices as set forth in the Contract, except as follows:

- a. When the total cost of work to be done, or of materials to be furnished, is more than one hundred and twenty-five (125%) percent of the total contract price for the item stated in the Proposal, then either party to the Contract, upon demand, shall be entitled to a revised consideration on that portion of the work above one hundred and twenty-five (125%) percent of the total contract price stated in the Proposal.
- b. When the total cost of work to be done, or of materials to be furnished, is less than seventy-five (75%) percent on the total contract price for the item stated in the Proposal, then either party to the Contract, upon demand, shall be entitled to a revised consideration of the work actually done.
- c. Revised consideration shall be determined by supplemental agreement between the parties, which supplemental agreement shall be included with, and shall become a part of, the Contract.

3.0 OMITTED ITEMS:

The Owner may, in writing, order the omission from the work of any item found unnecessary to the project. Such omission shall be subject to all provisions of Paragraph C-5.02.

4.0 EXTRA WORK:

When the proper completion of the project requires work for which no quantities or prices were shown in the Proposal, such work shall be called "EXTRA WORK" and shall be performed by the Contractor when so directed in writing by the Owner. "EXTRA WORK" shall be performed in accordance with these Specifications and as may be directed by the Engineer.

Prices for extra work shall be itemized and covered by a supplement agreement submitted by the Contractor and approved by the Owner prior to the starting of such work.

Claims for extra work not authorized in writing by the Owner prior to the performance thereof will be rejected.

5.0 MAINTENANCE OF TRAFFIC:

When the work requires partial or complete closing of any driveway, alley, street, or roadway, the Contractor shall so schedule and prosecute his work that traffic will be hindered to a minimum.

6.0 REMOVAL AND DISPOSAL OF STRUCTURES AND OBSTRUCTIONS:

All structures and/or obstructions on the site of the work, which are not to remain in place or which are not to be used in the new construction shall be removed as directed by the Engineer. Such items of removal are not listed in the Proposal and will not be paid for as separate items; the cost of doing such work shall be included in the unit price bid for other items.

7.0 TOOLS AND ACCESSORIES:

When special wrenches, gauges, or other special tools or accessories are required to properly maintain and operate any machine or equipment furnished under this Contract, the furnishing of such tools and accessories shall be deemed to have been included in the Contract and they shall be furnished by the Contractor without extra cost to the Owner.

8.0 GUARANTEES:

All structural, mechanical and electrical equipment or instrument shall be guaranteed against mechanical and physical defects, leakage, breakage, or other damage occurring during normal operation for a period of one (1) year after such equipment or instruments have been accepted by the Owner. The Contractor shall promptly repair or make good, at his own expense, any defect in such equipment and instruments.

9.0 GENERAL GUARANTEE:

All work included in the Contract shall be guaranteed against faulty material or workmanship for a period of one (1) year after the work has been accepted by the Owner.

Neither final acceptance of the work, nor final payment thereof, nor occupancy and use of the work by the Owner shall constitute a waiver of the Owner's right to require the Contractor to repair or make good any such faulty materials or workmanship.

10.0 FINAL CLEANING UP:

Upon completion of the work and before acceptance and final payment will be made, the Contractor shall remove from the site all machinery, equipment, tools, and materials and shall dispose of all rubbish, temporary structures, and surplus backfill. The site shall be left in a neat and presentable condition throughout. Any land area, driveway, sidewalk, alley, street or road (concrete or asphalt) which has been cut or disturbed during the prosecution of the work shall be repaired at the Contractor's expense to a condition at least as good or better than as originally existed.

11.0 EXISTING STRUCTURES:

The Plans show the locations of all known surfaces and subsurface structures. However, the exact location of gas mains, water mains, conduits, sewer, etc., is unknown and the Owner assumes no responsibility for failure to show any of these structures on the Plans or to show them in their exact location. It is mutually agreed such failure will not be considered sufficient basis for claims for additional compensation for extra work or for increasing the pay quantities in any manner whatsoever, unless the obstruction encountered is such as necessitates, or requires the building of special work, provision for which is not made in the Plans and Proposal, in which case the provisions in these Specifications for extra work shall apply.

END OF SECTION

SECTION 01110
SCOPE OF WORK

PART 1 - G E N E R A L

1.1 SUMMARY

- A. Section Includes: Identification and summary description of the Project, Work sequence, and Contractor use of Premises,

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following items are listed to illustrate the overall nature of the project. By no means is this listing to be considered complete, for a complete understanding of the project see the drawings.
- B. New Construction:
 - 1. New construction consists additions to the Edinburg West WTP Reservoir Raw Water Supply And Distribution System including but not limited to the construction and / or installation, of the following:
 - a. Replacement of eleven (11) Sluice Gates and Appurtenances from gate wells & stand pipes
 - b. Installation of two (2) 48-inch RCLHPP Raw Water Pipeline extensions with reinforced concrete headwalls and Duck Bill Check Valves to interior of reservoir
 - c. Construction of Reinforced Concrete Gatewell with sluice gate, railing, grating, and stair connecting two (2) existing 36-inch RCP and one 48-inch RCP to be installed from the gatewell into Cell 5 of the reservoir

1.3 WORK SEQUENCE

- A. Contractor shall submit for a review by the Engineer's representative a detailed sequence of proposed construction activities.

1.4 CONTRACTOR USE OF PREMISES

- A. Comply with procedures for access to the site as specified in Section 01145 - Use of Premises.

PART 2 - P R O D U C T S - NOT USED

PART 3 - E X E C U T I O N - NOT USED

END OF SECTION

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SECTION 01145
USE OF PREMISES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

- A. Section includes general use of the site including properties inside and outside of rights-of-way, work affecting road and notification to adjacent occupants.

1.2 BOUNDARIES

- A. Confine access and operations and storage areas to boundaries provided by Owner as stipulated in the Conditions of the Contract; trespassing on abutting lands or other lands in the area is not allowed.
- B. Contractor may make arrangements, at Contractor's cost, for temporary use of private properties, in which case Contractor and Contractor's surety shall indemnify and hold harmless the Owner against claims or demands arising from such use of properties outside of boundaries. Submit notarized copy of agreement between private property owner and Contractor prior to use of the area.

1.3 PROPERTIES OUTSIDE OF BOUNDARIES

- A. Altering the condition of properties adjacent to and along the boundaries will not be permitted.
- B. Means, methods, techniques, sequences, or procedures which will result in damage to properties or improvements in the vicinity outside of boundaries will not be permitted.
- C. Any damage to properties outside of boundaries shall be repaired or replaced to the satisfaction of the Engineer and at no cost to the Owner.

1.4 USE OF SITE

- A. Obtain approvals of governing authorities prior to impeding or closing public roads or streets. Do not close more than two consecutive intersections at one time.
- B. Notify Owner and Engineer at least 48 hours prior to closing a street or a street crossing. Permits for street closures are required in advance and are the responsibility of the Contractor.
- C. Maintain access for emergency vehicles including access to fire hydrants.
- D. Avoid obstructing drainage ditches or inlets; when obstruction is unavoidable due to requirements of the Work, provide grading and temporary drainage structures to maintain unimpeded flow.
- E. Perform daily clean-up of dirt outside the construction zone, and debris, scrap materials, and other disposable items. Keep streets and driveways clean of dirt, debris and scrap materials. Do not leave building, roads, streets or other construction areas unclean overnight.

1.5 PUBLIC, TEMPORARY, AND CONSTRUCTION ROADS AND RAMPS

- A. Construct and maintain temporary detours, ramps, and roads to provide for normal public traffic flow when use of public roads or streets is closed by necessities of the Work.
- B. Provide mats or other means to prevent overloading or damage to existing roadways from tracked equipment or large or heavy trucks or equipment.
- C. Construct and maintain access roads and parking areas.

1.6 SURFACE RESTORATION

- A. Restore existing site to condition before construction to satisfaction of Engineer.
- B. Grade and drain expanded site according to plans and Specifications.

PART 2 - P R O D U C T S – NOT USED

PART 3 - E X E C U T I O N – NOT USED

END OF SECTION

SECTION 01150
PROJECT PROCEDURAL DEFINITIONS

PART 1 - PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section defines and explains certain terms in order to minimize potential misunderstandings between the Owner, the Owner's designated representative, Contractor, and Engineer.

1.2 TERMS, DEFINITIONS, AND EXPLANATIONS

- A. Drawing/Plan Clarification: An answer from the Owner's designated representative or Engineer, in response to an inquiry from the Contractor, intended to make some requirement(s) of the Drawings or Plans clearly understood. Drawing/Plan clarifications may be sketches, drawings, or in narrative form and will not change any requirements of the Drawings or Plans. Responses to Contractor inquiries shall be outlined in Section 01151.
- B. Notice of Defects: A notice issued by the Engineer documenting that the work or some portion thereof has not been performed in accordance with the requirements of the Contract Documents. Payment shall not be made on any portion of the work for which a Notice of Defect has been issued and the work not corrected to the satisfaction of the Engineer. Upon receipt of a Notice of Defect, the Contractor shall provide a written Response to Notice of Defect within ten (10) working days after receipt of the Notice. The Contractor's response shall be in accordance with the Conditions of the Contract.
 - 1. If the Contractor disputes issuance of the Notice of Defect, the Owner's designated representative has ten (10) working days in which to respond by either:
 - a. withdrawing the Notice of Defect, or
 - b. directing the Contractor to correct the work. Such determination by the Owner's designated representative shall be final and conclusive of the matter.
 - 2. If directed to correct the work, the Contractor shall do so within ten (10) working days after receipt of such direction from the Resident Project Representative, or such other time as may be agreed to with the Resident Project Representative.
- C. Project Communications: Routine written communications between the Owner, Engineer, and the Contractor shall be in letter or field memo format. Such communications shall not be identified as Requests for Information or Request for Technical Instructions nor shall they substitute for any other written requirement pursuant to the provisions of these Contract Documents.
- D. Request for Information/Request for Technical Instructions: A request from the Contractor, to the Resident Project Representative or Engineer, seeking an interpretation or a clarification of some requirement of the Contract Documents. The Contractor shall clearly and concisely set forth the issue for which it seeks clarification or interpretation and why a response is needed from the Resident Project Representative or Engineer. The Contractor shall, in the written request, set forth its interpretation or understanding of the Contract's requirements along with reasons why it has reached such an understanding. Responses from the Resident Project Representative or Engineer will not change any requirements of the Contract Documents.
 - 1. Responses to Contractor inquiries shall be as outlined in Section 01151.

- E. Substitution/Or-Equal Submittals: A written request from the Contractor to substitute a material, article, device, product, fixture, form, type of construction, or process called for in the Contract Documents with another item that shall be substantially equal in all respects to that so indicated or supplied.
- F. Schedule Submittals: When required, the Contractor shall submit schedules, schedule updates, schedule revisions, time impact analysis, etc., for review and acceptance.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 01151

REQUESTS FOR INFORMATION / REQUESTS FOR TECHNICAL INSTRUCTIONS (RFI'S/RFTI'S)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section includes mandatory procedures and sets forth policies to be followed in requesting technical information or clarification.

1.2 PROCEDURES AND POLICIES

- A. In the event that the Contractor or Subcontractor, at any tier, determines that some portions of the Drawings, Specifications, or other Contract Documents require clarification or interpretation by the Owner or Engineer, the Contractor shall submit a Request for Information or a Request for Technical Instructions in writing to the Resident Project Representative. RFI's/RFTI's may only be submitted by the Contractor. The Contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed. In the RFI/RFTI, the Contractor shall set forth an interpretation or understanding of the requirement along with reasons why such an understanding was reached.
- B. The Owner acknowledges that this is a complex project and its successful completion will be a cooperative effort between all parties. The Owner does not intend to limit or restrict communications between any of the parties.
- C. The Resident Project Representative will review all RFI's/RFTI's to determine whether they are Requests for Information or Request for Technical Instructions within the meaning of this term. If the Resident Project Representative determines that the document is not an RFI/RFTI, it will be returned to the Contractor, unreviewed as to content, for resubmittal in the proper manner.
- D. Responses to Requests for Information/Request for Technical Instructions shall be issued within ten (10) working days of receipt of the request from the Contractor unless the Resident Project Representative or Engineer determines that a longer time is necessary to provide an adequate response. If a longer time is determined necessary by the Resident Project Representative or Engineer, they will, within ten (10) working days of the receipt of the request, notify the Contractor of the anticipated response time. If the Contractor submits a Request for Information /Request for Technical Instructions on an activity within ten (10) working days or less of float on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Resident Project Representative or Engineer to respond to the request provided that the Resident Project Representative or Engineer responds within ten (10) working days set forth above.
- E. Responses from the Resident Project Representative or Engineer will not change any requirement of the Contract Documents. In the event the Contractor believes that a response to a Request for Information / Request for Technical Instructions will cause a change to the requirements of the Contract Document, the Contractor shall immediately give written notice to the Engineer stating that the Contractor considers that the response warrants a Change Order. Failure to give such written notice within ten (10) working days shall waive the Contractor's right to seek additional time or cost under the General Conditions.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 01255
CHANGE ORDER PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Procedures for processing Change Orders, including:
 - 1. Assignment of a responsible individual for approval and communication of changes in the Work;
 - 2. Documentation of change in Contract Price and Contract Time;
 - 3. Change procedures, using proposals and construction contract modifications, work change directive, stipulated price change order, unit price change order, time and materials change order;
 - 4. Execution of Change Orders;
 - 5. Correlation of Contractor submittals.

1.2 REFERENCES

- A. Rental Rate Blue Book for Construction Equipment (Data Quest Blue Book). Rental Rate is defined as the full, unadjusted base rental rate for the appropriate item of construction equipment.

1.3 RESPONSIBLE INDIVIDUAL

- A. Contractor shall provide a letter indicating the name and address of the individual authorized to execute change documents, and who shall also be responsible for informing others in Contractor's employ and Subcontractors of changes to the Work. The information shall be provided at the Pre-construction Conference.

1.4 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

- A. Contractor shall maintain detailed records of changes in the Work. Provide full information required for identification and evaluation of proposed changes, and to substantiate costs of changes in the Work.
- B. Contractor shall document each proposal for a change in cost or time with sufficient data to allow evaluation of the proposal.
- C. Proposals shall include, as a minimum, the following information as applicable:
 - 1. Quantities of items in the original Bid Proposal with additions, reductions, deletions, and substitutions.
 - 2. When Work items were not included in the Bid Proposal, Contractor shall provide unit prices for the new items, with supporting information as required by the Engineer.
 - 3. Justification for any change in Contract Time.
 - 4. Additional data upon request.
- D. For changes in the Work performed on a time-and-material basis, the following additional information may be required:
 - 1. Quantities and description of products and equipment.
 - 2. Taxes, insurance and bonds.
 - 3. Overhead and profit.
 - 4. Dates and times work was performed, and by whom.
 - 5. Time records and certified copies of applicable payrolls.
 - 6. Invoices and receipts for products, rented equipment, and subcontracts, similarly documented.

- E. For changes in the work performed on a time-and-materials basis, rental equipment will be paid as follows:
 - 1. Rented equipment will be paid by actual invoice cost for the duration of time required to complete the extra work without markup for overhead and profit. If the extra work comprises only a portion of the rental invoice where the equipment would otherwise be on the site, the Contractor shall compute the hourly equipment rate by dividing the actual monthly invoice by 176. (One day equals 8 hours and one week equals 40 hours.)
 - 2. Operating costs shall not exceed the estimated operating costs given in the Blue Book for the item of equipment. Overhead and profit will be allowed on operating cost.
- F. For changes in the work performed on a time-and-materials basis using Contractor-owned equipment, use Blue Book rates as follows:
 - 1. Contractor-owned equipment will be paid at the Blue Book Rental Rate for the duration of time required to complete the extra work without markup for overhead and profit. The Rental Rate utilized shall be the lowest cost combination of hourly, daily, weekly or monthly rates. Use 150 percent of the Rental Rate for double shifts (one extra shift per day) and 200 percent of the Rental Rate for more than two shifts per day. Standby rates shall be 50 percent of the appropriate Rental Rate shown in the Blue Book. No other rate adjustments shall apply.
 - 2. Operating costs shall not exceed the estimated operating costs given in the Blue Book for the item of equipment. Overhead and profit will be allowed on operating cost. Operating costs will not be allowed for equipment on standby.

1.5 CHANGE PROCEDURES

- A. Changes to Contract Price or Contract Time can only be made by issuance of a Change Order. Issuance of a Work Change Directive will be formalized into a Change Order. All changes will be in accordance with the requirements of the Contract Document.
- B. The Engineer will advise of minor changes in the Work not involving an adjustment to Contract Price or Contract Time as authorized by the General Conditions by issuing supplemental instructions.
- C. Contractor may request clarification of Drawings, Specifications or Contract Documents or other information by using a Request for Information. Response by the Engineer to a Request for Information does not authorize the Contractor to perform tasks outside the scope of the Work. All changes must be authorized as described in this section.
- D. Change Orders for work not specified in Division 00 shall be accompanied with a Cost and Price Summary plus justification of overhead rate.

1.6 PROPOSALS AND CONTRACT MODIFICATIONS

- A. The Engineer may issue a Request for Proposal, which includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications. The Engineer may also request a proposal in the response to a Request for Information. Contractor shall prepare and submit a proposal within 7 days or as specified in the request.
- B. The Contractor may propose an unsolicited change by submitting a proposal to the Engineer describing the proposed change and its full effect on the Work, with a statement describing the reason for the change and the effect on the Contract Price and Contract Time including full documentation.

1.7 WORK CHANGE DIRECTIVE

- A. Engineer may issue a signed Work Change Directive instructing the Contractor to proceed with a change in the Work. A Work Change Directive will subsequently be incorporated in a Change Order.

- B. The document will describe changes in the Work and will designate a method of determining any change in Contract Price or Contract Time.
- C. Contractor shall proceed promptly to execute the changes in the Work in accordance with the Work Change Directive.

1.8 STIPULATED PRICE CHANGE ORDER

- A. A stipulated price Change Order will be based on an accepted proposal including the Contractor's lump sum price quotation with Schedule of Values.

1.9 UNIT PRICE CHANGE ORDER

- A. Where Unit Prices for the affected items of Work are included in Division 00, the unit price Change Order will be based on the unit prices.
- B. Where unit prices of Work are not pre-determined in the Division 00, the Work Change Directive or accepted proposal will specify the unit prices to be used.

1.10 TIME-AND-MATERIAL CHANGE ORDER

- A. Contractor shall provide an itemized account and supporting data after completion of change.
- B. Engineer will determine the change allowable in Contract Price and Contract Time as provided in Contract Documents.
- C. Contractor shall maintain detailed records of work done on time-and-material basis as specified in Contract Documents.
- D. Contractor shall provide full information required for evaluation of changes and shall substantiate costs for changes in the Work.

1.11 EXECUTION OF CHANGE DOCUMENTATION

- A. Engineer will issue Change Orders, Work Change Directives, or accepted proposal for signatures of parties as described in the Contract Documents.

1.12 CORRELATION OF CONTRACTOR SUBMITTALS

- A. For Stipulated Price Contracts, Contractor shall promptly revise the Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item.
- B. For Unit Price Contracts, the next monthly estimate of work after acceptance of a Change Order will be revised to include any new items not previously included and the appropriate unit rates.
- C. Contractor shall promptly revise progress schedules to reflect any change in Contract Time, and shall revise schedules to adjust time for other items of work affected by the change, and resubmit for review.
- D. Contractor shall promptly enter changes to the on-site and record copies of the Drawings, Specifications or Contract Documents as required in Section 01785 - Project Record Documents.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 01270
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Procedures for measurement and payment plus conditions for nonconformance assessment and nonpayment for rejected products.

1.2 AUTHORITY

- A. Measurement methods delineated in Specification sections are intended to complement the criteria of this section. In the event of conflict, the requirements of the Specification section shall govern.
- B. Resident Project Representative will take all measurements and compute quantities accordingly.
- C. Contractor shall assist by providing necessary equipment, workers, and survey personnel as required by Resident Project Representative.

1.3 UNIT QUANTITIES SPECIFIED

- A. Quantity and measurement estimates stated in the Agreement are for contract purposes only.
- B. Quantities and measurements supplied or placed in the Work and verified by Resident Project Representative shall determine payment as stated in the Contract Documents.
- C. If the actual Work requires greater or lesser quantities than those quantities indicated in the Bid Form, provide the required quantities at the unit prices contracted, except as otherwise stated in the Contract Documents.

1.4 MEASUREMENT OF QUANTITIES

- A. Measurement by Weight: Reinforcing steel, rolled or formed steel or other metal shapes will be measured by CRSI or AISC Manual of Steel Construction weights. Welded assemblies will be measured by CRSI or AISC Manual of Steel Construction or scale weights.
- B. Measurement by Volume:
 - 1. Stockpiles: Measured by cubic dimension using mean length, width, and height or thickness.
 - 2. Excavation and Embankment Materials: Measured by cubic dimension using the average end area method.
- C. Measurement by Area: Measured by square dimension using mean length and width or radius.
- D. Linear Measurement: Measured by linear dimension, at the item centerline.
- E. Stipulated Price Measurement: By unit designated in the agreement.
- F. Other: (Including but not limited to, each and lump sum). Items measured by weight, volume, area, or lineal means or combination, as appropriate, as a completed item or unit of the Work.

1.5 PAYMENT

- A. Payment Includes: Full compensation for all required supervision, labor, products, tools, equipment, plant, transportation, services, and incidentals; and erection, application or installation of an item of the Work; and Contractor's overhead and profit.

- B. Total compensation for required Unit Price Work shall be included in Unit Price bid in Section A-5 Bid Proposal
- C. Interim payments for stored materials will be made only for materials to be incorporated under items covered in unit prices, unless disallowed in Supplementary Conditions.
- D. Progress payments will be based on the Resident Project Representative's observations and evaluations of quantities incorporated in the Work multiplied by the unit price.
- E. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities determined by Engineer multiplied by the unit price for Work which is incorporated in or made necessary by the Work.

1.6 NONPAYMENT FOR REJECTED PRODUCTS

- A. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable to Resident Project Representative.
 - 2. Products determined as nonconforming before or after placement.
 - 3. Products not completely unloaded from transporting vehicle.
 - 4. Products placed beyond the lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work, unless specified otherwise.
 - 6. Loading, hauling, and disposing of rejected products.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01292
SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Preparation and submittal of a Schedule of Values for stipulated price contracts or for major lump sum items on unit price contracts for which the Contractor requests progress payments.

1.2 DEFINITION

- A. The Schedule of Values is an itemized list that establishes the value of each part of the Work for a stipulated price contract and for major lump sum items in a unit price contract. The Schedule of Values is used as the basis for preparing applications for payments. Quantities and unit prices may be included in the schedule when designated by the Engineer.

1.3 PREPARATION

- A. For stipulated price contracts, subdivide the Schedule of Values into logical portions of the Work, such as major work items or work in contiguous geographic areas. Use Section 01325- Construction Schedule to guide the subdivision of work items. The items in the Schedule of Values will correlate directly with the tasks enumerated in the Construction Schedule. Then organize each portion using the Table of Contents of this Project Manual as an outline for listing the value of work by Sections. A pro rata share of mobilization, bonds, and insurance may be listed as separate items for each portion of the work.
- B. For unit price contracts, items should include a proportional share of Contractor's overhead and profit so that the total of all items will equal the Contract Price.
- C. For lump sum equipment items where submittal of operation/maintenance data and testing are required, include a separate item for equipment operation and maintenance data submittal valued at 5 percent of the lump sum amount for each equipment item and a separate item for testing and adjusting valued at 5 percent of the lump sum amount for each equipment item.
- D. Round off figures for each listed item to the nearest \$100.00 except for the value of one item, if necessary, to make the total of all items in the Schedule of Values equal the Contract Price for stipulated price contracts or the lump sum amount in Bid Proposal.
- E. Type the schedule of values on 8-1/2-inch by 11-inch white bond paper.

1.4 SUBMITTAL

- A. Submit within 30 days of Notice to Proceed, or at the pre-construction meeting, whichever occurs sooner.
- B. Revise the Schedule of Values and resubmit for items affected by contract modifications, change orders, and work change directives. After the changes are reviewed without exception by the Engineer, make the submittal at least 10 days prior to submitting the next application for progress payment.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01312
COORDINATION AND MEETINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section includes general coordination including pre-construction conference, site mobilization conference, and progress meetings.

1.2 RELATED DOCUMENTS

- A. Coordination is required throughout the documents. Refer to all of the Contract Documents and coordinate as necessary.

1.3 ENGINEER AND REPRESENTATIVES

- A. The Engineer may act directly or through designated representatives as defined in the Conditions of the Contract and as identified by name at the preconstruction conference.

1.4 CONTRACTOR COORDINATION

- A. Coordinate scheduling, submittals, and Work of the various Specifications sections to assure efficient and orderly sequence of installation of interdependent construction elements.
- B. Verify that utility requirement characteristics of operating equipment are compatible with existing or planned utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements 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 line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. Conceal pipes, ducts, and wiring within the construction in finished areas, except as otherwise indicated. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean up of Work for Substantial Completion and for portions of Work designated for Owner's partial occupancy.
- F. Coordinate access to site for correction of nonconforming Work to minimize disruption of Owner's activities where Owner is in partial occupancy.

1.5 PRECONSTRUCTION CONFERENCE

- A. Engineer will schedule a pre-construction conference.
- B. Attendance Required: Owner's Representatives, Engineer's Representatives, Resident Project Representative, Contractor, major Subcontractors, and Funding Agency Representatives (if applicable).
- C. Agenda:
 - 1. Distribution of Contract Documents.
 - 2. Designation of personnel representing the parties in Contract, and the Engineer.
 - 3. Review of insurance.
 - 4. Discussion formats proposed by the Contractor for schedule of values (if any), and construction schedule.

5. Procedures and processing of shop drawings and other submittals, substitutions, pay estimates or applications for payment, Requests for Information, Request for Proposal, Change Orders, and Contract closeout.
6. Scheduling of the Work and coordination with other contractors and utility service providers.
7. Review of Subcontractors.
8. Appropriate agenda items listed for Site Mobilization Conference, paragraph 1.06C, when pre-construction conference and site mobilization conference are combined.
9. Procedures for testing.
10. Procedures for maintaining record documents.
11. Other items as may be deemed appropriate.

1.6 SITE MOBILIZATION CONFERENCE

- A. When required by the Contract Documents, Engineer will schedule a conference at the
- B. Project site prior to Contractor occupancy.
- C. Attendance Required: Engineer representatives, Resident Project Representative, Special Consultants, Contractor's Superintendent, and major Subcontractors.
- D. Agenda:
 1. Use of premises by Owner and Contractor.
 2. Safety and first aid procedures.
 3. Construction controls provided by Owner.
 4. Temporary utilities.
 5. Survey and layout.
 6. Security and housekeeping procedures.
 7. Field office requirements.

1.7 PROGRESS MEETINGS

- A. Project meetings shall generally be held at Project field office or other location as designated by the Engineer. Meeting shall generally be held at monthly intervals, or more frequent intervals if directed by Engineer.
- B. Attendance Required: Job superintendent, major Subcontractors and Suppliers, Owner's Representatives, Engineer's Representatives, Funding Agency Representatives (if any), and Resident Project Representative as appropriate to agenda topics for each meeting.
- C. Engineer or his representative will make arrangements for meetings, and recording minutes.
- D. Engineer or his representative will prepare the agenda and preside at meetings.
- E. Contractor shall provide required information and be prepared to discuss each agenda item.
- F. Agenda:
 1. Review minutes of previous meetings.
 2. Review of Record Documents.
 3. Review of Work progress schedule submittal, and pay estimates, payroll and compliance submittals.
 4. Field observations, problems, and decisions.
 5. Identification of problems which may impede planned progress.
 6. Review of submittals schedule and status of submittals.
 7. Review of RFI and RFP status.
 8. Change order status.
 9. Review of off-site fabrication and delivery schedules.
 10. Maintenance of progress schedule.
 11. Corrective measures to regain projected schedules.
 12. Planned progress during succeeding work period.
 13. Coordination of projected progress.

- 14. Maintenance of quality and work standards.
- 15. Effect of proposed changes on progress schedule and coordination.
- 16. Other items relating to Work.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 01321

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Photographic requirements for construction photographs and submittals.

1.2 SUBMITTALS

- A. Prints: Furnish 2 sets of 4-inch by 6-inch prints of each view and submit 1 print directly to the Engineer within 7 days of taking photographs. One print shall be retained by the Contractor in the field office at the Project site and available at all times for reference.
- B. Extra Prints: When requested by the Engineer, the Contractor shall submit extra prints of photographs, with distribution directly to designated parties who will pay the costs for the extra prints directly to the photographer.
- C. When required by individual sections, submit photographs taken prior to start of construction to show original site conditions.
- D. When required by Contract Documents, submit photographs with monthly Pay Estimate.
- E. Contractor shall submit digital photographs on a Computer Disc (CD) or Digital Versatile Disc (DVD) of digital photographs using a digital camera with a resolution of 3264 x 2448 - 8 Megapixel, but must comply with Parts 1 and 2 of this section.

1.3 QUALITY ASSURANCE

- A. Contractor shall be responsible for the timely execution of the photographs, their vantage point, and quality.
- B. Photographs: Two prints; color, matte finish; 4 x 6 -inch size, mounted on 8-1/2 x 11- inch soft card stock, with left edge binding margin for three hole punch. Digital photos shall not be distorted to fit card stock.

PART 2 - PRODUCTS

2.1 PRECONSTRUCTION PHOTOGRAPHS

- A. Prior to the commencement of any construction, take digital color photographs of the site of the project and present two sets of prints to the Engineer for their use in contract administration and inspection. Subject matter of the photographs to be determined by the Engineer.
- B. The photographs shall show on a non-reflective chalkboard readable in the photograph:
 - 1. Job number.
 - 2. Date and time photographs were taken.
 - 3. Location and compass direction of the photograph, along with the project number.
 - 4. Date shall be on digital image.
 - 5. Provide notation of vantage point marked for location and direction of shot, on a key plan of the site.
- C. Sufficient number of photographs shall be taken to show the existence or non-existence of cracked paved surfaces and the condition of trees, shrubs, and grass.
- D. Identify each photograph with an applied label or rubber stamp on the back with the following information:

1. Name of the Project.
2. Name and address of the photographer (if a professional photographer is used).
3. Name of the Contractor.
4. Date the photograph was taken.
5. Photographs shall be in plastic pockets and bound in three-ring notebook for easy access and viewing.

2.2 PROGRESS PHOTOGRAPHS

- A. Take photographs of subject matter selected by Resident Project Representative at intervals, coinciding with the cutoff date associated with each application for payment. Select the vantage points for each shot each month to best show the status of construction and progress since the last photographs were taken.
 1. Vantage Points: Follow direction by the Resident Project Representative to select vantage points. During each of the following construction phases take not less than 2 of the required shots from the same vantage point each time to create a time-lapse sequence.
 2. Photos shall be submitted according to Paragraphs 1.03 B. and 2.01 B and D.

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01325

CONSTRUCTION SCHEDULE

PART 1 - PART 1 GENERAL

1.1 GENERAL

- A. Provide Construction Schedules for Work included in this Contract in accordance with requirements in this Section. Create a Construction Schedule using Critical Path Method (CPM) computer software capable of mathematical analysis of Precedence Diagramming Method (PDM) schedules. Provide printed activity listings and bar charts in formats described in this Section.
- B. Combine activity listings and bar charts with a narrative report to form the Contractor's Construction Schedule submittal for the Engineer.

1.2 SCHEDULING STAFF

- A. Employ or retain services of an individual experienced in critical path scheduling for the duration of the Contract. This person shall cooperate with the Engineer and shall update the Contractor's schedule at least monthly as required to indicate current status of the Work.

1.3 SUBMITTALS

- A. Make Construction Schedule submittals for review by the Engineer in accordance with requirements of the Conditions of the Contract.
- B. During the pre-construction meeting provide sample bar charts and activity listings produced from the scheduling software proposed. Scheduling software is subject to approval of the Engineer and must meet requirements provided in this Section. Review of the samples will be provided by the Engineer within 7 days of the submittal.
- C. Within 21 days of receipt of approval of the Contractor's format, or 30 days of the Notice to Proceed, whichever is later, submit a proposed Construction Schedule for review. The Construction Schedule submittal shall be based on the following:
 - 1. The level of detail and number of activities required in the schedule are dependent on the project type.
 - a. For wastewater projects, the work shall be categorized by Work Type and Area Code in the schedule.
 - 2. For projects with multiple types of tasks within the scope, these types of work shall be indicated separately within the schedule.
 - 3. For projects with work at different physical locations or service areas, or different facilities within a site, each location or facility shall be indicated separately within the schedule. Work on each floor of a multi-story building shall be shown as separate tasks.
 - 4. For projects with multiple crafts or significant subcontractor components, these elements shall be indicated separately within the schedule. Unless permitted by the Engineer, tasks shall consist of work covered by only one division of the Project Manual.
 - 5. Unless permitted by the Engineer, each schedule task shall be the same as a schedule of values line item, and vice versa.
 - 6. For projects with significant major equipment items or materials representing over 5 percent of the Total Contract Price, the schedule shall indicate dates when these items are to be purchased, when they are to be delivered, and when installed. Activities for testing, adjustment, and delivering O & M manuals shall be included.
 - 7. No task except the acquisition of major equipment items shall represent more than one percent of the Total Contract Price for facility projects and 3 percent of the Total Contract Price for other projects. The duration of tasks may not exceed 40 calendar days.

8. For projects where operating facilities are involved, each period of work which will impact any process or operation shall be identified in the schedule and must be agreed to by the Engineer and the facility operator prior to starting work in the area.
9. Construction Schedule submittals shall include:
 - a. Printed bar charts which meet the criteria outlined in this Section and which are produced by the Contractor's approved scheduling software.
 - b. Activity listings which meet the criteria outlined in this Section and which are produced by the Contractor's approved scheduling software.
 - c. Predecessor/successor listing sorted by Activity ID which meets the criteria outlined in this Section and which is produced by the Contractor's approved scheduling software.
 - d. A logic network diagram shall be required with the first construction schedule submittal for facilities projects.
 - e. A graphic or tabular display of estimated monthly billings for the Work shall be prepared and submitted by the Contractor with the first schedule submittal. This information is not required in monthly updates, unless significant changes in work require re-submittal of the schedule for review. The display shall allocate units indicated in the bid schedule or the schedule of values to Construction Schedule activities. (Weighted allocations are acceptable, where appropriate). The dollar value associated with each allocated unit will be spread across the duration of the activity on a monthly basis. The total for each month and a cumulative total will be indicated. These monthly forecasts are only for planning purposes of the Engineer. Monthly payments for actual work completed will be made by the Engineer in accordance with the Conditions of the Contract.
 - f. A narrative report which shall provide the information outlined in this Section.
- D. No payment will be made until the Construction Schedule and billing forecast are accepted by the Engineer.
- E. If the Contractor desires to make changes in his method of operating and scheduling, after approval of the original schedule has been given by the Engineer, the Contractor shall notify the Engineer in writing, stating the reasons for the change. If the Engineer considers these changes to be of significant nature, the Contractor may be required to revise and resubmit for approval all or the affected portion of the Contractor's Construction Schedule to show the effect on the Work.
- F. Upon written request from the Engineer, the Contractor shall revise and submit for approval all or any part of the Construction Schedule submittal to reflect changed conditions in the Work or deviations made from the original plan and schedule.
- G. The Contractor's Construction Schedule shall thereafter be updated with Actual Start and Actual Finish Dates, Percent Complete, and Remaining Duration of each Activity and submitted monthly. The data date to be used in updating the monthly Construction Schedule shall be the same data date as is used in the monthly Application for Payment. This monthly update of the schedule shall be required before the monthly Application for Payment will be processed for payment.

1.4 SCHEDULING COMPUTER SOFTWARE REQUIREMENTS

- A. The Contractor's Construction Schedule shall be created using CPM computer software which provides mathematical analysis of PDM schedules. The software shall be capable of creating bar charts and activity listings which can be sorted by various fields, i.e., Sort by Activity ID; Sort by Early Start; Sort by Total Float; Sort by Area Code; sort by specification section number; and sort by Subcontractor. The software shall be capable of producing a logic network diagram.
- B. The PDM scheduling software shall be capable of producing activity listings and bar charts with the following information for each activity in the schedule:
 1. Activity ID
 2. Activity Description

3. Estimated (Original) Duration
 4. Remaining Duration
 5. Actual Duration
 6. Early Start Date
 7. Late Start Date
 8. Early Finish Date
 9. Late Finish Date
 10. Free Float
 11. Total Float
 12. Activity Codes (such as Area Code, Work Type, Specification Section, Subcontractor)
- C. The PDM scheduling software shall be capable of printing calendars using the mathematical analysis of the schedule, indicating the Contractor's standard work days of the week and scheduled holidays.
- D. Scheduling software shall be capable of printing an activity listing which indicates the Predecessors and Successors, Lag Factors and Lag Relationships used in creating the logic of the schedule.
- E. Scheduling software shall be capable of printing a bar chart of the entire schedule for the Work included in this Contract. The bar chart format shall provide a monthly time scale and shall be such that a 12-month time scale shall not exceed one page width. Bar charts may be printed or plotted on 8.5" x 11", 8.5" x 14" or 11" x 17" sheet sizes. Over-size plots are not acceptable.

1.5 NARRATIVE SCHEDULE REPORT

- A. The Narrative Report shall include a listing of the Activities Started This Month; Activities Completed This Month; Activities Continued This Month; Activities Scheduled To Start or Complete Next Month; Problems Encountered This Month; Actions Taken to Solve These Problems.
- B. The narrative Schedule Report shall include a description of changes made to the Construction Schedule Logic (i.e., changes in Predecessors and Lags); Activities Added to the Schedule; Activities Deleted from the Schedule; any other changes made to the Schedule other than the addition of Actual Start Dates and Actual Finish Dates and changes of Data Date and Remaining Durations for re-calculation of mathematical analysis.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 01330

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Submittal procedures for:
 - 1. Schedule of Values.
 - 2. Construction Schedules.
 - 3. Shop Drawings, Product Data, and Samples
 - 4. Operations and Maintenance Data.
 - 5. Manufacturer's Certificates.
 - 6. Construction Photographs.
 - 7. Project Record Documents.
 - 8. Video Tapes.
 - 9. Design Mixes.

1.2 SUBMITTAL PROCEDURES

- A. Scheduling and Handling:
 - 1. Schedule submittals well in advance of the need for the material or equipment for construction. Allow time to make delivery of material or equipment after submittal has been approved.
 - 2. Develop a submittal schedule that allows sufficient time for initial review, correction, resubmission and final review of all submittals. The Engineer will review and return submittals to the Contractor as expeditiously as possible but the amount of time required for review will vary depending on the complexity and quantity of data submitted. In no case will a submittal schedule be acceptable which allows less than 30 days for initial review by the Engineer. This time for review shall in no way be justification for delays or additional compensation to the Contractor. Recognizing that time is of the essence, the Contractor is to stamp the top of each submittal with the words ROUTINE or CRITICAL. Routine submittals shall be processed in accordance with the timeframe set forth previously. Critical submittals are those that: were overlooked by the Contractor, involve complex coordination, or are crucial to the successful completion of a specific portion of the project. For critical submittals:
 - a. Contractor shall indicate on the submittal his realistically estimated date of when a review must be returned;
 - b. Upon return of critical submittals, Contractor shall date-stamp the transmittal page with date and time received;
 - c. Contractor is cautioned that the use of critical submittals is not a substitute for proper due diligence on his part. Review of critical submittals found to be routine shall be accompanied by an invoice for excess time and material expenditures that were required in order to complete the critical review as compared to a routine review. The Resident Project Representative shall make the determination as to whether a critical submittal was in fact routine.
 - 3. The Engineer's review of submittals covers only general conformity to the Drawings, Specifications and dimensions which affect the layout. The Contractor is responsible for quantity determination. Quantities may be verified by the Engineer. The Contractor is responsible for any errors, omissions or deviations from the Contract requirements; review of submittals in no way relieves the Contractor from his obligation to furnish required items according to the Drawings and Specifications.

4. Submit sufficient copies of documents. Unless otherwise specified in the following paragraphs or in the Specifications, provide 6 copies in addition to the number the Contractor requires returned. For portions of the project involving electrical or signal components, provide one additional copy (7 copies in addition to the number the Contractor requires returned).
 5. Revise and resubmit submittals as required. Identify all changes made since previous submittal.
 6. A maximum of three (3) reviews will be conducted on any one submittal. Submittals requiring more than three (3) reviews will be considered inadequate and result in a recovery of review expenses from the Contractor.
 7. The Contractor shall assume the risk for material or equipment which is fabricated or delivered prior to approval. No material or equipment shall be incorporated into the Work or included in periodic progress payments until approval has been obtained in the specified manner.
- B. Transmittal Form and Numbering:
1. Transmit each submittal to the Engineer with a Transmittal Cover.
 2. Sequentially number each transmittal including the Specification Section number followed by a area designation number and the sequential number beginning with the number 1. Re-submittals shall use the original number with an alphabetic suffix (i.e., 2A for first re-submittal of Submittal 2 or 15C for third re-submittal of Submittal 15). Each submittal shall only contain one type of work, material, or equipment. Mixed submittals will not be accepted.
 3. Identify time nature of submittal, either ROUTINE or CRITICAL.
 4. Identify variations from requirements of Contract Documents and identify product or system limitations.
 5. For submittal numbering of video tapes, see paragraph 1.10 Video.
- C. Transmittal Cover:
1. Transmittal Cover, certifying that the items have been reviewed in detail and are correct and in accordance with Contract Documents, except as noted by any requested variance. A stamp may be used to print the information on the Transmittal Cover except for the Contractor's signature. Regardless of whether the transmittal cover is typed or stamped, the transmittal cover text shall be a minimum of fourteen (14) point.
 2. As a minimum, Transmittal Cover information shall include:
 - a. Contractor's name.
 - b. Job number.
 - c. Submittal number.
 - d. Certification statement that the Contractor has reviewed the submittal and it is in compliance with the Contract Documents.
 - e. Signature line for Contractor.
 - f. Submittal type – routine or critical
 3. The bottom half of the Transmittal Cover shall be kept blank.
- D. Electronic copy submittals:
1. Electronic copies of the approved paper copy Operation and Maintenance Manuals are to be produced in Adobe Acrobat's Portable Document Format (PDF) Version 9.0 or higher.
 2. Do not password protect and/or lock the PDF document.
 3. Create one (1) PDF document (PDF file) for each equipment O&M Manual.
 4. Drawings or other graphics must be converted to PDF format and made part of the one (1) PDF document.
 - a. Scanning to be used only where actual file conversion is not possible.
 5. Rotate pages that must be viewed in landscape to the appropriate position for easy reading.
 6. Images only shall be scanned at a resolution of 300 dpi or greater.
 - a. Perform Optical Character Recognition (OCR) capture on all images.
 - b. Achieve OCR with the "original image with hidden text" option.

SUBMITTAL PROCEDURES

01330-2 OF 4

IFB: 06-10-2020

- c. Word searches of the PDF document must operate successfully to demonstrate OCR compliance.
- 7. Create bookmarks in the navigation frame, for each entry in the Table of Contents/Index.
 - a. Normally three (3) levels deep (i.e., "Chapter," "Section," "Sub-section").
- 8. Thumbnails must be generated for each PDF file.
- 9. Set the opening view for PDF files as follows:
 - a. Initial view: Bookmarks and Page.
 - b. Magnification: Fit in Window.
 - c. Page layout: Single page.
 - d. Set the file to open to the cover page of the manual with bookmarks to the left, and the first bookmark linked to the cover page.
 - e. All PDF documents shall be set with the option "Fast Web View" 1 to open the first 2 pages of the document for the viewer while the rest of the document continues to load.
 - f. File naming conventions:
 - 1) File names shall use a "ten dot three" convention (XXXXXX-YYYY-Z.PDF) where XXXXX is the Specification Section number, YYYY is the area designation number and Z is the sequential submittal number.
- 10. Labeling:
 - a. As a minimum, include the following labeling on all CD-ROM discs and jewel 19 cases:
 - 1) Project Name.
 - 2) Equipment Name and Project Tag Number.
 - 3) Project Specification Section.
 - 4) Manufacturer Name.
 - 5) Vendor Name.
- 11. Binding:
 - a. Include labeled CD(s) in labeled jewel case(s). Bind jewel cases in standard three-ring binder Jewel Case Page(s), inserted at the front of the Final paper copy submittal.
 - b. Jewel Case Page(s) to have means for securing Jewel Case(s) to prevent loss (e.g., flap and strap).

1.3 SCHEDULE OF VALUES

- A. Submit a Schedule of Values in accordance with Section 01292 - Schedule of Values.

1.4 CONSTRUCTION SCHEDULE

- A. Submit Construction Schedules in accordance with Section 01325 - Construction Schedule.

1.5 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. Submit shop drawings in accordance with Section 01340 - Shop Drawings, Product Data, and Samples.

1.6 OPERATIONS AND MAINTENANCE DATA

- A. Submit Operations and Maintenance data in accordance with Section 01782 - Operations and Maintenance Data.

1.7 MANUFACTURER'S CERTIFICATES

- A. When required in Specification sections, submit manufacturers' certificate of compliance for review by Engineer.
- B. Transmittal Cover, as described in paragraph 1.02C, shall be placed on front page of the certification.
- C. Submit supporting reference data, affidavits, and certifications as appropriate.
- D. Certificates may be recent or previous test results on material or product, but must be acceptable to Engineer.

SUBMITTAL PROCEDURES

01330-3 OF 4

IFB: 06-10-2020

1.8 CONSTRUCTION PHOTOGRAPHS

- A. Submit Construction Photographs in accordance with Section 01321 – Construction Photographs.

1.9 PROJECT RECORD DOCUMENTS

- A. Submit Project Record Documents in accordance with Section 01785 - Project Record Documents.

1.10 VIDEO

- A. Submit television video tapes as required for Acceptance Testing for Sanitary Sewers.
- B. Transmittal forms for video tapes shall be numbered sequentially beginning with TV01, TV02, etc.

1.11 DESIGN MIXES

- A. When specified in Specifications, submit design mixes for review.
- B. Transmittal Cover, as described in paragraph 1.02C, shall be placed on front page of each design mix.
- C. Mark each design mix to identify proportions, gradations, and additives for each class and type of design mix submitted. Include applicable test results on samples for each mix.
- D. Maintain a copy of approved design mixes at mixing plant.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL

- A. Submittals made as part of this project will become a vital portion of the project record and will be referenced by the Owner for the useful life of the project. All submittals shall be of high quality. To this end, the following requirements are made:
 - 1. As much as possible, all catalog cuts and manufacturer's information shall be original.
 - 2. Copies, when required, shall be clean and entirely legible.
 - 3. Neither facsimiles nor copies of facsimiles are to be included as part of any submittal.
 - 4. Binders, if used, shall be rugged, lock-ring type. Spine of binders shall be clearly labeled with the information outlined in items 1.02 C.2.a. through c.
- B. Reviewed submittals shall be returned to Contractor for distribution to subcontractors and other trades as required. As a minimum, submittals returned to the Contractor will be marked with review comments indicating findings of the review and giving instruction as to necessity of a re-submittal. The Engineer may, at his option, use a stamp for this purpose. Detailed correspondence covering the review may also accompany returned submittals.

END OF SECTION

SECTION 01340
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Methods, schedule, and process to be followed for shop drawings, product data, and sample submittals.

1.2 REQUIREMENT

- A. Submit shop drawings, product data and samples as required by the General Conditions and as designated in the Specifications using the procedures specified in Section 01330 – Submittal Procedures and the requirements of this Section.
- B. Shop drawings, product data and samples are not considered Contract Documents.

1.3 SHOP DRAWING/SUBMITTAL SCHEDULE

- A. Submit a separate Shop Drawing/Submittal schedule at the same time the construction schedule is submitted. List products, materials and equipment for which Shop Drawings and other submittals are required in the order in which they appear in the Specifications. Including product data and sample submittals in schedule.

1.4 SHOP DRAWINGS

- A. Submit shop drawings for review as required by the Specifications.
- B. Place Contractor's Transmittal Cover on each drawing as described in Section 01330 – Submittal Procedures.
- C. On the drawings, show accurately and distinctly, the following:
 - 1. Field and erection dimensions clearly identified as such;
 - 2. Arrangement and section views;
 - 3. Relation to adjacent materials or structure, including complete information for making connections between work under this Contract and work under other contracts;
 - 4. Kinds of materials and finishes;
 - 5. Parts list and descriptions;
 - 6. Assembly drawings of equipment components and accessories showing their respective positions and relationships to the complete equipment package;
 - 7. Where necessary for clarity, identify details by reference to the Contract Drawings.
- D. Make drawings to scale providing a true representation of the specific equipment or item to be furnished.

1.5 PRODUCT DATA

- A. Submit product data for review as required in Specification sections.
- B. Place Contractor's Transmittal Cover on each data item submitted, as described in Section 01330 – Submittal Procedures.
- C. Mark each copy to identify applicable products, models, and options to be used in this Project. Supplement manufacturers' standard data to provide information unique to this Project, where required by the Specifications.
- D. For products specified only by reference standard, give manufacturers, trade name, model or catalog designation and applicable reference standard.

1.6 SAMPLES

- A. Submit samples for review as required by the Specifications.
- B. Place Contractor's Transmittal Cover on each sample as described in Section 01330 – Submittal Procedures.
- C. Submit the number of samples specified in Specifications.
- D. Reviewed samples which may be used in the Work are identified in Specifications.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 01360
PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Options for making product or process selections.
- B. Procedures for proposing equivalent construction products or processes.

1.2 DEFINITIONS

- A. Product: Means materials, equipment, or systems incorporated into the Project. Product does not include machinery and equipment used for production, fabrication, conveying, and erection of the Work. Products may also include existing materials or components designated for reuse.
- B. Process: Any proprietary system or method for installing system components resulting in an integral, functioning part of the Work. For this Section, the word Product includes Processes.

1.3 SELECTION OPTIONS

- A. Approved Products: Construction products or processes of certain manufacturers or suppliers designated in the Specifications followed by the words "or approved equal." Approval of alternate products or processes not listed in the Specifications may be obtained through provisions for product options and substitutions in the Contract Documents, and by following the submittal procedures specified in 01330- Submittal Procedures.
- B. Product Compatibility: To the maximum extent possible, provide products that are of the same type or function from a single manufacturer, make, or source. Where more than one choice is available as a Contractor's option, select a product which is compatible with other products already selected, specified, or in use by the Owner.

1.4 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor's responsibility related to product options and substitutions is defined in the Contract Documents.
- B. Furnish information the Engineer deems necessary to judge equivalency of the alternate product.
- C. Pay for laboratory testing, as well as any other review or examination costs, needed to establish the equivalency between products in order to obtain information upon which the Engineer can base a decision.
- D. If the Engineer determines that an alternate product is not equal to that named in the Specifications, the Contractor shall furnish the specified products.

1.5 ENGINEER'S REVIEW

- A. Alternate products or processes may be used only if approved in writing by the Engineer. The Engineer's determination regarding acceptance of a proposed alternate product is final.
- B. Alternate products will be accepted if the product is judged by the Engineer to be equivalent to the specified product or to offer substantial benefit to the Owner.
- C. The Owner retains the right to accept any product or process deemed advantageous to the Owner, and similarly, to reject any product or process deemed not beneficial to the Owner.

1.6 SUBSTITUTION PROCEDURE

- A. Collect and assemble technical information applicable to the proposed product to aid in determining equivalency as related to the approved product specified.
- B. Submit a written request for a construction product to be considered as an alternate product.
- C. Submit the product information after the effective date of the Agreement.
- D. Submit 5 copies of each request for alternate product approval. Include the following information:
 - 1. Complete data substantiating compliance of proposed substitution with Contract Documents.
 - 2. For products:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature with product description, performance and test data, and reference standards.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product was used and date of installation. Include the name of the Owner, Architect/Engineer, and installing contractor.
 - 3. For construction methods:
 - a. Detailed description of proposed method.
 - b. Drawings illustrating methods.
 - 4. Itemized comparison of proposed substitution with product or method specified.
 - 5. Data relating to changes in construction schedule.
 - 6. Relation to separate contracts, if any.
 - 7. Accurate cost data on proposed substitution in comparison with product or method specified.
 - 8. Other information requested by the Engineer.
- E. Approved alternate products will be subject to the same review process as the specified product would have been for shop drawings, product data, and samples.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01422
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section includes general quality assurance as related to Reference Standards and a list of references.

1.2 QUALITY ASSURANCE

- A. For Products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on the date of the Contract.
- C. Request clarification from Engineer before proceeding should specified reference standards conflict with Contract Documents.

1.3 SCHEDULE OF REFERENCES

AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W. Washington, DC 20001
ACI	American Concrete Institute P.O. Box 9094 Farmington Hills, MI 48333-9094
AGC	Associated General Contractors of America 1957 E Street, N.W. Washington, DC 20006
AI	Asphalt Institute Asphalt Institute Building College Park, MD 20740
AITC	American Institute of Timber Construction 333 W. Hampden Avenue Englewood, CO 80110
AISC	American Institute of Steel Construction 400 North Michigan Avenue Eighth Floor Chicago, IL 60611
AISI	American Iron and Steel Institute 1000 16th Street, N.W. Washington, DC 20036

ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017
ANSI	American National Standards Institute 1430 Broadway New York, NY 10018
APA	American Plywood Association Box 11700 Tacoma, WA 98411
API	American Petroleum Institute 1220 L Street, N.W. Washington, DC 20005
AREA	American Railway Engineering Association 50 F Street, N.W. Washington, DC 20001
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103
AWPA	American Wood-Preservers' Association 7735 Old Georgetown Road Bethesda, MD 20014
AWS	American Welding Society P.O. Box 35104 Miami, FL 33135
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
CFR	Code of Federal Regulations
CLFMI	Chain Link Fence Manufacturers Institute 1101 Connecticut Avenue, N.W. Washington, DC 20036
CRSI	Concrete Reinforcing Steel Institute 933 Plum Grove Road Schaumburg, IL 60173-4758
DIPRA	Ductile Iron Pipe Research Association
EJMA	Expansion Joint Manufacturers Association 707 Westchester Avenue White Plains, NY 10604
FS	Federal Standardization Documents General Services Administration Specifications Unit (WFSIS) 7th and D Streets, S.W.

REFERENCE STANDARDS

01422-2 OF 4

IFB: 06-10-2020

	Washington, DC 20406
ICEA	Insulated Cable Engineer Association P.O. Box 440 S. Yarmouth, MA 02664
IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane P.O. Box 1331 Piscataway, NJ 0855-1331
ISA	International Society of Arboriculture 303 West University P.O. Box GG Savoy, IL 61874
MIL	Military Specifications General Services Administration Specifications Unit (WFSIS) 7th and D Streets, S.W. Washington, DC 20406
NACE	National Association of Corrosion Engineers 1440 South Creek Drive Houston, TX 71084
NEMA	National Electrical Manufacturers' Association 2101 L Street, N.W., Suite 300 Washington, DC 20037
NFPA	National Fire Protection Association Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101
NRMCA	National Ready Mix Concrete Association
NSF	National Sanitary Foundation
OSHA	Occupational Safety Health Administration U.S. Department of Labor Government Printing Office Washington, DC 20402
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077-1083
PCI	Prestressed Concrete Institute 201 North Wacker Drive Chicago, IL 60606
SDI	Steel Deck Institute Box 9506 Canton, OH 44711

REFERENCE STANDARDS

01422-3 OF 4

IFB: 06-10-2020

SSPC	Steel Structures Painting Council 4400 Fifth Avenue Pittsburgh, PA 15213
TAC	Texas Administrative Code
TxDOT	Texas Department of Transportation 11th and Brazos Austin, TX 78701 2483
UL	Underwriters' Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062
UNI-BELL	UNI-BELL Pipe Association 2655 Villa Creek Drive, Suite 155 Dallas, TX 75234

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01450
CONTRACTOR'S QUALITY CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance and control of installation and manufacturer's field services and reports.

1.2 MEASUREMENT AND PAYMENT

- A. No payment will be made for this item. Include the cost of Contractor's quality control in overhead cost for this project.

1.3 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' installation instructions, including each step in sequence.
- C. Request clarification from Engineer before proceeding should manufacturers' instructions conflict with Contract Documents.
- D. Comply with specified standards as minimum requirements for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce the specified level of workmanship.

1.4 REFERENCES

- A. Obtain copies of standards and maintain at job site when required by individual Specification sections.

1.5 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual Specification sections, provide material or product suppliers' or manufacturers' technical representative to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, operator training, test, adjust, and balance of equipment as applicable, and to initiate operation, as required. Conform to minimum time requirements for start-up operations and operator training if defined in Specification sections.
- B. Manufacturer's representative shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions. Submit report within 14 days of observation to Resident Project Representative for review.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 01452
INSPECTION SERVICES

PART 1 - PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Inspection services and references

1.2 INSPECTION

- A. Engineer and/or Owner will appoint Resident Project Representative as a representative of the Owner to perform inspections, tests, and other services specified in individual specification Sections.
- B. Alternately, Engineer and/or Owner may appoint, employ, and pay an independent firm to provide additional inspection, tests or construction management services as indicated in Section 01454 - Testing Laboratory Services.
- C. Reports will be submitted by the independent firm to Engineer, and Owner, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- D. Assist and cooperate with the Resident Project Representative; furnish samples of materials, design mix, equipment, tools, and storage.
- E. Notify Resident Project Representative 24 hours prior to expected time for operations requiring services.
- F. Sign and acknowledge observation or testing reports when requested by Resident Project Representative or independent firm.
- G. The Contractor shall notify the Engineer at least twenty-four (24) hours prior to the beginning at any point. He shall not begin new portions of the work to the detriment of portions already begun.
- H. Owner's normal working hours are **Monday through Friday from 8:00 AM to 5:00 PM**. The Contractor shall notify the Owner at least twenty-four (24) hours in advance for any work that is to be scheduled beyond the limits of the Owner's working hours, and he shall not begin any such work schedule unless proper inspection by the Contractor has been pre-arranged with the Owner, with the cost for such work beyond the Owner's working hours borne by the Contractor.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 01454
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing laboratory services and Contractor responsibilities related to those services.

1.2 REFERENCES

- A. ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
- B. ASTM D 3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.
- C. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- D. ASTM E 329 - Specification for Minimum Requirements for Agencies Engaged the Testing and/or Inspection of Materials Used in Construction.

1.3 SELECTION AND PAYMENT

- A. The Owner shall employ and pay for the services of an independent testing laboratory, or laboratories, to perform product and material quality control, perform in-place quality control and verification identified in individual Specification sections for the following:
 - 1. Proof Rolling density
 - 2. Embankment and Backfill soil density
 - 3. Concrete
 - 4. Asphalt and Concrete Pavement including subgrade
- B. All other testing required by the Conditions of the Contract and Specifications shall be paid by the Contractor.
- C. No separate payment. Contractor's labor and material expense and overhead and profit associated with the testing shall be included in the various other bid items.
- D. All tests required by the project plans and specifications shall be included in a schedule of values.
- E. The Contractor shall coordinate the services of the project's Geotechnical Engineer of Record to conduct observation and testing of the subgrade preparation, and the selection, placement and compaction of select fill material. The foundation excavations for structures shall be observed by the Geotechnical Engineer of Record prior to steel and/or concrete placement to assess that the foundation materials are capable of supporting the design loads and are consistent with the subsurface materials described in the project's Geotechnical Engineering Study.
- F. Remedial work re-testing costs, stand-by and overtime costs, resulting from deficiencies in materials and/or workmanship, shall be borne by the Contractor.

1.4 QUALIFICATION OF LABORATORY

- A. Meet laboratory requirements of ASTM E 329 and applicable requirements of ASTM C 1077, ASTM D 3666, and ASTM D 3740.
- B. Where a laboratory subcontracts any part of the testing services, such work shall be placed with a laboratory complying with the requirements of this Section.

1.5 LABORATORY REPORTS

- A. The testing laboratory shall provide and distribute copies of laboratory reports to the distribution list provided by the Engineer.
- B. One copy of each laboratory report distributed or faxed to the Contractor shall be kept at the site field office for the duration of the project.
- C. Before close of business on the working day following test completion and review, reports which indicate failing test results shall be transmitted immediately via fax from the testing laboratory to the material supplier, Contractor, Engineer and Resident Project Representative.

1.6 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume any duties of the Contractor.
- D. Laboratory has no authority to stop the Work.

1.7 CONTRACTOR RESPONSIBILITIES

- A. Provide safe access to the Work and to manufacturer's facilities for the Engineer, Resident Project Representative and for testing laboratory personnel.
- B. Provide to the testing laboratory a copy of the construction schedule and a copy of each update to the construction schedule.
- C. Notify the Resident Project Representative and the testing laboratory during normal working hours of the day previous to the expected time for operations requiring inspection and testing services. If the Contractor fails to make timely prior notification, then the Contractor shall not proceed with the operations requiring inspection and testing services.
- D. Notify the Resident Project Representative 24 hours in advance if the Specification requires the presence of the Resident Project Representative or testing laboratory for sampling or testing.
- E. Request and monitor testing as required to provide timely results and to avoid delay to the Work. Provide samples to the laboratory in sufficient time to allow the required test to be performed in accordance with specified test methods before the intended use of the material.
- F. Cooperate with laboratory personnel in collecting samples on site. Provide incidental labor and facilities for safe access to the Work to be tested; to obtain and handle samples at the site or at source of products to be tested; and to facilitate tests and inspections including storage and curing of test samples.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 CONDUCTING TESTING

- A. Laboratory sampling and testing specified in individual Specification sections shall conform to the latest issues of ASTM standards, TxDOT methods, or other recognized test standards as approved by the Engineer.
- B. The requirements of this section shall also apply to those tests for approval of materials, for mix designs, and for quality control of materials as performed by the testing laboratories employed by the Owner.

END OF SECTION

SECTION 01502
MOBILIZATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Mobilization of construction equipment and facilities onto the site.

1.2 MEASUREMENT AND PAYMENT

- A. Measurement and payment for mobilization is on a stipulated price basis.
- B. Mobilization payments will be made in accordance with the following provisions:
1. 1. Authorization for payment of twenty (20) percent of the Contract Price for mobilization will be made upon receipt and approval by Engineer of the following items, as applicable:
 - a. Establishment of the field office for the Resident Project Representative where an office is required by other Sections;
 - b. Establishment of the Contractor's field office;
 - c. Establishment of Contractor's material and equipment storage areas (as evidenced by executed leases or rental agreements); and
 - d. Issuance of Notice to Proceed by Engineer to Contractor.
 2. Authorization for payment of fifty (50) percent of the Contract Price for mobilization will be eligible for payment upon receipt and approval by Engineer of the following items, as applicable:
 - a. Schedule of values;
 - b. Trench safety program;
 - c. Construction schedule.
 - d. Pre-construction photographs; and
 - e. Dewatering plan, if required.
 3. Authorization for payment of the remaining thirty (30) percent of the Contract Price for mobilization will be made upon completion of Work amounting to five (5) percent of the Contract Price less the Mobilization unit price.
- C. Mobilization payments will be subject to retainage amounts stipulated in the General Conditions.
- D. All cost difference between the stipulated amount and the actual cost of the initial mobilization and the cost of all subsequent mobilization shall be included in the various other prices bid.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 01504
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Temporary facilities and necessary controls for project including, furnishings utilities, telephone, sanitary facilities, storage, safety requirements, first aid equipment, fire protection, security measures, protection of Work and property, barriers and enclosures, access roads and parking, pest and rodent control and disposal of trash, debris and excavated material, environmental controls, field offices and sheds, and removal after construction.
- B. Facilities and controls specified in this section are considered minimum for Project. Provide additional facilities and controls for proper execution of Work and to meet Contractor's responsibilities for protection of persons and property.

1.2 UNIT PRICES

- A. No separate payment will be made for any temporary facilities and controls required under this section. Include cost of such work in contract price listed for mobilization.

1.3 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for this item. Include the cost of Temporary Facilities and Controls in associated items for this project.
 - 2. No separate payment will be made for construction fencing.
- B. Stipulated Price (Lump Sum). If Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.4 CONTRACTOR'S RESPONSIBILITY

- A. Comply with applicable requirements specified in other sections of Specifications.
 - 1. Maintain and operate temporary facilities and systems to assure continuous service.
 - 2. Modify and extend systems as Work progress requires.
 - 3. Completely remove temporary materials and equipment when no longer required.
 - 4. Restore existing facilities used for temporary services to specified or to original condition.

PART 2 - PRODUCTS

2.1 TEMPORARY UTILITIES

- A. Obtaining Temporary Service:
 - 1. Make arrangements with utility service companies for temporary services.
 - 2. Abide by rules and regulations of utility service companies or authorities having jurisdiction.
 - 3. Be responsible for utility service costs until Work is substantially complete. Included are fuel, power, light, heat, and other utility services necessary for execution, completion, testing, and initial operation of Work.
- B. Water:
 - 1. Water service is currently available at water plant site.
 - 2. Contractor to provide water required for and in connection with Work to be performed and for specified tests of piping, equipment, devices, or for other use as required for proper completion of Work.
 - 3. Provide and maintain adequate supply of potable water for domestic consumption by Contractor personnel and Project Representative.

4. Remove temporary piping and connections and restore affected portions of the facility to original condition before final acceptance.
5. Development of Potable Water Supply:
 - a. Potable water is not available at construction site.
 - b. Provide potable water for human consumption during construction period.
 - c. Furnish potable water that meets requirements of Laws and Regulations.
- C. Electricity and Lighting:
 1. Electrical power supplier is AEP. Contractor shall coordinate with AEP for power to Field Offices. AEP power maps show power within the site boundary.
 2. Provide electric powered service required for Work, including testing of Work. Provide power for lighting, operation of equipment, or other use.
 3. Electric power service includes temporary power service or generator to maintain plant operations during scheduled shutdown.
 4. Minimum lighting level shall be 10-foot candles for open areas; 20-foot candles for stairs and shops. Provide minimum of one 300-watt lamp for each 200 square feet in work area.
- D. Temporary Heat and Ventilation:
 1. Provide temporary heat as necessary for protection or completion of Work.
 2. Provide temporary heat and ventilation to assure safe working conditions; maintain enclosed areas at minimum of 50°F.
- E. Telephone:
 1. Provide emergency telephone service at Project Site for use by Contractor personnel and others performing work or furnishing services at site.
 2. Provide Houston-Metro lines, allowing unlimited calls, without charge in Greater Houston Metropolitan area with "call waiting" and "call forwarding" options. Provide one telephone answering machine with beeperless remote message retrieval capability.
- F. Sanitary Facilities:
 1. Provide and maintain sanitary facilities for persons on job site; comply with regulations of State and local departments of health.
 2. Enforce use of sanitary facilities by construction personnel at job site. Enclose sanitary facilities. Pit-type toilets will not be permitted. No discharge will be allowed from these facilities. Collect and store sewage and waste so as not to cause nuisance or health problem. Haul sewage and waste off-site and properly dispose in accordance with applicable regulation.
 3. Locate toilets near Work site and secluded from view insofar as possible. Keep toilets clean and supplied throughout course of Work.

2.2 STORAGE SHEDS AND BUILDINGS

- A. Provide adequately ventilated, watertight storage facilities with floor above ground level for materials and equipment susceptible to weather damage.
- B. Storage of materials not susceptible to weather damage may be on blocks off ground.
- C. Store materials in neat and orderly manner. Place materials and equipment to permit easy access for identification, inspection, and inventory.
- D. Fill and grade site for temporary structures to provide drainage away from temporary and existing buildings.

2.3 SAFETY REQUIREMENTS

- A. At preconstruction conference submit and follow safety program in accordance with the Conditions of the Contract. Include documented response to trench safety requirements as specified in Section 02165 – Contactor Designed Excavation Support System.

- B. Conduct operations in strict accord with applicable Federal, State, and local safety codes and statutes and with good construction practice. Establish and maintain procedures for safety of all work, personnel, and equipment involved in Project.
- C. Observe and comply with Texas Occupational Safety Act (Art. 5182a, V.C.S.) and with all safety and health standards promulgated by Secretary of Labor under Section 107 of Contract Work Hours and Standards Act, published in 29 CFR Part 1926 and adopted by Secretary of Labor as occupational safety and health standards under Williams-Steiger Occupational Safety and Health Act of 1970, and to other legislation enacted for safety and health of Contractor employees. Safety and health standards apply to subcontractors and their employees as well as to Contractor and its employees.
- D. Observance of and compliance with regulations is solely and without qualification responsibility of Contractor without reliance or superintendence of or direction by the Authority or OWNER'S Representative. Immediately advise OWNER'S Representative of investigation or inspection by Federal Safety and Health Inspectors of Contractor or subcontractor's work or place of work on job site under this Contract, and after investigation or inspection, advise OWNER'S Representative of results. Submit one copy of accident reports to OWNER'S Representative within 10 days of occurrence.
- E. Protect areas occupied by workmen using best available devices for detection of lethal and combustible gases. Test devices frequently to assure functional capability. Constantly observe infiltration of liquids into Work area for visual or odor evidences of contamination, immediately take appropriate steps to seal off entry of contaminated liquids to Work area.
- F. Implement safety measures, including but not limited to safety personnel, first-aid equipment, ventilating equipment and other safety equipment, as specified or detailed on Drawings.
- G. Maintain required coordination with Police and Fire Departments during entire period covered by Contract.
- H. In safety plan include project safety analysis. Itemize major tasks and potential safety hazards. Plan to eliminate hazards or protect workers and public from each hazard.

2.4 FIRST AID EQUIPMENT

- A. Provide first aid kit throughout construction period. List telephone numbers for physicians, hospitals, and ambulance services in each first aid kit.
- B. Have at least one person thoroughly trained in first aid and CPR procedures present on site whenever Work is in progress. Contractor to conform to protocols and requirements for training and protection against "blood borne pathogens."

2.5 FIRE PROTECTION

- A. Conform to specified fire protection and prevention requirements established by Federal, State, or local governmental agencies and as provided in Safety Program.

2.6 SECURITY MEASURES

- A. Protect all Work materials, equipment, and property from loss, theft, damage, and vandalism. Duty to protect property of the Authority used in connection with performance of Contract.
- B. Fences:
 - 1. If existing fencing or barriers are breached or removed for purposes of construction, provide and maintain temporary security fencing equal to existing.
 - 2. Enclose temporary offices and storage areas with fence adequate to protect temporary facilities against acts of theft, violence and vandalism.
 - 3. When entire or part of site is to be permanently fenced, permanent fence may be built to serve for both permanent and temporary protection of the work site, provided that damaged or defaced fencing is replaced prior to substantial completion.

4. Protect temporary and permanent openings and close openings in existing fences to prevent intrusion by unauthorized persons. Bear responsibility for protection of plant and material on site of the Work when openings in existing fences are not closed.
5. During night hours, weekends, holidays, and other times when no work is performed at site, provide temporary closures or enlist services of security guards to protect temporary openings.
6. Fence temporary openings when openings are no longer necessary.

2.7 PROTECTION OF UTILITIES AND PIPELINES

- A. Prevent damage to existing utilities during construction. Utilities shown on Drawings are at approximate locations. Pre-locate, by whatever means may be required (metal detection equipment, probes, excavation, survey), underground utilities before excavating. Perform investigative work and repairs required after investigation. Contractor is responsible for damages caused by failure to locate and preserve these underground utilities. Give owners of utilities at least 5 days notice before commencing Work in area, for locating utilities during construction, and for making adjustments or relocation of utilities when they conflict with proposed Work. Include cost for temporary relocation of utilities necessary to accommodate construction in unit cost for utility construction unless otherwise noted on Drawings. Bypassing of sanitary waste to storm drainage facilities is not allowed. Utility service lines are not shown on Drawings. Anticipate service lines exist and repair them when damaged due to construction activity. No separate payment will be made for repair work. Include payment in unit price for work in appropriate sections.
- B. Utilize Utility Coordinating Committee One Call System, which must be called 48 hours in advance. Toll free telephone number is 1-800-344-8377, Texas One Call System.
- C. Prior to abandonment of utility, make arrangements with OWNER'S Representative and utility owner to terminate service, remove meters, transformers, and poles as required.
- D. When excavating near pipelines and prior to start of excavation, request representative of pipeline company to come to construction site(s) to meet representatives of Contractor and Project Representative to discuss actual procedures that will be used. Request pipeline company's representative to probe and locate pipelines in at least three locations: one at each side of proposed excavation and one at centerline of proposed utility. Representative of pipeline company and Project Representative must be present to observe activities of Contractor at all times when excavation is being conducted within 15 feet of pipeline.

2.8 PROTECTION OF WORK AND PROPERTY

- A. Preventive Actions:
 1. Take precautions, provide programs, and take actions necessary to protect Work, public and private property from damage.
 2. Take action to prevent damage, injury or loss, including, but not limited to, the following:
 - a. Store apparatus, materials, supplies, and equipment in orderly, safe manner that will not interfere with progress of Work or Work of others.
 - b. Provide suitable storage for materials subject to damage by exposure to weather, theft, breakage, or otherwise.
 - c. Place upon Work or any part thereof only safe loads.
 - d. Frequently clean up refuse, rubbish, scrap materials, and debris caused by construction operations, keeping Project site safe and orderly.
 - e. Provide safe barricades and guard rails to protect pedestrian and vehicular traffic around openings, scaffolding, temporary stairs and ramps, excavations, elevated walkways, and other hazardous areas.
 3. Obtain written consent from proper parties before entering or occupying privately-owned land except on easements provided for construction.

4. Assume full responsibility for preservation of public and private property on or adjacent to site. When direct or indirect damage is done by or on account of any act, omission, neglect, or misconduct in execution of Work by Contractor, restore to condition equal to or better than that existing before damage was done.
- B. Barricades and Warning Signals: Where Work is performed on or adjacent to any roadway, right-of-way, or public place, furnish and erect barricades, fences, lights, warning signs, and danger signals; and take other precautionary measures for protection of persons or property and of the Work. Paint barricades to be visible at night. From sunset to sunrise, furnish and maintain at least one light at each barricade. Erect sufficient barricades to keep vehicles and pedestrians from being driven on or into Work under construction. Maintain barricades, signs, lights, and provide watchmen until Project is accepted by the Authority. Whenever Work creates encroachment on public roadways, station flagmen to manage traffic flow in accordance with approved traffic control plan.
- C. Protection of Existing Structures:
 1. Underground Structures:
 - a. Underground structures are defined to include, but not be limited to, sewer, water, gas, and other piping, manholes, chambers, electrical signal and communication conduits, tunnels, and other existing subsurface installations located within or adjacent to limits of Work.
 - b. Known underground structures including water, sewer, electric, and telecommunication service connections are shown on Drawings. This information is not guaranteed to be correct or complete.
 - c. Explore ahead of trenching and excavation work and sufficiently uncover obstructing underground structures to determine their location, to prevent damage to them and to prevent interruption of utility services. Restore damage to underground structure to original condition at no additional cost.
 - d. Necessary changes in location of Work may be made by the Authority to avoid unanticipated underground structures.
 - e. If permanent relocation of underground structure or other subsurface installations is required and not otherwise provided in Contract, the Authority will direct Contractor in writing to perform Work, which is paid for under provisions for changes as described in the Conditions of the Contract.
 2. Surface Structures: Surface structures are defined as existing buildings, structures and other constructed installations above ground surface. Included with structures are their foundations or extension below the surface. Surface structures include, but are not limited to buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks, guard cables, fencing, and other facilities visible above ground surface.
 3. Protection of Underground and Surface Structures:
 - a. Support in place and protect from direct or indirect injury underground and surface structures located within or adjacent to limits of Work. Install supports carefully and as required by party owning or controlling structure. Before installing structure supports, satisfy OWNER'S Representative that methods and procedures have been approved by owner of structure.
 - b. Avoid moving or changing property of public utilities or private corporations without prior written consent of responsible official of that service or public utility. Representatives of these utilities reserve the right to enter within limits of this Project for purpose of maintaining their properties, or of making changes or repairs to their property that may be considered necessary by performance of this Contract.
 - c. Notify owners and/or operators of utilities and pipelines of the nature of construction operations and dates when operations will be performed. When construction operations are required in immediate vicinity of existing structures, pipelines, or utilities, give minimum of 5 working days advance notice. Probe and flag location of underground utilities prior to commencement of excavation. Keep flags in place until construction operation reaches and uncovers utility.

- d. Assume risks attending presence or proximity of underground and surface structures within or adjacent to Work including but not limited to damage and expense for direct or indirect injury caused by his work to structure. Immediately repair damage.
 - e. Employ structural engineer to ensure safety and integrity of structures and facilities.
- D. Protection of Installed Products:
- 1. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of Work.
 - 2. Control traffic to prevent damage to equipment, materials, and surfaces.
 - 3. Provide coverings to protect equipment and materials from damage. Cover projections, wall corners, jambs, sills, and exposed sides of openings in areas used for traffic and passage of materials in subsequent work.

2.9 ROADS AND PARKING

- A. General:
- 1. Build and maintain access roads to and on site of the Work to provide for delivery of material and for access to existing and operating plant facilities on site.
 - 2. Build and maintain dust free roads which are suitable for travel at 20 miles per hour.
 - 3. Prevent interference with traffic on existing roads.
 - 4. Minimize use by construction traffic of existing streets and driveways.
 - 5. Do not allow heavy vehicles or construction equipment in existing parking areas.
- B. Off-Site Access Roads:
- 1. Build and maintain graded earth roads.
 - 2. Build roads only in public right-of-way or easements obtained by OWNER.
 - 3. Obtain rights-of-way or easements when electing to build along other alignment.
- C. On-Site Access Roads:
- 1. Maintain access roads to storage areas and other areas to which frequent access is required.
 - 2. Maintain similar roads to existing facilities on site of the Work to provide access for maintenance and operation.
- D. Designate temporary parking areas to accommodate construction and management personnel. When site space is not adequate, provide additional off-site parking. Locate as approved by OWNER'S Representative.

2.10 ENVIRONMENTAL CONTROLS

- A. Provide and maintain methods, equipment, and temporary construction as necessary for controls over environmental conditions at construction site and adjacent areas.
- B. Comply with statutes, regulations, and ordinances which relate to proposed Work for prevention of environmental pollution and preservation of natural resources, including but not limited to National Environmental Policy Act of 1969, PL 91-190, Executive Order 11514.
- C. Work to minimize impact to surrounding environment. Adopt construction procedures that do not cause unnecessary excavation and filling of terrain, indiscriminate destruction of vegetation, air or stream pollution, nor harassment or destruction of wildlife.
- D. Recognize and adhere to environmental requirements of Project. Limit disturbed areas to boundaries established by Contract. Avoid pollution of "on-site" streams, sewers, wells, or other water sources.
- E. Burning of rubbish, debris, or waste materials is not permitted.

2.11 POLLUTION CONTROL

- A. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by discharge of noxious substances from construction operations.

- B. Provide equipment and personnel to perform required emergency measures to contain spillage, and to remove contaminated soils or liquids. Excavate and dispose of contaminated earth off-site, and replace with suitable compacted fill and topsoil.
- C. Provide systems for control of atmospheric pollutants.
 - 1. Prevent toxic concentrations of chemicals.
 - 2. Prevent harmful dispersal of pollutants into atmosphere.
- D. Use equipment that conforms to current Federal, State, and local laws and regulations.
- E. Install or otherwise implement positive controls to prevent hazardous materials migrating from Work area.

2.12 PEST AND RODENT CONTROL

- A. Provide rodent and pest control as necessary to prevent infestation of construction or storage areas.
- B. Employ methods and use materials which will not adversely affect conditions at site or on adjoining properties.

2.13 NOISE CONTROL

- A. Provide vehicles, equipment, and construction activities that minimize noise to greatest degree practicable. Conform noise levels to latest OSHA standards. Do not permit noise levels to interfere with Work or create nuisance in surrounding areas.
- B. Conduct construction operations during daylight hours except as approved by OWNER'S Representative.
- C. Select construction equipment to operate with minimum noise and vibration. When in opinion of OWNER'S Representative, objectionable noise or vibration is produced by equipment, rectify conditions without additional cost to Authority. Sound Power Level (PWL) of equipment shall not exceed 85 dbA (re: 10-12 watts) measured 5 feet from piece of equipment. Explicit equipment noise requirements are specified with equipment specifications.

2.14 DUST CONTROL

- A. Control objectionable dust caused by operation of vehicles and equipment. Apply water or use other methods, subject to approval of OWNER'S Representative, to control amount of dust generated.

2.15 MUD CONTROL

- A. Prevent mud nuisance caused by construction operations, unpaved roads, excavation, backfilling, demolition, or other activities.

2.16 FIELD OFFICES AND SHEDS

- A. Contractor's Field Office:
 - 1. Maintain on Project Site weather tight space in which to keep copies of Contract Documents, progress schedule, shop drawings, and other relevant documents.
 - 2. Provide field office with adequate space to examine documents, and provide lighting and telephone service in that space.
- B. Engineer's Field Office:
 - 1. Provide separate Field Office on Project Site for Engineer, as follows:
 - a. Minimum size of 12' x 50'.
 - b. The Field Office shall be divided into three separate spaces (two offices and a conference) by full height walls with a single 3'-0" x 6'-8" door for passage. The conference space shall be located in the center of the building. The office space shall be located at the end of the building and shall be 12' x 14'.
 - c. Each space shall have an exterior 3'-0" x 6'-8" weathertight door located on one side of building.

- d. Each space shall have a minimum of one (1) 4'-0" x 5'-0" window.
 - e. Walls and Ceiling shall be insulated with finished interior surfaces.
 - f. Flooring may be plywood, vinyl, or VCT tile. Carpet shall not be used.
 - g. Field Office shall be structurally sound, weather-tight, have floor raised above ground, adequately braced, and anchored to prevent movement.
 - h. Provide heating and air-conditioning for the following minimum criteria:
 - 1) Heating: Minimum 75 degrees oF ID temp @ 10 oF ambient
 - 2) Cooling: Minimum 75 degrees oF ID temp @ 105 oF ambient).
 - i. Provide a fully plumbed indoor restroom located in one corner of the center section of the building. The restroom shall contain a flush toilet, sink, medicine cabinet with mirror, and storage shelving. Connect fixtures to complete potable water, sanitary, and vent systems.
 - j. Make connections to electrical power source and provide electrical service to building for duration of project.
 - k. Provide a skirt around perimeter of building of same material as building.
 - l. Construct a wood porch with steps and covered overhang at each entrance. Construct a handicap accessible ramp to main entrance. Provide wooden railing around porch, steps, and ramp. The wood porch shall be assessable to the Engineer's and Owner's Field Office.
 - m. Provide exterior lighting over entrance door.
 - n. Provide ten 110 volts AC duplex receptacles with at least three in each space.
- C. Owner's Field Office:
- 1. Provide separate Field Office on Project Site for Owner, as follows:
 - a. Minimum size of 12' x 50'.
 - b. The Field Office shall be divided into two separate spaces (one office and a conference) by full height walls with a single 3'-0" x 6'-8" door for passage. The conference space shall be located in the center of the building. The office space shall be located at the end of the building and shall be 12' x 14'.
 - c. Each space shall have an exterior 3'-0" x 6'-8" weathertight door located on one side of building.
 - d. The office space shall have a minimum of one (1) 4'-0" x 5'-0" window.
 - e. The conference space shall have a minimum of three (3) 4'-0" x 5'-0" window.
 - f. Walls and Ceiling shall be insulated with finished interior surfaces.
 - g. Flooring may be plywood, vinyl, or VCT tile. Carpet shall not be used.
 - h. Field Office shall be structurally sound, weather-tight, have floor raised above ground, adequately braced, and anchored to prevent movement.
 - i. Provide heating and air-conditioning for the following minimum criteria:
 - 1) Heating: Minimum 75 degrees oF ID temp @ 10 oF ambient
 - 2) Cooling: Minimum 75 degrees oF ID temp @ 105 oF ambient).
 - j. Provide a fully plumbed indoor restroom located in one corner of the center section of the building. The restroom shall contain a flush toilet, sink, medicine cabinet with mirror, and storage shelving. Connect fixtures to complete potable water, sanitary, and vent systems.
 - k. Make connections to electrical power source and provide electrical service to building for duration of project.
 - l. Provide a skirt around perimeter of building of same material as building.
 - m. Construct a wood porch with steps and covered overhang at each entrance. Construct a handicap accessible ramp to main entrance. Provide wooden railing around porch, steps, and ramp. The wood porch shall be assessable to the Engineer's and Owner's Field Office.
 - n. Provide exterior lighting over entrance door.
 - o. Provide ten 110 volts AC duplex receptacles with at least three in each space.
 - 2. Arrange and Pay For:
 - a. Janitorial service, including daily dusting, floor cleaning, and trash removal, and monthly comprehensive cleaning, including windows.

- b. Electrical, water, phone, internet and sewer service
- c. Electric wiring, power, and lighting fixtures capable of providing at least 75-foot candles of light on work surfaces.
- d. A continuous supply of toilet paper, paper hand towels and hand soap for each restroom.
- e. Private telephone line.
- f. Dedicated telephone line for facsimile (fax) machine.
- g. Dedicated telephone line for computer modem.
- h. Bottled drinking water service with dispenser.
- 3. Provide Following Furnishings and Equipment:
 - a. Three (3) office desks with six drawers (2 with locks) and padded, upholstered swivel chairs.
 - b. Three (3) plan table not less than 36 inches by 96 inches.
 - c. Two (2) metal drafting stools with backs.
 - d. Eighteen (18) straight chairs.
 - e. Three (3) swivel chairs.
 - f. Three (3) metal filing cabinet, 18 inches by 30 inches by 52 inches, 4 drawers with locks.
 - g. One supply cabinet with not less than 15 square feet of shelves.
 - h. Two (2) bookcase with not less than 12 linear feet of shelves for each bookcase.
 - i. Two (2) plan hold rolling stand of 12 binders, with binders.
 - j. Five (5) wastebaskets.
 - k. Two (2) Dry erase board 96 by 48 inches, magnetic.
 - l. Refrigerator, 6.0 cubic feet capacity.
 - m. Microwave oven, 1.0 cubic feet.
 - n. Field Office Data Service and Equipment: Provide one of the following data services for the duration of the project for each Field Office. Contractor is responsible for all maintenance of service and hardware. Data service shall be dedicated to the Engineer and not shared with any other party. The Contractor shall provide a durable and weather tight system for connecting the Engineer's trailer to the service provider's facilities at the jobsite boundary:
 - 1) Provide high-speed Internet access (DSL, fiber optic, or cable modem); with a minimum 5-megabit per second download / 1-megabit per second upload. This access must have a minimum of 8 (5 usable) IP address. In addition, it must provide an average roundtrip delay of less than 100 ms to the Engineer's Internet gateway.
 - o. Provide new data service hardware corresponding with above options. Contractor is responsible for all maintenance of service and hardware:
 - 1) Provide appropriate DSL, fiber optic or cable modem device. In addition, provide one Cisco ASA 5505 firewall with 3DES software, part number ASA5505-50-BUN-K9 or appropriate later and Cisco 4 hour response onsite Smartnet Maintenance for duration of project.
 - p. Field Office Local Area Network: Provide the following to create a local area network for the Engineer:
 - 1) Install Category 5e cabling to support all specified computers, printers, and other network device. This cabling should be home-run to a patch panel and meet all applicable installation standards for CAT5e. Patch panel and jack locations to be coordinated with Engineer.
 - 2) Provide 10/100 Ethernet Switch sized to support all specified network devices for Engineer with an allowance for 50 percent growth/spare ports.
 - 3) Provide APC SmartUPS 1500 uninterruptable power supply.
 - 4) Provide Category 5e patch cables for all networking equipment; both for patch panel to switch connection and for wall jack to network device connection.
 - q. Field Office Computer Systems: Furnish and install two (2) new complete DELL computer systems. Contractor is responsible for all maintenance of hardware and software. Each DELL system shall consist of, as a minimum:
 - 1) Intel motherboard.

TEMPORARY FACILITIES AND CONTROLS

01504-9 OF 12

IFB: 06-10-2020

- 2) Intel(R) Core(TM) i7-940 processor (2.93GHz, 1MB L2 + 8MB shared L3 cache with QPI Technology (or better).
 - 3) Hard Drive: 500GB RAID 1 (2 x 500GB SATA HDDs).
 - 4) Minimum 8GB DDR3-1066MHz SDRAM
 - 5) One parallel and 2 serial ports (not including modem).
 - 6) Minimum 4 USB ports.
 - 7) 22-inch, wide LCD - TFT, active matrixwide color LCD. 1680 x 1050, 0.25 mm dot pitch or better, non-interlaced.
 - 8) Minimum 256 MB video card
 - 9) One hundred and one key keyboard
 - 10) MS mouse and mouse pad
 - 11) DELL (20x max, dual format, DVD +/-R) drive, or equivalent with sound card and speakers.
 - 12) Intel Etherexpress 10/100 RJ-45 PCI network card.
 - 13) Cables, connectors, and controller cards, as necessary, to provide a functioning system, including computer accessories.
 - 14) A/C surge suppressor with telephone line protection sized for computer system.
 - 15) Uninterruptable power supply, APC model SmartUPS 700 or equivalent.
 - 16) Four (4) gigabit USB flash media storage device
 - 17) One hundred DVR media.
 - 18) Microsoft Windows XP Professional operating system.
 - 19) Microsoft Office 2007 Professional.
 - 20) Adobe Acrobat, latest version (full package, not just the free reader).
 - 21) McAfee Virus Scan, latest version.
 - 22) Current version of Business and Legal Reports Safety Training Presentations, Product Code 11006100.
- r. Additional Computer-Related Items:
- 1) DELL Laser Printer:
 - a) Onsite DELL maintenance for duration of project.
 - b) One hundred and twenty eight megabit additional memory.
 - c) Paper, toner, and other supplies for duration of project.
 - 2) DELL Inkjet Printer:
 - a) Paper, ink cartridges, and other supplies for duration of project.
 - 3) AutoCAD for Windows by AutoDesk latest version.
 - 4) Canon PowerShot SD870 Digital Camera, or approved equal.
 - a) Two Spare batteries.
 - b) Two 1-gigabit compact flash cards.
 - 5) DELL Document Flatbed Scanner:
 - a) All required cabling and interface cards.
- s. One telephone with answering machine.
4. Locate field office where directed.
 5. Have field office ready for occupancy within 2 weeks after start of sitework.

2.17 REMOVAL

- A. Remove temporary buildings and furnishings before inspection for substantial completion or when directed.
- B. Clean and repair damage caused by installation or use of temporary facilities.
- C. Remove underground installations to minimum depth of 24 inches and grade to match surrounding conditions.
- D. Restore existing facilities used during construction to specified or original condition.

PART 3 - EXECUTION (NOT USED)

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SECTION 01510
STORM WATER POLLUTION PREVENTION PLAN

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope

1. This item shall govern the control measures necessary to prevent and control soil erosion, sedimentation and water pollution which may degrade receiving waters including rivers, streams, lakes, reservoirs, tidal waters, groundwater and wetlands. The control measures contained herein shall be installed and maintained throughout the construction contract and coordinated with the permanent or existing temporary pollution control features specified elsewhere in the plans and specifications to assure effective and continuous water pollution control throughout the construction and post construction period. These control measures shall not be used as a substitute for the permanent pollution control measures unless otherwise directed by the Engineer in writing. The controls may include silt fences, rock filter dams, revet mattresses, gabions, dikes, swales, sediment traps and basins, pipe slope drains, paved flumes, construction exits, temporary seeding, sodding, mulching, soil retention blankets or other structural or non-structural water pollution controls.

1.2 SUBMITTALS

- A. Submittals shall be as specified in Section 01330.
- B. The Contractor shall be required to jointly sign the Pollution Prevention Plan Certification and file a Notice of Intent (NOI) with the Owner, to the Environmental Protection Agency (EPA).
- C. Prior to the start of construction, the Contractor shall submit to the Engineer, for approval, schedules for accomplishment of the pollution control measures in accordance with the Storm Water Pollution Prevention Plan. Work on the project shall not begin until the schedules for implementation of the controls and methods of operations have been reviewed and approved by the Engineer in writing. The Contractor shall provide the Engineer, for information purposes, proposed methods of pollution control for Contractor operations in areas which are outside the project limits (such as construction and haul roads, field offices, equipment and supply areas, and material sources) as well as a plan for disposal of waste materials.

1.3 SITE DESCRIPTION

A. Project Name and Location

1. Raw Water Supply and Distribution Additions to Edinburg West WTP Reservoir. This site is located at 1752 South Monmack, Edinburg, Texas.

B. Owner's Name and Address

City of Edinburg
415 W. University Drive
Edinburg, Texas 78541

C. Description:

1. The project is located on a 9 acre site. The work includes, but is not limited to, replacement of eleven sluice gates and appurtenances from gatewells and stand pipes within the Edinburg West Water Treatment Plant reservoir (reservoir); installation of two (2) 48-inch RCLHPP raw water pipeline extensions with reinforced concrete headwalls and Duck Bill Check Valves to interior of reservoir; construction of reinforced concrete gatewell with sluice gate, railing, grating, and stair connecting two (2) existing 36-inch

RCP and one 48-inch RCP to be installed from the gatewell to the interior of the reservoir as indicated in the contract documents and specifications.

D. Runoff Coefficient

1. The final average coefficient of runoff for the entire disturbed area will approximately $C=0.56$ in the site. The actual site is approximately 9 acres of which approximately 0.5 acres will be disturbed by construction activities.

E. Name of Receiving Waters

1. The site drains through several existing creeks and swales that discharge into the Hidalgo County Drainage channel south of the proposed site.

1.4 CONTROLS

A. Erosion and Sediment Controls

1. Stability Practices for the Site:
 - a. Maximum preservation of natural vegetation and buffer zones by minimizing rough grading.
 - b. Permanent sod, seeding and hydro-mulching as called for in the construction plans.
 - c. Newly graded right of way will have textured soil surfaces to reduce the sheet flow and improve surface water impoundment.
2. Structural Practices for this Site:
 - a. Silt fence.
 - b. Construction exits
 - c. Stockpiles will be surrounded by silt fence or other approved methods.
 - d. Trench excavation spoils not immediately hauled off will be backfilled into the trenches in a continuous operation.

B. Narrative

1. Completion of the entire project is expected to be 24 months. The sequence of construction will be as follows:
2. Clear and grub for perimeter control (i.e. installation of silt fence and rock berms).
3. Install all perimeter controls as indicated in the construction drawings.
4. Install construction entrances and exits and rock berms at all creek crossings as indicated on the construction drawings.
5. General project construction- beginning with site clearing, rough grading followed by utility trenching and installation followed by the construction of facility structures and road construction.
6. Once storm drainage system is installed, provide for inlet protection as indicated in the construction plans.
7. Install permanent sod, seeding or hydro-mulching as called for in the Plans and Specifications.
8. When all construction activity is complete and the site is stabilized, remove structural controls and re-seed any areas disturbed by their removal.

C. Storm Water Management

1. The majority of the right of way will be graded at less than 5:1 slope.
2. The storm water from the street will be conveyed by curb and gutter system then into an underground storm drainage system that discharges into the existing creeks within the site. The storm water from the site will be conveyed via overland flow and earthen swales throughout the site.

1.5 OTHER CONTROLS

A. Waste Disposal

1. All waste materials shall be collected and stored in a dumpster. Contractor shall meet all local and State solid waste management regulations. All trash and construction debris from the site will be deposited in the dumpster. The dumpster will be emptied as often as necessary, and the trash will be hauled from the site. No construction materials will be buried on-site. All personnel will be instructed regarding the correct procedure for disposal. Notices stating these practices will be posted in the office trailer. The Contractor shall be responsible for collection of all waste material.

B. Hazardous Waste

1. All hazardous waste materials will be disposed of in the manner specified by local or state regulations. Contractor's personnel will be instructed in these practices.

C. Sanitary Waste

1. All sanitary waste will be collected from the portable units as necessary by a licensed sanitary waste management contractor.

1.6 MAINTENANCE AND INSPECTION PROCEDURES

A. The following is a list of minimum erosion and sediment controls.

1. Stabilization practices for the site
 - a. Permanent sod and seeding of site.
2. Structural practices for the site
 - a. Silt fence.
 - b. Stabilized construction entrances and exits.
 - c. Stabilized creek crossing.

1.7 EROSION AND SEDIMENT CONTROL INSPECTION AND MAINTENANCE PRACTICES:

A. The following inspection and maintenance practices shall be used to maintain erosion and sediment controls:

1. All control measures shall be inspected at least once each week and following a construction site storm event of 0.5 inches or greater.
2. All measures shall be maintained in good working order; if a repair is necessary, the repair shall be initiated within twenty-four (24) hours of report.
3. Built up sediment shall be removed from silt fences and hay bales when it has reached one-third the height of the structure.
4. Silt fences shall be inspected for depth of sediment, tears, in securely attached fabric, and firmness of fence posts.
5. A maintenance inspection report shall be made after each inspection. A copy of the report form to be completed by the Contractor's inspector is attached.

1.8 SPILL PREVENTION

A. The minimum following material management practices shall be used to reduce the risk of spills or other accidental exposure of materials and substances to storm water runoff.

1. GOOD HOUSEKEEPING

- a. The following good housekeeping practices shall be followed on-site during the construction project.
 - (1) An effort shall be made to store only enough products required to do the job.

- (2) All materials stored on-site shall be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.
- (3) Products shall be kept in their original containers with the original manufacturer's labels.
- (4) Substances shall not be mixed with one another unless recommended by the manufacturer.
- (5) Whenever possible, all of a product shall be used up before disposing of the container.
- (6) Manufacturers' recommendations for proper use and disposal shall be followed.
- (7) The Contractor shall inspect daily, to ensure proper use and disposal of material on-site.

B. Hazardous Products

1. The following practices shall be used to reduce the risks associated with hazardous materials.
 - a. Products shall be kept in original containers unless they are not resealable.
 - b. Original labels and material safety data containing important product information shall be safe guarded.
 - c. If surplus product must be disposed of, manufacturers' or local and state recommended methods for proper disposal shall be follows.

C. Product Specific Practices

1. The following product specific practices shall be followed on site:
 - a. *Petroleum Products:* All on-site vehicles shall be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products shall be stored in tightly sealed containers which are clearly labeled. Any asphalt substances used on-site shall be applied according to the manufacturer's recommendations.
 - b. *Fertilizers:* Shall be applied only in the minimum amounts as specified. Once applied, the fertilizer shall be worked into the soil to limit exposure to storm water. Storage shall be in a covered shed. The contents of any partially used bags of fertilizer shall be transferred to a sealable plastic bin to avoid spills.
 - c. *Paints:* All containers shall be tightly sealed and stored when not required for use. Excess paint shall not be discharged to the storm sewer system but will be properly disposed of according to manufacturers' instructions and state and local regulations.
 - d. *Concrete Trucks:* Will not be allowed to wash out or discharge surplus concrete or drum wash water on the site.

D. Spill Prevention Practices

1. The following practices shall be followed for spill prevention and clean up:
 - a. Manufacturers' recommended methods for spill clean up shall be clearly posted and site personnel shall be made aware of the procedures and the location of the information and clean up supplies.
 - b. Materials and equipment necessary for spill clean up shall be kept in the material storage area on site. Equipment and materials include but not limited to brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for clean up.
 - c. All spills shall be cleaned up immediately after discovery.
 - d. The spill area shall be kept well ventilated and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
 - e. Spills of toxic or hazardous material regardless of the size shall be reported to the appropriate state or local government agency.

- f. The spill prevention plan shall be adjusted to include additional written measures to prevent this type of spills from reoccurring and clean up the spill if there is another. A description of the spill, what caused it, and the clean up measures shall also be included.
- g. The Contractor shall designate at least two (2) site personnel who shall receive spill prevention and clean up training. The individuals shall become responsible for spill prevention and clean up. The names of responsible spill personnel shall be posted in the materials storage area and in the office trailer on site.

PART 2 - PRODUCTS

2.1 SILT FENCE:

- A. *Fabric.* Fabric materials shall meet the requirements of TxDOT Materials Specification D-9-6230, Silt Fence.
- B. *Fence Types:* Two types of silt fences are identified as follows:
 - 1. Type 1: This system is a self-supported fence, using a woven geotextile fabric.
 - 2. Type 2: This system is a not-reinforced fence, using a non-woven geotextile fabric.
- C. *Posts:* Posts for fence Types 1 and 2 shall be a minimum of 48 inches long, essentially straight, and shall be wood or steel, unless otherwise shown on the plans. Soft wood posts shall be at least 3 inches in diameter or nominal 2 x 4 inches and essentially straight. Hardwood posts shall have a minimum cross section of 1.5 x 1.5 inches. Steel posts shall be "T" or "L" shaped with a minimum weight of 1.3 pounds per linear foot.
- D. *Net Reinforcement:* Net reinforcement for the Type 2 fence system shall be galvanized welded wire mesh of a minimum 12.5 gauge wire or equal, as approved by the Engineer, with a maximum opening size of 4 inches square and shall be at least 24 inches wide.
- E. *Tension Reinforcement and Staples:* Tension reinforcement for the Type 1 fence shall consist of wire or wire cable of at least 12.5 gauge.
- F. Staples used to secure reinforcement and fabric to wood posts shall have a crown at least 3/4 inch wide and legs a minimum of 1/2 inch long.
- G. When the type of fabric or type of reinforcement system is not specified on the plans, the Contractor may select either of the described types for use in construction of the silt fence.

2.2 STABILIZED STREAM CROSSINGS:

- A. The material used to prevent erosion and vehicular rutting at stream crossings shall be concrete rubble or course graded aggregate. Unless otherwise directed, the rubble or aggregate used in this application shall conform to the requirements of ASTM D448, size #3 (1 to 2 inch) or as directed by the Engineer.

2.3 STABILIZED CONSTRUCTION EXITS:

- A. Coarse Aggregate Construction
 - 1. The coarse aggregate construction entrance/exit shall consist of open graded coarse aggregate with a size of 4-inch to 8-inch.
- B. Timber Construction
 - 1. Timber for construction shall consist of treated railroad ties and lumber. The railroad ties and lumber shall be treated to control rot and shall be No. 2 quality or better and free of large and loose knots. Timber shall be fastened with nuts and bolts or lag bolts all of which shall meet or exceed ASTM-A307.

C. Foundation Course

1. The foundation course shall be flexible base, bituminous concrete, portland cement concrete, or other material as approved by the Engineer.

PART 3 - EXECUTION

3.1 GENERAL:

A. Prevention Plan

1. These guidelines and quantities of controls set forth here and in the Plans are to be considered minimum requirements. It is the Engineer's intent that the pollution prevention plan be adaptable to changing conditions in the field, both expected and unexpected. The Engineer may require additional or modified controls in order to meet the legal requirements of the NPDES construction permit.
2. The Contractor may develop his own Pollution Prevention Plan if so desired. The plan must be submitted and approved by the Engineer and must meet all regulations and guidelines of the EPA's NPDES storm water permitting requirements.

a. Construction Requirements

- (1) The Engineer has the authority to limit the disturbed surface area exposed by construction operations. The Contractor shall provide control measures to prevent or minimize the impact to receiving waters as required by the plans and/or as directed in writing by the Engineer.
- (2) The Contractor shall effectively prevent and control erosion and sedimentation on the site at the earliest practicable time. Control measures, where applicable, shall be implemented prior to the commencement of each construction operation or immediately after the area has been disturbed.
- (3) The Contractor shall limit the amount of disturbed earth as directed by the Engineer. If the Contractor is not able to effectively control soil erosion and sedimentation resulting from construction operations, the Engineer shall limit the amount of disturbed area to that which the Contractor is able to work in.
- (4) Should the control measures fail to function effectively, the Contractor shall act immediately to bring the erosion and sedimentation under control by maintaining existing controls or by providing additional controls as directed by the Engineer. When in the opinion of the Engineer the site is adequately stabilized, the Contractor may be required to remove and dispose of the control measures specified by the Engineer.
- (5) All erosion, sediment and water pollution controls shall be maintained in good working order. A rain gauge shall be located at the project site. Within 24 hours of a rainfall event of 0.5 inch or more as measured by the project rain gauge, the Contractor and Engineer shall inspect the entire project to determine the condition of the control measures. Sediment will be removed and devices repaired as soon as practicable but no later than 7 days after the surrounding exposed ground has dried sufficiently to prevent further damage from equipment needed for repair operations.
- (6) In the event of continuous rainfall over a 24 hour period, or other circumstances that preclude equipment operations in the area, the Contractor will hand carry and install additional backup devices as determined by the Engineer. The Contractor shall remove silt accumulations and deposit the spoils in an area approved by the Engineer as soon as practicable. Any corrective action needed for the control measures shall be accomplished in the sequence directed by the Engineer, however areas adjacent to waterbodies shall generally have priority followed by devices protecting storm sewer inlets.

3. The Contractor shall also conform to the following practices and controls.
 - a. Disposal areas, stockpiles and haul roads shall be constructed in a manner that shall minimize and control the amount of sediment that may enter receiving waters. Disposal areas shall not be located at any wetland, waterbody or streambed.
 - b. Construction operations in streams, wetlands and other waterbodies shall be restricted to those areas where it is necessary to perform the work shown on the plans. Wherever streams are crossed, temporary stabilized stream crossings shall be used.
 - c. Protected storage for paints, chemicals, solvents, fertilizers and other potentially toxic materials shall be provided by the Contractor at a location approved by the Engineer.
 - d. Construction staging areas and vehicle maintenance areas shall be constructed by the Contractor in a manner to minimize the runoff of pollutants at a location approved by the Engineer. The Contractor shall prevent pollution of receiving waters with petroleum products or other hazardous or regulated substances. When work areas or material sources are located adjacent to a waterbody, control measures such as dikes, gabions or rock berms, shall be used to keep sediment and other contaminants from entering the adjacent waterbody. Care shall be taken during the construction and removal of such barriers to minimize down-gradient sedimentation.
 - e. All waterways shall be cleared as soon as practicable of pipe, shoring, formwork or other obstructions placed during construction operations that are not a part of the finished work.
 - f. Disturbance of vegetation shall be minimized as directed by the Engineer.
 - g. The Contractor shall clean paved surfaces as necessary to remove sediment which has accumulated on the roadway.
4. The project will not be accepted or approved by the Engineer until the Contractor provides a uniform perennial vegetative cover, or that equivalent permanent stabilization measures supplemented by temporary measures when necessary (such as riprap, gabions, soil retention blankets, mulching) have been employed that will control erosion sedimentation and water pollution until sufficient vegetative cover can be established.

3.2 SILT FENCE

A. Construction Methods

1. Silt fence shall be used during construction near the perimeter of a disturbed area to intercept sediment from sheet flow. Silt fence of the self-supported Type 1 shall be used only at location where the length of overland runoff is less than 100 feet, the embankment is less than 20 feet in height, the slopes are 3:1 or flatter, or the installation will be required for less than 6 months. The silt fence installation methods shall be as specified below, unless otherwise shown on the plans, for the type specified or selected. The physical alignment and location of the fence shall be approved by the Engineer.
 - a. Installation of Posts
 - (1) Posts for fence types 1 and 2 shall be embedded 18 inches deep, or adequately anchored if in rock, with a spacing of 6 to 8 feet, and installed on a slight angle toward the anticipated run-off source.
 - b. Fabric Anchoring
 - (1) Trenches for fence types 1 and 2 shall be dug along the uphill side of the fence to anchor 6 to 8 inches of fabric. The trench shall have a minimum cross section of 6 x 6 inches. The fabric for fence types 1 and 2 shall be installed in the trench such that 4 to 6 inches of fabric is against the side of the trench and approximately 2 inches of fabric is across the bottom in the upstream direction. The trench shall be backfilled and hand tamped as approved by the Engineer.

c. Fabric Attachment

- (1) *Fence Type 1:* The fabric shall be attached to wood posts by staples or locking plastic ties at a maximum spacing of 6 inches. Attachment to steel posts shall be by sewn vertical pockets or locking plastic ties if the posts have suitable projections. The top of the fabric shall be fastened to the tension reinforcement wire or wire cable by hog rings, locking plastic ties, or cord at a maximum spacing of 2 feet.
- (2) *Fence Type 2:* The reinforcement shall be attached to the end posts, if wood, by staples or locking plastic ties, or if steel, by T-clips, locking plastic ties, or sewn vertical pockets at a minimum of 4 locations. The reinforcement shall be attached to each succeeding post as approved by the Engineer. Connect the ends of successive reinforcement sheets or rolls at a fence post at least 6 times with hog rings or locking plastic ties. The fabric shall be fastened to the top strand or reinforcement by hog rings, locking plastic ties, or cord at a maximum spacing of 2 feet.

- d. *Fabric Splices:* Splices for fence Types 1 and 2 shall occur at a fence post and shall have a minimum lap of 6 inches attached in at least 6 places. Splices in concentrated flow areas shall not be permitted.

B. Maintenance

1. The silt fence shall be maintained in good condition (including staking, anchoring, tension adjustments, etc.) by the Contractor. All necessary work and materials to maintain the integrity of the fence shall be provided until earthwork construction and permanent erosion control features are in place and/or the disturbed area has been adequately stabilized. This type of routine maintenance shall not be paid for directly but will be considered subsidiary to this item. The areas damaged by the removal process shall be stabilized by the Contractor using appropriate methods as approved by the Engineer.

3.3 STABILIZED STREAM CROSSING

A. Construction Methods

1. At all locations where vehicles shall be crossing any creek, a 6" deep and 14' wide (minimum) rubble or aggregate crossing shall be installed. The crossing length shall be from toe to toe on the stream bank side slopes.

B. Maintenance

1. The crossing will be maintained while working in the area. Washouts and rutting shall be repaired within a 48-hour period after damage is noted.

3.4 STABILIZED CONSTRUCTION ENTRANCE & EXITS:

A. Construction Methods

1. When tracking conditions exist, traffic shall not be allowed to cross or leave the construction site and move directly onto a public roadway, alley, sidewalk, parking area, or other right of way in areas other than at locations of construction entrances and exits. Construction entrances and exits can be either for long or short-term use. Foundation courses, if needed, shall be used with the long-term construction exits.
2. The exit shall be placed over a foundation course, if directed by the Engineer. The foundation course and/or compacted subgrade shall be properly graded to direct runoff from the construction exit to a sediment trap as shown in the plans or as directed by the Engineer. The exit shall normally be constructed a minimum length of 50 feet. The width shall be at least 14 feet for one-way traffic and 25 feet for 2-way traffic but shall not be less than full width of all points of ingress and egress and shall be sufficient for all ingress and egress.

B. Maintenance

1. Exits shall be maintained in a condition which will prevent tracking or flowing of sediment onto public right of way and may require periodic removal and replacement of stone or timber, or other material as conditions demand and repair and/or clean out of any measures used to trap sediment. Sediment spilled, dropped, washed or tracked onto public right of way shall be immediately removed by the Contractor and disposed of at an approved site and in a manner that will not contribute to additional siltation.
2. When necessary, wheels shall be cleaned to remove sediment prior to entrance onto public right of way. When vehicle washing is required, the construction exit shall be graded to drain into a sediment trap or sediment basin. Sediment shall be prevented from leaving the construction site.
3. The construction exits shall be removed promptly when directed by the Engineer. Discarded materials shall become the property of the Contractor for his disposal at an approved site. The area beneath the construction exit and area damaged by the removal process shall be stabilized by the Contractor using appropriate methods as approved by the Engineer.

3.5 CONTRACTOR CERTIFICATION FOR

**PROJECT: RAW WATER SUPPLY AND DISTRIBUTION ADDITIONS TO EDINBURG
WEST WTP RESERVOIR**

- A. I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the stormwater discharges associated with industrial activity from the construction site identified as part of this certification. Further, by my signature, I understand that I am the permittee, along the any subcontractors signing such certifications to the general NPDES permit for the stormwater discharges associated with industrial activity from the identified site. As permittee, I understand that I and my company, are legally required under the Clean Water Act, to ensure compliance with the terms and conditions of the stormwater pollution prevention plan developed under the NPDES permit and the terms of the NPDES permit.

Signature:

For:

Work Responsible

Title:

Date: _____

**3.6 PROJECT: RAW WATER SUPPLY AND DISTRIBUTION ADDITIONS TO EDINBURG
WEST WTP RESERVOIR**

- A. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signed: _____

Date: _____

**3.7 PROJECT: RAW WATER SUPPLY AND DISTRIBUTION ADDITIONS TO EDINBURG
WEST WTP RESERVOIR**

- A. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signed: _____
Inspector

Construction Company

Date: _____

**STORM WATER POLLUTION PREVENTION PLAN
INSPECTION AND MAINTENANCE REPORT**

**PROJECT: RAW WATER SUPPLY AND DISTRIBUTION ADDITIONS TO EDINBURG
WEST WTP RESERVOIR**

Inspector: _____ Date: _____

Days Since Last Rainfall: _____ Amount of Last Rainfall: _____ Inches

STABILIZATION MEASURES

AREA	DATE SINCE LAST DISTRUBANCE	DATE SINCE NEXT DISTURBANCE	STABILIZED?	STABILIZED WITH	CONDITION

Stabilization Required:

To Be Performed By: _____ On Or Before: _____

**STORM WATER POLLUTION PREVENTION PLAN
INSPECTION AND MAINTENANCE REPORT**

STRUCTURAL CONTROLS

FILTER FABRIC FENCE

**3.8 PROJECT: RAW WATER SUPPLY AND DISTRIBUTION ADDITIONS TO EDINBURG
WEST WTP RESERVOIR**

LOCATION	BOTTOM OF FABRIC STILL BURIED?	FABRIC TORN OR SAGGING?	POTS TIPPING OVER?	HOW DEEP IS THE SEDIMENT?

Maintenance Required For Silt Fences:

To Be Performed By: _____

On Or Before: _____

**STORM WATER POLLUTION PREVENTION PLAN
INSPECTION AND MAINTENANCE REPORT**

**PROJECT: RAW WATER SUPPLY AND DISTRIBUTION ADDITIONS TO EDINBURG
WEST WTP RESERVOIR**

Changes Required To The Pollution Prevention Plan?

Reasons For Changes:

Inspector's Signature:

Date:

END OF SECTION

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SECTION 01555
TRAFFIC CONTROL AND REGULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Traffic Control and Regulation

1.2 METHODS OF PAYMENT

- A. No separate payment will be made for traffic control and regulation. Include the cost of traffic control and regulation in unit price for work requiring such control.

1.3 REFERENCES

- A. Texas Manual of Uniform Traffic Control Devices (TMUTCD)
- B. Texas Department of Transportation (TxDOT) permit (if applicable)

1.4 PERFORMANCE REQUIREMENTS

- A. Provide all necessary signs, barricades, marking, lighting, and other equipment and supplies required to comply with the TMUTCD (and TxDOT permit, if applicable)
- B. Provide all necessary certified flagmen required to comply with the TMUTCD (and TxDOT, City, and/or County permit, if applicable)

PART 2 - PRODUCTS

- A. Equipment and materials must be furnished, installed and operated by an experienced contractor regularly engaged in traffic control system design, installation and operation.
- B. All equipment must be in good repair and operating order.
- C. Sufficient standby equipment and materials shall be kept available to ensure continuous operation, where required.

PART 3 - EXECUTION

- A. Provide labor, material, equipment, techniques and methods required to provide safe traffic control and regulation. Monitor effectiveness of the installed system and its effect on adjacent property.
- B. Notify, TxDOT, City and /or County as required by the permit(s) (if applicable).
- C. Provide continuous system operation, including nights, weekends and holidays. Arrange for appropriate backup if electrical power is primary energy source for traffic control system.
- D. Remove system(s) upon completion of construction or when traffic control is no longer required.

END OF SECTION

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SECTION 01561
TRENCH SAFETY SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Trench safety system for the construction of trench excavations.
- B. Trench safety system for structural excavations which fall under provisions of State and Federal trench safety laws.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Measurement for trench safety systems used on trench excavations is on a linear foot basis measured along the centerline of the trench, including manholes and other line structures.
 - 2. No payment will be made for trench safety systems for structural excavations under this section. Include payment for trench safety system in applicable structure installation sections.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 DEFINITIONS

- A. A trench shall be defined as a narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.
- B. The trench safety system requirements will apply to larger open excavations if the erection of structures (or other installations) limits the space between the excavation slope and installed structure to dimensions equivalent of a defined trench above.
- C. Trench Safety Systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

1.4 SUBMITTALS

- A. Submit a safety program specifically for the construction of trench excavation. Design the trench safety program to be in accordance with OSHA 29CFR standards governing the presence and activities of individuals working in and around trench excavations.
- B. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid by Contractor.
- C. Review of the safety program by the Owner will only be in regard to compliance with this specification and will not constitute approval by the Owner nor relieve Contractor of obligations under State and Federal trench safety laws.

1.5 REGULATORY REQUIREMENTS

- A. Install and maintain trench safety systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.
- B. The Contractor is responsible for obtaining a copy of this section of the Federal Register.

- C. Legislation that has been enacted by the Texas Legislature with regard to Trench Safety Systems, is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., §756.021 (Vernon 1991).

1.6 INDEMNIFICATION

- A. Contractor shall indemnify and hold harmless the Owner, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgements or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.
- B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner in case the Owner is negligent either by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and the hiring of the Contractor.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and maintain trench safety systems in accordance with provisions of OSHA 29CFR.
- B. Install specially designed trench safety systems in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program.
- C. A competent person, as identified in the Contractor's Trench Safety Program, shall verify that trench boxes and other premanufactured systems are certified for the actual installation conditions.

3.2 INSPECTION

- A. Contractor, or Contractor's independently retained consultant, shall make daily inspections of the trench safety systems to ensure that the installed systems and operations meet OSHA 29CFR and other personnel protection regulations requirements.
- B. If evidence of possible cave-ins or slides is apparent, Contractor shall immediately stop work in the trench and move personnel to safe locations until the necessary precautions have been taken by Contractor to safeguard personnel entering the trench.
- C. Maintain a permanent record of daily inspections.

3.3 FIELD QUALITY CONTROL

- A. Contractor shall verify specific applicability of the selected or specially designed trench safety systems to each field condition encountered on the project.

END OF SECTION

SECTION 01572
SOURCE CONTROLS FOR EROSION AND SEDIMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Description of erosion and sediment control and other control-related practices which shall be utilized during construction activities.

1.2 UNIT PRICES

- A. No separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items of which this work is a component.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PREPARATION AND INSTALLATION

- A. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than site work specifically directed by the Resident Project Representative to allow soil testing and surveying.
- B. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately by the Contractor.
- C. The Contractor shall be responsible for collecting, storing, hauling, and disposing of spoil, silt, and waste materials as specified in this or other Specifications and in compliance with applicable federal, state, and local rules and regulations.
- D. Contractor shall conduct all construction operations under this Contract in conformance with the erosion control practices described in the SWPPP, Drawings, and this Specification.
- E. The Contractor shall install, maintain, and inspect erosion and sediment control measures and practices as specified in the SWPPP, Drawings, and in this or other Specifications.

3.2 TOPSOIL PLACEMENT FOR EROSION AND SEDIMENT CONTROL SYSTEMS

- A. When topsoil is specified as a component of another Specification, the Contractor shall conduct erosion control practices described in this Specification during topsoil placement operations.
 - 1. When placing topsoil, maintain erosion and sediment control systems, such as swales, grade stabilization structures, berms, dikes, waterways, and sediment basins.
 - 2. Maintain grades which have been previously established on areas to receive topsoil.
 - 3. After the areas to receive topsoil have been brought to grade, and immediately prior to dumping and spreading the topsoil, loosen the subgrade by disking or by scarifying to a depth of at least 2 inches to permit bonding of the topsoil to the subsoil.
 - 4. No sod or seed shall be placed on soil which has been treated with soil sterilants until sufficient time has elapsed to permit dissipation of toxic materials.

3.3 SEDIMENT CONTROL MAINTENANCE

- A. All erosion, sediment, and water pollution controls will be maintained in good working order. A rain gauge provided by the Contractor shall be located on the project site. Within 24 hours of a rainfall event of 0.5 inches or more as measured by the project rain gauge, the Contractor and the Resident Project Representative shall inspect the entire project to determine the condition of the control measures. Sediment shall be removed and devices repaired as soon as practicable but no later than 7 days after the surrounding ground has dried sufficiently to prevent further damage from equipment operations needed for repairs.
- B. In the event of continuous rainfall over a 24 hour period, or other circumstances that preclude equipment operation in the area, the Contractor shall install additional backup storm water pollution control devices, as determined by the Resident Project Representative, by other appropriate methods. The Contractor shall remove sediment accumulations and deposit the spoils in an area approved by the Resident Project Representative as soon as practical and in accordance with the SWPPP. Any corrective action needed for the control measures is to be accomplished in the sequence directed by the Resident Project Representative; however, areas adjacent to receiving waters shall generally have priority, followed by devices protecting storm sewer inlets.

3.4 DUST CONTROL

- A. Implement dust control methods to control dust creation and movement on construction sites and roads and to prevent airborne sediment from reaching receiving streams or storm water conveyance systems, to reduce on-site and off-site damage, to prevent health hazards, and to improve traffic safety.
- B. Control blowing dust by using one or more of the following methods:
 - 1. Mulches bound with chemical binders.
 - 2. Temporary vegetative cover.
 - 3. Spray-on adhesives on mineral soils when not used by traffic.
 - 4. Tillage to roughen surface and bring clods to the surface.
 - 5. Irrigation by water sprinkling.
 - 6. Barriers using solid board fences, snow fences, burlap fences, crate walls, bales of straw, or similar materials.
- C. Implement dust control methods immediately whenever dust can be observed blowing on the project site.

3.5 KEEPING STREETS CLEAN

- A. Keep streets clean of construction debris and mud carried by construction vehicles and equipment. If necessary to keep the streets clean, install stabilized construction exits at construction, staging, storage, and disposal areas. A vehicle/equipment wash area (stabilized with coarse aggregate) may be installed adjacent to the stabilized construction exit, as needed. Release wash water into a drainage swale or inlet protected by erosion and sediment control measures. Construction exit and wash areas are specified in Section 01575 - Stabilized Construction Exit.
- B. In lieu of or in addition to stabilized construction exits, shovel or sweep the pavement to the extent necessary to keep the street clean. Waterhosing or sweeping of debris and mud off of the street into adjacent areas is not allowed.

3.6 EQUIPMENT MAINTENANCE AND REPAIR

- A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose. Locate such areas so that oils, gasoline, grease, solvents, and other potential pollutants cannot be washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid as well as solid waste. Clean and inspect maintenance areas daily.

- B. On a construction site where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.7 WASTE COLLECTION AND DISPOSAL

- A. Contractor shall formulate and implement a plan for the collection and disposal of waste materials on the construction site. In plan, designate locations for trash and waste receptacles and establish a collection schedule. Methods for ultimate disposal of waste shall be specified and carried out in accordance with applicable local, state, and federal health and safety regulations. Make special provisions for the collection and disposal of liquid wastes and toxic or hazardous materials.
- B. Keep receptacles and waste collection areas neat and orderly to the extent possible. Waste shall not be allowed to overflow its container or accumulate from day-to-day. Locate trash collection points where they will least likely be affected by concentrated storm water runoff.

3.8 WASHING AREAS

- A. Vehicles such as concrete delivery trucks or dump trucks and other construction equipment shall not be washed at locations where the runoff will flow directly into a watercourse or storm water conveyance system. Designate special areas for washing vehicles. Locate these areas where the wash water will spread out and evaporate or infiltrate directly into the ground, or where the runoff can be collected in a temporary holding or seepage basin. Beneath wash areas construct a gravel or rock base to minimize mud production.

3.9 STORAGE OF CONSTRUCTION MATERIALS AND CHEMICALS

- A. Isolate sites where chemicals, cements, solvents, paints, or other potential water pollutants are stored in areas where they will not cause runoff pollution.
- B. Store toxic chemicals and materials, such as pesticides, paints, and acids in accordance with manufacturers' guidelines. Protect groundwater resources from leaching by placing a plastic mat, packed clay, tar paper, or other impervious materials on any areas where toxic liquids are to be opened and stored.

3.10 DEMOLITION AREAS

- A. Demolition activities which create large amounts of dust with significant concentrations of heavy metals or other toxic pollutants shall use dust control techniques to limit transport of airborne pollutants. However, water or slurry used to control dust contaminated with heavy metals or toxic pollutants shall be retained on the site and shall not be allowed to run directly into watercourses or storm water conveyance systems. Methods of ultimate disposal of these materials shall be carried out in accordance with applicable local, state, and federal health and safety regulations.

3.11 SANITARY FACILITIES

- A. Provide and maintain sanitary facilities for persons on the job site; comply with the regulations of State and local departments of health.
- B. Enforce the use of sanitary facilities by construction personnel at the job site. Such facilities shall be enclosed. Pit-type toilets will not be permitted. No discharge will be allowed from these facilities. Collect and store sewage and waste so as not to cause a nuisance or health problem; have sewer and waste hauled off-site and properly disposed in accordance with City regulations.
- C. Located toilets near the Work site and secluded from view insofar as possible. Keep toilets clean and supplied throughout the course of the Work.

3.12 PESTICIDES

- A. Use and store pesticides during construction in accordance with manufacturers' guidelines and with local, state, and federal regulations. Avoid overuse of pesticides which could produce contaminated runoff. Take great care to prevent accidental spillage. Never wash pesticide containers in or near flowing streams or storm water conveyance systems.

END OF SECTION

SECTION 01573

FILTER FABRIC

Part 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

- A. This work shall consist of furnishing and placing of the materials for placing filter fabric as indicated or directed by the Engineer.
- B. The filter fabric shall have the capacity of passing ground water without the transportation of soil placed around the filter fabric.

Part 2 - PART 2 - PRODUCTS

2.01 MATERIALS:

- A. General
 1. The fabric shall be constructed exclusively of synthetic thermoplastic fibers and may be either woven or non-woven to form a mat of uniform quality.
 2. Fabric fibers may be either continuous or discontinuous and oriented in either a random or an aligned pattern throughout the fabric.
 3. The fabric shall be mildew resistant, rot proof, shall be satisfactory for use in a wet soil and aggregate environment, contain ultraviolet stabilizers and have non-ravelling edges.
 4. Physical Requirements
- B. The fabric shall meet the following requirements when sampled and tested in accordance with the methods indicated in table below.

Fabric Requirements		
Physical Property	Test Method	Requirement
Tensile Strength, N (lb.)	ASTM D 4632	445 (100) Minimum
Elongation @ Yield, %	ASTM D 4632	10-40
Trapezoidal Tear, N (lb.)	ASTM D 4533	222 (50) Minimum
Apparent Opening Size	ASTM D 4751	20-50
Permittivity, 1/sec	ASTM D 4491	0.1 Minimum
Ultraviolet Stability original tensile strength retained after 500 hrs. exposure, %	ASTM D 4355	80 Minimum

1. All materials shall be shipped with suitable wrapping to protect the fabric during shipping and storage at the job site.

Part 3 - PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

- A. Catalog cuts, samples of material selected and the manufacturer's certification of compliance with the specification shall be submitted for review before any materials are ordered.
- B. The "Filter Fabric" shall be installed in accordance with the manufacturer's recommendations, as indicated or as directed by the Engineer.
- C. When lapping is required, it shall be in accordance with the manufacturer's recommendations.
- D. Backfilling around the Filter Fabric shall be done in such a way as not to damage the Filter Fabric material during the placement.

Part 4 - PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

- A. Work and acceptable material for "Filter Fabric" will be measured by the square yard, complete in place.

4.02 PAYMENT:

- A. The accepted quantities of filter fabric shall be paid for at the contract unit price per square yard in place.
- B. When not listed as a separate contract pay item, filter fabric shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provide in the proposal contract.
- C. Compensation, whether by contract pay items or incidental work will be for furnishing all materials, labor, equipment, tools, and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION

SECTION 01576
WASTE MATERIAL DISPOSAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Disposal of waste material and salvageable material.

1.2 UNIT PRICES

- A. No separate payment will be made for waste material disposal under this Section. Include payment in unit price for related sections.

1.3 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01330 - Submittal Procedures.
- B. Obtain and submit disposal permits for proposed disposal sites if required by federal, state and local ordinances.
- C. Submit a copy of written permission from property owner, along with description of property, prior to disposal of excess material.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 SALVAGEABLE MATERIAL

- A. Excavated Material: When indicated on Drawings, load, haul, and deposit excavated material at a location or locations shown on Drawings outside the limits of Project.
- B. Other Salvageable Materials: Conform to requirements of individual Specification Sections.

3.2 EXCESS MATERIAL

- A. Vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage, shall become the property of Contractor and shall be removed from the job site and legally disposed of.
- B. Waste materials shall be removed from the site on a daily basis, such that the site is maintained in a neat and orderly condition.

END OF SECTION

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SECTION 01578
CONTROL OF GROUND WATER AND SURFACE WATER

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations, and foundation beds in a stable condition, and controlling ground water conditions for tunnel excavations.
- B. Protecting work against surface runoff and rising flood waters.
- C. Disposing of removed water.

1.2 METHOD OF PAYMENT

- A. No separate payment will be made for control of ground water and surface water. Include the cost to control ground water and surface water in unit price for work in related sections.

1.3 REFERENCES

- A. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49 kg) Rammer and 12-inch (304.8 mm) Drop.
- B. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).
- C. Federal Register 40 CFR (Vol. 55, No. 222) Part 122, EPA Administered Permit Programs (NPDES), Para.122.26(b)(14) Storm Water Discharge.
- D. Texas Commission of Environmental Quality, TCEQ General Permit Number TX150000 Relating to Discharges from Construction Activities.

1.4 DEFINITIONS

- A. Ground water control includes both dewatering and depressurization of water-bearing soil layers.
 - 1. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts, and disposing of removed water. The intent of dewatering is to increase stability of tunnel excavations and excavated slopes; prevent dislocation of material from slopes or bottoms of excavations; reduce lateral loads on sheeting and bracing; improve excavating and hauling characteristics of excavated material; prevent failure or heaving of the bottom of excavations; and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.
 - 2. Depressurization includes reduction in piezometric pressure within strata not controlled by dewatering alone, as required to prevent failure or heaving of excavation bottom or instability of tunnel excavations.
- B. Excavation drainage includes keeping excavations free of surface and seepage water.
- C. Surface drainage includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines as required to protect the Work from any source of surface water.
- D. Equipment and instrumentation for monitoring and control of the ground water control system includes piezometers and monitoring wells, and devices, such as flow meters, for observing and recording flow rates.

1.5 PERFORMANCE REQUIREMENTS

- A. Conduct surface and subsurface investigations to identify ground water and surface water conditions and to provide parameters for design, installation, and operation of control systems.
- B. Design a ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Section 01561 - Trench Safety Systems, to produce the following results:
 - 1. Effectively reduce the hydrostatic pressure affecting:
 - a. Excavations.
 - b. Tunnel excavation, face stability or seepage into tunnels.
 - 2. Develop a substantially dry and stable subgrade for subsequent construction operations.
 - 3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities, and other work.
 - 4. Prevent the loss of fines, seepage, boils, quick condition, or softening of the foundation strata.
 - 5. Maintain stability of sides and bottom of excavations.
- C. Provide ground water control systems that may include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.
- D. Provide drainage of seepage water and surface water, as well as water from any other source entering the excavation. Excavation drainage may include placement of drainage materials, such as crushed stone and filter fabric, together with sump pumping.
- E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.
- F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.
- G. Assume sole responsibility for ground water and surface water control systems and for any loss or damage resulting from partial or complete failure of protective measures and any settlement or resultant damage caused by the control operations. Modify control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells, or affect potentially contaminated areas. Repair damage caused by control systems or resulting from failure of the system to protect property as required.

1.6 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01330 - Submittals.
- B. Submit a Ground Water and Surface Water Control Plan for review by the Engineer prior to start of any field work. Submit a plan to include the following:
 - 1. Results of subsurface investigation and description of the extent and characteristics of water bearing layers subject to ground water control.
 - 2. Excavation drainage methods including typical drainage layers, sump pump application and other necessary means.
 - 3. Surface water control and drainage installations.
 - 4. Proposed methods and locations for disposing of removed water.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Comply with requirements of agencies having jurisdiction.
- B. Obtain permit from TCEQ under the Texas Pollutant Discharge Elimination System (TPDES), for storm water discharge from construction sites.
- C. Monitor ground water discharge for contamination while performing pumping in the vicinity of potentially contaminated sites.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Equipment and materials are at the option of Contractor as necessary to achieve desired results for control of ground and surface water.
- B. Eductors, well points, or deep wells, where used, must be furnished, installed and operated by an experienced contractor regularly engaged in ground water control system design, installation, and operation.
- C. All equipment must be in good repair and operating order.
- D. Sufficient standby equipment and materials shall be kept available to ensure continuous operation, where required.

PART 3 - EXECUTION

3.1 GROUND WATER CONTROL

- A. There is a possibility of encountering septic/leaching fields; Contractor may not discharge into public watercourse or drainage but to haul by tank truck to nearest wastewater treatment facility.
- B. Provide labor, material, equipment, techniques and methods to lower, control and manage ground water in a manner compatible with construction methods and site conditions. Monitor effectiveness of the installed system and its effect on adjacent property.
- C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify Engineer in writing of any changes made to accommodate field conditions and changes to the Work. Provide revised drawings and calculations with such notification.
- D. Provide for continuous system operation, including nights, weekends, and holidays. Arrange for appropriate backup if electrical power is primary energy source for dewatering system.
- E. Remove system upon completion of construction or when dewatering and control of surface or ground water is no longer required.
- F. Compact backfill to not less than 95 percent of the maximum dry density in accordance with ASTM D 698.

3.2 EXCAVATION DRAINAGE

- A. Contractor may use excavation drainage methods if necessary to achieve well drained conditions. The excavation drainage may consist of a layer of crushed stone and filter fabric, and sump pumping in combination with sufficient wells for ground water control to maintain stable excavation and backfill conditions.

3.3 SURFACE WATER CONTROL

- A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb
- B. walls, pipes, sumps or other approved means. The requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.
- C. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by such agencies.

END OF SECTION

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SECTION 01580
PROJECT IDENTIFICATION SIGNS

PART 1 - GENERAL

1.1 SCOPE

- A. This section governs furnishing, installing and maintaining project signs as described below.

1.2 DESIGN REQUIREMENTS

- A. Design sign and structure to remain in place and withstand 90 miles-per-hour wind velocity.
- B. Sign Manufacturer/Maker/Painter: Experienced as a professional sign company.
- C. Painting: Adequate to withstand weathering, fading and chipping for duration of construction.
- D. Appearance: Project signs shall present a fresh, new and neat look. All project signs shall be new or refurbished so as to look new.

1.3 NUMBER AND LOCATION

- A. Linear Projects: A linear project is one involving paving, overlay, sewer lines, storm drainage or water mains that run in the right-of-way over a distance. A linear project requires project signs at each end of the construction.
- B. Single Site or Building Projects: Provide one project sign each.
- C. Sites: Provide one sign at each site at a location designated by the Engineer.

1.4 UNIT PRICES

- A. Unless indicated in the Bid Form, no separate payment will be made for design, fabrication, installation and maintenance of project identification signs under this Item. Include cost of work performed under this Item in pay item of which this work is a component.

PART 2 - PRODUCTS

2.1 SIGN MATERIALS

- A. Structure and Framing: Use new 4-inch by 4-inch wood posts to reach 8-feet above existing grade. Paint structural members white on all sides and edges to resist weathering. Set posts approximately 4-feet apart. Use new 2-inch by 6-inch wood for framing of skids.
- B. Sign: For sign use 4-foot by 8-foot marine plywood, minimum 3/4-inch thick and 2-inch by 4-inch for framing plywood. Use full size sheets for sign to minimize joints; do not piece wood to fabricate a sign face. Paint sign material white, two (2) coats, on all sides and edges to resist weathering.
- C. Paint and Primers: White paint used to prime surfaces and to resist weathering shall be an industrial grade, fast drying, oil-based paint with gloss finish. Paint all signs surfaces with two (2) coats of this weather-protective paint prior to adding any lettering.
- D. Sign Lettering: Make lettering and symbols from 3M Scotchcal Pressure Sensitive Films or approved equal, or at Contractor's option, signs may be painted using approved paints. Whether film or paint is used, match color to 3M Scotchcal Pressure Sensitive Film, Black.
- E. Rough Hardware: Galvanized steel or brass for fasteners and other hardware.

2.2 SIGN COMPONENTS

- A. Sign
 - 1. The 4-foot by 8-foot component of the sign has fields of information as indicated on the Exhibits on the construction drawings.
 - a. List at least the title of the Project, and names of the OWNER, ENGINEER, and CONTRACTOR.
 - b. Second Line of Lettering on Sign Painted shall Read: Edinburg West Water Treatment Plant Expansion 8 MGD.
- B. Sign Support Structure
 - 1. Sign Posts: 4-inch by 4-inch sign posts, 8-feet long for skid mounting and 11-feet long minimum for post hole mounting to set top of posts at 8-feet above existing grade.
 - 2. Skid Members: 2-inch by 6-inch framing material.
- C. Fasteners
 - 1. ½-inch by 5½-inch button heads carriage bolts for posts with nuts and flat head washers. Cover button heads with white reflective film or paint to match sign background.

PART 3 - EXECUTION

3.1 INSTALLATION AND MAINTENANCE

- A. Installation
 - 1. Install project identification sign within fourteen (14) calendar days after date of Notice to Proceed.
 - 2. Erect at location designated by the Engineer or where shown on the Drawings. In either case, position the sign in such a manner as to be fully visible and readable to the general public.
 - 3. Erect sign level and plumb.
 - 4. If post hole mounted, sink posts at least 3-feet below grade. Stabilize posts to minimize lateral motion. Leave minimum of 9-feet of post above existing grade for mounting of the sign.
 - 5. Erect sign so that the top edge of the sign is at a nominal 8-feet above existing grade.
 - 6. Skid mounted signs shall be allowed only when approved by the Engineer. Approval of the use of skid-mounted signs shall not release the Contractor from responsibility of maintaining a project sign on the project site and shall not make Owner responsible for the security of such signs.
- B. Maintenance and Removal
 - 1. Maintain signs and supports clean. Repair deterioration and damage.
 - 2. Remove signs, framing, supports and foundations at completion of project and restore the area.

3.2 QUALITY ASSURANCE

- A. Shop Drawings
 - 1. Submit Shop Drawings prior to construction and installation of sign(s). Submit sufficient copies (three (3) copies will not be returned) to allow proper approval and fabrication.
 - 2. Submittal will show content, layout, lettering style, lettering size and colors.

END OF SECTION

SECTION 01610
BASIC PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for transportation, delivery, handling, and storage of materials and equipment.

1.2 PRODUCTS

- A. Products: Means material, equipment, or systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components designated for reuse.
- B. Do not reuse materials and equipment, designated to be removed, except as specified by the Contract Documents.
- C. Provide equipment and components from the fewest number of manufacturers as is practical.
- D. in order to simplify spare parts inventory and to allow for maximum interchangeability of components. For multiple components of the same size, type or application, use the same make and model of component throughout the project.

1.3 TRANSPORTATION

- A. Make arrangements for transportation, delivery, and handling of equipment and materials required for timely completion of the Work.
- B. Transport and handle products in accordance with instructions.
- C. Consign and address shipping documents to the proper party giving name of Project and street address. Shipments shall be delivered to the Contractor.

1.4 DELIVERY

- A. Arrange deliveries of products to accommodate the short term site completion schedules and in ample time to facilitate inspection prior to installation. Avoid deliveries that cause unnecessarily lengthy use of limited storage space.
- B. Coordinate deliveries to avoid conflict with Work and conditions at the site and to accommodate the following:
 - 1. Work of other contractors or the Owner.
 - 2. Limitations of storage space.
 - 3. Availability of equipment and personnel for handling products.
 - 4. Owner's use of premises.
- C. Have products delivered to the site in manufacturer's original, unopened, labeled containers.
- D. Immediately upon delivery, inspect shipment to assure:
 - 1. Product complies with requirements of Contract Documents.
 - 2. Quantities are correct.
 - 3. Containers and packages are intact; labels are legible.
 - 4. Products are properly protected and undamaged.

1.5 PRODUCT HANDLING

- A. Coordinate the off-loading of materials and equipment delivered to the job site. If necessary to move stored materials and equipment during construction, Contractor shall relocate materials and equipment at no additional cost to the Owner.

- B. Provide equipment and personnel necessary to handle products, including those provided by the Owner, by methods to prevent damage to products or packaging.
- C. Provide additional protection during handling as necessary to prevent breaking, scraping, marring, or otherwise damaging products or surrounding areas.
- D. Handle products by methods to prevent over bending or overstressing.
- E. Lift heavy components only at designated lifting points.
- F. Handle materials and equipment in accordance with Manufacturer's recommendations.
- G. Do not drop, roll, or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

1.6 STORAGE OF MATERIAL

- A. Store and protect materials in accordance with manufacturer's recommendations and requirements of these Specifications.
- B. Make necessary provisions for safe storage of materials and equipment. Place loose soil materials, and materials to be incorporated into the Work to prevent damage to any part of the Work or existing facilities and to maintain free access at all times to all parts of the Work and to utility service company installations in the vicinity of the Work. Keep materials and equipment neatly and compactly stored in locations that will cause a minimum of inconvenience to other contractors, public travel, adjoining owners, tenants, and occupants. Arrange storage in a manner to provide easy access for inspection.
- C. Restrict storage to areas available on the construction site for storage of material and equipment as shown on Drawings or approved by the Resident Project Representative.
- D. Provide off-site storage and protection when on-site storage is not adequate.
- E. Do not use lawns, grass plots, or other private property for storage purposes without written permission of the owner and other person in possession or control of such premises.
- F. Protect stored materials and equipment against loss or damage.
- G. Store in manufacturers' unopened containers.
- H. Materials delivered and stored along the line of the Work shall be neatly, safely, and compactly stacked along the work site in such manner as to cause the least inconvenience and damage to property owners and the general public, and shall be not closer than 3 feet to any fire hydrant. Public and private drives and street crossings shall be kept open.
- I. Damage to lawns, sidewalks, streets or other improvements shall be repaired or replaced to the satisfaction of the Resident Project Representative. The total length which materials may be distributed along the route of construction at any one time is 1000 lineal feet, unless otherwise approved in writing by the Resident Project Representative.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01650
FACILITY START-UP

PART 1 - PART 1 -GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Procedures and actions, required of the Contractor, which are necessary to achieve and demonstrate Substantial Completion.
 - 2. Requirements for Substantial Completion Submittals.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 -Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 -General Requirements.
 - 3. Section 11005 -Equipment: Basic Requirements.
 - 4. Section 13440 -Instrumentation for Process Control: Basic Requirements.

1.2 DEFINITIONS

- A. Project Classified System (PCS): A defined part of the Project, consisting of an arrangement of items, such as equipment, structures, components, piping, wiring, materials, or incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent system.
- B. Pre-Demonstration Period: The period of time, of unspecified duration after initial construction and installation activities during which Contractor, with assistance from manufacturer's representatives, performs in the following sequence:
 - 1. Finishing type construction work to ensure the Project has reached a state of Substantial Completion.
 - 2. Equipment start-up.
 - 3. Personnel training.
- C. Demonstration Period: A period of time, of specified duration, following the Pre-Demonstration Period, during which the Contractor initiates process flow through the facility and starts up and operates the facility, without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion. Demonstration Period includes the following steps:
 - 1. Functional Testing and Performance Testing.
 - 2. Disinfection of Facilities.
 - 3. May include follow-up (post operation) Personnel training, if required in individual specifications sections.
 - 4. Completion of all submittals and work to allow Owner to issue Final Acceptance.
- D. Functional Tests: A test or tests in the presence of the Owner to demonstrate that individual installed equipment or systems or subsystems meet manufacturer's installation and adjustment requirements and other requirements specified including, but not limited to, noise, vibration, alignment, speed, proper electrical and mechanical connections, thrust restraint, proper rotation and initial servicing.
- E. Performance Test: A test performed in the presence of the Owner and after all required functional tests, to demonstrate and confirm without exceeding specified downtime limitations that the equipment and/or system meet the specified performance requirements.
- F. Cleaning and Disinfection of Facilities: See Section 01733.

- G. Substantial Completion: The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

1.3 SUBMITTALS

- A. Submit in the chronological order listed below prior to the completion of the Pre-Demonstration Period.
1. Master operation and maintenance training schedule:
 - a. Submit 60 days (minimum) prior to first training session for Owner's personnel.
 - b. Schedule to include:
 - 1) Target date and time for Owner witnessing of each system initial start-up.
 - 2) Target date and time for Operation and Maintenance training for each system, both field and classroom.
 - 3) Target date for initiation of Demonstration Period.
 - c. Submit for review and approval by Owner.
 - d. Include holidays observed by Owner.
 - e. Attend a schedule planning and coordination meeting 90 calendar days prior to first anticipated training session.
 - 1) Provide a status report and schedule-to-complete for requirements prerequisite to manufacturer's training.
 - 2) Identify initial target dates for individual manufacturer's training sessions.
 - f. Schedule to be resubmitted until approved.
 - g. Adjust training schedule to ensure training of appropriate personnel as deemed necessary by Owner and to allow full participation by manufacturer's representatives.
 - h. Adjust schedule for interruptions in operability of equipment.
 - i. All training must be complete at least 14 days prior to initiation of Demonstration Period.
 - j. Owner reserves the right to insist on a minimum 7 days' notice of rescheduled training session not conducted on master schedule target date for any reason.
 2. Substantial Completion Submittal:
 - a. File Contractor's Notice of Substantial Completion and Request for Inspection.
 - b. Approved Operation and Maintenance manuals received by Engineer minimum 1 week prior to scheduled training.
 - c. Written request for Owner to witness each system pre-demonstration start-up. Request to be received by Owner minimum 1 week before scheduled training of Owner's personnel on that system.
 - d. Equipment installation and pre-demonstration start-up certifications.
 - e. Letter verifying completion of all pre-demonstration start-up activities including receipt of all specified items from manufacturers or suppliers as final item prior to initiation of Demonstration Period.
 3. Pre-Demonstration Start-up Plan:
 - a. Schedule for Manufacturer's installation certification and start-up of equipment or systems.
 - 1) Submit at least 21 days prior to first system start-up.
 - 2) Indicate plan, procedures, checklist, and log format.
 - b. Include plan for Management of Water Used for Start-up as required in this Section.
 - 1) Describe use of clean water (potable water from City of Edinburg) or product flow (raw water from HCID No. 1 & 2) for start-up of various systems and how water will be provided, handled, and disposed.
 - c. Include log/documentation format.
 - 1) Documentation shall include:
 - a) Log and description of problems, outages, failures, and alarms.
 - b) Description of any corrective action taken.

- c) Log of calibration settings.
 - d) Log of water quality test reports and any other testing performed to prove acceptable operation of facilities.
 - e) Any calculations or pertinent information.
 - f) Other information requested by Owner during review.
- 2) See Section 13440 for additional instrumentation and controls requirements.
- 4. Pre-Demonstration Period Equipment Start-up Notices:
 - a. Provide written request to Owner to witness each system pre-demonstration startup.
 - 1) Request to be received by Owner minimum 1 week before start-up activities.
- 5. Training Materials:
 - a. Submit written outlines of proposed training sessions not less than 21 days prior to scheduled training.
 - b. Provide complete training materials to include operation and maintenance data as required in this section to be retained by trainee.
 - c. Upon completion of training session, submit log of attendees and copy of materials distributed and retained by trainees.
- 6. Notice of Training Session:
 - a. Submit Notice of Training Session to confirm date, time, location, and agenda of each training session not less than 7 days prior to each session so that Owner may schedule staff.
 - b. Owner reserves the right to insist on a minimum 7 days notice of rescheduled training session not conducted on notified date for any reason.
 - c. Unless specified in individual specification sections, training sessions may not be held until systems/equipment have been started-up, the corresponding final O&M Manuals have been approved and delivered per Section 01330, and the corresponding Training Materials have been submitted.
- 7. Quality Control Submittals:
 - a. a. Manufacturer's Certificate of Proper Installation:
 - 1) When specified in the individual Specifications, submit certificate certifying:
 - a) The product or system has been installed in accordance with the manufacturer's recommendations, inspected by the manufacturer's authorized representative, and serviced with the proper lubricants.
 - b) Necessary safety equipment has been properly installed.
 - c) Electrical and mechanical connections have been made meeting quality and safety standards and as required.
 - d) Free from undue stress imposed by exterior connections or loads.
 - e) Adjustments have been made and the product or system is ready for testing, facilities startup, and operation.
 - 2) See Section 13440 for additional instrumentation and controls requirements.
 - b. Certificate of Successful Start-up:
 - 1) Prepare and submit upon completion of successful testing and startup of respective equipment system, subsystem or component.
 - c. Log of manufacturer's representative present.
 - d. Completed log/checklists for start-up of each system.
 - e. Certifications of calibration for analytical instruments and testing equipment.
 - f. See Section 13440 for additional instrumentation and controls requirements.
- 8. Demonstration Period Plan:
 - a. Functional and performance test plan and schedule for testing and demonstration of equipment, units, and systems.
 - b. Integrate major activities required for demonstration of instrumentation and control systems as described in Section 13440.
 - c. Submit at least 21 days prior to start of related testing.
 - 1) Indicate test plan, procedures.
 - d. Include scheduling of Disinfection of Facilities.
 - e. Include plan for Management of Water Used for Demonstration as required in this Section.

- 1) Describe use of potable water from City of Edinburg or product flow (raw water from HCID No. 1 & 2) for demonstration and how water will be provided, handled, and disposed.
- f. Include log/documentation format.
 - 1) Documentation shall include:
 - a) Operational scenarios utilized or simulated during demonstration.
 - b) Log and description of problems, outages, failures, and alarms.
 - c) Description of any corrective action taken.
 - d) Log of changes in operations, settings, flows, etc.
 - e) Log of water quality test reports and any other testing performed to prove acceptable operation of facilities.
 - f) Any calculations or pertinent information.
 - g) Contractor's written certification that the equipment or system performs as specified.
 - h) Other information required by Owner during review.
 - g. See Section 13440 for additional instrumentation and controls requirements.
9. Disinfection Plan as defined in Section 01733.
 - a. Submit with Demonstration Plan.
10. Notice of Completion of Pre-Demonstration Period:
 - a. File Contractor's Notice that all Pre-Demonstration Period tasks are completed and project is ready for Demonstration Period.
 - 1) Notice represents that Contractor certifies that the project has reached a state of tentative Substantial Completion and will be Substantially Completed after successful completion of Demonstration Period.
 - 2) Notice shall include a Request for Inspection.
 - 3) Notice shall represent that all Pre-Demonstration tasks have been completed, specifically including the following:
 - a) Pre-Demonstration start-up of systems.
 - (1) Notice given to Owner for each system start-up.
 - b) Personnel Training.
 - c) Quality Control Submittals.
 - d) Approval and submission of all shop drawings, O&M Manuals, and Miscellaneous Submittals.
 - e) Receipt of all specified items from manufacturers or suppliers as final items prior to initiation of Demonstration Period.
 - (1) Includes any spare parts and special tools.
11. Demonstration Period Notice of Test:
 - a. Submit Notice of Test (functional or performance) to confirm date, time, location, and plan for each of Demonstration Period tests.
 - 1) Submit not less than 10 days prior to each functional test.
 - 2) Submit not less than 21 days prior to performance test.
 - b. See Section 13440 for additional instrumentation and controls requirements.
 - c. Owner reserves the right to insist on a minimum 10 days notice of rescheduled tests not conducted on notified date for any reason.
12. Demonstration Period Test Reports:
 - a. To be submitted at the completion of the Demonstration Period.
 - b. Provide functional and performance log/testing reports, in a format acceptable to Owner.
 - c. Provide certification that function and performance test has been completed and is acceptable for each piece of equipment.
 - d. See Section 13440 for additional instrumentation and controls requirements.

1.4 SEQUENCING AND SCHEDULING

- A. Basic Start-up Schedule:
 1. The basic order for bringing the individual process units and support systems on-line shall be as listed below:
 - a. Storage Reservoir (2 MG Clearwell):

- 1) Pre-Demonstration:
 - a) Disinfection per Section 01733.
 - b) Potable water to fill from City of Edinburg (coordinate with Owner).
- 2) Demonstration:
 - a) Receive filtered water.
 - b) Chloramine disinfection required.
 - c) Sampling and monitoring required.
- b. Backwash Pumping System:
 - 1) Pre-Demonstration:
 - a) Backwash Pump checkout.
 - b) Required to complete initial filter backwashing.
 - c) Disinfection per Section 01733. .
 - 2) Demonstration:
 - a) Automatic operation required.
- c. Filters:
 - 1) Pre-Demonstration:
 - a) Flow control valve checkout.
 - b) Backwash and skimming per Section 11121.
 - c) Disinfection per Section 01733.
 - d) Air Blowers required.
 - e) Backwash Pumps required.
 - 2) Demonstration:
 - a) Auto backwash required.
 - b) Backwash waste to Equalization Basins.
 - c) Air Blowers required.
 - d) Backwash Pumps required.
 - e) Influent chlorination required.
 - f) Influent ammonia feed required.
- d. Rapid Mix Structure:
 - 1) Pre-Demonstration:
 - a) Initial fill from Raw Water Pump Station.
 - b) Initial Rapid Mix Mixer checkout.
 - 2) Demonstration:
 - a) Rapid Mix Mixer Required
 - b) Raw Water Pumps Required.
 - c) Raw water chlorination required.
 - d) Permanganate feed required.
 - e) Chlorine feed required
 - f) Ammonia feed required
 - g) Raw water sampling required.
- e. Sedimentation Basin :
 - 1) Pre-Demonstration:
 - a) Collector mechanism checkout.
 - b) Sedimentation pumps checkout
 - c) Equal fill required to evenly load structure during initial fill.
 - d) Flow from Influent Structure (Rap Mix).
 - 2) Demonstration:
 - a) Collector mechanisms required.
 - b) Sedimentation Pumps required.
 - c) Effluent (filter influent) sampling required.
- f. Sludge Thickener:
 - 1) Pre-Demonstration:
 - a) Collector mechanism checkout.
 - b) Initial fill from Backwash Clarifier Pump Station.
 - 2) Demonstration:
 - a) Collector mechanisms required.

- b) Overflow to Drain line at Influent Structure.
- g. Sludge Dewatering:
 - 1) Pre-Demonstration:
 - a) Belt Filter Press and support systems checkout.
 - 2) Demonstration:
 - a) Belt Filter Presses required.
 - b) Compressed air system required.
 - c) Polymer feed system required.
 - d) Contractor responsible for hauling dewatered Solids.
 - e) Coordinated dewatered residuals disposal with Owner.
- h. Transfer and High Service Pumping:
 - 1) Pre-Demonstration:
 - a) Transfer and High Service Pump checkout.
 - b) Suction and discharge line disinfection required.
 - 2) Demonstration:
 - a) Coordinate transfer and high service pumping (potable water) with Owner.
 - b) Sampling and monitoring required.

1.5 COST OF START-UP

- A. Contractor to pay all costs associated with Facility start-up. Owner will provide chemicals for pre-demonstration and demonstration period. Owner will assist in staffing during demonstration period.

PART 2 - PRODUCTS -(NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 GENERAL

- A. Facility Start-up Divided into Two Periods:
 - 1. Pre-Demonstration Period including:
 - a. Completion of construction work to bring Project to a state of Substantial Completion.
 - b. Start-up of Equipment.
 - c. Training of Personnel.
 - d. Completion of the filing of all required submittals.
 - e. Filing of Contractor's Notice of Substantial Completion and Request for Inspection.
 - 2. Demonstration Period including:
 - a. Demonstration of functional integrity of Facility.

3.2 MANAGEMENT OF WATER USED FOR START-UP AND DEMONSTRATION

- A. Water to initially fill and start the plant will come from City of Edinburg. Transfer of water from City of Edinburg to the plant Storage Reservoir (2 MG Clearwell) shall be coordinated with the Owner.
 - 1. It will not be allowable to introduce raw water with native levels of iron and manganese into the filters, clearwell, and chemical feed systems without prior treatment.
 - 2. The provisions outlined in this section are meant to be Basic Requirements that may be enhanced or modified by the Contractor with the Owner's approval.
- B. General Requirements:
 - 1. Contractor shall include management and handling of water into the plans submitted for the Pre-Demonstration and Demonstration Periods.
 - 2. Coordinate schedule of potable and raw water needs with Owner to ensure that water is available from the City of Edinburg or HCID No. 1 & 2.
 - 3. Water may be released to the Storage Reservoir (2 MG Clearwell) with Owner approval.
 - a. Highly chlorinated water shall be dechlorinated per Section 01733 prior to discharge.

4. Filter media must be installed (backwashed, scraped, etc.) in accordance with Section 11226 prior to being placed in a filtration mode. Contractor shall coordinate plant operation with the Owner when water is being treated for public consumption.
5. Untreated raw water from the HCID No. 1 & 2 may not be placed in the Clearwell, filtered through the filters, used to backwash filters, or used as a supply source for chemical feed systems.
6. Finished water can be delivered to the 36" transmission pipeline. Transfer and the High Service Pump Station can be fully demonstrated unless finished water meets The Texas Commission of Environmental Quality (TCEQ) potable water standards and plant finished water goals.
 - a. OWNER must approve quality prior to distribution.

3.3 PRE-DEMONSTRATION PERIOD

- A. Completion of Construction Work:
 1. Complete the work to bring the Project to a state of substantial completion.
- B. Equipment Start-up:
 1. Requirements for individual items of equipment are included in Divisions 2 through 16 of these Specifications.
 2. Prepare the equipment so it will operate properly and safely and be ready to demonstrate functional integrity during the Demonstration Period.
 3. Perform Equipment Start-up to extent possible without introducing product flow.
 4. Introduce product flow to complete Equipment Start-up.
 5. Procedures include but are not necessarily limited to the following:
 - a. Test or check and correct deficiencies of:
 - 1) Power, control, and monitoring circuits for continuity prior to connection to power source.
 - 2) Voltage of all circuits.
 - 3) Phase sequence.
 - 4) Cleanliness of connecting piping systems.
 - 5) Alignment of connected machinery.
 - 6) Vacuum and pressure of all closed systems.
 - 7) Lubrication.
 - 8) Valve orientation and position status for manual operating mode.
 - 9) Tankage for integrity using clean water.
 - 10) Pumping equipment using clean water.
 - 11) Instrumentation and control signal generation, transmission, reception, and response. See Section 13440.
 - 12) Tagging and identification systems.
 - 13) All equipment: Proper connections, alignment, calibration and adjustment.
 - b. Calibrate all safety equipment.
 - c. Manually rotate or move moving parts to assure freedom of movement.
 - d. "Bump" start electric motors to verify proper rotation.
 - e. Perform other tests, checks, and activities required to make the equipment ready for Demonstration Period.
 - f. Documentation:
 - 1) Prepare a log showing each equipment item subject to this paragraph and listing what is to be accomplished during Equipment Start-up. Provide a place for the Contractor to record date and person accomplishing required work. Submit completed document before requesting inspection for Substantial Completion certification.
 6. Obtain certifications, without restrictions or qualifications, and deliver to Engineer:
 - a. Manufacturer's equipment installation check letters.
 - b. Instrumentation Supplier's Instrumentation Installation Certificate.
- C. Personnel Training:

1. See individual equipment specification sections.
 2. Conduct all personnel training after completion of Equipment Start-up for the equipment for which training is being conducted.
 - a. Personnel training on individual equipment or systems will not be considered completed unless:
 - 1) All pretraining deliverables are received and approved before commencement of training on the individual equipment or system.
 - 2) No system malfunctions occur during training.
 - 3) All provisions of field and classroom training specifications are met.
 - b. Training not in compliance with the above will be performed again in its entirety by the manufacturer at no additional cost to Owner.
 3. Field and classroom training requirements:
 - a. Hold classroom training on-site.
 - b. Notify each manufacturer specified for on-site training that the Owner reserves the right to video record any or all training sessions. Organize each training session in a format compatible with video recording.
 - c. Training instructor: Factory trained and familiar with giving both classroom and "hands-on" instructions.
 - d. Training instructors: Be at classes on time. Session beginning and ending times to be coordinated with the Owner and indicated on the master schedule. Normal time lengths for class periods can vary, but brief rest breaks should be scheduled and taken.
 - e. Organize training sessions into maintenance verses operation topics and identify on schedule.
 - f. Plan for minimum class attendance of 10 people at each session and provide sufficient classroom materials, samples, and handouts for those in attendance.
 - g. Instructors to have a typed agenda and well prepared instructional material. The use of visual aids, e.g., films, pictures, and slides is recommended for use during the classroom training programs. Deliver agendas to the Engineer a minimum of 7 days prior to the classroom training. Provide equipment required for presentation of films, slides, and other visual aids. Training sessions will be video taped by Owner.
 - h. In the on-site training sessions, cover the information required in the Operation and Maintenance manuals submitted according to Section 01340 and the following areas as applicable to PCS's.
 - 1) Operation of equipment.
 - 2) Lubrication of equipment.
 - 3) Maintenance and repair of equipment.
 - 4) Troubleshooting of equipment.
 - 5) Preventive maintenance procedures.
 - 6) Adjustments to equipment.
 - 7) Inventory of spare parts.
 - 8) Optimizing equipment performance.
 - 9) Capabilities.
 - 10) Operational safety.
 - 11) Emergency situation response.
 - 12) Takedown procedures (disassembly and assembly).
 - i. Address above Paragraphs 1), 2), 8), 9), 10), and 11) in the operation sessions. Address above Paragraphs 3), 4), 5), 6), 7), and 12) in the maintenance sessions.
 - j. Maintain a log of classroom training provided including: Instructors, topics, dates, time, and attendance.
- D. Complete the filing of all required submittals:
1. Shop Drawings.
 2. Operation and Maintenance Manuals.
 3. Training material.
- E. Filing of Contractor's Notice of Substantial Completion and Request for Inspection of Project or PCS:

1. File the notice when the following have been completed:
 - a. Construction work (brought to state of Substantial Completion).
 - b. Equipment Start-up.
 - c. Personnel Training.
 - d. Submittal of required documents.
2. Engineer will review required submittals for completeness within 14 calendar days of Contractor's notice. If complete, Engineer will complete inspection of the Work, within 14 calendar days of Contractor's notice.
3. Engineer will inform Contractor in writing of the status of the Work reviewed, within 14 calendar days of Contractor's notice.
 - a. Work determined not meeting state of Substantial Completion:
 - 1) Contractor: Correct deficiencies noted or submit plan of action for correction within 14 days of Engineer's determination.
 - 2) Engineer: Reinspect work within 14 days of Contractor's notice of correction of deficiencies.
 - 3) Reinspection costs incurred by Engineer will be billed to Owner who will deduct them from final payment due Contractor.
 - b. Work determined to be in state of tentative Substantial Completion: Engineer to prepare tentative "Engineer's Certificate of Substantial Completion."
 - c. Engineer's Certificate of Substantial Completion:
 - 1) Certificate tentatively issued subject to successful Demonstration of functional integrity.
 - 2) Issued for Project as a whole or for one or more PCS.
 - 3) Issued subject to completion or correction of items cited in the certificate (punch list).
 - 4) Issued with responsibilities of Owner and Contractor cited.
 - 5) Executed by Engineer.
 - 6) Accepted by Owner.
 - 7) Accepted by Contractor.
 - d. Upon successful completion of Demonstration Period, Engineer will endorse certificate attesting to the successful demonstration, and citing the hour and date of ending the successful Demonstration Period of functional integrity as the effective date of Substantial Completion.

3.4 DEMONSTRATION PERIOD

- A. General:
 1. Demonstrate the functional integrity of the mechanical, electrical, and control interfaces of the respective equipment and components comprising the Facility as evidence of Substantial Completion.
 2. Duration of Demonstration Period: 120 consecutive hours.
 3. If, during the Demonstration Period, the aggregate amount of time used for repair, alteration, or unscheduled adjustments to any equipment or systems that renders the affected equipment or system inoperative exceed 10 percent of the Demonstration Period, the demonstration of functional integrity will be deemed to have failed. In the event of failure, a new Demonstration Period will recommence after correction of the cause of failure. The new Demonstration Period shall have the same requirements and duration as the Demonstration Period previously conducted.
 4. Conduct the demonstration of functional integrity under full operational conditions.
 5. Owner will provide operational personnel to provide process decisions affecting plant performance. Owner's assistance will be available only for process decisions. Contractor will perform all other functions including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period.
 6. Owner reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, etc., to verify the functional integrity of automatic and manual backup systems and alternate operating modes.

7. Time of beginning and ending any Demonstration Period shall be agreed upon by Contractor, Owner, and Engineer in advance of initiating Demonstration Period.
8. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's questions, provide final field instruction on select systems and to respond to any system problems or failures which may occur.
 - a. Provide final field instruction on the following systems:
 - b. For the above systems, provide a total of 160 HRS instruction, divided among the systems as follows:
9. Provide all labor, supervision, maintenance, equipment, vehicles or any other item necessary to operate and demonstrate all systems being demonstrated.

END OF SECTION

SECTION 01725
FIELD SURVEYING

PART 1 - GENERAL

1.1 QUALITY CONTROL

- A. Conform to State of Texas laws for surveys requiring licensed surveyors.

1.2 UNIT PRICES

- A. No separate payment will be made for Field Surveying. Include the cost of Field Surveying in other related bid items.

1.3 SUBMITTALS

- A. Submit to Engineer the name, address, and telephone number of Surveyor before starting survey work.
- B. Submit documentation verifying accuracy of survey work on request.
- C. Submit certificate signed by surveyor, that the elevations and locations of the Work are in conformance with Contract Documents.
- D. Submit information under provisions of Section 01330 - Submittal Procedures.

1.4 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and survey work as it progresses.
- B. Prepare a certified survey setting forth dimensions, locations, angles, and elevations of construction and site Work upon completion of foundation walls and major site improvements.
- C. Submit Record Documents under provisions of Section 01785 - Project Record Documents.

1.5 EXAMINATION

- A. Verify locations of survey control points prior to starting Work.
- B. Notify Engineer immediately of any discrepancies discovered.

1.6 SURVEY REFERENCE POINTS

- A. Control datum for survey is that established by Owner-provided survey as indicated on Drawings.
- B. Locate and protect survey control points prior to starting site work; preserve permanent reference points during construction.
- C. Notify Engineer 48 hours in advance of need for relocation of reference points due to changes in grades or other reasons.
- D. Report promptly to Engineer the loss or destruction of any reference point.
- E. Contractor shall reimburse Owner for cost of reestablishment of permanent reference points disturbed by Contractor's operations.

1.7 SURVEY REQUIREMENTS

- A. Utilize recognized engineering survey practices.

- B. Establish elevations, lines and levels to provide appropriate controls for the Work. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading; fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- C. Verify periodically layouts by same means.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01740

WARRANTIES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This section specifies general administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1.2 SUBMITTAL REQUIREMENTS

- A. Submit written warranties to the OWNER prior to the date fixed by the Engineer for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the work, or a designated portion of the work, submit written warranties upon request of the Owner.
- B. Assemble warranties, service, and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.
- C. Number of original signed copies required: Two (2) each.
- D. Table of Contents: Neatly types, in orderly sequence. Provide complete information for each item.
 - 1. Product or work item.
 - 2. Firm, with name of principal, address and telephone number.
 - 3. Scope.
 - 4. Date of beginning of warranty, service, or maintenance contract.
 - 5. Duration of warranty, or service maintenance contract.
 - 6. Provide information for Owner's personnel:
 - a. Proper procedure in case of failure.
 - b. Instances which might affect the validity of warranty.
 - 7. Contractor, name of responsible principal, address and telephone number.

1.3 FORMS OF SUBMITTALS

- A. Prepare in duplicate packets.
- B. Format:
 - 1. Size 8-1/2 inches x 11 inches, punch sheets for standard 3-post binder.
 - a. Fold larger sheets to fit into binders.
 - 2. Cover: Identify each packet with typed or printed title 'WARRANTIES'. List:
 - a. Title of Project.
 - b. Name of Contractor.
 - 3. Binders: Commercial quality, three-post binder, with durable and cleanable plastic covers and maximum post width of 2 inches.

1.4 WARRANTY SUBMITTAL REQUIREMENTS

- A. For all major pieces of equipment, submit a warranty from the equipment manufacturer. The manufacturer's warranty period shall be concurrent with the Contractor's for two (2) years, unless otherwise specified, commencing at the time of final acceptance by the Owner.

- B. The Contractor shall be responsible for obtaining certificates for equipment warranty for all major equipment specified under Divisions 11, 13, 14, 15 and 16 and which has a 1 HP motor or which lists for more than \$1,000. The Engineer reserves the right to request warranties for equipment not classified as major. The Contractor shall still warrant equipment not considered to be "major" in the Contractor's once-year warranty period even though certificates of warranty may not be required.
- C. For certain pieces of equipment, the OWNER may require a warranty greater than two (2) years. The requirement for a two-year warranty shall be specified in individual sections of the Specifications.

1.05 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
- B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace, or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Contractor's is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the OWNER can enforce such other duties, obligations, rights, or remedies.
- E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- F. The Owner reserves the right to refuse to accept work for the project where a special warranty, certification, or similar commitment is required on such work or part of the work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- G. Disclaimers and Limitations: Manufacturer's disclaimers and limitation on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the Contractor.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01770
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures including final submittals such as operation and maintenance data, warranties, and spare parts and maintenance materials.

1.2 CLOSEOUT PROCEDURES

- A. Comply with the Contract Documents regarding Final Completion and Final Payment when Work is complete and ready for Engineer's final inspection.
- B. Provide Project Record Documents in accordance with Section 01785.
- C. Complete or correct items on punch list, with no new items added. Any new items will be addressed during warranty period.
- D. The Owner will occupy portions of the Work as specified in other Sections.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final inspection.
- B. For facilities, clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to a sanitary condition.
- D. Clean or replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and temporary construction facilities from the site following the final test of utilities and completion of the work.

1.4 ADJUSTING

- A. Adjust operating equipment to ensure smooth and unhindered operation.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operations and maintenance data as noted in 01330 - Submittal Procedures.

1.6 WARRANTIES

- A. Provide one original of each warranty from Subcontractors, suppliers, and manufacturers.
- B. Provide Table of Contents and assemble warranties in 3-ring/D binder with durable plastic cover.
- C. Submit warranties prior to final Application for Payment.
- D. Warranties shall commence in accordance with the requirements in the Contract Documents.

1.7 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual Specification sections.
- B. Deliver to location within the Owner's jurisdiction as directed by Resident Project Representative; obtain receipt prior to final Application for Payment.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01782
OPERATIONS AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Submittal requirements for equipment and facility operating and maintenance manuals.

1.2 MEASUREMENT AND PAYMENT

- A. The value of approved equipment operations and maintenance manuals is 5 percent of the individual equipment value as indicated in the Bid Proposal or Schedule of Values. This amount can be included in the next Application for Payment after approval of a submitted manual.

1.3 SUBMITTALS

- A. Along with the schedule for other submittals as required in Section 01330 - Submittal Procedures, submit a list of operation and maintenance manuals and parts manuals to be provided.
- B. The Contractor shall provide (6) complete sets of hard-covered ring-bound loose-leaf O&M manuals. In addition to "as-built" system drawings, the manuals shall include internal wiring diagrams and operating and maintenance literature for all components provided under this section. The submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, programming and configuration, adjustment, calibration, testing and maintenance of each component and/or instrument. The O&M manual shall be professionally composed and compiled and shall not be an assembly of "cut-sheets". Engineer shall have sole discretion of acceptance of O&M manual contents and composition.
- C. Submit six (6) documents, bound in 8-1/2x11-inch text pages, 3-ring/D binders with durable plastic covers.
- D. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- E. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- F. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified.
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.

- b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties.
- G. Within one month prior to placing the equipment or facility in service, submit two copies of operation and maintenance manual and parts manual for review.
- H. Submit one copy of completed volumes in final form 10 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
- I. Revise and resubmit final volumes within 10 days after final inspection.

1.4 EQUIPMENT OPERATION AND MAINTENANCE DATA

- A. Furnish operation and maintenance manuals for all equipment. Operation and maintenance manual must contain all information required for Owner to operate, maintain, and repair equipment. The manual must be prepared by equipment manufacturer, furnished to the Engineer by Contractor, and, as a minimum, contain the following:
 - 1. Equipment functions, normal operating characteristics, and limiting conditions.
 - 2. Assembly, installation, alignment, adjustment, and checking instructions.
 - 3. Operating instructions for start-up, normal operation, regulation and control, normal shutdown, and emergency shutdown.
 - 4. Lubrication and detailed maintenance instructions. The maintenance instructions are to include detailed drawings giving the location of each maintainable part and lubrication point and detailed instructions on disassembly and reassembly of the equipment.
 - 5. Troubleshooting guide.
 - 6. Complete spare parts list with predicted life of parts subject to wear, lists of spare parts recommended on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.
 - 7. Outline, cross-section, and assembly drawings; engineering data; wiring diagram.
 - 8. Test data and performance curves.
- B. Furnish parts manuals for all equipment. The manual must be prepared by equipment manufacturers, furnished to Engineer by Contractor, and, as a minimum, contain the following.
 - 1. Detailed drawings giving the location of each maintainable part.
 - 2. Complete spare parts list with predicted life of parts subject to wear, lists of spare parts recommended on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01785
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Maintenance and Submittal of Project Record Documents and samples.

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Maintain one record copy of documents at the site in accordance with the Contract Documents.
- B. Store Record Documents and samples in field office if a field office is required by Contract Documents, or in a secure location. Provide files, racks, and secure storage for Record Documents and samples.
- C. Label each document "PROJECT RECORD" in neat, large, printed letters.
- D. Maintain Record Documents in a clean, dry, and legible condition. Do not use Record Documents for construction purposes.
- E. Keep Record Documents and Samples available for inspection by Resident Project Representative.

1.3 RECORDING

- A. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.
- B. Contract Drawings and Shop Drawings: Legibly mark each item to record all actual construction, or "as built" conditions, including:
 - 1. Measured depths of elements of foundation in relation to finish first floor datum.
 - 2. Measured horizontal locations and elevations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Elevations of underground utilities referenced to bench mark utilized for project.
 - 4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
 - 5. Field changes of dimension and detail.
 - 6. Changes made by modifications.
 - 7. Details not on original contract drawings.
 - 8. References to related shop drawings and modifications.
- C. Record information with a red felt-tip marking pen on a set of blue or black line opaque drawings, provided by Engineer.

1.4 SUBMITTALS

- A. At contract closeout, deliver Project Record Documents to Engineer.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 02050
BASIC SITE MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aggregate Base Course
 - 2. Drain Rock
 - 3. Gravel
 - 4. Imported Select Fill
 - 5. Native Material
 - 6. Select Native Material
 - 7. Sand
 - 8. Granular Backfill
 - 9. Stabilization Material
 - 10. Granular Base
 - 11. Cement Stabilized Sand

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. C 117 – Standard Test Method for Materials Finer than 75-um (No. 200) Sieve
 - 2. C 131 – Standard Test Method for Resistance to Degradation of Small-Size in Mineral Aggregates by Washing.
 - 3. C 136- Standard Test Method for Sieve Analysis of Fine and Course Aggregates.
 - 4. D 4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- B. Texas Department of Transportation (TXDOT)
 - 1. Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. (2004 Edition)

1.3 SUBMITTALS

- A. Product Data:
 - 1. Material Source
 - 2. Gradation
 - 3. Testing Data
- B. Quality Control for Aggregate Base Course:
 - 1. Test Reports: Reports for tests required by Sections of Standard Specifications
 - 2. Certificates of Compliance: Certificates as required by Sections of Standard Specifications

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General
 - 1. Provide material having maximum particle size not exceeding 4 inches and that is free of trash, lumber, debris, leaves, grass, roots, stumps, and other organic matter.

2. Materials derived from processing demolished or removed asphalt concrete are not acceptable.
- B. Aggregate Base Course:
1. Crushed gravel.
 2. Consist of hard durable particles of fragments of stone or gravel, screened or crushed to required size and grading and free from organic matter, lumps or ball or clay, alkali, or other deleterious matter.
 3. Materials derived from processing demolished or removed asphalt concrete can be blended with approved base course material and used only as base course under asphaltic concrete paving. It cannot be used as structural backfill under or around any buried facilities.
 4. When sampled and tested in accordance with specified test methods, material shall comply with following requirements:
 - a. Percentage of Wear: Not to exceed 40 percent after 500 revolutions when tested in accordance with ASTM C 131.
 - b. Plasticity Index: Not be more than 5 when tested in accordance with A ASTM D 4318.
 5. Aggregate Base Course for Structure:
 - a. Consist of crushed or fragmented particles.
 - b. Grade within the following limits when tested in accordance with ASTM C 117 and ASTM C 136:

Sieve Sizes (Square Openings)	Percent by Weight Passing Sieve
1 inch	100
½ inch	79-91
Number 4	49-61
Number 16	27-35
Number 200	7-11

- C. Drain Rock
1. Consist of hard, durable particles of stone or gravel, screened or crushed to specified size and gradation.
 2. Free from organic matter, lumps or balls of clay, or other deleterious matter.
 3. Crush or waste coarse material and waste fine material as required to meet gradation requirements.
 4. Durability: Percentage of wear not greater than 40 percent when tested in accordance with ASTM C 131.
 5. Conform to size and grade within the limits as follows when tested in accordance with ASTM C 117 and C 136:

Sieve Size (Square Openings)	Percent By Weight Passing Sieve
2 inch	100
1-1/2 inch	95-100
3/4 inch	50-100
3/8 inch	15-55
Number 200	0-2

- D. Gravel
1. Hard, durable particles of stone or gravel, screened or crushed to the specified sizes and gradations.
 2. Washed and free of organic matter, lumps or balls of clay, and the deleterious matter.
 3. Crush or waste coarse material, and add or waste fine material in order to provide a evenly graded mixture meeting the specified gradations.
 4. Fraction of Material Passing Number 40 Sieve: Material having plasticity index not greater than 5 when tested in accordance with ASTM D 4318.

5. Durability: Percentage of wear not greater than 40 percent when tested in accordance with ASTM C 131.

Sieve Size (Square Openings)	Percent by Weight Passing Sieve		
	Type A	Type B	Type C
2 inch	100	---	---
1-1/2 inch	95-100	100	---
3/4 inch	35-60	55-85	100
3/8 inch	15-40	35-65	50-100
Number 4	0-5	20-35	30-45
Number 30	---	5-15	10-20
Number 200	---	2-9	2-9

- E. Imported Select Fill:
1. One of the following:
 - a. Crushed limestone base conforming Item 247, Type A, Grade 3 of the TXDOT Standard Specifications.
 - b. Low-Plasticity clayey soils or low-plasticity granular soils having the following characteristics:
 - 1) Plasticity index between 5 and 16 percent.
 - 2) Maximum gravel content (percent retained on the No. 4 sieve) of 40 percent.
- F. Native Material:
1. The following on-site materials observed during the geotechnical investigation for the Work are anticipated to be suitable for reuse as Native Material.
 - a. Sandy Clay (CL).
 - b. Silty sand (SM).
 - c. Clayey sand (SC).
 - d. Silty clay (CL).
 2. On-site materials not listed are considered to be spoil and shall be removed from the site.
 - a. Clay soils (CH) were observed in the area of the proposed Chemical Facilities Building (CFB) and Chemical Facility Storage (CFS). These high plasticity clays may not be reused as Native Material.
- G. Select Native Material
1. Sound, Native Materials as specified, and conforming to the following additional requirements.
 2. Plasticity index between 5 and 16.
- H. Sand:
1. Clean, coarse, natural sand of the specified sizes and gradations.
 2. PI from non-plastic to maximum of 10 and maximum liquid limit of 30.

Sieve Size (Square Openings)	Percent by Weight Passing Sieve		
	Type 1	Type 2 (ASTM C33)	Type 3
1/2 inch	100		---

3/8 inch	90-100	100	---
Number 4	80-100	95-100	---
Number 8		80-100	---
Number 16		50-85	100
Number 30		25-60	---
Number 50		5-30	---
Number 100		0-10	---
Number 200	20	0	0

I. Granular Backfill:

1. Free-draining Type A Gravel or Type 3 Sand as specified herein.

J. Stabilization Material:

1. Clean, hard, durable particles of crushed rock or gravel screened or crushed to the specified sizes and gradations.
2. Free of any detrimental quantity of soft, friable, thin, elongated, or laminated pieces, disintegrated material, organic matter, oil alkali, or other deleterious substance.
3. Free of slaking or decomposition under the action of alternate wetting and drying.
4. Durability: Percentage of wear not greater than 40 percent when tested in accordance with ASTM C 131.
5. The portion of material retained on the 3/8 inch sieve shall contain at least 50 percent of particles having three or more fractured faces. Not over 5 percent shall be pieces that show no such faces resulting from crushing. Of that portion which passes the 3/8-inch sieve but is retained on the No. 4 sieve, not more than 10 percent shall be pieces that show no faces resulting from crushing.
6. conform to size and grade when tested in accordance with ASTM C 117 and ASTM C 136.

Sieve Size (Square Openings)	Percent By Weight Passing Sieve
1 inch	100
3/4 inch	90-100
Number 4	0-10
Number 200	0-2

K. Granular Base:

1. The material shall consist of crushed limestone base materials meeting all of the requirements of 2004 TXDOT Standard Specification Manual Item 247, Type A, Grade 1 or 2 including triaxial strength.
2. Percent passing No. 200 sieve should not exceed 15 percent.
3. Compact to at least 95 percent of the maximum dry density by modified moisture-density relationship (ASTM D 1557) at moisture content between -2 and +3 percentage points of optimum.
4. Caliche material may be used and should be compacted to at least 95 percent of the maximum dry density in accordance with ASTM D 1557 at moisture content between -2 and +3 percentage points of optimum.

5. The plasticity index of caliche shall be a maximum of 12 and the wet ball mill (TEX-116-E) amount shall be a maximum of 40-45. Maximum wet ball mill increase -40 sieve is 20
6. Min compressive strength (TEX-117-E) requirements for caliche are 35-45 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure and may need the addition of lime or cement to untreated caliche to be met.
7. Lime or cement may be used to treat the base material as the subgrade soils have less than 8000 ppm sulfates.
8. Flexible Base shall conform to Item: 02717 Flexible Base Course

L. Cement Stabilized Sand:

1. Cement stabilized sand shall be a mixture of a minimum of 1.5 sacks of Standard Type 1 Portland Cement per cubic yard of sand.

PART 3 - EXECUTION

Not Used.

END OF SECTION

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SECTION 02055
PREPARING RIGHT-OF-WAY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division-1 Specification sections, apply to work specified in this section.

1.2 DESCRIPTION

- A. The work covered by this section consists of preparing the right-of-way for construction operations by removing and disposing of all obstructions from the right-of-way and from designated easements, where removal of such obstructions is not otherwise provided for in the plans and specifications.
- B. Such obstructions shall be considered to include, but not limited to, foundations, floor slabs, concrete, brick, lumber, plaster, cisterns, abandoned utility pipes or conduits, fences, retaining walls, and all other debris, as well as buried concrete slabs, curbs, driveways, and sidewalks.
- C. This item shall also include the removal of trees, stumps, bushes, shrubs, brush, roots, vegetation, logs, rubbish, paved parking areas, miscellaneous stone, brick, drainage structures, manholes, inlets, scrap iron and all debris whether above or below ground except live utility facilities.
- D. The use of explosives will not be permitted on this project.
- E. It is the intent of this specification to provide for the removal and disposal of all obstructions to the new construction together with other objectionable materials not specifically provided for elsewhere by the plans and specifications.
- F. Unless shown otherwise on the plans, all fences along the right-of-way which are damaged, or removed temporarily by the Contractor shall be replaced by the Contractor to an equal or better condition at no additional cost to the owner.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

- A. Areas designated on the plans shall be cleared of all obstructions, vegetation, abandoned structures, etc., as defined above, except trees or shrubs specifically designated by the Engineer for preservation. Trees and shrubs designated for preservation shall be carefully trimmed as directed in other sections of the specifications and shall be protected from scarring, barking, or other injuries during construction operations. Exposed ends of pruned limbs shall be treated with an approved asphaltic material.
- B. Unless otherwise indicated on the plans, all underground obstruction shall be removed to the following depths:
- C. In areas to receive embankment, two feet (2') below natural ground.
 - 1. In areas to be excavated, two feet (2') below the lowest elevation of the excavation.

2. All other areas, two feet (2') below natural ground.
- D. Holes remaining after removal of all obstructions, objectionable materials, vegetation, etc. shall be backfilled and tamped as directed by the Engineer, and the entire area bladed to prevent ponding of water and to provide drainage. In areas that are to be immediately excavated, backfilling and blading may be eliminated if approved by the Engineer. Areas to be used as borrow sites and material sources shall have all obstructions objectionable materials, vegetation, etc., removed to the complete extent necessary to prevent such objectionable matter from becoming mixed with the material to be used in the construction.
- E. Where a conduit is shown to be replaced, it shall be removed in its entirety and all connections to the existing line shall be extended to the new line. Where an existing conduit is to be cut and plugged, the line shall be cut back not less than two feet (2') long and shall be plugged by using a precast stopper grouted into place.
- F. Materials to be removed will be designated as "Non-Salvageable" and shall become the property of the Contractor and be removed from the site and disposed of properly, in accordance with all applicable, local, state, and Federal laws.

END OF SECTION

SECTION 02084
FRAMES, GRATES, RINGS, AND COVERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Iron castings for manhole frames and covers, inlet frames and grates, catch basin frames and grates, meter vault frames and covers, adjustment rings, and extensions.
- B. Ring grates.

1.2 REFERENCES

- A. AASHTO - American Association of State Highway and Transportation Officials Standard Specification for Highway Bridges.
- B. ASTM A 48 - Specification for Gray Iron Castings.
- C. ASTM A 615 - Standard Specification for Deformed Billet-Steel Bars for Concrete Reinforcement.
- D. AWS - D 12.1 Welding Reinforcing Steel.

1.3 SUBMITTALS

- A. Submit product data in accordance with Section 01330 - Submittal Procedures.
- B. Submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.
- C. Submit shop drawings for fabrication and installation of casting assemblies that are not included in Drawings. Include plans, elevations, sections and connection details. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

PART 2 - PRODUCTS

2.1 CASTINGS

- A. Castings for frames, grates, rings and covers shall conform to ASTM A 48, Class 30. Provide locking covers if indicated on Drawings.
- B. Castings shall be capable of withstanding the application of an AASHTO H-20 loading without permanent deformation.

- C. Fabricate castings to conform to the shapes, dimensions, and with wording or logos shown on the Drawings. Standard dimensions for manhole covers are 32 inches in diameter.
- D. Castings shall be clean, free from blowholes and other surface imperfections. Cast holes in covers shall be clean and symmetrical, free of plugs.

2.2 BEARING SURFACES

- A. Machine bearing surfaces between covers or grates and their respective frames so that even bearing is provided for any position in which the casting may be seated in the frame.

2.3 SPECIAL FRAMES AND COVERS

- A. Where indicated on the Drawings, provide watertight manhole frames and covers with a minimum of four bolts and a gasket designed to seal cover to frame. Supply watertight manhole covers and frames, Model R-1916H (32-inch cover diameter) manufactured by Neenah Foundry Company, Model V-2420 by Vulcan Foundry, or approval equal.
- B. Where shown on the Drawing, provide manhole frames and covers with 48-inch-diameter clear opening, with inner cover for 22-inch diameter clear opening. Provide inner cover with pattern shown on Drawings, Vulcan Foundry V-7, Neenah Foundry, Model R-1741-F, or approved equal.

2.4 FINISH

- A. Unless otherwise specified, coat iron castings with the manufacturer's standard asphaltic paint.

2.5 FABRICATED RING GRATES

- A. Ring grates shall be fabricated from reinforcing steel conforming to ASTM A 615.
- B. Welds connecting the bars shall conform to AWS D 12.1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install castings according to approved shop drawings, instructions given in related specifications, and applicable directions from the manufacturer's printed materials.
- B. Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true, and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in formwork until permanently set.
- C. Ring grates shall be fabricated in accordance with the City standard detail and shall be set in mortar.

END OF SECTION

SECTION 02140

DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Responsibilities and execution for dewatering of excavations for channels, structures and pipelines.
- B. Related Sections include but not necessarily limited to:
 - 1. Division 0 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 – General Requirements.
 - 3. Division 2 – Site Construction.

1.2 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. The Contractor shall employ a specialty dewatering subcontractor with experience in the field of large dewatering system design, installation, operation, and maintenance. The Contractor shall document successful completion of at least five (5) projects in soils and ground water conditions similar to the project.
 - 2. The Contractor's dewatering system shall be designed by a Texas Licensed Professional Engineer experienced in the design, installation, and operation of dewatering systems. The design shall acknowledge the type of excavation and support system proposed for the project.

1.3 SYSTEM DESCRIPTION

- A. Dewatering consists of the design, furnishing, installation, operation, maintenance, monitoring, reporting, and removal of a dewatering system(s) to achieve completion of all work performed under this Contract without damage to adjacent improvements and materials.
- B. The Contractor shall provide, operate, and maintain groundwater control systems for the construction of the Project as required. The groundwater control systems shall be adequate to keep excavations free from water and in a hydrostatically-controlled condition during construction, and shall dewater and dispose of the water so as not to cause injury to public or private property, cause a nuisance or a menace to the public, or adversely impact the water quality of the local streams or water bodies.
- C. During all subsurface work, the Contractor shall keep excavations free of water and control surface runoff so as to prevent entry or collection of water in excavations or in other isolated areas of the site. The dewatering system shall include any deep wells, wellpoints, sumps, and other equipment, appurtenances, and related earthwork necessary to perform the function.
- D. Before installation of dewatering systems, Contractor shall submit the method, installation and details of the dewatering system proposed to be used to the Engineer for review.
- E. Review by the Engineer of the method, installation, and operation and maintenance details submitted by the Contractor shall not in any way relieve the Contractor from full responsibility for errors therein or from the entire responsibility for complete and adequate design and performance of the system in controlling the water level and hydrostatic pressures in excavated areas. The Contractor shall be solely responsible for proper design, installation, proper operation, maintenance, and any failure of any component of the dewatering system for this Contract.

- F. Direct point discharges from dewatering operations to area tributaries are prohibited. After appropriate treatment the water may be released through treatment features to surrounding water conveyance features or facilities. All proposed discharges shall be approved by the Owner.
- G. The selection of dewatering wells, sumps, subsurface drains, and the configuration of dewatering systems shall be a Contractor responsibility. Provisions described in this specification shall govern the performance aspects of the dewatering systems designed and selected by the Contractor.

1.4 SUBMITTALS

- A. See Section 01330.
- B. Drawings and complete design data showing methods and equipment proposed to be utilized in dewatering.
- C. As a minimum, submit the following for each dewatering system utilized:
 - 1. Drawings indicating the location and size of deep wells, observation wells, wellpoints, sumps, vacuum headers, flow rate meters, discharge lines, means to clarify discharge water before it reaches adjacent creeks, and any other groundwater control system component.
 - 2. Capacities and details of pumps, prime movers, and standby equipment.
 - 3. Design calculations proving adequacy of system and selected equipment.
 - 4. Detailed description of the dewatering schedule, operation, maintenance and well abandonment procedures, if wells are used.
 - 5. Projected drawdown in wells with elevations, if wells are used.
 - 6. Plan view drawing indicating estimated zone of influence with groundwater elevations, if wells are used.
 - 7. Detailed description of methods for controlling settlement of existing utilities and structures.
 - 8. Estimated dewatering system discharge flow rate.
- D. Coordinate and submit dewatering plan concurrent with submittals specified in Section 02165.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sumps:
 - 1. The Contractor shall size sumps such that they maintain excavations in a dewatered condition.
 - 2. Contractor shall size sump pumps and all piping to remove all anticipated groundwater and stormwater runoff.
 - 3. Sumps shall handle any leakage through the temporary shoring walls.
- B. Standby Equipment:
 - 1. Maintain on site sufficient equipment and materials for necessary modifications and to ensure continuous and successful operation of the dewatering and monitoring systems.
 - 2. Provide one hundred percent standby electrical generating capacity with automatic switching from lien to generator, including all safety features to prevent back-feeding the electrical supply system.
- C. Dewatering Effluent Piping:
 - 1. PVC pressure rated pipe.
 - a. ASTM 2241 or ASTM D1785 Schedule 40 (minimum).

PART 3 - EXECUTION

3.1 PERFORMANCE AND DESIGN REQUIREMENTS

A. General:

1. Contractor shall maintain dewatering system such that it is in continuous operation without any interruptions due to groundwater.
2. Dewatering water shall not be discharged directly into surface water bodies. The Contractor shall provide at a minimum a sediment/clarification basin(s) before allowing water to flow overland to adjacent creeks. The Contractor shall submit location, size and layout of basin(s) for review.
3. Supply a separate electrical service for dewatering and dedicate it solely to the operation of the dewatering systems.
4. Maintain water levels a minimum of 2 feet below the bottom of all excavations at all times and under all conditions, except for rainfall events that cause general flooding in the project area.
5. Keep excavations free of water during excavation, construction of structures, installation of pipelines, placing of materials described in Sections 02200 and 02317.
6. Control runoff from groundwater seeps so as to prevent entry or collection of water in excavations or in other isolated areas of the site.
7. The dewatering system will include any sumps, deep wells, well points, pumps, and other equipment, appurtenances, and related earthwork necessary to perform the function.
8. Design and operate dewatering systems so as to prevent removal of the in-situ soils.
9. Do not start dewatering prior to the Engineer's review and acceptance of the method, installation, and details of the proposed dewatering system.

3.2 INSTALLATION

A. Sumps:

1. Construct sumps to maintain excavations in a dewatered condition.

B. Well development:

1. Develop all wells and wellpoints after installation to remove fines from drilling and construction activities.

C. Dewatering system protection and dewatering effluent pipelines:

1. Protect all dewatering wells throughout construction.
2. Wells and dewatering effluent pipelines damaged prior to end of construction shall be reinstalled and redeveloped at no additional cost to the Owner.

D. Maintain excavations in a dewatered condition continuously and without interruptions:

1. Dewatering will be a continuous operation.
2. Do not shut down dewatering systems between shifts, on holidays, or weekends, or during work stoppage without written permission from the Engineer.

3.3 FIELD QUALITY CONTROL

A. General:

1. Monitor dewatering effluent daily for visual signs of contamination.

B. Dewatering Wells:

1. Record and make available to the Engineer on a daily basis:
 - a. The location and number of dewatering wells and sump pumps in operation.
 - b. Total flow indicated on the flow meters.
 - c. The rate of flow at the time of the recording.
2. Consistency is an important factor in ensuring that water level data are accurate; therefore, assign and make known to the Engineer specific member(s) of workforce responsible for collecting and reporting the required information.

- C. Perform any additional testing or monitoring as necessary to assure provision of a properly functioning dewatering system.
 - 1. The Contractor shall establish horizontal and vertical control survey points (movement measurement points) at the locations shown on the Drawings.
 - 2. Perform a baseline survey of these structure monitoring points before the start of dewatering operations.
 - 3. On a weekly basis and until dewatering operations are completed perform survey measurements and submit to the Engineer/Owner.

3.4 DEMOBILIZATION

- A. Upon written authorization of the Engineer, remove all dewatering system elements with the exception of those observation wells so designated by the Engineer

END OF SECTION

SECTION 02165
CONTRACTOR DESIGNED EXCAVATION SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Requirements for excavation support systems such as sheeting, shoring, and bracing of trenches, and open excavations greater than 4 feet in depth.
- B. Related Sections include but not necessarily limited to:
 - 1. Division 0 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 – General Requirements.
 - 3. Division 2 – Site Construction.
 - 4. Division 5 – Metals.

1.2 QUALITY ASSURANCE

- A. Referenced Standards: This section incorporates by reference the latest revision of the following documents. It is a part of this section as specified and modified. In case of conflict between the requirements of this section and that of the listed documents, the requirements of this section shall prevail:
 - 1. ASTM A36 and A992 Structural Steel.
 - 2. ASTM A328, Steel Sheet Piling.
 - 3. ASTM A572, Structural Steel.
 - 4. AWS D1.1, Structural Welding Code.
 - 5. OSHA, Occupational Safety and Health Act.
 - 6. 2009 International Building Code (IBC).
- B. Support of excavation shall be designed, and shop drawings signed and stamped, by a Structural Engineer, licensed to practice in the State of Texas and experienced in the design of excavation support systems.
- C. The excavation support system shall be installed by a qualified subcontractor with at least 5 years experience installing similar systems or the prime contractor if prime contractor meets the same requirements for sub-contractor.

1.3 SYSTEM DESCRIPTION

- A. Where excavation support systems are necessary, they shall be furnished, placed, maintained and, except as shown or specified otherwise, removed by the Contractor. The Contractor shall be responsible for the design and selection of methods in conformance with OSHA and the design criteria as specified herein.
- B. Excavation Support Systems description:
 - 1. Design requirements:
 - a. The design, planning, installation, and removal, if required, of all sheeting, shoring, soil-nailing, H piles, lagging and bracing and laying back slopes shall be accomplished in such a manner as to maintain the required excavation for structures and pipeline construction and to maintain the undisturbed state of the soils below and adjacent to the excavation.
 - b. The method of support shall be selected by the Contractor and reviewed by the Engineer.

1.4 SUBMITTALS

- A. Section 01330: Submittals.
- B. Prior to commencing excavation work requiring excavation support systems such as sheeting, shoring, and bracing, the Contractor shall submit its plans for excavation support systems to the Engineer for review. No excavations shall be started until the submittal review of the excavation support system is complete. Said review by the Engineer of the Contractor's design shall not be construed as a detailed analysis for adequacy of the support system, nor shall any provision of the above requirements be construed as relieving the Contractor of its overall responsibility and liability for the work. Information to be provided shall be made in accordance with these Contract Documents and shall include the following:
 - 1. Method of installation and removal of all sheeting, sheet piling, soldier piles, shoring and bracing. Design shall be performed by a licensed Texas Professional Engineer and shall comply with applicable requirements of the Building Code and OSHA with respect to excavation and construction.
- C. The following shall be submitted in compliance with Section 01330.
 - 1. The proposed excavation support system for each construction component where excavation support systems will be used.
 - 2. Arrangement, size, and details for each excavation support system, and construction methods to be used for the installation of each system.
 - 3. Pile installation methods, sequence connection details, bracing preloading.
 - 4. Depths below the main excavation bottom elevation to which the support system will be installed.
 - 5. Elevations of ground surface, struts, and shores, as applicable.
 - 6. Permissible depth to which excavation may be carried before supports must be installed and preloaded.
 - 7. Full excavation depth load to be carried by various excavation support system members.
 - 8. Preloads as required.
 - 9. Proposed sequence of strut and shore removal as applicable and as related to backfilling operations.
 - 10. Dewatering.
 - 11. Predrilling, if required.
- D. The above submittals shall be coordinated by the Contractor with other shop drawing submittals for work specified elsewhere in which support of excavation is required.
- E. Contingency plan for alternative procedures to be implemented if the excavation support system is found to perform unfavorably or if obstructions are encountered driving.

1.5 DESIGN CRITERIA

- A. Shop drawings for the various excavation support systems shall be prepared in accordance with the following criteria:
 - 1. Design the excavation support system and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads in such manner as will allow the safe and expeditious construction of the permanent structures to minimize ground movement or settlement, and to prevent damage to or movement of adjacent structures, access drives, and utilities. Design for loads appropriate for conditions presented in the geotechnical report.
 - 2. Design support members to resist the maximum loads expected to occur during the excavation and support removal stages.
 - 3. In running sand and silt and gravel, provide dewatering and positive means for securing timber lagging to the soldier piles to prevent shifting or falling off of the lagging, and positive means for preventing sloughing and containing material behind lagging.

4. No portion of the excavation support system's vertical face will be permitted to penetrate the design lines as indicated on the Drawings for the permanent structures or utilities to be constructed within the excavation.
5. Vertical support capacity shall be provided for wall systems and internal bracing elements, for loads due to vertical force components of tieback anchors, the weight of the structural system themselves, and live load on any portion of the system.

1.6 PROJECT CONDITIONS

- A. Provisions shall be made for contingencies as follows:
 1. Provide contingency plan for alternative procedures to be implemented if unfavorable performance is evidenced.
 2. Keep on hand materials and equipment necessary to implement contingency plan.
 3. See the non-contractual geotechnical report for additional, available information and design recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel sheet piling shall be of appropriate weight and length.
- B. Fabricated connections, walers, and accessories, steel H-piles, W shapes, and other structural steel shall conform to the requirements of ASTM A36 or ASTM A572 as noted. Unless otherwise approved conform to Sections 05505 and 05120.
- C. Wood Lagging: Untreated hardwood of sufficient thickness as required by design.
- D. Pile Driving Hammer: Vibratory and/or impact type hammer of sufficient size for installations capable of consistently delivering driving energy to the pile.
- E. Other Engineered system may be used with materials as required by the engineered design that are consistent with all other contract requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. The construction excavation support systems such as of sheeting, shoring, soldier piles and bracing shall not disturb the state of soil adjacent to the trench or excavation and below the excavation bottom. Sheeting, shoring, soldier piles and bracing shall be removed after placement and compaction of initial backfill, except as noted otherwise.
- B. Damage to existing facilities during installation of excavation support system shall be avoided. If damage occurs it shall be repaired at no cost to the Owner, and to the satisfaction of the utility owner.
- C. Water control measures shall be provided in accordance with the requirements specified in Section 02140.
- D. Shoring shall extend below the planned bottom of excavation or measures shall be implemented to provide support and retention of the excavation below the shoring.

3.2 SOLDIER PILES

- A. Soldier piles shall be installed by necessary methods to tip elevation shown on approved shop drawings.
- B. Prebored holes shall be filled with a low strength grout mix designed by the Contractor.

3.3 SHEETING AND WOOD LAGGING

- A. Sheeting and wood lagging shall be installed in such a manner as to minimize the gap between the boards, unless specifically approved. As installation progresses, the voids between the excavation face and the lagging or sheeting shall be backfilled with sand or geotextile and sand rammed into place. Materials such as geotextile shall be used where necessary to allow drainage of groundwater without loss of soil or packing material.
- B. If unstable material is encountered, suitable measures shall be taken to retain it in place or to otherwise prevent soil displacement.
- C. Extend lagging down to final subgrade.
- D. A sufficient quantity of material shall be on hand for sheeting, shoring, bracing, and other operations for protection of work and for use in case of emergency.

3.4 STEEL SHEET PILING

- A. Steel sheet piling shall not impact adjacent utilities or facilities. Installation methods shall be adapted to existing subsurface conditions and for installation of sheet piling to the full depth of penetration required, and to proper alignment and plumbness, specified herein, without damage to the sheet piling or rupture of its interlocks.
- B. Steel sheet piling shall be installed in plumb position with each pile interlocked with adjoining piles for its entire length so as to form a continuous diaphragm throughout the length of each run of wall, bearing tightly against original ground. Install sheet piling to depth required for design. Exercise care during installation so that interlocking members can be extracted without injury to adjacent ground. The installation equipment shall be suitable to the type and nature of the subsurface materials anticipated to be encountered. The equipment, the methods of installation, cutting, and splicing shall conform to the approved shop drawings.

3.5 OBSTRUCTIONS DURING DRIVING

- A. If driving obstructions are encountered, special provisions approved by the Engineer should be taken to prevent pile damage and achieve the Contractor's design tip elevations. Obstructions may consist of a sudden increase in penetration resistance and lateral deviation in the horizontal position of the sheet pile resulting from hitting an obstruction such as a boulder.
- B. The Engineer shall be the sole judge as to whether an obstruction is encountered and will confer with the Contractor to select remedial course of action.

3.6 INTERNAL BRACING SUPPORT SYSTEM

- A. All bracing support members shall be installed and maintained in tight continuous contact with each other and with the surface being supported.
- B. Bracing members shall be preloaded as necessary in accordance with the design.
- C. Struts shall be provided with intermediate bracing as needed to enable them to carry their maximum design load without distortion or buckling. Provide diagonal bracing as necessary to maintain the stability of the system. Web stiffeners, plates, or angles shall be provided as needed to prevent rotation, crippling, or buckling of connectors at points of bearing between structural steel members. Allow for eccentricities resulting from field fabrication and assembly.

3.7 INSTRUMENTATION AND MONITORING

- A. Shoring Wall Monitoring:
 - 1. The Contractor shall establish horizontal control survey points (movement measurement points) on the tops of soldier piles, sheet piles, and soil-nailed walls at a spacing not greater than 20 feet horizontal spacing on all sides of the excavation shoring system.
 - 2. Perform at least two initial baseline surveys on different days of horizontal position of the shoring to an accuracy of 0.01 foot.

3. On a weekly basis until backfilling is complete perform survey measurements and submit to the Engineer/Owner.

3.8 REMOVAL OF SUPPORT SYSTEMS

- A. Where removal is required, wholly or in part, such removal shall be performed in a manner that will not disturb or damage adjacent new or existing construction or utilities. Fill all voids immediately with materials and procedures approved by the Engineer.
- B. Support systems for excavations that will have structures or pipes installed in future work shall remain in place.
- C. All damage to property resulting from removal shall be promptly repaired at no cost to the Owner. The Engineer shall be the sole judge as to the extent and determination of the materials and methods for repair.

END OF SECTION

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SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preparation of subgrade for slabs, walks, pavements, and other sitework.
 - 2. Rough and finish grading.
 - 3. Excavation for filling and grading.
 - 4. Filling and subgrade preparation.
 - 5. Geotechnical Data
- B. Related Documents: The Contract Documents, as defined in Section 01110 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.
- C. Related Sections:
 - 1. Section 02317 – Excavation & Backfill for Utilities

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM C 136 - Method for Sieve Analysis of Fine and course Aggregates.
 - 2. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 Pound Rammer and 12 Inch Drop.
 - 3. ASTM D 1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 4. ASTM D 1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 Pound Rammer and 18 Inch Drop.
 - 5. ASTM D 2167 - Test Method for Density and Unit Weight of Soil In-Place by the Rubber Balloon Method.
 - 6. ASTM D 2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - 7. ASTM D 2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 8. ASTM D 3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 - 9. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO T 88 - Mechanical Analysis of Soils

1.3 DEFINITIONS

- A. Building Area Subgrade Pad: Portion of site directly beneath and within a line 10 feet 0 inches beyond building and appurtenances including limits of any future building expansion areas indicated on Drawings.
- B. Soils Engineer: Geotechnical professional responsible for inspections and/or testing as specified in the Contract Documents, including approval of excavated subgrades (including proof rolling), approval of fill/backfill sources and optimum moisture curves, approval of fill/backfill materials being incorporated into the Work, approval of on-site relative density testing, and approval of methods used to remediate unsuitable materials. Retained and compensated the by Owner.

1.4 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Procedures for submittals.

1. Shop Drawings:
 - a. Submit drawings or details indicating proposed alternate earthwork procedures or proposed procedures not indicated in Contract Documents.
 - b. Submit drawings or details of design for use of fabrics or geogrids.
 2. Samples: Submit 2 samples in airtight container to Testing Laboratory for Testing Laboratory testing.
 - a. 10 pound sample of each type of fill material.
 - b. 10 pound sample of each type of aggregate.
 - c. 10 pound sample of topsoil.
 3. Assurance/Control Submittals:
 - a. Material Source: Submit name of imported materials suppliers. Provide materials from same source throughout the Work. Change of source requires Contracting Officer approval.
 - b. Test Reports: Submit the following reports directly to Contracting Officer from Testing Laboratory, with copy to Contractor. Prepare reports in conformance with Section 01450 - Contractor's Quality Control:
Test reports on borrow material.
 - 1) Verification of each footing subgrade.
 - 2) Field density test reports.
 - 3) Optimum moisture-maximum density curve for each type of soil encountered.
 - 4) Report of actual unconfined compressive strength and bearing tests/results for each strata tested. Give "three-dimensional" description of each test location.
 - c. Certificates: Gradation and certification of aggregate material for Testing Laboratory review.
 - d. Qualification Documentation: Submit earthwork company documentation of experience indicating compliance with specified qualification requirements.
- B. Section 01770 - Closeout Procedures: Procedures for closeout submittals.
1. Project Record Documents: Accurately record final grade contours, spot elevations, and slope gradients.

1.5 QUALITY ASSURANCE

- A. Qualifications: Earthwork company specializing in performing the Work of this Section with minimum 5 years documented experience.
- B. Regulatory Requirements: Perform earthwork in accordance with applicable requirements of governing authorities having jurisdiction.
- C. Pre-Installation Meetings:
 1. Convene a pre-installation meeting one-week prior to commencing Work of this Section.
 2. Require attendance of parties directly affecting Work of this Section.
 3. Review conditions of earthwork operations, earthwork procedures and coordination with related Work.
 4. Agenda:
 - a. Tour, inspect, and discuss conditions of existing soils and soil substrates.
 - b. Review dust control measures and their requirements.
 - c. Review required submittals, both completed and yet to be.
 - d. Review Survey and Civil sitework Drawings.
 - e. Approve proposed earthwork equipment.
 - f. Approve excess material dump location.
 - g. Approve import material storage location.
 - h. Review and finalize construction schedule related to earthwork and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
 - i. Review required inspections, testing, certifying, and material usage accounting procedures.

- j. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
- k. Review safety precautions relating to earthwork operations.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

A. Existing Conditions:

- 1. Geotechnical Data:
 - a. Soils investigation reports and data are not a part of Contract Documents.
 - b. Soil and subsurface investigations were conducted at site by an Independent Testing Laboratory and a report with log of borings prepared. Report was obtained for Architect and Engineer design use only.
 - c. A copy of the report is available from the owner.
 - d. Soils investigation data is not warranted to indicate actual conditions. Owner, Architect, and Engineer do not assume responsibility for variations in kind, depth, quantity and condition of soils. Owner, Architect and Engineer disclaim responsibility for accuracy, true location, and extent of soils investigation prepared by others; and further disclaim responsibility for interpretation of data by Contractor such as projecting soil bearing values, rock profiles, soil stability, and presence, level, and extent of underground water.
 - e. Contractor may make additional test borings and other exploratory operations at no additional cost to the owner. Coordinate tests with owner.
- 2. Classification of Excavations: Contractor acknowledges that Contractor has investigated project site to determine type, quantity, quality, and character of excavation work to be performed. Consider all excavation as unclassified excavation, including when Rock Excavation is encountered.
 - a. Rock excavation will not be considered for extra compensation.
- 3. Existing Utilities: Contact local utility companies and make arrangements to obtain utility company location and marking service prior to start of Earthwork operations.
 - a. Locate existing underground utilities in areas of Work. If utilities are to remain in place, provide means of support and protection during Earthwork operations.
 - 1) Pothole and locate existing underground utilities at locations to assure that no conflict with Work of this Contract will occur and required clearance is available to prevent damage to existing utilities.
 - 2) Perform potholing minimum 10 days before start of excavation or underground work.
 - b. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility company and Contracting officer immediately for directions.
 - c. Coordinate with Contracting officer and utility companies to keep existing utility services and facilities in operation.
 - d. Repair damaged utilities to satisfaction of utility company, at no additional cost to OWNER.
 - e. Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, during occupied hours, except when permitted in writing by Contracting officer and then only after acceptable temporary utility services have been provided and approved by Contracting officer.
 - f. Demolish and completely remove from site existing underground utilities indicated on Drawings to be removed as specified. Coordinate with utility companies for shut-off of services if lines are active.

PART 3 - PRODUCTS

3.1 MATERIALS

- A. Subsoil: Approved by Testing Laboratory and Contracting Officer.
1. Excavated and re-used material, Imported Borrow, Select or local borrow
 2. Graded.
 3. Free of lumps larger than three (3") inches, rocks larger than two (2") inches, and debris.
 4. Conforming to ASTM D 2487 SC and GC.
- B. Aggregate: Approved by Testing Laboratory and Contracting Officer.
1. Coarse Gravel: Crushed rock or washed gravel, or a combination of both; free of shale, clay, friable material and debris; graded in accordance with ASTM D 2487 Group Symbol GW within the following limits:

SIEVE SIZE	PERCENT PASSING
2 inches	100
1 inch	95
3/4 inch	95 to 100
5/8 inch	75 to 100
3/8 inch	55 to 85
No. 4	35 to 60
No. 16	15 to 35
No. 40	10 to 25
No. 200	5 to 10

2. Pea Gravel: Natural Stone; washed, free of clay, shale, organic matter; graded in accordance with ASTM D 2487 Group Symbol GM; to the following limits:
 - a. Minimum Size: 1/4 inch.
 - b. Maximum Size: 5/8 inch.
3. Fine Sand: Natural River or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with ASTM D 2487 Group Symbol SW; within the following limits:

SIEVE SIZE	PERCENT PASSING
No. 4	100
No. 14	10 to 100
No. 50	5 to 90
No. 100	4 to 30
No. 200	0

- C. Topsoil: Approved by Testing Laboratory and Contracting Officer.
1. See other Sections.
- D. Filter/Drainage Fabrics:
1. Mirafi 140NS.
 2. Phillips 66 Supac 4NP.
 3. DuPont Typar 3341.
- E. Soil Stabilization Materials.
- F. Structural Fill/Structural Backfill:
1. Fill/backfill placed underneath foundations, including distance beyond foundation lines as indicated in the Drawings.
 2. Structural Fill/Backfill, Select Fill/Backfill, and Engineered Fill/Backfill shall be considered synonymous.
 3. Granular soil with a maximum Liquid Limit (LL) of 35%, Plasticity Index (PI) between 5 and 17, and 3 IN maximum particle size (or 1/2 loose lift thickness, if smaller). Soils classified as CH, CL, MH, ML, SM, GM, OH, OL, and Pt shall NOT be suitable as structural fill.

4. Materials shall be maintained to a moisture content within 2% of optimum until final lift of structural fill is permanently covered.
 5. Structural fill shall be placed in lifts not exceeding 8 IN.
 6. Materials complying with TxDOT 2004 Standard Specification for Construction of Highways, Streets, and Bridges, Item 247, Flexible Base, Type A, B, or C, Grades 1-3 shall be acceptable for use as structural fill. In the event that materials not complying with the TxDOT Standard Specifications are used for structural fill, grain size analyses and Atterberg Limits shall be performed for every 5,000 cubic yards of material placed.
- G. Granular Fill Under Building Floor Slabs-On-Grade, Foundations with Pressure Relief Valves: Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33 gradation size No. 67, 3/4 IN to No. 4

3.2 SOURCE QUALITY CONTROL

- A. Section 01450 - Contractor's Quality Control: Testing Laboratory services.
- B. Testing and Analysis:
 1. Soil: Perform in accordance with ASTM D 2216, ASTM D 4318, ASTM D 1140, ASTM D 422, and ASTM D 1883.
 2. Aggregate: Perform in accordance with ASTM C 33 and ASTM E 11.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials from same source throughout the Work.

PART 4 - EXECUTION

4.1 EXAMINATION

- A. Verification of existing conditions before starting work.
- B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to for earthwork operations to begin.
 1. Verify that existing site soils and soil conditions encountered are as indicated in Geotechnical Data.
 2. Verify quantity and type of each soil material before start of material installation.
 3. Backfilling:
 - a. Verify imported fill and stockpiled fill to be reused is approved.
 - b. Verify foundation perimeter drainage installation has been inspected and approved.
 - c. Verify foundation or basement walls are braced to support surcharge forces imposed by backfilling operations.
 - d. Verify areas to be backfilled are free of debris, snow, ice, or water and ground surfaces are not frozen.
- C. Report in writing to Contracting officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

4.2 PREPARATION

- A. Clear site as specified in Section 02233.
- B. Identify required lines, elevations, levels, contours, grades, and datum necessary to perform earthwork operations as indicated on Drawings.
- C. Examine Project Site before start of earthwork operations. Identify areas and prepare to brace or

- shore areas of adjacent property subject to rotation, slumping, or cave-in to prevent dislocation of adjacent soil, pavement, utilities, structures, or other items to remain.
- D. Verify that survey benchmark and intended elevations for Work are as indicated on Drawings. Short form contour designations are intended to be a continuing of the long form benchmark.
 - E. Locate, identify, and protect existing utilities to remain and previously installed utilities that may be damaged by construction operations.
 - 1. Notify Contracting officer and utility company immediately of utilities, not indicated on Drawings, encountered.
 - 2. Maintain existing utilities, active utilities, and drainage systems in operating condition.
 - 3. Comply with utility company requirements and directions of Contracting officer to keep utilities in operation.
 - 4. Repair damage to utilities as directed by utility company & Contracting officer.
 - F. Protect plant life, lawns, fences, existing structures, sidewalks, paving and curbs from earthwork operations, excavating equipment, and vehicular traffic.
 - G. Protect benchmarks, property corners, and other survey monuments from damage or displacement. Where markers are required to be removed, provide removal and reinstallation by licensed land surveyor licensed in State where project is located.
 - H. Remove material encountered in grading operations that is unsuitable for backfilling, subgrade or foundation purposes as determined by Testing Laboratory and as directed by Contracting officer. Dispose of materials off-site in an approved manner in accordance with requirements of authorities having jurisdiction.
 - I. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:
 - 1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use pumping equipment.
 - 2. After drainage of low area is complete, remove mulch, mud, debris, and other unsuitable material by using equipment and methods keeping natural soils underlying low areas dry and undisturbed.
 - 3. If proposed for fill, dry muck, mud, and other materials removed from low areas on-site by spreading in thin layers for inspection by Testing Laboratory and Contracting officer. Place material determined by the Testing Laboratory and contracting Officer suitable for use as fill material into lowest elevation of site filling operation. Do not place under building subgrade pad or paving subgrade. If material is determined by the Testing Laboratory and Contracting officer to be unsuitable, remove material from site.

4.3 EXCAVATION FOR FILLING AND GRADING

- A. Provide dewatering, drainage, and ground water management to control moisture of soils when performing grading operations during periods of wet weather.
- B. Shore, brace, and drain excavations to maintain excavations safe, secure, and free of water at all times.
- C. Provide protection for workers within trench areas in accordance with local, State, and Federal Occupational Safety and Health requirements and regulations.
 - 1. Slope, shore, sheet, or brace excavation side walls greater than 5 feet in depth.
 - 2. Provide lateral travel distance to excavation exit ladder or steps maximum 25 feet for trenches minimum 4 feet in depth.
- D. Unacceptable Fill Material for Building and Paving Areas: Excavated material containing rock or stone greater than 4 inches in largest dimension.
- E. Acceptable Fill Material:
 - 1. Rock or stone less than 4 inches in largest dimension as fill to within 24 inches of surface of

- proposed subgrade when mixed with suitable material.
2. Rock or stone less than 2 inches in largest dimension mixed with suitable material as fill within the upper 24 inches of proposed subgrade.

4.4 FILLING AND SUBGRADE PREPARATION

- A. Fill areas to contours and elevations as indicated on Drawings with materials specified herein.
- B. Place fill in continuous lifts as specified herein.
- C. Refer to Section 02317 for filling requirements for utilities.
- D. Areas Exposed by Excavation or Stripping:
 1. Scarify areas exposed by excavation or stripping on which building subgrade preparations are to be performed to minimum six (6") inch depth.
 2. Compact to minimum ninety-five (95%) percent optimum density in accordance with ASTM D 698 in accordance with ASTM D 1557 at minimum moisture content minus (-2%) two percent below and maximum two (2) percent above optimum moisture content.
 3. Proofroll to detect any areas of insufficient compaction by making minimum of five (5) complete passes with fully-loaded tandem-axle dump truck, or Contracting Officer approved equivalent, in each of two perpendicular directions under supervision and direction of Testing Laboratory and Contracting Officer.
 4. Excavate and recompact areas failing to meet specified requirements.
- E. Fill Material Placement:
 1. Place in six (6") inch maximum lifts compacted minimum ninety-five (95%) percent optimum density in accordance with ASTM D 698 in accordance with ASTM D 1557 at minimum moisture content of two (2%) percent below and maximum moisture content two (2%) percent above optimum moisture content.
- F. Provide material imported from off-site with CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above pavement design subgrade CBR or LBR value indicated on Drawings.

4.5 MAINTENANCE OF SUBGRADE

- A. Verify finished subgrade for conformance to elevations as indicated on Drawings and for specified conditions for subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.
- C. Remove areas of finished subgrade with compaction density below specified density to depth required as directed by Testing Laboratory and Contracting officer. Fill removed areas and compact to specified compaction density
- D. Provide surface of subgrade after compaction hard, uniform, smooth, stable, and true to grade and cross-section.

4.6 FINISH GRADING

- A. Grade areas other than paved areas and building pad areas to finish grade elevations or contours as indicated on Drawings including the following:
 1. Excavated areas.
 2. Filled and transition areas.
 3. Landscaped areas.
- B. Provide finish graded areas uniform and smooth, free from rocks, debris, or irregular surface changes with maximum tolerance of 0.10 feet above or below established finish subgrade elevation. Provide graded surfaces sloping uniformly between indicated elevations.

- C. Provide drainage ditches graded with uniform slope to allow drainage without ponding, minimizing potential for erosion.
- D. Refer to Section 02221 for placing topsoil and fine grading in landscaped areas.

4.7 USE OF EXPLOSIVES

- A. Blasting with any type of explosive is prohibited.

4.8 FIELD QUALITY CONTROL

- A. Section 01450 – Contractor's Quality Control: Field-testing and inspection.
- B. Excavation: Notify Testing Laboratory and Contracting Officer for visual inspection of bearing surfaces, 48 hours prior to backfilling and other subsequent Work.
- C. Site Tests - Quantity:
 - 1. See Architectural Specifications
- D. Site Tests - Methods:
 - 1. Perform tests on each type of existing on-site or imported off-site material used for compacted fill.
 - a. Moisture & Density Relationship: ASTM D 698 or ASTM D 1557.
 - b. Mechanical Analysis: AASHTO T-88
 - c. Plasticity Index: ASTM D 4318
 - 1) One optimum moisture-maximum density curve for each type of soil encountered.
 - 2) Report of actual unconfined compressive strength and bearing tests/results for each strata tested. Give "three-dimensional" description of each test location.
 - 2. Perform field density tests for in-place materials in accordance to one of the following standards:
 - a. Sand-Cone Method: ASTM D 1556
 - b. Balloon Method: ASTM D 2167
 - c. Nuclear Method: ASTM D 2922 (Method B-Direct Transmission)
 - 3. Perform a CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) test for each type of imported off-site material in areas where pavement will be placed.
- E. If tests indicate the Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to the Owner.
- F. Do not include in bid price the cost of inspection services indicated herein as being performed by the Soils Engineer.
- G. Moisture density relations, to be established by the Soils Engineer required for all materials to be compacted.
- H. Extent of compaction testing will be as necessary to assure compliance with Specifications.
- I. Give minimum of 24 HR advance notice to Soils Engineer when ready for compaction or subgrade testing and inspection.
- J. Should any compaction density test or subgrade inspection fail to meet Specification requirements, perform corrective work as necessary.
- K. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests

4.9 COMPACTION DENSITY REQUIREMENTS

- A. Obtain approval from Soils Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations

- B. Provide dewatering system necessary to successfully complete compaction and construction requirements. The Contractor is responsible for dewatering as required. See Section 02140 for additional requirements related to Contractor-designed dewatering.
- C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by Soils Engineer.
- D. Stabilize subgrade with well graded granular materials as directed by Soils Engineer.
- E. Assure by results of testing that compaction densities comply with the following requirements:
 - 1. Sitework:

LOCATION	COMPACTION DENSITY
Under Paved Areas, Sidewalks and Piping:	
Cohesive soils	95 percent per ASTM D1557
Cohesionless soils	80 percent relative density per ASTM D4253 and ASTM D4254
Unpaved Areas:	
Cohesive soils	90 percent of ASTM D1557
Cohesionless soils	65 percent relative density per ASTM D4253 and ASTM D4254

- 2. Structures:

LOCATION	COMPACTION DENSITY
Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under fill material	95 percent per ASTM D1557
Outside structures next to walls, piers, columns and any other structure exterior member not supporting flatwork or other foundations.	90 percent per ASTM D1557 (95 percent per ASTM D1557 where backfill supports foundations/flatwork)

- 3. Specific areas:

LOCATION	COMPACTION DENSITY
Outside structures under equipment support foundations	95 percent per ASTM D1557
Under void (not supporting foundations)	90 percent per ASTM D1557
Granular fill under base slabs with pressure relief valves, and under building floor slabs-on-grade	80 percent relative density per ASTM D4253 and ASTM D4254

4.10 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

- A. General.
 - 1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
 - 2. Obtain fill and backfill material necessary to produce grades required.
 - a. Materials and source to be approved by Soils Engineer.

- b. Excavated material approved by Soils Engineer may also be used for fill and backfill, subject to conformance with this specification.
 - 3. In this Section of the Specifications, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil.
 - 4. In the paragraphs of this Section of the Specifications, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels
- B. Excavation Requirements for Structures:**
- 1. General:
 - a. Do not commence excavation for foundations for structures until Soils Engineer approves:
 - 1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
 - 2) Density and moisture content of site area compacted fill material meets requirements of specifications.
 - 3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
 - 4) Surcharge or mass fill material has been removed from construction area or portions thereof.
 - 5) Engineer/Soils Engineer grants approval to begin excavations
 - b. The terms "fill" and "backfill" used in this subpart for new fills shall indicate the use of structural fill as defined in Part 2.
 - 2. Dimensions:
 - a. Excavate to elevations and dimensions indicated or specified.
 - b. Allow additional space as required for construction operations and inspection of foundations.
 - 3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings.
 - a. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Soils Engineer.
 - 4. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill.
 - a. Remove loose materials and bring excavations into approved condition to receive concrete or fill material.
 - b. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to density stated in this Specification Section before fill material can be placed thereon.
 - c. Do not carry excavations lower than shown for foundations except as directed by Soils Engineer or Engineer.
 - d. If any part of excavations is carried below required depth without authorization, maintain excavation and start foundation from excavated level with concrete of same strength as required for superimposed foundation, and no extra compensation will be made to Contractor therefore.
 - 5. Make excavations large enough for working space, forms, dampproofing, waterproofing, and inspection.
 - 6. Notify Soils Engineer and Engineer as soon as excavation is completed in order that subgrades may be inspected.
 - a. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Soils Engineer as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and

- superimposed foundation, fill, and building loads to be placed thereon.
- b. Soils Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
 - c. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.
 - d. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
7. Dewatering:
- a. Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.
 - b. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
 - c. Employ dewatering specialist for selecting and operating dewatering system.
 - d. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.
 - e. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
 - 1) Install groundwater monitoring wells as necessary.
 - f. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
 - g. See Section 02140 for additional dewatering requirements.
8. Subgrade stabilization:
- a. If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support pads is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by Soils Engineer.
 - b. Provide compaction density of replacement material as stated in this specification section.
 - c. Loose, wet, or soft materials, when approved by Soils Engineer, may be stabilized by a compacted working mat of well graded crushed stone.
 - d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.
 - e. Remove and replace frozen materials as directed by Soils Engineer.
 - f. Method of stabilization shall be performed as directed by Soils Engineer.
 - g. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Soils Engineer.
9. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction.
- a. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DegF before structure is completed and heated to a temperature of at least 50 DegF.
10. Protection of structures:
- a. Prevent new and existing structures from becoming damaged due to construction operations or other reasons.
 - b. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.
11. Shoring:
- a. Shore, sheet pile, slope, or brace excavations as required to prevent them from collapsing.
 - b. Remove shoring as backfilling progresses but only when banks are stable and safe from

- caving or collapse.
- c. See Section 02165 for additional requirements related to Contractor-designed excavation support systems.
- 12. Drainage:
 - a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.
 - b. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water.
 - c. Provide pumping required to keep excavated spaces clear of water during construction.
 - d. Should any water be encountered in the excavation, notify Engineer and Soils Engineer.
 - e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
- 13. Frost protection:
 - a. Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground.
 - b. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved.
 - c. Protect excavation from frost if placing of concrete or fill is delayed.
 - d. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
 - e. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DegF.
- C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:
 - 1. General:
 - a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by Soils Engineer and scarified to a depth of 6 IN and compacted to density specified herein.
 - b. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2 percent.
 - c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Soils Engineer as being free of undesirable material and compacted to specified density.
 - 2. Obtain approval of fill and backfill material and source from Soils Engineer prior to placing the material.
 - 3. Granular fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of granular fill unless otherwise indicated
 - 4. Granular fill under base slabs with pressure relief valves:
 - a. Provide a minimum thickness of 6 IN of filter material over the subgrade.
 - b. Provide a minimum thickness of 1 FT of drainage material between the bottom of the base slab and the top of the filter material.
 - c. Compact as specified in this Section.
 - d. A geotextile filter fabric approved by the Engineer may be substituted for the filter material.
 - 5. Fill and backfill placement:
 - a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Soils Engineer.
 - b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
 - c. Compact material by means of equipment of sufficient size and proper type to obtain specified density.

- d. Use hand operated equipment for filling and backfilling next to walls.
- e. Do not place fill and backfill when the temperature is less than 40 DegF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.
- f. Use vibratory equipment to compact granular material; do not use water.
- 6. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content, outside the exterior limits of foundations located around perimeter of structure the following horizontal distance whichever is greater:
 - a. As required to provide fill material to indicated finished grade.
 - b. 5 FT.
 - c. Distance equal to depth of compacted fill below bottom of foundations.
 - d. As directed by Soils Engineer.
 - e. See Drawings for additional requirements at specific structures.
- D. Filling and Backfilling Adjacent to Structures.
 - 1. This paragraph of this Specification applies to fill and backfill placed outside of and adjacent to structures above bottom level of both foundations and piping but not under paving.
 - 2. Provide material as approved by Soils Engineer for filling and backfilling outside of structures.
 - 3. Fill and backfill placement:
 - a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Soils Engineer.
 - b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
 - c. Compact material with equipment of proper type and size to obtain density specified.
 - d. Use only hand operated equipment for filling and backfilling next to walls and retaining walls.
 - e. Do not place fill or backfill material when temperature is less than 40 DegF and when subgrade to receive material is frozen, wet, loose, or soft.
 - f. Use vibratory equipment for compacting granular material; do not use water.
 - 4. Backfilling against walls:
 - a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved.
 - b. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.
 - c. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
 - d. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

4.11 PROTECTION

- A. Protect building subgrade pad and building related earthwork from damage by construction operations and erosion.
- B. Prohibit vehicles from entering building subgrade pad area. Vehicles not permitted.
- C. Scarify surface, reshape, and compact areas damaged by construction operations or weather erosion.

END OF SECTION

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SECTION 02210 EXCAVATION & EMBANKMENT

PART 1 - GENERAL

1.1 WORK INCLUDED IN THIS SECTION

- A. Description: This item shall consist of preparing for construction operation and doing all required excavation within the limits of the Right-Of-Way and from the designated or approved sources. The removal and proper utilization of disposal of all excavation material, the erection of all embankments, and the shaping, construction, compacting and furnishing of all earthwork on the entire Right-Of-Way and approaches thereto in conformity with the lines, grades and typical sections as shown on the plans and established by the Engineer.
1. All materials encountered of whatever nature within the limits of the street Right-Of-Way, which are unacceptable, or considered waste, shall be removed and disposed of as directed, by the Engineer.
 2. The rough excavation shall be carried to such depth that sufficient material will be left above the designated grade to allow for compaction. Likewise on embankments, sufficient material shall be placed above the designated grade to allow for compaction and settlement. Should the Contractor over-excavate below the designated grades, he shall replace with material approved by the Engineer and installed as directed by the Engineer at the Contractor's expense.
 3. The control staking and centerline staking will be accomplished by the Contractor and shall include one set of alignment and grade stakes. All slope stakes, bluetoops, and additional alignment stakes shall be furnished by the Contractor.
- B. Related Work: Related Work specified elsewhere:
1. Section 02055 - Preparing Right-Of-Way
 2. Section 03308 – Concrete, Materials and Proportioning
 3. Section 02200 – Earthwork

1.2 QUALITY ASSURANCE:

- A. Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.3 SUBMITTALS:

- A. Submittals shall be made in accordance with Section 01330.

PART 2 - PRODUCTS

2.1 EQUIPMENT:

- A. Grading Equipment

The Contractor may use any type of earth moving equipment he wishes or has at his disposal, provided such equipment is in a satisfactory condition and of such capacity that the grading schedule as planned by the Contractor and as approved by the Engineer can be maintained.

B. Compaction Equipment

1. Tamping rollers shall consist of two metal rollers, drums or shells of forty (40) inches minimum diameter each not less than forty-two (42) inches in length and unit-mounted in a rigid frame in such manner that each roller, drum or shell shall be surmounted by metal studs with tamping feet projecting no less than seven (7) inches from the surface of the drum and spaced not less than six (6) inches nor more than ten (10) inches measured diagonally from center to center. The area of each tamping foot shall be not less than five (5) square inches and no more than eight (8) square inches. Each unit shall be provided with suitable tamper foot cleaning device. Where more than one rolling unit is used, the rolling units shall be pivoted on the main frame in a manner which will permit the rolling units to adapt themselves to uneven ground and to rotate individually. When empty, the weight of the roller shall be such that the unit pressure applied by the tamping foot in contact with the ground is not less than 120 pounds per square inch.
2. Pneumatic rollers shall consist of not less than nine (9) pneumatic tire wheels running on two (2) axles in such manner that the rear group of tires will not follow in the tracks of the forward group and shall be mounted on a rigid frame provided with platform or body suitable for ballast loading. The front axle shall rotate around the kingpin, so located, that the roller may be turned within a minimum circle. The pneumatic tire roller under working conditions shall have an effective rolling width of approximately sixty (60) inches and shall give a minimum compression of three hundred and twenty-five (325) pounds per inch of tire tread. The roller shall be drawn by either a suitable tractor or a truck of adequate tractive effort.
3. Smooth self-propelled rollers shall weigh at least ten (10) tons and may be tandem or three-wheel type. The wheels of the roller shall be equipped with adjustable scrapers.

PART 3 - INSTALLATION

3.1 EXCAVATION:

- A. The excavation material shall be handled in such a way as to allow the selected material to be properly placed in embankments and in the capping of the subgrades as determined by the Engineer.
- B. All material shall be stockpiled on site for later use by the Contractor or the Owner.
- C. Excess excavation will be required to be hauled off the property and disposed of properly.
- D. During excavation the grades will be maintained in such condition to provide for proper drainage. When directed by the Engineer, temporary drains or drainage ditches shall be installed to divert surface water.
- E. In cut areas the top of the subgrade under the areas to be paved shall be scarified and compacted to a minimum depth of six inches to not less than 95% to the maximum density as determined by procedures set out under TEX 113-E. When the required density can not be achieved the material shall be undercut and replaced with suitable material as directed by the Engineer.
- F. During compaction operations, water shall be added to the subgrade material. Such watering shall be done by approved methods using approved equipment. The moisture shall not be more than 2% above or below the optimum moisture content, or as provided for in the geo-technical report.
- G. Borrow: Borrow excavation shall consist of excavation made outside the normal grading limits to obtain material for the completion of embankments and for other purposes. There is no anticipated borrow on this project.

- H. Preparation of Embankment Areas: Prior to placing any embankment, all "Preparing Right-Of-Way" operations shall have been completed on the areas over which the involved embankment is to be placed. Stump holes or other small excavation in the limits of the embankments shall be backfilled with suitable materials and thoroughly tamped by approved methods before commencing embankment construction. Any suitable surplus material shall be stock-piled in approved areas for later use as directed by the Engineer. Area shall be scarified to a depth of 6 inches, with all large rocks and debris to be removed. A thin layer of approximately 3 inches of fill material shall be spread over the scarified foundation and the whole area compacted.
- I. When embankment is to be placed on natural slopes steeper than 3 to 1, horizontal benches shall be constructed as directed by the Engineer.
 - 1. All embankments shall be constructed in successive horizontal lifts of not more than 6 inches loose depth layers. The material shall have the proper moisture content before rolling and compaction. Wetting and drying of the material shall be done with approved equipment and methods approved by the Engineer.
 - 2. Each layer shall be compacted to not less than ninety-five percent (95%) of the maximum density as determined by procedures set out under TEX 113-E or ASTM 698.
 - 3. The Contractor shall be responsible for the stability of all embankments made under this Contract and shall replace any portion which, in the opinion of the Engineer, has become displaced due to negligence on the part of the Contractor.

3.2 TRUENESS TESTS

- A. In those areas upon which a sub-base or base course is to be placed, the surface of the subgrade shall be straight edge; it shall show no deviation in excess of five hundredths (0.05) of a foot from true grade as established by grade pins or hubs. In areas not under sub-base or base course, the surface shall not deviate more than one tenth (0.10) of a foot from true grade as established by grade pins or hubs.

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SECTION 02220

TRENCH EXCAVATION, BACKFILL, AND COMPACTION FOR UTILITIES

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK

- A. Excavation, shoring, dewatering, pipe bedding, trench backfill, compaction, grading and cleanup of all pipeline trenching for the project.
- B. All work must be done in accordance with these specifications and the safety requirements of the State and OSHA Standards.

1.02 JOB CONDITIONS

- A. Site Acceptance
 - 1. Accept site in condition existing during Contract time frame.
 - 2. Ground water/surface water found during construction are conditions of the contract and responsibility of Contractor.
- B. Adverse Weather
 - 1. Place no backfill that is excessively wet or frozen.
 - 2. Place no backfill in excessively wet or frozen trenches.

PART 2 - PRODUCTS

2.01 MATERIAL CLASSIFICATIONS FOR PIPE BEDDING AND BACKFILL

Materials for bedding and backfill shall be classified for the purpose of quality control in accordance with the Unified Soil Classification Symbols as defined in ASTM D2487 and with ASTM D2321. Material use and application is defined by class in accordance with ASTM D2321, or by product descriptions, as described below. Determination of source of materials for bedding and backfill to meet the stated conditions shall be responsibility of Contractor, but use of such materials shall be subject to approval of Engineer. Contractor shall submit characterization/sieve analysis of proposed pipe embedment material for approval prior to commencement of construction.

- A. Class Designations Based on Laboratory Testing (ASTM D2321):
 - 1. Class IA and IB: Manufactured aggregates, open or dense graded, clean.
 - a. Plasticity Index: Non-plastic.
 - b. Gradation: 100% passing 1½" sieve, ≤ 50% passing No. 4 sieve, and < 5% passing No. 200 sieve.
 - 2. Class II: Well and poorly graded gravels and sands, clean or with little to moderate fines (GW, GP, SW, SP, and combinations of the preceding with GM, GC, SM, and SC)
 - a. Plasticity Index: Non-plastic
 - b. Gravel (GW, GP) Gradation: 100% passing 1½" sieve, < 5% passing No. 200 sieve (i.e. <5% fines), and < 50% of the non-fines passing a No. 4 sieve. For pipes 15" diameter and smaller, bedding material shall be ¾-inch maximum (i.e. 100% passing ¾-inch sieve).
 - c. Sand (SW, SP) Gradation: 100% passing 1½" sieve, < 5% passing No. 200 sieve (i.e. <5% fines), and > 50% of the non-fines passing a No. 4 sieve.
 - d. Gravel, Sand W/ Fines Gradation: 100% passing 1½" sieve, and 5% to 12% passing No. 200 sieve (i.e. 5% to 12% fines).

-
3. Class III: Silty/clayey gravels and sands, gravel-sand-silt/clay mixtures (GM, GC, SM, SC)
- a. Plasticity Index: (Refer to ASTM D2321)
 - b. Gradation: 100% passing 1½" sieve, 12% to 50% passing No. 200 sieve.
- B. Designations Based on Product Descriptions:
- 1. Excavated Material Backfill: Excavated material may be used in the trench backfill, provided that all hard rock and stones having any dimensions greater than 6" and frozen earth, debris and roots larger than 2" are removed for the initial backfill. Plasticity Index shall be less than 30. Excavated backfill material must be approved by Engineer for bedding material.
 - 2. Select Backfill: Select Backfill shall be gravel, fine rock cuttings, sand, sandy loam or loam free from excessive clay. Rock cuttings shall have no dimensions greater than 2 inches. Plasticity Index shall be between 7 and 22. Select backfill must be approved by Engineer.
 - 3. Sand Backfill: Sand backfill shall be clean, hard, durable, uncoated grains, free from lumps and organic material. All materials must pass a No. 8 sieve with less than 5% passing a No. 200 sieve.
 - 4. Granular Backfill: Granular backfill shall be free flowing, such as sand or hydraulically graded stone fines, or mixed sand and gravel, or sandy loam. The material shall be free from lumps, stones over 2 inches in diameter, clay and organic matter.
 - 5. Controlled Density Fill: Use high slump mixture of portland cement, fly ash and fine aggregate formulated, licensed and marketed as K-Krete or equal. Provide mixture with minimum 28-day compressive strength of 70 psi with no measurable shrinkage or surface settlement.
- 2.02 CRADLING ROCK
- A. Use crushed rock or stone with 70-100% passing 1½ inch sieve and no more than 50% passing 1 inch sieve.
- 2.03 SHEETING, SHORING AND BRACING
- A. Use sound timber or structural steel.
 - B. Use shapes and sizes as required.
- 2.04 GEOTEXTILE MATERIAL FOR UNSTABLE TRENCHES
- A. Where the ENGINEER determines that unstable wall or trench bottom conditions are present, a geotextile material shall be installed.
 - B. The geotextile shall be a nonwoven, needle point construction and shall consist of long-chain polyethylene or polyamide. The fibers shall be oriented into a stable network whereby they retain their positions with each other. The textile shall be free of any chemical treatment commonly found in soil. The contractor shall conform to the following properties:

Tensile Strength: 130 LBS.
ASTM D 4632

Elongation: 50%
ASTM D 4632

Mullen Burst Strength: 250 psi
ASTM D 3786

Coefficient of Permeability: 0.10cm/sec.
K-cm/sec. (20 CFMC-GET-2, Constant Head)
ASTM D 4491

Puncture Strength: 80 LBS.

- C. The geotextile shall be furnished in protective wrapping to protect the material from ultraviolet radiation, contamination from other substances, and abrasion or shipping damage. Any material received damaged, shall be rejected.

PART 3 - EXECUTION

3.01 GENERAL

- A. Dewatering
1. Execute work "dry". No pipe or conduits shall be laid or concrete poured on wet soil.
 2. Prevent surface water from flowing into excavation.
 3. Provide equipment for handling water encountered as required. Obtain approval of proposed method of dewatering.
 4. No Sanitary sewer shall be used for disposal of trench water.
- B. Protection of Existing Utilities:
1. Notify all utilities of location and schedule of work.
 2. Locations and elevations of utilities shown on plans are to be considered approximate only. Notify utility and Engineer of conflicts between existing and proposed facilities.
 3. Repair, relay or replace existing utilities damaged, destroyed or disrupted during work. Unless specified otherwise, replacement will be at the Contractors expense.
- C. Sheet piling, Shoring and Bracing
1. All sheet piling, shoring, and bracing shall be in accordance with the Excavation Safety System Plan, these specifications and the safety requirements of the State and OSHA Standards.
 2. Provide as necessary, to hold walls of excavation, prevent damage to adjacent structures, and to protect workmen and property.
 3. Leave Sheet piling and shoring in place where removal might cause damage to work or otherwise indicated on drawings.
 4. When movable trench shield is used below spring line of pipe, it shall be lifted prior to any forward movement to avoid pipe displacement.
- D. Changes in Grade
1. Grades may be adjusted 1.5 feet (plus or minus) from plan grades to suit unforeseen construction conflicts or conditions with prior approval of Engineer.
 2. No additional compensation will be made for such changes.

3.02 EXCAVATION AND TRENCHING

- A. General
1. Method of excavation at Contractor's option.
 2. Allow no more than 300 feet of trench to be open at one time.
 3. Excavate by hand under tree roots 3 inches and larger, and under and around structures and utilities.
 4. Stockpile and replace topsoil to a minimum of 8-inches for surface restoration in grassed or agricultural areas.

B. Trench Characteristics

1. Depth

- a. As indicated for pipe installation to lines and grades required with proper allowance for thickness of pipe and type of bedding specified or indicated.

2. Width

- a. Minimum trench width shall be pipe O.D. plus 16 inches or pipe O.D. $\times 1.25 + 12$ inches, whichever is greater.

- b. Maximum width as follows:

Pipe Size Inches	Maximum Trench Width
4	2-feet 0-inches
6	2-feet 0-inches
8	2-feet 4-inches
10	2-feet 4-inches
12	2-feet 6-inches
15	2-feet 9-inches
18	3-feet 0-inches
Over 18	Pipe O.D. $\times 2$

3. Trench walls must be vertical below top of pipe and may be vertical or sloped above pipe to conform to excavating codes.
4. Provide bell holes for each pipe joint where pipe bears on undisturbed earth.
5. Trench bottom shall be free of large stones and other foreign material.

3.03 SOFT, SPONGY OR UNSTABLE MATERIALS (e.g. peat, muck, and highly expansive soils)

A. Stop work and notify Engineer.

B. Perform remedial work as directed.

C. If material is judged unsuitable and removal is authorized, remove and replace with trench stabilizing material as directed by Engineer.

3.04 ROCK EXCAVATION

A. Excavate any rock to maintain minimum 6-inch clearance around pipe.

B. Dispose of rock material not suitable for backfill as directed by Engineer.

C. Use of explosives not permitted without prior written authorization from owner and Engineer.

D. Provide Special Hazard Insurance covering liability for blasting operations.

3.05 PIPE EMBEDMENT

A. Bedding

1. Place after bottom of trench has been excavated to proper depth and grade.
2. Place, compact and shape bedding material to conform to barrel of pipe and bell to insure continuous firm bedding for full length of pipe.
3. Provide bedding as described in following table unless indicated otherwise on Plans or in Special Conditions.

<u>Pipe Material</u>	<u>Minimum Bedding Class</u>
Non-reinforced Concrete Pipe	Class C
Reinforced Concrete Pipe	Class D
Ductile Iron Pipe	Class D
Steel Cylinder	Class C
Flexible (PVC) or Composite Pipe	Class I, II, and III*

*Refer to ASTM D2321 and standard pipe bedding details in the Drawings.

- B. Haunching (bottom of pipe to springline)
1. Haunching shall be same material used for bedding.
 2. Place after pipe has been bedded and checked for alignment, grade and internal obstructions.
 3. Do not backfill until concrete or mortar has sufficiently cured.
 4. Record location of connections and appurtenances before backfilling.
 5. Work bedding under pipe haunches and compact by hand to springline of pipe in 6-inch maximum lifts.
- C. Initial Backfill
1. Initial backfill shall be same material used for bedding.
 2. From springline to not less than 6-inches above top of pipe, place backfill and compact in 6-inch layers using vibratory compactors.
 3. Backfill simultaneously on both sides of pipe to prevent displacement.
- D. Unstable Wet Soil Conditions
1. Where the Engineer determines that the trench bottom or trench wall is unstable at the bedding zone, special pipe embedment material stabilization shall be required.
 2. Unstable bedding zone conditions shall be determined immediately after trench excavation by checking soil bearing strength capacities at the bedding zone using a Standard Pocket Penetrometer or other appropriate means. A minimum of three readings shall be obtained and averaged. The soil to be tested in the bedding zone shall not be allowed to dry, and shall be tested under "in-situ" conditions. If, in the Engineer's opinion, the soil has dried, the Penetrometer Test shall be taken by removing some amount of soil from the wall (or bottom) surface in order to obtain a representative sample. If the average reading is less than 8 blows per foot, then the pipe bed shall be prepared as follows:
 - a. The trench shall be dewatered to the greatest extent possible and rock shall be placed and compacted to form a firm trench bottom. No pipe shall be laid until stabilization is to the satisfaction of the Engineer.
 - b. A geotextile material shall be placed in the trench and the embedment material and pipe installed as indicated on the Drawings. Overlap of geotextile around the top of the pipe envelope shall be a minimum of 12 inches.
 - c. The geotextile shall be installed in accordance with the manufacturer's recommendations. Prior to installation, the geotextile shall be stretched, aligned, and placed without any wrinkles. If the material is damaged or punctured, the damaged area shall be patched by overlapping and stitching.

3.06 TRENCH BACKFILL

- A. Final Backfill
1. Place backfill into trench at an angle so that impact on installed pipe is minimized.
 2. Compaction of all backfill material shall be performed in a manner that shall not crack, crush, and/or cause the installed pipe to be moved from the established grade and/or alignment.

3. Place cushion of 4-foot compacted backfill above pipe envelope before using heavy compacting equipment.
 4. Use excavated material for final backfill subject to the requirements stated for Select Backfill unless otherwise specified.
 5. Areas under or within 5 feet of pavement, and under or within 2 feet of utilities, buildings, or walks shall be backfilled with sand and mechanically compacted to the top of the subgrade in 8 inch lifts to a minimum of 95% Standard Proctor Density.
 6. Areas not subject to vehicular traffic shall be backfilled in layers not more than 12-inches.
 7. Structural and non structural backfill shall be mechanically compacted. Compaction method is at discretion of Contractor with following exceptions:
 - a. If in Owner's opinion compaction method presents potential damage to pipe, it will not be allowed.
 - b. Flooding or water jetting may be permitted only if a geotechnical report justifying the use of water jetting/puddling is submitted to the Engineer by a qualified laboratory and the Engineer approves.
 8. Mound excavated materials no greater than 6-inches in open areas only.
 9. Fill upper portion of trench with topsoil as specified hereinbefore.
- B. Controlled Density Fill
1. Use where shown on plans.
 2. Provide suitable forms to limit volume of control density fill material.
 3. Prevent flow of material into existing drain lines.
 4. Protect exposed utility lines during placement.
 5. Place material in accordance with suppliers' written recommendations unless directed otherwise by Engineer.

3.07 EXCESS MATERIAL

- A. Waste of excess excavated material shall be the responsibility of the Contractor.

3.08 TESTING

- A. Unless specified elsewhere, testing will be responsibility of Owner.
- B. Standard Proctor Density
1. ASTM D698.
 2. One (1) required for each type of material encountered.
- C. In Place Density
1. ASTM D1556 (Sand Cone)
 2. ASTM D2167 (Balloon)
 3. ASTM D3017 (Nuclear)
- D. One (1) test per 250 linear feet of trench on alternating lifts, with a minimum of three tests per visit, for non-structural areas. One (1) test per 100 linear feet of trench on alternating lifts, with a minimum of three tests per visit, for structural areas.
- E. Contractor will be responsible for any costs associated with testing performed as a result of failed tests

PART 4 - MEASUREMENT AND PAYMENT

4.01 TRENCH EXCAVATION

- A. Trench excavation shall be considered incidental to pipeline installation.
- B. Payment shall be made at the contract unit price per cubic yard only if a bid item is established in the contract.

4.02 BACKFILL

- A. Payment for backfill shall be made at the contract unit price per cubic yard only if a separate bid item is established in the contract, otherwise it shall be considered incidental to the pipeline installation.
- B. No allowance for waste shall be made.
- C. If Engineer orders an initial backfill material other than that specified in contract, it shall be paid for as an extra in price per cubic yard as compacted in place, EXCEPT if a higher class embedment is ordered by Engineer because the Contractor has over-excavated the trench width.
- D. If the Engineer orders the excavated material to be removed and disposed of and replaced with another material and a separate bid item is not established as a bid item, the material shall be paid as an extra.
- E. If the Contractor fails to compact the backfill to the density requirements, the Engineer may order the material removed and replaced at no cost to the Owner.
- F. The disposal of rejected material shall be at no cost to the Owner.
- G. Payment for geotextile envelopment in unstable trench soils shall be made at the bid price for "Trench Stabilization in Unstable Wet Soils" in the bid form.

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SECTION 02221

TOPSOIL

PART 1 - GENERAL

Drawings, Standard General Conditions of Contract, Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.1 DESCRIPTION

This section governs the preparation of the ground surface for topsoil application, removal of topsoil from designated stockpiles or areas to be stripped from approved sources off the site, and placement of the topsoil on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the Owner.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 02200 - Earthwork

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth or hazardous to humans and animals, and it shall be free from subsoil and stumps, roots, brush, stones 2 inches or more in diameter, clay lumps or similar objects. Brush and other vegetation which will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sods and herbaceous growth such as grass and weeds are not to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH when tested in accordance with the methods of testing of the Association of Official Agricultural Chemists in effect on the date of invitation of bids. The organic content shall be not less than 2% nor more than 20% as determined by the wet-combustion method (chromic acid reduction). There shall be not less than 20% nor more than 80% of the material passing the 200 mesh sieve as determined by the wash test in accordance with AASHTO T 11.

All topsoil to be imported by the Contractor shall conform to the above specifications.

B. Inspection and Tests: Ten days prior to stripping topsoil for use on site, the Owner's representative shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths for testing purposes as specified in 2.1 A.

PART 3 - EXECUTION

3.1 GENERAL

- A. Areas to receive topsoil include all areas disturbed by construction which are to be revegetated, as indicated on the Drawings, or as instructed by the Owner in writing.
- B. Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the Owner before the various operations are started.
- C. Strip top 4" to 6" of site for the topsoil stockpile.

D. Grade site to within 4" to 6 " of finished grade and compact. Seed or sod in accordance with the drawings.

3.2 PREPARING THE GROUND SURFACE

- A. Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the Owner, to a minimum depth of 2 inches to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 1 inch in any dimension and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas which are too compact to respond to these operations shall receive scarification by the use of small tillers or hand tools.
- B. Grades on the areas to be topsoiled which have been established by others, as shown on the plans, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and properly compacted condition to prevent, insofar as practical, the formation of low places or pockets where water will stand.

3.3 OBTAINING TOPSOIL

- A. Prior to the stripping of topsoil from designated areas, any vegetation, briars, stumps and large roots, rubbish or stones found on such areas which may interfere with subsequent operations shall be removed using methods approved by the Owner. Heavy sod or other cover which cannot be incorporated into the topsoil by disking or other means shall be removed.
- B. When suitable topsoil is secured off the site, the Contractor shall locate and obtain the supply, subject to the approval of the Owner. The Contractor shall notify the Owner sufficiently in advance of operations in order that necessary measurements and tests can be made. The Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be hauled to the site of the work and placed for spreading, or spread as required. Any topsoil hauled to the site of the work and stockpiled shall be rehandled and placed without additional compensation.

3.4 PLACING TOPSOIL

- A. The topsoil shall be evenly spread on the prepared areas to a uniform depth of 4 inches after compaction, unless otherwise shown on the plans. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that turfing operations can proceed with a minimum of soil preparation or tilling.
- B. After spreading, any large stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks 1 inch or more in diameter, roots, litter or any foreign matter shall be raked up and disposed of by the Contractor. After spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the Owner. The compacted topsoil surface shall conform to the required lines, grades and cross sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

END OF SECTION

SECTION 02222

REMOVING EXISTING PAVEMENTS AND STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Removing concrete paving, asphaltic concrete pavement, and base courses.
- B. Removing concrete curbs, concrete curbs and gutters, sidewalks and driveways.
- C. Removing pipe culverts and sewers.
- D. Removing existing inlets and manholes.
- E. Removing miscellaneous structures of concrete or masonry.

1.2 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate removal work with utility companies.

PART 2 - PRODUCTS- NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

- A. Obtain advance approval from OWNERS for dimensions and limits of removal work.
- B. Identify known utilities below grade. Stake and flag locations.

3.2 PROTECTION

- A. Protect the following from damage or displacement:
 - 1. Adjacent public and private property.
 - 2. Trees, plants, and other landscape features designated to remain.
 - 3. Utilities designated to remain.
 - 4. Pavement and utility structures designated to remain.
 - 5. Bench marks, monuments, and existing structures designated to remain.

3.3 REMOVALS

- A. Remove pavements and structures by methods that will not damage underground utilities. Do not use a drop hammer near existing underground utilities.
- B. Minimize amount of earth loaded during removal operations.
- C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to a minimum depth of 2 inches.

- D. Where street and driveway saw cut locations coincide or fall within 3 feet of existing construction or expansion joints, break out to existing joint.
- E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.
- F. Where existing end of pipe culvert or end of sewer is to remain, install an 8-inch-thick masonry plug in pipe end prior to backfill.

3.4 BACKFILL

- A. Backfill of removal areas shall be in accordance with requirements of Section 02317 - Excavation and Backfill for Structures.

3.5 DISPOSAL

- A. Inlet frames, grates, and plates; and manhole frames and covers, may remain City property.
- B. Properly remove from the site debris resulting from work under this section.

END OF SECTION

SECTION 02233
CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Removing surface debris and rubbish.
- B. Clearing site of plant life and grass.
- C. Removing trees and shrubs.
- D. Removing root system of trees and shrubs.

1.2 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for this work. Work under this specification should be considered subsidiary to other bid items.

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate clearing work with utility companies.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life and features designated to remain are identified and tagged.

3.2 PROTECTION

- A. Protect the following from damage or displacement:
 - 1. Living trees located 3 feet or more outside of the intersection of side slopes and original ground line.
 - 2. Plants other than trees and landscape features designated to remain.
 - 3. Utilities designated to remain.
 - 4. Bench marks, monuments, and existing structures designated to remain.

3.3 CLEARING

- A. Remove stumps, main root ball, and root system to:
 - 1. A depth of 24 inches below the finished subgrade elevation in the area bounded by lines two feet behind back of curbs.
 - 2. A depth of 24 inches below the finished surface of the required cross section for other areas.
- B. Clear undergrowth and deadwood without disturbing subsoil.
- C. Remove vegetation from topsoil scheduled for reuse.

3.4 REMOVAL

- A. Remove debris, rubbish, and extracted plant material life from the site in accordance with requirements of Section 01576 - Waste Material Disposal.

END OF SECTION

SECTION 02234
SITE WORK: GRADING

PART 1 GENERAL

1.01 DESCRIPTION

A. Stripping

Within limits indicated on drawings, or in areas where existing grade is to be altered, in areas to be excavated, and in other required locations, strip any existing top soil to a maximum of 6-inch depth and stockpile in approved areas for subsequent replacement.

B. Drainage

Maintain surface drainage on site during construction.

C. Finished Grade

After construction has been substantially completed and site fill made, grade site 4 inches lower than finished grade on all unpaved areas, clear ground surface of all foreign materials, then place 4 inches of top soil to bring site to smooth, finished grade as indicated.

PART 2 PRODUCTS

2.01 MATERIAL

Use approved excess excavation or borrow material. Where necessary to borrow material, borrow from approved source, excavate and clean up borrow areas. Material stripped from site is not to be reused unless specifically designated on plans or by the Special Conditions.

PART 3 EXECUTION

3.01 FILL UNDER STRUCTURES AND ROADS

Place dirt fill in 8-inch maximum layers, measured loose, and compact at or near optimum moisture with tamping roller (sheep's-foot) pulled with crawler-mounted tractor to at least 95 percent density ASTM Standard D 698. Fill to be placed to subgrade elevation without addition of top soil. Where fill to subgrade elevation is less than 6 inches, scarify to a depth of 6 inches and compact as specified before.

As an acceptable alternate to the compacted fill requirements, cement stabilized sand may be used as a backfill material.

Beneath roadways the natural clay subgrade shall be lime stabilized to improve its shrink-swell characteristics. The clay subgrade should be treated to a depth of 8-inches with about 6 percent hydrated lime in accordance with Texas State Department of Highways and Public Transportation (SDHPT) 1982 Standard Specifications Items 260 and 264. The lime-soil should be compacted to 95 percent of standard Proctor (ASTM D-698) maximum dry density at -1 to +3 percent of optimum moisture content. The exact percentage of lime and cement should be determined by the testing laboratory just prior to construction.

3.02 SITE FILL

Place approved fill to within 4 inches of finish grade shown on all areas not covered by structures or roads in 12-inch maximum layers, measured loose, and compact at or near optimum moisture to at least 90 percent density ASTM Standard D 698.

END OF SECTION

SECTION 02317
EXCAVATION AND BACKFILL FOR UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

1.2 DEFINITIONS

- A. Pipe Foundation: Suitable and stable native soils that are exposed at the trench subgrade after excavation to depth of bottom of the bedding as shown on the Drawings, or foundation backfill material placed and compacted in over-excavations.
- B. Pipe Bedding: The portion of trench backfill that extends vertically from top of foundation up to a level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.
- C. Haunching: The material placed on either side of pipe from top of bedding up to spring line of pipe and horizontally from one trench sidewall to opposite sidewall.
- D. Initial Backfill: The portion of trench backfill that extends vertically from spring line of pipe (top of haunching) up to a level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.
- E. Pipe Embedment: The portion of trench backfill that consists of bedding, haunching and initial backfill.
- F. Trench Zone: The portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.
- G. Unsuitable Material: Unsuitable soil materials are the following:
 - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
 - 2. Materials that cannot be compacted to required density due to either gradation, plasticity, or moisture content.
 - 3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
 - 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- H. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement are considered suitable, unless otherwise indicated.
- I. Backfill: Suitable material meeting specified quality requirements placed and compacted under controlled conditions.
- J. Ground Water Control Systems: Installations external to trench, such as well points or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom.
- K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as a part of excavation drainage.

- L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using a drainage layer, as defined in ASTM D 2321, placed on the foundation beneath pipe bedding or thickened bedding layer of Class I material.
- M. Trench Conditions are defined with regard to the stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.
 - 1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as a result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
 - 2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.
 - a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
 - b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in the embedment zone in combination with ground water control in predominately sandy or silty soils.
 - 3. Unstable Trench: Unstable trench conditions exist in the pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.
- N. Subtrench: Subtrench is a special case of benched excavation. Subtrench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of a subtrench depends upon trench stability and safety as determined by the CONTRACTOR.
- O. Trench Dam: A placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along the trench.
- P. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.
- Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.
- R. Trench Safety Systems include both protective systems and shoring systems as defined in Section 01561 - Trench Safety Systems.
- S. Trench Shield (Trench Box): A portable worker safety structure moved along the trench as work proceeds, used as a protective system and designed to withstand forces imposed on it by cave-in, thereby protecting persons within the trench. Trench shields may be stacked if so designed or placed in a series depending on depth and length of excavation to be protected.
- T. Shoring System: A structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of the ground affecting adjacent installations or improvements.
- U. Special Shoring: A shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on the Drawings.

1.3 REFERENCES

- A. ASTM C 12 - Standard Practice for Installing Vitrified Clay Pipe Lines.
- B. ASTM D 558 - Test Methods for Moisture-Density Relations of Soil Cement Mixtures.
- C. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (304.8-mm) Drop.

- D. ASTM D 1556 - Test Method for Density in Place by the Sand-Cone Method.
- E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
- F. ASTM D 2487 - Classification of Soils for Engineering Purposes.
- G. ASTM D 2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- H. ASTM D 3017 - Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- I. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- J. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.
- K. TxDOT Tex-110-E - Determination of Particle Size Analysis of Soils.
- L. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

1.4 SCHEDULING

- A. Schedule work so that pipe embedment can be completed on the same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

1.5 SUBMITTALS

- A. Conform to Section 01330 - Submittal Procedures.
- B. Submit a written description for information only of the planned typical method of excavation, backfill placement and compaction, including:
 - 1. Sequence of work and coordination of activities.
 - 2. Selected trench widths.
 - 3. Procedures for foundation and embedment placement, and compaction.
 - 4. Procedure for use of trench boxes and other pre-manufactured systems while assuring specified compaction against undisturbed soil.
 - 5. Procedure for installation of Special Shoring at locations identified on the Drawings.
- C. Submit a ground and surface water control plan if required.
- D. Submit backfill material sources and product quality information in accordance with requirements.
- E. Submit a trench excavation safety program in accordance with requirements of Section 01561 - Trench Safety System. Include designs for special shoring meeting the requirements defined in Paragraph 1.7, Special Shoring Design Requirements.
- F. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.

1.6 TESTS

- A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the City of Edinburg.
- B. Perform backfill material source qualification testing in accordance with requirements of Section 02320 - Utility Backfill Materials for type of pipe being used.

1.7 SPECIAL SHORING DESIGN REQUIREMENTS

- A. Have special shoring designed or selected by the CONTRACTOR'S Professional Engineer to provide support for the sides of the excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a pre-manufactured system selected by the CONTRACTOR'S Professional Engineer to meet the project site requirements based on the manufacturer's standard design.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Perform excavation with hydraulic excavator or other equipment suitable for achieving the requirements of this Section.
- B. Use only hand-operated tamping equipment until a minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.
- C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.
- D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting requirements as specified in Paragraph 1.08, Special Shoring Design Requirements.

2.2 MATERIAL CLASSIFICATIONS

- A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions for particular pipe material.
- B. Concrete Backfill: Conform to requirements for 3000 psi concrete as specified in Section 03308 - Concrete Material & Proportioning.
- C. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.

PART 3 - EXECUTION

3.1 STANDARD PRACTICE

- A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between the standard practice and the requirements of this Section, this Section governs.
- B. Install rigid pipe to conform with standard practices described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between the standard practice and the requirements of this Section, the more stringent requirement will be applied.

3.2 PREPARATION

- A. Maintain barricades and warning lights for streets and intersections affected by the Work, and is considered hazardous to traffic movements.
- B. Perform work to conform with applicable safety standards and regulations. Employ a trench safety system as specified in Section 01561 - Trench Safety Systems.

- C. Immediately notify the agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from the OWNER and agency for any repairs or relocations, either temporary or permanent.
- D. Remove existing pavements and structures, including sidewalks and driveways, if applicable.
- E. Install and operate necessary dewatering and surface water control measures.
- F. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed.

3.3 PROTECTION

- A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within the grading limits as designated on the Drawings, and in accordance with requirements of Section 01572 – Source Controls for Erosion and Sedimentation.
- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities are indicated on the Drawings.
- D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density, pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to City.

3.4 EXCAVATION

- A. Except as otherwise specified or shown on the Drawings, install underground utilities in open cut trenches with vertical sides.
- B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on the Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.
- C. Determine trench excavation widths using the following schedule as related to pipe outside diameter (O.D.). Maximum trench width shall be the minimum trench width plus 24 inches.

<u>Nominal Pipe Size, Inches</u>	<u>Minimum Trench Width, Inches</u>
Less than 18	O.D. + 18
18 to 30	O.D. + 24
Greater than 30	O.D. + 36

- D. Use sufficient trench width or benches above the embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from the surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.
- E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify the OWNER and obtain instructions before proceeding.
- F. Shoring of Trench Walls.
 - 1. Install Special Shoring in advance of trench excavation or simultaneously with the trench excavation, so that the soils within the full height of the trench excavation walls will remain laterally supported at all times.
 - 2. For all types of shoring, support trench walls in the pipe embedment zone throughout the installation. Provide trench wall supports sufficiently tight to prevent washing the trench wall soil out from behind the trench wall support.

3. Unless otherwise directed by the OWNER, leave sheeting driven into or below the pipe embedment zone in place to preclude loss of support of foundation and embedment materials. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and the trench wall in the vicinity of the pipe zone.
 4. Employ special methods for maintaining the integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
 5. If sheeting or other shoring is used below top of the pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into the embedment zone shall be the equivalent of a 1-inch-thick steel plate. Fill voids left on removal of supports with compacted backfill material.
- G. Use of Trench Shields. When a trench shield (trench box) is used as a worker safety device, the following requirements apply:
1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to the trench sidewalls.
 2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor the degree of compaction reduced.
 3. When required, place, spread, and compact pipe foundation and bedding materials beneath the shield. For backfill above bedding, lift the shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
 4. Maintain trench shield in position to allow sampling and testing to be performed in a safe manner.

3.5 HANDLING EXCAVATED MATERIALS

- A. Use only excavated materials which are suitable as defined in this Section. Place material suitable for backfilling in stockpiles at a distance from the trench to prevent slides or cave-ins.
- B. When required, provide additional backfill material conforming to requirements of the particular pipe being installed.
- C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect excess stockpiles for use on site. Maintain site conditions clean and safe.

3.6 GROUND WATER CONTROL

- A. Implement ground and surface water control as required. Provide a stable trench to allow for proper installation.

3.7 TRENCH FOUNDATION

- A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.
- B. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.8 BEDDING, HAUNCHING, AND INITIAL BACKFILL - PLACEMENT AND COMPACTION

- A. Immediately prior to placement of embedment materials, the bottoms and sidewalls of trenches shall be free of loose, sloughing, caving, or otherwise unsuitable soil.
- B. Place embedment including bedding, haunching, and initial backfill as shown on Drawings.

- C. For pipe installation, manually spread embedment materials around the pipe to provide uniform bearing and side support when compacted. Do not allow materials to free-fall from heights greater than 24 inches above top of pipe. Perform placement and compaction directly against the undisturbed soils in the trench sidewalls, or against sheeting which is to remain in place.
- D. Do not place trench shields or shoring within height of the embedment zone unless means to maintain the density of compacted embedment material are used. If moveable supports are used in embedment zone, lift the supports incrementally to allow placement and compaction of the material against undisturbed soil.
- E. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.
- F. Place haunching material manually around the pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside the pipe with sand bags or other suitable means.
- G. Place electrical conduit, if used, directly on foundation without bedding.
- H. Shovel in-place and compact embedment material using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping is not allowed.
- I. For sanitary sewer utility installation adhere to the following material.
 - 1. Class I and II embedment.
 - a. Maximum 6-inches compacted lift thickness.
 - b. Compaction by methods determined by CONTRACTOR to achieve a minimum of 95 percent of the maximum dry density as determined according to ASTM D 698 for Class I and II materials.
 - c. Moisture content Class I and II materials within 2 percent of optimum as determined according to ASTM D 698.
 - 2. Cement stabilized sand.
 - a. Maximum 6-inches compacted lift thickness.
 - b. Compaction by methods determined by CONTRACTOR to achieve a minimum of 95 percent of the maximum dry density as determined according to ASTM D 558 for cement stabilized materials.
 - c. Moisture content of cement stabilized sands on the dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.
 - 3. Flowable Fill
 - a. Mixture of sand, Portland cement, fly ash and water to comply with the specification for American Concrete Institute (ACI) 229R-94 Code Controlled Low Strength Materials.

3.9 SECONDARY BACKFILL UNDER PAVED AND UN-PAVED AREAS- PLACEMENT AND COMPACTION

- A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only the minimum length of trench open as necessary for construction.
- B. Secondary backfill under paved areas (asphalt or concrete) shall be placed in lifts and compact by methods selected by the CONTRACTOR. Fully compact each lift before placement of the next lift.
 - 1. "Bank Run Sand Backfill"
 - a. Maximum 10-inches compacted lift thickness.
 - b. Compaction by vibratory equipment to a minimum of 95 percent of the maximum dry density determined according to ASTM D 698.
 - c. Moisture content within 2 percent of optimum determined according to ASTM D 698

2. "Cement-stabilized Sand Backfill"
 - a. Maximum lift thickness determined by CONTRACTOR to achieve uniform placement and required compaction, but not exceeding 24 inches.
 - b. Compaction by vibratory equipment to a minimum of 95 percent of the maximum dry density determined according to ASTM D 558.
 - c. Moisture content on the dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.
 3. "Select Backfill"
 - a. Maximum 6-inches compacted thickness.
 - b. Compaction by equipment providing tamping or kneading impact to a minimum of 95 percent of the maximum dry density determined according to ASTM D 698.
 - c. Moisture content within 2 percent of optimum determined according to ASTM D 698.
- C. Secondary backfill under un-paved areas shall be placed in lifts and compact by methods selected by the CONTRACTOR. Fully compact each lift before placement of the next lift. A random backfill of suitable material may be used.
1. Random Backfill
 - a. Maximum 10-inch compacted lift thickness for clayey soils and maximum 12-inch lift thickness for granular soils.
 - b. Compact to a minimum of 90 percent of the maximum dry density determined according to ASTM D 698.
 - c. Moisture content within 2 percent of optimum determined according to ASTM D 698.
 2. Fat clays (CH) may be used as secondary backfill outside paved areas at the CONTRACTOR'S option. If the required density is not achieved, the CONTRACTOR, at his option and at no additional cost to the City, may use lime stabilization to achieve compaction requirements or use a different suitable material.
 - a. Maximum 6-inch compacted lift thickness for clayey soils and maximum 12-inch lift thickness for granular soils.
 - b. Compact to a minimum of 90 percent of the maximum dry density determined according to ASTM D 698.
 - c. Moisture content as necessary to achieve density.
- D. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave the sheeting in place. Cut off sheeting 1.5 feet or more above the crown of the pipe. Remove trench supports within 5 feet from the ground surface.
- E. For sewer pipes, use backfill materials described here as determined by trench limits. As trench zone backfill in paved areas for streets and to one foot back of curbs and pavements, use cement stabilized sand for pipe of nominal sizes less than 36 inches. Uniformly backfill trenches partially within limits one foot from streets and curbs according to the paved area criteria. Use select backfill within one foot below pavement subgrade for rigid pavement. For asphalt concrete, use flexible base material within one foot below pavement subgrade.
- F. When shown on Drawings, a random backfill of suitable material may be used in trench zone for trench excavations outside pavements.
- G. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.

3.10 MANHOLES, JUNCTION BOXES, AND OTHER PIPELINE STRUCTURES

- A. Meet the requirements of adjoining utility installations for backfill of pipeline structures, as shown on the Drawings.

3.11 FIELD QUALITY CONTROL

- A. Test for material source qualifications as defined in the specifications.

- B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction at no additional cost to Owner.
- C. Tests will be performed on a minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is a noticeable change in material gradation or plasticity.
- D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement- stabilized sand in accordance with ASTM D 558. Additional moisture-density relationship tests will be performed whenever there is a noticeable change in material gradation or plasticity.
- E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at the following frequencies and conditions.
 - 1. A minimum of one test for every 20 cubic yards of compacted embedment and for every 50 cubic yards of compacted trench zone backfill material.
 - 2. A minimum of three density tests for each full shift of Work.
 - 3. Density tests will be distributed among the placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.
 - 4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.
 - 5. Density tests may be performed at various depths below the fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.
 - 6. Two verification tests will be performed adjacent to in-place tests showing density less than the acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.
 - 7. Recompact placement will be retested at the same frequency as the first test series, including verification tests.
- F. Recondition, re-compact, and retest at CONTRACTOR'S expense if tests indicate Work does not meet specified compaction requirements. Core and test for compressive strength for hardened soil cement with nonconforming density, at CONTRACTOR'S expense.
- G. Acceptability of crushed rock compaction will be determined by inspection.

3.12 DISPOSAL OF EXCESS MATERIAL

- A. Properly dispose of excess materials.

END OF SECTION

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SECTION 02320
UTILITY BACKFILL MATERIALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Material Classifications.
- B. Utility Backfill Materials:
 - 1. Bank run sand
 - 2. Select backfill
 - 3. Random backfill
 - 4. Pea gravel
 - 5. Crushed Aggregate
- C. Material Handling and Quality Control Requirements.

1.2 DEFINITIONS

- A. Unsuitable Material: Unsuitable soil materials are the following:
 - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
 - 2. Materials that cannot be compacted to the required density due to either gradation, plasticity, or moisture content.
 - 3. Materials that contain large clods, aggregates, and stones greater than 4 inches in any dimension; debris, vegetation, and waste; or any other deleterious materials.
 - 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material: Suitable soil materials are the following:
 - 1. Those meeting specification requirements.
 - 2. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement.
- C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for the structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.
- D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. The foundation base provides a smooth, level working surface for the construction of the concrete foundation.
- E. Backfill Material: Classified soil material meeting specified quality requirements for the designated application as embedment or trench zone backfill.
- F. Embedment Material: Soil material placed under controlled conditions within the embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching, and initial backfill.
- G. Secondary Backfill/Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in the trench zone from top of embedment zone to base course in paved areas or to the surface grading material in unpaved areas.
- H. Foundation: Either suitable soil of the trench bottom or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.

- I. Source: A source selected by the CONTRACTOR for supply of embedment or trench zone backfill material. A selected source may be the project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.
- J. Refer to Section 02317 - Excavation and Backfill for Utilities for other definitions regarding utility installation by trench construction.

1.3 REFERENCES

- A. ASTM C 33 - Specification for Concrete Aggregate.
- B. ASTM C 40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 123 - Test Method for Lightweight Pieces in Aggregate.
- D. ASTM C 131 - Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- E. ASTM C 136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- F. ASTM C 142 - Test Method for Clay Lumps and Friable Particles in Aggregates.
- G. ASTM D 1140 - Test Method for Amount of Materials in Soils Finer Than No. 200 Sieve.
- H. ASTM D 2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- I. ASTM D 2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
- J. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- K. ASTM D 4643 - Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
- L. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.
- M. TxDOT Tex-104-E - Test Method for Determination of Liquid Limit of Soils (Part 1)
- N. TxDOT Tex-106-E - Test Method - Methods of Calculating Plasticity Index of Soils.
- O. TxDOT Tex-110-E - Determination of Particle Size Analysis of Soils.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit a description of source, material classification and product description, production method, and application of backfill materials.
- C. Submit test results for samples of off-site backfill materials to comply with Paragraph 2.03, Materials Testing.
- D. Before stockpiling materials, submit a copy of temporary easement or approval from landowner for stockpiling backfill material on private property.
- E. For each delivery of material, provide a delivery ticket which includes source location.

1.5 TESTS

- A. Perform tests of sources for backfill material in accordance with Paragraph 2.03B.
- B. Verification tests of backfill materials may be performed by the City of Edinburg.

- C. Random fill obtained from the project excavation as source is exempt from prequalification requirements by CONTRACTOR but must be inspected by City testing lab for unacceptable materials based on ASTM D 2488.

PART 2 - PRODUCTS

2.1 MATERIAL CLASSIFICATIONS

- A. Materials for backfill shall be classified for the purpose of quality control in accordance with the Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02.
- B. Class Designations Based on Laboratory Testing:
1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
 - a. Plasticity index: nonplastic.
 - b. Gradation: D_{60}/D_{10} - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.
 2. Class II: Poorly graded gravel and gravel-sand mixtures, little or no fines, poorly graded sands and gravelly sands, little or no fines (GP, SP):
 - a. Plasticity index: nonplastic to 4.
 - b. Gradations: (GP, SP): amount passing No. 200 sieve - less than 5 percent.
 3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
 - a. Plasticity index: greater than 7.
 - b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.
 4. Class IVA: Lean clays (CL).
 - a. Plasticity Indexes:
 - 1) Plasticity index: greater than 7, and above A line.
 - 2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
 - b. Liquid limit: less than 50.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
 5. Class IVB: Fat clays (CH)
 - a. Plasticity index: above A line.
 - b. Liquid limit: 50 or greater.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
 6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to the more restrictive class.

2.2 PRODUCT DESCRIPTIONS

- A. Soils classified as silt (ML), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by the OWNER. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by the applicable backfill installation specification. Refer to Section 02317 - Excavation and Backfill for Utilities.
- B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to the following limits for deleterious materials:

1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.
 2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.
 3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.
- C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in the product specification, and approved by OWNER, provided that the physical property criteria are determined to be satisfactory by testing.
- D. Bank Run Sand Backfill: Durable bank run sand classified as SP, SW, or SM by the Unified Soil Classification System (ASTM D 2487) meeting the following requirements:
1. Less than 15 percent passing the number 200 sieve when tested in accordance with ASTM D 1140. The amount of clay lumps or balls not exceeding 2 percent.
 2. Material passing the number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318:
 - a. Liquid limit: not exceeding 25 percent.
 - b. Plasticity index: not exceeding 7.
- E. Cement Stabilized Sand Backfill.
- F. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with a plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Section 02951 - Pavement Repair and Resurfacing, to meet plasticity criteria.
- G. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by the applicable backfill installation specification. Refer to Section 02317 - Excavation and Backfill for Utilities.
- H. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
1/2"	100
3/8"	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

- I. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:
1. Materials of one product delivered for the same construction activity from a single source.
 2. Non-plastic fines.
 3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.
 4. Crushed aggregate shall have a minimum of 90 percent of the particles retained on the No. 4 sieve with 2 or more crushed faces as determined by Test Method Tex-460-A, Part I.
 5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from a naturally occurring single source. Uncrushed gravel are not acceptable materials for embedment where crushed stone is shown on the applicable utility embedment drawing details.

6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are the same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.
7. Gradations, as determined in accordance with Tex-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment by Ranges of Nominal Pipes Sizes		
	>15"	15" - 8"	< 8"
1"	95 - 100	100	-
3/4"	60 - 90	90 - 100	100
1/2"	25 - 60	-	90 - 100
3/8"	-	20 - 55	40 - 70
No. 4	0 - 5	0 - 10	0 - 15
No. 8	-	0 - 5	0 - 5

2.3 MATERIAL TESTING

- A. Ensure that material selected, produced and delivered to the project meets applicable specifications and is of sufficient uniform properties to allow practical construction and quality control.
- B. Source or Supplier Qualification. Perform testing, or obtain representative tests by suppliers, for selection of material sources and products. Provide test results for a minimum of three samples for each source and material type. Tests samples of processed materials from current production representing material to be delivered. Tests shall verify that the materials meet specification requirements. Repeat qualification test procedures each time the source characteristic changes or there is a planned change in source location or supplier. Qualification tests shall include, as applicable:
 1. Gradation. Complete sieve analyses shall be reported regardless of the specified control sieves. The range of sieves shall be from the largest particle through the No. 200 sieve.
 2. Plasticity of material passing the No. 40 sieve.
 3. Los Angeles abrasion wear of material retained on the No. 4 sieve.
 4. Clay lumps.
 5. Lightweight pieces
 6. Organic impurities
- C. Production Testing. Provide reports to the OWNER from an independent testing laboratory that backfill materials to be placed in the Work meet applicable specification requirements.
- D. Assist the OWNER in obtaining material samples for verification testing at the source or at the production plant.

PART 3 - EXECUTION

3.1 SOURCES

- A. Use of material encountered in the trench excavations is acceptable, provided applicable specification requirements are satisfied. If excavation material is not acceptable, provide from other approved source.

- B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that the OWNER may obtain samples for verification testing.
- C. Obtain approval for each material source by the OWNER before delivery is started. If sources previously approved do not produce uniform and satisfactory products, furnish materials from other approved sources. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet the requirements of the specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once a material is approved by the OWNER, expense for sampling and testing required to change to a different material will be credited to the City through a change order.
- D. Bank run sand, select backfill, and random backfill, if available in the project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete the work from off-site sources.
- E. The City does not represent or guarantee that any soil found in the excavation work will be suitable and acceptable as backfill material.

3.2 MATERIAL HANDLING

- A. When backfill material is obtained from either a commercial or non-commercial borrow pit, open the pit to expose the vertical faces of the various strata for identification and selection of approved material to be used. Excavate the selected material by vertical cuts extending through the exposed strata to achieve uniformity in the product.
- B. Establish temporary stockpile locations for practical material handling and control, and verification testing by the OWNER in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.
- C. When stockpiling backfill material near the project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering the drainage system.
- D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.3 FIELD QUALITY CONTROL

- A. Quality Control
 - 1. The OWNER may sample and test backfill at:
 - a. Sources including borrow pits, production plants and CONTRACTOR's designated off-site stockpiles.
 - b. On-site stockpiles.
 - c. Materials placed in the Work.
 - 2. The OWNER may resample material at any stage of work or location if changes in characteristics are apparent.
- B. Production Verification Testing: The City's testing laboratory will provide verification testing on backfill materials, as directed by the OWNER. Samples may be taken at the source or at the production plant, as applicable.

END OF SECTION

SECTION 02321
CEMENT STABILIZED SAND

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cement stabilized sand material.

1.2 MEASUREMENT AND PAYMENT

- A. No payment will be made for cement stabilized sand under this Section. Include payment for cement stabilized sand in unit price for applicable utility or structure installation section.

1.3 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregates (Fine Aggregate).
- B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- D. ASTM C 123 - Standard Test Method for Lightweight Pieces in Aggregate.
- E. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- F. ASTM C 150 - Specification for Portland Cement.
- G. ASTM D 558 - Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.
- H. ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
- I. ASTM D 2487 - Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- J. ASTM D 3665 - Practice for Random Sampling of Construction Materials.
- K. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.4 SUBMITTALS

- A. See Section 01330.
- B. Submit proposed target cement content and production data for sand-cement mixture in accordance with the requirements of Paragraph 2.3, Material Qualifications.

1.5 DESIGN REQUIREMENTS

- A. Sand-cement mixture shall produce a minimum unconfined compressive strength of 100 pounds per square inch in 48 hours.
 - 1. Design will be based on strength specimens molded in accordance with ASTM D 558 at a moisture content within 3 percent of optimum and within 4 hours of batching.
 - 2. Determine minimum cement content from production data and statistical history. Mix shall contain not less than 1.1 sacks of cement per ton of dry sand.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement: Type I Portland cement conforming to ASTM C 150.
- B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank run sand of Section 02317 Excavation & Backfill For Utilities, and the following requirements:
 - 1. Classified as SW, SP, SW-SM, SP-SM, or SM by the United Soil Classification System of ASTM D 2487.
 - 2. Deleterious materials:
 - a. Clay lumps, ASTM C 142; less than 0.5 percent.
 - b. Lightweight pieces, ASTM C 123; less than 5.0 percent.
 - c. Organic impurities, ASTM C 40, color no darker than the standard color.
 - 3. Plasticity index of 4 or less when tested in accordance with ASTM D 4318.
- C. Water: Potable water, free of oils, acids, alkalies, organic matter, or other deleterious substances, meeting requirements of ASTM C 94.

2.2 MIXING MATERIALS

- A. Add required amount of water and mix thoroughly in a pugmill-type mixer.
- B. Stamp batch ticket at plant with time of loading. Material not placed and compacted within 4 hours after mixing shall be rejected.

2.3 MATERIAL QUALIFICATION

- A. Determine the target cement content of the material as follows:
 - 1. Obtain samples of sand-cement mixtures at the production facility representing a range of cement content consisting of at least three points.
 - 2. Complete the molding of samples within 4 hours after the addition of water.
 - 3. Perform strength tests (average of two specimens) at 48 hours and 7 days.
 - 4. Perform cement content tests on each sample.
 - 5. Perform moisture content tests on each sample.
 - 6. Plot average 48-hour strength vs. cement content
 - 7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).
- B. Test the raw sand for the following properties at the point of entry into the pug-mill:
 - 1. Gradation.
 - 2. Plasticity index.
 - 3. Organic impurities.
 - 4. Clay lumps and friable particles.
 - 5. Lightweight pieces.
 - 6. Moisture content.
 - 7. Classification.
- C. Present the data obtained in a format similar to that provided in the sample data form attached to this Section.
- D. The target content may be adjusted if statistical history so indicates. For determination of minimum product performance use the formula:

$$f'_c + 1/2 \text{ standard deviation}$$

PART 3 - EXECUTION

3.1 PLACING

- A. Place sand-cement mixture in a maximum 12-inch-thick loose lift and compact to 95 percent of ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. The target moisture content during compaction is ± 3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at the plant.
- B. Do not place or compact sand-cement mixture in standing or free water.

3.2 FIELD QUALITY CONTROL

- A. Samples of delivered product will be taken in the field at point of delivery for testing in accordance with ASTM D 3665.
- B. Four specimens shall be prepared and molded (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting the moisture content. Samples will be molded at approximately the same time the material is being used, but no later than 4 hours after water is added to mix.
- C. After molding, specimens will be removed from the molds and sealed in a plastic bag or similar material to minimize moisture loss. Specimens will be cured at a room temperature between 60 and 80 degrees F until ready for testing.
- D. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.
- E. A strength test will be the average of the strengths of two specimens molded from the same sample of material and tested at the same age. The average daily strength will be the average of the strengths of all specimens molded during one day's production and tested at the same age.
- F. Precision and Bias: Test results shall meet the recommended guideline for precision in ASTM D 1633 Section 9.
- G. Reporting: Test reports shall contain, as a minimum, the following information:
 - 1. Supplier and plant number
 - 2. Time material was batched
 - 3. Time material was sampled
 - 4. Test age (exact hours)
 - 5. Average 48-hour strength
 - 6. Average 7-day strength
 - 7. Specification section number
 - 8. Compliance / non-compliance
 - 9. Mixture identification
 - 10. Truck and ticket numbers
 - 11. The time of molding
 - 12. Moisture content at time of molding
 - 13. Required strength
 - 14. Test method designations
 - 15. Compressive strength data as required by ASTM D 1633

3.3 ACCEPTANCE

- A. The strength level of the material will be considered satisfactory if:
 - 1. The average 48-hour strength is greater than 100 psi with no individual strength test below 60 psi, or
 - 2. All 7-day individual strength tests exceed 100 psi.

- B. The material will be considered acceptable for partial payment if any 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 60 psi.
- C. The material will be considered unacceptable and subject to removal and replacement at the Contractor's expense if any individual strength test has a 7-day strength less than 60 psi.
- D. If the moving average of any three daily 48-hour averages falls below 100 psi, the supplier shall discontinue shipment to the project until that plant is capable of producing a material which exceeds 100 psi at 48 hours. A total of five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.
- E. The testing laboratory shall notify the Contractor, Owner, and material supplier by facsimile of all tests indicating results falling below specified strength requirements.

END OF SECTION

SECTION 02444
CHAIN LINK FENCE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Scope: This section governs for furnishing the quantities of chain link fencing and gates as shown on the plans, including all posts, bracing and accessories as called for herein and the installation of all items, complete in every respect at the locations shown on the plans.
- B. Related Work (if utilized in this project)
 - Site Work
 - 1. Section 01576 - Waste Materials Disposal
 - 2. Section 03310 – Concrete
- C. Submittals: Submit the following in accordance with Contract Documents:
 - 1. Product data for all materials used.
 - 2. Shop drawings showing sizes, fabrication, anchorage, finishes and other pertinent data.
- D. Product Delivery, Storage and Handling
 - 1. Deliver fabric, posts, gates and accessories to jobsite with sufficient protection, bracing, etc. to ensure arrival in undamaged condition.
 - 2. Store in original bundles on level supports and protect to prevent damage until erected.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Price: No payment will be made under this section, include payment in lump sum for site work.
- B. Measurement shall be per linear foot of finished fence.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fabric and Accessories

- 1. Fabric Mesh

Wire fabric for fencing shall be nine (9) gauge steel with a minimum tensile strength of 80,000 psi. Mesh size shall be 2-inch between parallel wires. Top salvages knuckled for fabric 60-inch high and under, and both top and bottom

salvages twisted and barbed for fabric over 60-inch high. Furnish one-piece fabric width up to 12-feet high.

2. Barbed Wire

Wire for mounting on security arms to be twelve and one half (12½) gauge with 4-point barbs spaced 5-inches apart. Three strands of barbed wire will be required.

3. Fabric Ties

Ties to be eleven (11) gauge steel to fasten fabric to top rail at 18-inch intervals. Ties shall be furnished to fasten the fabric to bottom tension wire at 18-inch intervals and line posts at 15-inch intervals.

4. Bottom Tension Wire

Wire to be seven (7) gauge coil wire.

B. Framing and Accessories

1. Top Rail

Top rail shall be 1.66-inch O.D. steel pipe weighing 2.27 lbs./ft. Top rail shall be furnished in random lengths not less than 18-feet per section and shall be joined with outside sleeve, steel couplings not less than 6-inches long and having a wall thickness of not less than 0.70-inch. Couplings shall be designed to allow for expansion movement to the top rail.

2. Posts

Posts shall be furnished in sufficient quantity to provide a maximum spacing of 10-feet. Minimum sizes and weights as follows:

LINE POST REQUIREMENTS

Fabric Height	Pipe Section (Size)	Wt./Ft.	Embedment Length
0 to 4 ft.	1.90" O.D.	2.72 lbs.	24"
Over 4 to 8 ft.	2.375" O.D.	3.65 lbs.	24"
Over 8 to 12 ft.	2.875" O.D.	5.79 lbs.	24"

CORNER POST, PULL POST AND ENDPPOST REQUIREMENTS

Fabric Height	Pipe Section (Size)	Wt./Ft.	Embedment Length
0 to 4 ft.	2.375" O.D.	3.65 lbs.	30"
Over 4 to 8 ft.	2.875" O.D.	5.79 lbs.	36"
Over 8 to 12 ft.	3.500" O.D.	9.10 lbs.	36"

GATE POSTS

Gate Leaf Width	Pipe Section (Size)	Wt./Ft.	Embedment Length
Up to 6 ft.	2.875" O.D.	5.79 lbs.	30"
6 to 13 ft.	4.000" O.D.	9.11 lbs.	36"
13 to 18 ft.	6.625" O.D.	18.79 lbs.	42"

3. Post Brace Assembly

Manufacturer's standard adjustable brace at end and gate posts, and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Brace to be same material as top rail and trussed to line posts with 0.375" diameter rod with adjustable turnbuckles.

4. Post Caps

Post caps for pipe sections shall be designed to exclude all moisture. Where barbed wire is specified, extension arms shall be integral with post caps. Where top rail is specified, post caps shall have an opening for top rail. All post caps shall have a 2-inch skirt for rigidity.

5. Stretcher Bars and Bands

Stretcher bars shall be not less than 3/16-inch by 3/4-inch flat steel and not more than 2-inches shorter than the fabric height. One stretcher bar shall be provided for each gate and end post. Two stretcher bars shall be provided for each corner and pull posts. Stretcher bars shall be attached to terminal posts with 1-inch by c-inch flat steel bands, with d-inch carriage bolts at intervals not exceeding 15-inches.

6. Barbed Wire Support Arms

Manufacturer's standard barbed wire supporting arms, metal and finish to match fence framework, with provision for anchorage to posts and attaching 3 rows of barbed wire to each arm. Supporting arms may be either attached to posts or integral with post top weather cap and must be capable of withstanding 250 lbs. downward pull at outermost end. Arms shall be at an angle of 45-degrees from vertical.

C. Gates

1. Fabrication

Fabricate perimeter frames of gates from metal and finish to match fence framework. Assemble gate frames by welding or with special fittings and rivets for rigid connections, providing security against removal or breakage connections. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware and accessories. Space frame members maximum of 8-feet apart unless otherwise indicated.

Provide same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges and at top and bottom edges. Attach stretcher bars to gate frame not more than 15-inch o.c.

Install diagonal cross-bracing consisting of d" diameter adjustable length truss rods on gates to ensure frame rigidity without sag or twist.

Where barbed wire is indicated above gates extend end members of gate frames 1'-0" above to member and prepare to receive 3 strands of wire. Provide necessary clips for securing wire to extensions.

2. Swing Gates

Fabricate perimeter frames of minimum 1.90" O.D. pipe weighing 2.72 lbs./ft. The top of all gate frames shall align with the fencing top rail. Vehicular gates shall be 4-inches greater in overall height than the adjacent fencing so as to extend to within 2-inches of pavement between 6-inch curbs, if curbs are designated on the plans.

- a. Corner and tee fittings of malleable iron or pressed steel having means for attaching diagonal members. Hinges of malleable iron providing for full 180 degree swing with bottom hinges to be ball and socket type.
- b. Diagonal braces consisting of c-inch diameter truss rods with turn-buckles, two for each gate frame. Vertical gates shall have vertical 1.90-inch O.D. pipe brace at center of each gate leaf.

3. Gate Hardware

Provide hardware and accessories for each gate, galvanized per ASTM A-153, and in accordance with the following:

- a. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180 deg. gate opening. Provide 1½ pair of hinges for each leaf over 6' nominal height.
- b. Latch: Forked type or plunger-bar type to permit operation from either side of gate with padlock eye as integral part of latch.
- c. Keeper: Provide keeper for vehicle gates which automatically engages gate leaf and holds it in open position until manually released. Keeper to be anchored at least 12-inches into a 12-inch diameter by 24-inch concrete footing.
- d. Double Gates: Provide gate stops for double gates, consisting of mushroom type flush plate with anchors, set in concrete and designed to engage center drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch permitting both gate leaves to be locked with single padlock.

4. Roller Gates

Contractor to be responsible for design of roller gate using same fabric as for fence. Plans indicate size of opening and requirement for single or double gate application. Attached sketch provides minimum requirements to be incorporated into Contractor's roller gate design. Design to provide for free flowing opening and closing. Additional rollers or support bearing wheel should be incorporated to minimize binding where necessary.

D. Miscellaneous

Miscellaneous fittings and fasteners shall be furnished in sufficient quantities to erect all fencing materials in a proper manner.

E. Galvanizing

All material used in chain link fencing shall be hot dip zinc coated as specified by the following:

1. All Posts and Pipe: ASTM Designation A-120 (1.8 oz/sf).
2. All H-Beam Sections: ASTM Designation A-123 (2.0 oz/sf).
3. Fence Fabric: ASTM Designation A-392, Class I (1.2 oz/sf).
4. Tension Wire, Barbed Wire: ASTM Designation A-121, Class III (0.80 oz/sf).
5. Post Caps, Stretcher Bars and Miscellaneous Fittings, ASTM Designation A-153.
6. The weight of zinc coating for all items shall be determined in accordance with ASTM Method A-90.

PART 3 EXECUTION

- A. The Contractor shall perform all clearing of brush and debris, which may be necessary for the installation of this fencing.
- B. The fencing panels between corner and terminal posts shall generally follow the finished ground elevations. However, the Contractor shall grade off minor irregularities in the path of the fencing as necessary to limit the variation of grade under the bottom edge of fence fabric to a distance of not more than 6-inches and not less than 2-inches to the ground.
- C. The maximum spacing for line posts shall be 10-feet. Pull posts shall not be located more than 500-feet apart and at each change in direction exceeding 20-degrees, both horizontally and vertically. Runs of fencing over 500-feet but less than 1,000-feet shall have a pull post in the center of the run. See attached detail for typical installation.
- D. Holes for concrete footings for all posts shall be drilled to the dimensions listed in the following:

HOLES FOR LINE AND END POSTS

Type Post	Fabric Height	Min. Hole Diameter	Min. Hole Depth	Post Embedment
Line	Up to 4'	9"	30"	24"
Line	Over 4' to 8'	9"	30"	24"
Line	Over 8' to 12'	9"	30"	24"
End	Up to 4'	12"	36"	30"
End	Over 4' to 8'	12"	42"	36"
End	Over 8' to 12'	12"	42"	36"

HOLES FOR GATE POSTS

Gate Post Size	Min. Hole Diameter	Min. Hole Depth	Post Embedment
2.875" O.D. x 5.79 lbs.	12"	42"	36"
4" O.D. x 9.10 lbs.	18"	42"	36"
6.625" O.D. x 18.97 lbs.	18"	48"	42"

- E. Concrete for footings shall be Class A and shall be in accordance with the Item, "Concrete". All concrete footings shall be cast up to finish grade and crowned one inch to shed water. Excess concrete not used in the footings and any other construction debris shall be removed from the site.
- F. The fence fabric shall be erected by securing one end and applying sufficient tension to the other end to remove all slack before making attachments. The fabric shall be cut and each span shall be attached independently at all corner posts and pull posts.
- G. Fastening to end, pull corner and gate posts shall be with stretcher bars which shall be secured to the posts with stretcher bar bands at intervals not exceeding 15-inches.
- H. Fence fabric shall generally follow the finished contour of the site with the bottom edge of the fabric located 2-inches above the grade.
- I. Erect fencing to generally follow ground surface and adjust irregularities in grade. Where depressions or swales are crossed by fencing, provide galvanized pipe and wire fabric laced to main fabric to prevent entrance of small animals but permit natural drainage flow.
- J. Join top rails with suitable sleeve-type couplings, making rigid connections with provisions for expansion and contraction. Pass rail through base line post barbed wire extension arm and fasten securely to terminal post.
- K. Brace all terminal posts with brace member securely fastened to terminal and first line post. Tie terminal post near ground line to line post at brace member with steel tension rod of d-inch minimum diameter, complete with turnbuckle.

END OF SECTION

SECTION 02611
REINFORCED CONCRETE STORM DRAIN PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of reinforced concrete storm drain pipe of types, sizes and classes shown on the plans furnished and installed in accordance with the locations, elevations and conditions set forth in the specifications or as designated by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforced Concrete Storm Drain Pipe: Reinforced concrete storm drain pipe shall meet the requirements of ASTM Designation C76-59T, Class 3 with either Type A or Type B Wall. Extra strength pipe shall meet the requirements of ASTH Designation C76-59T, Class 4 with either Type A or Type B wall. Where pipe is installed under highways, it shall be Class 4 with Type "A" Wall.
- B. Joints Material: Reinforced concrete drain pipe joints shall be constructed to Ram-Nek, rubber O-rings, or approved substitution. The Contractor may elect to use other types of joint material with p approval of the Engineer.
- C. Concrete: concrete used for pipe cradles shall meet the requirements of Class "C" concrete, as set out in the section title 'Concrete' of these specifications. This concrete shall be furnished by an approved transit mix concrete company and/or mixed on job site to specification herein established.

PART 3 - INSTALLATION

3.1 CONSTRUCTION METHODS

- A. Equipment: All equipment necessary and required for the proper construction of sewers and appurtenances shall be on project site in first class working condition and shall be approved by the Engineer before construction is permitted to start. The contractor shall provide such hand tamping devices and pneumatic tampers as may be necessary to obtain the proper compaction for the pipe and backfill as specified.
- B. Excavation:
1. Common: Common excavation shall consist of all excavation not classified as rock excavation and shall be carried out to net lines as specified and shown on the plans. If the excavation is carried out to a point below the required depth, this portion of the trench shall be filled at the Contractor's expense with selected material approved by the Engineer and thoroughly compacted to the specified elevation of the pipe bed.
 2. Rock: Rock excavation shall consist of the removal of boulders and detached rock 1/2 cubic yards in volume or greater. Also, all rock in ledges or masses which can be removed only the use of bars, sledges, mechanical hammers or by blasting.

The sides of the trenches shall be excavated to neat lines of the required width and no rock masses shall be allowed to extend into these lines. The bottom of the trench shall be

excavated on a horizontal to a depth of at least one-half the diameter of the pipe, or a minimum of 4 inches greater than the finished grade of the pipe bed. After removal of all broken material from the trench, this portion of the trench shall be filled with clean, dry sand, or an equivalent granular material to the elevation of the pipe bed.

When the use of explosives is necessary for the prosecution of the work, the Contractor shall use the utmost care not to endanger a life or property. All explosives shall be stored in a secure manner and all storage places shall be clearly marked 'DANGEROUS EXPLOSIVES'. The method of storing and handling explosives and highly inflammable materials shall conform to Federal, State and local laws and regulations. The Contractor shall not store or use explosives until he has taken the necessary legal precautions to save harmless the owner against any claims arising from such possessions or use of explosives.

- C. General: Excavated material not required or acceptable for backfill shall be disposed of by the Contractor as directed by the Engineer, or as specified herein. If, in the opinion of the Engineer, the bottom of the ditch consists of unstable soil, this soil shall be removed from the full width of the trench and replaced with a pit run gravel or pipe cradles. Pipe cradles shall be constructed in accordance with Paragraph 3-6. "Cradles" of this specification. Pit run gravel shall vary in size from $\frac{3}{4}$ ", to 3-1/2". The material shall be free from large amounts of organic material such as grass, roots, etc. The Engineer shall determine the depth of removal of unstable soil and the amount of backfill necessary. The cost of removing this unstable soil and replacing it with approved material shall be covered by a supplemental agreement.
- D. The sides of the trench shall be vertical unless otherwise approved by the Engineer. Spaces for the construction of pipe joints shall be excavated accurately to size so that the barrel supports the entire weight of the pipe and so that no less than $\frac{3}{4}$ of the length of the barrel is in continuous contact with the bed. Joint holes shall be large enough to permit easy working under the bottom of the pipe. The bottom of the ditch shall be shaped as shown on the plans.
- E. The Contractor shall install such trench bracing and sheeting as is necessary to protect the excavation, also, as required for the safety and to conform with governing laws. Such installations shall be governed by the requirements set forth under these Specifications, "Sheeting and Bracing."
- F. Unless otherwise provided, the bracing and sheeting shall be removed by the Contractor after the backfilling has been replaced to a point at least 12 inches above the top of the pipe. In no case shall any sheeting or bracing be removed until the backfilling conditions have been met. The cost of bracing and sheeting shall be included in the unit price per foot for the pipe.
- G. The Contractor shall take adequate precautions to prevent damage to all existing utilities. Any utility lines cut or damaged shall be repaired and restored to their former condition as specified on plans.

3.2 TUNNELING

- A. Pipe shall not be laid in tunnel excavation except as shown on the plans or with written permission of the Engineer.

3.3 EXCAVATION IN STREETS

- A. Excavation in streets, together with the maintenance of traffic where specified and the restoration of the pavement riding surface shall be in accordance with plan details or as required by other specifications included in the contract.

3.4 REMOVING OLD STRUCTURES

- A. When old inlets or manholes are encountered and no plan provision is made for adjustments or connection to the new sewers, such manholes and inlets shall be removed completely to a depth 1 foot below the bottom of the trench. In each instance, the bottom of the trench shall be restored to grade by backfilling and compacting by the methods provided hereinafter for backfill. Where the trench cuts through storm or sanitary sewers which are known and blocked

with a concrete plug in a manner satisfactory to the Engineer.

3.5 DEWATERING

- A. Trench: Storm Sewers shall not be constructed or laid in a trench in the presence of water. All water shall be removed from the trench sufficiently prior to the sewer placing operation to insure a dry, firm bed on which to place the sewer, and the trench shall be maintained of water may be accomplished by bailing, pumping, or by a well-point installation as conditions warrant.
- B. In the event that a trench can not be dewatered to the point where the pipe subgrade is free of mud, or it is difficult to keep the reinforcing steel clean in cast-in-place monolithic sewers, a seal shall be used in the bottom of the trench. Such seal shall consist of a lean concrete mixture (not less than 3 sacks of cement per cubic yard), with a minimum depth of 3 inches.

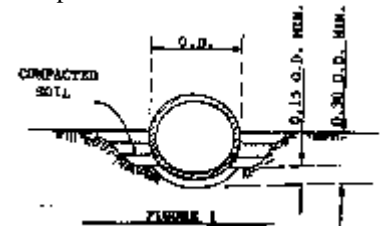
3.6 CRADLES

- A. When, in the opinion of the Engineer, the natural or filled material forming the bottom of the trench does not offer a suitable foundation for the pipe, he shall determine the location and dimensions of the necessary supporting cradles which must be added. These design details shall be shown on plans furnished the Contractor, who will carry out the required work under the Engineer's direction. Payment for any additional work incurred in this operation shall be covered by Supplemental Agreement.

- 1. Class B. Bedding:

The pipe shall be bedded as shown on Figure 1 on fine granular materials over an earth foundation, accurately shaped by means of a template to fit the lower part of the pipe exterior for at least 15 percent of its overall height. Selected materials from excavation or borrow shall then be placed along both sides of the pipe equally in layers not more than 6 inches thick and compacted by mechanical tamps or rammers for the remainder of the lower 30 percent of the overall height of the pipe.

Compacted Soil



3.7 LAYING AND INSTALLING PIPE

- A. The Contractor shall provide and install necessary batterboards, wires or mason's lines to insure installation of the pipe to the lines and grades set by the Engineer. The Contractor's facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench shall be damaged, nor the pipe disturbed that is already laid. The Engineer will inspect all pipe before it is placed in the trench and reject any sections that are damaged by handling or found to be defective to a degree that would affect the functioning of the pipe. Such pipe so rejected shall be immediately removed from the site of the work. Pipe having breaks or defects not sufficient to cause rejection shall be laid in such a way that the break or defect is at the top.
- B. The laying of the pipe in the finished trench shall be started at the lowest point and laid upgrade. The bells on bell and spigot pipe shall be laid upgrade. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform.
- C. No pipe shall be laid within 10 feet so no point where excavation work is in progress or in trenches containing a perceptible amount of water or on ground that is frozen unless special permission has been furnished by the Engineer.
- D. Before leaving the work at night, or any other time, the upper ends of all sewer lines shall be made to keep the line from floating out of place should the trench fill with water. Any damage to the sewer lines from failure to follow these provisions shall be repaired at the Contractor's expense.
- E. Provisions must be made at all times to keep the interior of the pipe that has been laid free from

dirt, silt, gravel and any other foreign matter and any such material that is deposited within the pipe from any cause whatsoever must be removed as the work progresses.

3.8 PIPE JOINTS

- A. The Contractor may utilize Ram-Neck flexible gasket joints provided same meets with the Federal specification SS-S-00210 (GSA-FSS) Type I. If state highway crossing are included in the project, they shall be constructed in accordance with the Texas Department of Transportation Specifications 1993 and shall be subject to their inspection and approval. The Texas Department of Transportation officials shall be notified in writing 48 hours before the work is planned, and if they so desire, their representative may be on hand to supervise the work.

3.9 BACKFILLING

- A. All trenches and excavation shall be backfilled within 24 hours after pipes are installed therein, unless other means of protecting the pipe is directed by the Engineer. At no time, however, shall any backfilling be done until the Engineer has inspected the pipe to be covered. Backfilling material containing stones or rocks exceeding 3 inches in diameter shall not be used adjacent to the pipe or until the fill over the pipe exceeds one foot. Backfilling material containing stones or rocks 3 inches in diameter or over shall not be used in trenches under paved areas. Joint holes shall be filled and tamped ahead of the rest of the backfilling operation. Tamping of these holes shall be sufficient to insure that no air pockets remain under the pipe, but it shall not be carried out to the degree that might disturb the pipe joint.
- B. After the bedding has been prepared and the pipes installed as required by the pertinent specifications, selected materials from excavation or borrow shall be placed along both sides of the pipe equally, in uniform layers not exceeding 6 inches in depth (loose measurement), wetted if required, and thoroughly compacted so that on each side of the pipe there shall be a berm of thoroughly compacted material at least as wide as the external diameter of the pipe, except insofar as the external diameter of the pipe, except insofar as undisturbed material protrudes into this area.
- C. Filling and/or backfilling shall be continued in this manner to the elevation of one foot above the pipe. Special care shall be taken to secure thorough compaction of the materials placed under the haunches of the pipe. All fill or backfill below the top of pipe shall be compacted mechanically in the manner prescribed above, regardless of whether or not such material is placed within the limits of the embankment or roadbed. Hand-operated mechanical tampers may be used with approval of the Engineer for compacting backfill.
- D. In the case of pipe placed in trenches, that portion of the backfill above the top of the pipe which supports the embankment or roadbed shall be mechanically compacted in 6 inch layers.
- E. The top 12 inches of backfill under paved streets shall be placed in two layers, each successive layer being wetted and thoroughly compacted with an approved tamping equipment. The finished surface shall be flush with the existing pavement or surface.
- F. All backfill shall be compacted to not less than 90% of the maximum density at content as determined by procedures set out under AASHTO-180. This compaction shall extend to the entire depth of each layer and the backfill when completed shall be homogeneous and uniformly compacted mass. Water jetting on backfill operations will not be permitted.
- G. If state highway crossings are included in the project, they shall be constructed in accordance with the Texas Department of Transportation Specifications 1993 and shall be subject to their inspection and approval. The Texas Department of Transportation officials shall be notified in writing 48 hours before the work is planned and, if they so desire, their representative may be on hand to supervise the work.

3.10 ADDITIONAL BACKFILLING

- A. Whenever excavation is made for installing pipe culverts or sewers across private property or beyond the limits of the embankment, the top soil removed in excavating the trench shall be kept separate and replaced, as nearly as feasible, in its original position and the entire area involved in the construction operations shall be restored to a presentable condition.

3.11 CLEANING AND RESTORATION OF THE SITE

- A. After the backfill is completed and the Contractor has disposed of all surplus material, dirt and rubbish from the site, the Contractor shall then restore all disturbed areas to their original condition unless otherwise directed by the Engineer.
- B. No work shall be considered complete until the surface conditions at or adjacent to the work are in as good or better condition as existed prior to the start of the job. Omissions of any to the construction features called for in the plans or in the specifications or ordered by the Engineer shall be corrected by the Contractor at his expense.

3.12 INSPECTION

- A. Prior to the final approval of the sewer lines, the Engineer, accompanied by the contractor's representative, shall make a thorough inspection by appropriate methods, of the entire installation. Any indication of defects in material or workmanship or obstruction in the pipe due to the Contractor's negligence shall be corrected by the Contractor without additional compensation and in manner as directed by the Engineer.

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SECTION 02633

PRECAST CONCRETE INLETS, HEADWALLS AND WINGWALLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pre-cast concrete inlets for storm sewers, including cast iron frame and plate or grate.
- B. Pre-cast concrete headwalls and wingwalls for storm sewers.

1.2 REFERENCES

- A. ASTM C 76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- B. ASTM C 270 - Specification for Mortar for Unit Masonry.

1.3 SUBMITTALS

- A. Submittal shall conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit shop drawings for approval of design and construction details for pre-cast concrete inlets, junction box headwalls, and wingwalls. Pre-cast units differing from the standard designs shown on the Drawings will be rejected unless shop drawing submittals are approved.
- C. Submit manufacturer's data and details for frames, grates, rings, and covers.

1.4 STORAGE AND SHIPMENT

- A. Store pre-cast units on level blocking. Do not place loads on them until design strength is reached. Shipment of acceptable units may be made when the 28 day strength requirements have been met.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete: Provide concrete for pre-cast machine-made units meeting requirements of ASTM C 76 regarding reinforced concrete, cement, aggregate, mixture, and concrete test. Minimum 28-day compressive strength shall be 4000 psi.
- B. Reinforcing Steel: Place reinforcing steel to conform to details shown on Drawings and as follows:
 - 1. Provide a positive means for holding steel cages in place throughout production of concrete units. The maximum variation in reinforcement position is plus or minus 10 percent of wall thickness or plus or minus 1/2 inch, whichever is less. Regardless of variation, the minimum cover of concrete over reinforcement as shown on the Drawings shall be maintained.
 - 2. Welding of reinforcing steel is not permitted.
- C. Mortar: Conform to requirements of ASTM C 270 Type S using Portland Cement.
- D. Miscellaneous metal: Cast-iron frames and plates conforming to requirements of Section 02084 - Frames, Grates, Rings, and Covers.

2.2 SOURCE QUALITY CONTROL

- A. Tolerances: Allowable casting tolerances for concrete units are plus or minus 1/4 inch from dimensions shown on the Drawings. Concrete thickness in excess of that required will not constitute cause for rejection provided that such excess thickness does not interfere with proper jointing operations.
- B. Pre-cast Unit Identification: Mark date of manufacture and name or trademark of manufacturer clearly on the inside of inlet, headwall, or wingwall.
- C. Rejection: Pre-cast units may be rejected for non-conformity with these specifications and for any of the following reasons:
 - 1. Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint.
 - 2. Surface defects indicating honeycombed or open texture.
 - 3. Damaged or misshaped ends, where such damage would prevent making a satisfactory joint.
- D. Replacement: Immediately remove rejected units from the work site and replace with acceptable units.
- E. Repairs: Occasional imperfections resulting from manufacture or accidental damage may be repaired if, in the opinion of OWNER, repaired units conform with requirements of these specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify lines and grades are correct.
- B. Verify compacted sub-grade will support loads imposed by inlets.

3.2 INSTALLATION

- A. Install inlets, headwalls, and wingwalls complete in place to the dimensions, lines, and grades as shown on the Drawings.
- B. Excavate in accordance with requirements of Section 02317 - Excavation and Backfill for Utilities.
- C. Bed pre-cast concrete units on foundations of firm, stable material shaped to conform to the shape of unit bases and in strict accordance with the manufacturer's installation guidelines.
- D. Provide adequate means to lift and place concrete units.

3.3 FINISHES

- A. Use a cement-sand mortar mix to seal joints, and fill lifting holes.
- B. When the box section of the inlet has been completed, shape the floor of the inlet with mortar to conform to Drawing details.
- C. Adjust cast iron inlet plate frames to line, grade, and slope shown on Drawings. Grout frame in place with mortar.

3.4 INLET WATERTIGHTNESS

- A. Verify that inlets are free of leaks. Repair leaks in an approved manner.

3.5 CONNECTIONS

- A. Connect inlet leads to the inlets as shown on the Drawings. Use jointing material as shown on the Drawings. Make connections watertight.

3.6 BACKFILL

- A. Backfill the area of excavation surrounding each completed inlet, headwall, or wingwall according to the requirements of Section 02317 - Excavation and Backfill for Utilities.

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SECTION 02921
HYDROMULCH SEEDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the preparation, application and protection of operations consisting of hydro-mulch seeding within the lines and limits as shown on PLANS and as further directed by the ENGINEER.

1.2 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
 - 1. TEXAS DEPARTMENT OF AGRICULTURE (TDA)
 - a. TDA Chapter 61 1994 Texas Seed Law-Rules and Regulations (March Issue)
 - 2. TEXAS DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS AND BRIDGES (TxDOT)
 - a. TxDOT Item 164 1995 Seeding for Erosion Control
 - b. TxDOT Item 166 1995 Fertilizer
 - c. TxDOT Item 168 1995 Vegetative Watering

1.3 QUALITY ASSURANCE

- A. A sample of each variety of seed to be furnished for analysis and testing when directed by the OWNER.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Each variety of seed to be furnished and delivered in separate bags or containers and protected from moisture until placed.

PART 2 - PRODUCTS

2.1 MANUFACTURER(S)

The following cellulose fiber mulch manufacturers are approved for providing hydraulic mulches with the exact trade name of mulches accepted. No variation will be accepted unless approved by the ENGINEER.

Trade Name of Approved Product	Name of Manufacturer	Manufacturer Address
American Fiber Mulch	American Fiber Manufacturing, Inc.	1701 Bench Mark Dr., Austin, TX 78728
Conwed Fibers Hydro Mulch	Conwed Fibers	1st Plaza, Suite 350, 1985 Tate Blvd., SE, Hickory, NC 28601
Second Nature Regenerated Wood Fiber	Central Fiber Corporation	4814 Fiber Lane Rd., Wellsville, KS 66092
Pro Mat	Tascon, Inc.	7607 Fairview, Houston, TX 77041

2.2 MATERIALS AND/OR EQUIPMENT

A. Seed

1. All seed must meet the requirements of the Texas Seed Law FDA Chapter 61 including the labeling requirements for showing pure live seed (PLS = purity x germination), name and type of seed. Seed furnished to be of the previous season's crop and the date of analysis shown on each bag to be within nine months of the time of use on the project. Buffalo grass to be treated with a dormancy method approved by the ENGINEER. The species and varieties of seed to be from among the types specified in Table 1 of Item 164 of the 2004 Texas Department of Transportation Specifications.

B. Planting Season and Seed Mixes

1. Planting seasons and seed mixes to conform to the requirements of Item 164 of the Texas Department of Transportation Specifications and/or as modified hereinafter.

C. Cellulose Fiber Mulch

1. Cellulose Fiber Mulch to be of the type and manufacturer as provided in paragraph 2.01 Manufacturers.
2. The mulch to be designed for use in conventional mechanical planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with fertilizers and other additives. The mulch to be such that, when applied, the material is to form a strong, moisture-retaining mat without the need of an asphalt binder. It shall be kept in a dry condition until applied and shall not be molded or rotted.

D. Fertilizer

1. Fertilizer to be in accordance with the 2004 Texas Department of Transportation Specification Item 166.

E. Water

1. Water to be in accordance with the 2004 Texas Department of Transportation Specification Item 168.

PART 3 - EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION AND/OR CONSTRUCTION

A. Construction Methods

1. After the designated areas have been completed to the lines, grades and cross sections shown on the PLANS, seeding to be performed in accordance with the requirements hereinafter described. Unless otherwise approved by the ENGINEER, all areas to be seeded to be cultivated to a depth of at least four (4) inches, except where seeding is to be done using a seed drill suitable for seeding into untilled soil. The seedbeds to be cultivated sufficiently to reduce the soil to a state of good tilth when the soil particles on the surface are small enough and lie closely enough together to prevent the seed from being covered too deeply for optimum germination. Cultivation of the seedbed will not be required in loose sand where depth of sand is four (4) inches or more.

B. Planting Season and Seed Mixes

Planting season and the required seed mixes to be in accordance with the required table for location of operation as specified in the 2004 Texas Department of Transportation Specification Item 164 as modified hereinafter.

Seed Type	Application Rate per Pounds/Acre	Planting Date(s)
Hulled Common Bermuda Grass 98/88	40	Jan 1 to Mar 31
Unhulled Common Bermuda Grass 98/88	40	Jan 1 to Mar 31
Hulled Common Bermuda Grass 98/88	40	Apr 1 to Sep 30
Hulled Common Bermuda Grass 98/88	40	Oct 1 to Dec 31
Unhulled Common Bermuda Grass 98/88	40	Oct 1 to Dec 31
Annual Rye Grass (Gulf)	30	Oct 1 to Dec 31

C. Water Application

1. Water application to be in accordance with the 2004 Texas Department of Transportation Item 168.

3.2 PROTECTION

A. Maintenance

1. The hydro-mulch seeding to be adequately watered until established. Any areas damaged by erosion or areas that do not have an acceptable turfing to be reseeded.

B. Final Acceptance

1. Final acceptance and payment will be dependent upon hydromulch seeded areas demonstrating a healthy well established growth.

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SECTION 03108

FORMWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Formwork requirements for concrete construction.

B. Related Sections include but are not necessarily limited to:

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.
3. Section 03311 - Concrete Mixing, Placing, Jointing, and Curing.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Concrete Institute (ACI):
 - a. 116R, Cement and Concrete Terminology.
 - b. 347R, Guide to Formwork for Concrete.
2. Building code:
 - a. International Building Code, 2012 Edition with all local Amendments.

B. Qualifications:

1. Formwork, shoring and reshoring to be designed by a professional structural engineer currently registered in the state where the Project is located and having a minimum of three (3) years' experience in this type of design work.
 - a. Above qualifications apply to elevated slabs and beams, and wall and column pours over 15 FT high.

C. Miscellaneous:

1. Design and engineering of formwork, shoring and reshoring as well as its construction is the responsibility of the Contractor.
2. Design requirements:
 - a. Design formwork for loads, lateral pressures and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code.
 - 1) Where conflicts occur between the above two standards, the more stringent requirements shall govern.
 - b. Design formwork to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.
3. For slabs and beams not cast on the ground, develop a procedure and schedule for removal of shores and installation of reshores and for calculating the loads transferred to the structure during this process.
 - a. Perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon.
 - b. When developing procedure, schedule and structural calculations, consider the following at each stage of construction:
 - 1) The structural system that exists.
 - 2) Effects of all loads during construction.
 - 3) Strength of concrete.
 - 4) The influence of deformations of the structure and shoring system on the distribution of dead loads and construction loads.

- 5) The strength and spacing of shores or shoring systems used, as well as the method of shoring, bracing, shore removal, and reshoring including the minimum time intervals between the various operations.
- 6) Any other loading or condition that affects the safety or serviceability of the structure during construction.

1.03 DEFINITIONS

A. Words and terms used in these Specifications are defined in ACI 116R.

1.04 SUBMITTALS

A. Shop Drawings:

1. See Section 01330 for the requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer and type of proposed form materials.
 - d. Manufacturer and type of proposed form ties.
 - e. Manufacturer and type of proposed form coating material.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Stay-in-place forms:
 - a. Alabama Metal Industries Corporation.

B. Submit request for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

A. Forms for Surfaces Exposed to View:

1. Wood forms:
 - a. New 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
 - b. Built-in-place or prefabricated type panel.
 - c. 4 x 8 FT sheets for built-in-place type except where smaller pieces will cover entire area.
 - d. When approved, plywood may be reused.
2. Metal forms:
 - a. Metal forms excluding aluminum may be used.
 - b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.

B. Forms for Surfaces Not Exposed to View:

1. Wood or metal sufficiently tight to prevent leakage.
2. Do not use aluminum forms where the aluminum is contact with fresh concrete.

2.03 ACCESSORIES

A. Form Ties:

1. Commercially fabricated for use in form construction.
 - a. Do not use wire rebar ties.
2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
3. 3/4 IN minimum to 1 IN maximum diameter cones on both ends.
4. Embedded portion of ties to be not less than 1-1/2 IN from face of concrete after ends have been removed.

5. Provide ties with built-in waterstops in all walls that will be in contact with process liquid during plant operation.
6. Through-wall ties that are designed to be entirely removed (taper ties) are not allowed in all walls that will be in contact with process liquid during plant operation.

B. Stay-In-Place Forms:

1. Ribbed expanded metal leave-in-place concrete forms commercially fabricated to provide an intentionally rougher surface.
2. Hot-dipped galvanized.
3. Similar to "Stay-Form" by Alabama Metal Industries Corporation.

PART 3 - EXECUTION

3.01 PREPARATION

A. Form Surface Treatment:

1. Before placing of either reinforcing steel or concrete, cover surfaces of forms with an approved coating material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future finishes.
 - a. A field applied form release agent or sealer of approved type or a factory applied nonabsorptive liner may be used.
2. Do not allow excess form coating material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.

B. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation.

1. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 FT apart.

C. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

3.02 ERECTION

A. Install products in accordance with manufacturer's instructions.

B. Tolerances:

1. Variation from plumb:
 - a. In lines and surfaces of columns, piers, walls, and in risers:
 - 1) Maximum in any 10 FT of height: 1/4 IN.
 - 2) Maximum for entire height: 1/2 IN.
 - b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
 - 1) Maximum in any 20 FT length: 1/4 IN.
 - 2) Maximum for entire length: 1/2 IN.
2. Variation from level or from grades specified:
 - a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores:
 - 1) Maximum in any 10 FT of length: 1/4 IN.
 - 2) Maximum in any bay or in any 20 FT length: 3/8 IN.
 - 3) Maximum for entire length: 3/4 IN.
 - b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
 - 1) Maximum in any bay or in 20 FT length: 1/4 IN.
 - 2) Maximum for entire length: 1/2 IN.
3. Variation of linear structure lines from established position in plan and related position of columns, walls, and partitions:
 - a. Maximum in any bay: 1/2 IN.

- b. Maximum in any 20 FT of length: 1/2 IN.
 - c. Maximum for entire length: 1 IN.
 - 4. Variation in sizes and location of sleeves, floor openings, and wall openings: Maximum of +1/2 IN.
 - 5. Variation in horizontal plan location of beam, column and wall centerlines from required location: Maximum of +1/2 IN.
 - 6. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls: Maximum of -1/4 IN, +1/2 IN.
 - 7. Footings and foundations:
 - a. Variations in concrete dimensions in plan: -1/2 IN, +2 IN.
 - b. Misplacement or eccentricity:
 - 1) 2 percent of footing width in direction of misplacement but not more than 2 IN.
 - c. Thickness:
 - 1) Decrease in specified thickness: 5 percent.
 - 2) Increase in specified thickness: No limit except that which may interfere with other construction.
 - 8. Variation in steps:
 - a. In a flight of stairs:
 - 1) Rise: +1/8 IN.
 - 2) Tread: +1/4 IN.
 - b. In consecutive steps:
 - 1) Rise: +1/16 IN.
 - 2) Tread: +1/8 IN.
 - 9. Establish and maintain in an undisturbed condition and until final completion and acceptance of Project, sufficient control points and bench marks to be used for reference purposes to check tolerances.
 - 10. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary of Project.
 - 11. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete.
- C. Make forms sufficiently tight to prevent loss of mortar from concrete.
- D. Place 3/4 IN chamfer strips in exposed to view corners of forms to produce 3/4 IN wide beveled edges.
- E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement by at least 1 IN.
- 1. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface.
 - 2. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines, control joints or at construction joints.
- F. Where circular walls are to be formed and forms made up of straight sections are proposed for use, provide straight lengths not exceeding 2 FT wide.
- 1. Brace and tie formwork to maintain correct position and shape of members.
- G. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract swelling.
- H. Anchor formwork to shores or other supporting surfaces or members so that movement of any part of formwork system is prevented during concrete placement.
- I. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.
- J. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation.
- 1. Securely brace forms against lateral deflection.

2. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.

K. Stay-In-Place Forms:

1. Support stay-in-place forms as required to maintain the formwork in proper position.
2. Hold the edge of stay-in-place forms back a minimum of 2 IN from all smooth formed concrete surfaces.
3. Stay-in-place forms may be used at the Contractor's option at:
 - a. Surfaces that will be backfilled with soil. Maintain a minimum of 3 IN of concrete cover over all reinforcing.
 - b. Roughened construction joints.
 - c. Other locations approved by Engineer.

3.03 REMOVAL OF FORMS

- A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.
- B. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.
- C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging.
 1. Perform any needed repairs or treatment required on such sloping surfaces at once, followed by curing specified in Section 03311.
- D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.
- E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
- F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in place until concrete has attained its specified 28-day compressive strength.
 1. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.
- G. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

3.04 RESHORING

- A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.
- B. While reshoring is underway, no superimposed dead or live loads shall be permitted on the new construction.
- C. During reshoring do not subject concrete in structural members to combined dead and construction loads in excess of loads that structural members can adequately support.
- D. Place reshores as soon as practicable after stripping operations are complete but in no case later than end of working day on which stripping occurs.
- E. Tighten reshores to carry their required loads without overstressing.

F. Shoring, reshoring and supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.

END OF SECTION

SECTION 03208

REINFORCEMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bar requirements for concrete construction.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.

1.02 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. SP-66, ACI Detailing Manual.
 - b. 318, Building Code Requirements for Structural Concrete.
 - 2. ASTM International (ASTM):
 - a. A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - b. A497, Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - c. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement (Including Supplementary Requirements S1).
 - d. A706, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - e. A775, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - 3. American Welding Society (AWS):
 - a. D1.4, Structural Welding Code Reinforcing Steel.
 - 4. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.
- B. Qualifications:
 - 1. Welding operators, processes and procedures to be qualified in accordance with AWS D1.4.
 - 2. Welding operators to have been qualified during the previous 12 months prior to commencement of welding.

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Mill certificates for all reinforcing.
 - d. Manufacture and type of proprietary rebar mechanical splices.
 - e. Manufacturer and type of rebar adhesive anchor including installation instructions.
 - 2. Qualifications of welding operators, welding processes and procedures.
 - 3. Rebar number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and rebar supports.
 - 4. Sufficient rebar details to permit installation of reinforcing.
 - 5. Rebar details in accordance with ACI SP-66.
 - 6. Locations where proprietary rebar mechanical splices are required or proposed for use.
 - 7. Shop Drawings shall be in sufficient detail to permit installation of reinforcing without

reference to Contract Drawings. Shop Drawings shall not be prepared by reproducing the plans and details indicated on the Contract Drawings but shall consist of completely redrawn plans and details as necessary to depict complete fabrication and installation of all reinforcing steel.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Support and store all reinforcing above ground.
- B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match the Shop Drawing mark numbers.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURES

- A. Subject to compliance with Contract Documents, the following Manufacturers are acceptable:
 - 1. Rebar adhesive anchors:
 - a. HIT-HY150 Max System by HILTI FASTENING SYSTEMS, INC.
 - b. HIT-RE 500 SD System by HILTI FASTENING SYSTEMS, INC.
 - c. HIT-HY20
 - 2. Rebar mechanical splices:
 - a. Lenton Rebar Splicing by Erico, Inc.
 - b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.
 - c. Bar-Grip Systems by Barsplice Products, Inc.
- B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

- A. Reinforcing Bars: ASTM A615, grade 60, deformed.
- B. Reinforcing Bars to be Welded: ASTM A706.
- C. Welded Wire Fabric: ASTM A185 or ASTM A497.
- D. Smooth Dowel Bars: ASTM A615, grade 60 with metal end cap to allow longitudinal movement equal to joint width plus 1 IN.
- E. Proprietary Rebar Mechanical Splices: To develop in tension and compression a minimum of 125 percent of the yield strength of the rebars being spliced.
- F. Welding Electrodes:
 - 1. E90 meeting requirements of AWS D1.4.
- G. Rebar Adhesive Anchors:
 - 1. Manufactured for the specific purpose of embedding and developing 125 percent of the yield strength of rebars in hardened concrete.
 - a. See Specification 05505 for additional requirements.

2.03 ACCESSORIES

- A. Metal Chairs, Runners, Bolsters, Spacers, Hangers, and Other Rebar Supports:
 - 1. Plastic-coated tips in contact with forms.
 - 2. Plastic coating meeting requirements of CRSI Manual of Standard Practice.
- B. Protective plastic caps at mechanical splices.

2.04 FABRICATION

- A. Tolerances:
 - 1. Sheared lengths: +1 IN.
 - 2. Overall dimensions of stirrups, ties and spirals: +1/2 IN.

3. All other bends: +0 IN, -1/2 IN.
- B. Minimum diameter of bends measured on the inside of the rebar to be as indicated in ACI 318 Paragraph 7.2.
- C. Ship rebars to jobsite with attached plastic or metal tags.
 1. Place on each tag the mark number of the rebar corresponding to the mark number indicated on the Shop Drawing.
 2. Mark numbers on tags to be so placed that the numbers cannot be removed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Tolerances:
 1. Rebar placement:
 - a. Clear distance to formed surfaces: +1/4 IN.
 - b. Minimum spacing between bars: -1/4 IN.
 - c. Top bars in slabs and beams:
 - 1) Members 8 IN deep or less: +1/4 IN.
 - 2) Members between 8 IN and 2 FT deep: -1/4 IN, +1/2 IN.
 - 3) Members more than 2 FT deep: -1/4 IN, +1 IN.
 - d. Crosswise of members: Spaced evenly within +1 IN.
 - e. Lengthwise of members: +2 IN.
 2. Minimum clear distances between rebars:
 - a. Beams, walls and slabs: Distance equal to rebar diameter, 1 IN, or 1.33 times the maximum aggregate size, whichever is greater.
 - b. Columns: Distance equal to 1-1/2 times the rebar diameter, 1-1/2 IN, or 1.33 times the maximum aggregate size whichever is greater.
 - c. Beam and slab rebars shall be threaded through the column vertical rebars without displacing the column vertical rebars and still maintaining the clear distances required for the beam and slab rebars.
 - d. See drawings for additional requirements. The most stringent shall govern.
- B. Minimum concrete protective covering for reinforcement: As shown on Drawings.
- C. Unless indicated otherwise on Drawings, provide splice lengths for reinforcing as follows:
 1. For rebars: Class B splice meeting the requirements of Paragraph 12.15 of ACI 318.
 2. For welded wire fabric: Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than 1 spacing of cross wires plus 2 IN, nor less than 1.5 x development length nor less than 6 IN. Development length shall be as required for the yield strength of the welded wire fabric in accordance with Paragraph 12.8 of ACI 318.
 3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer. Mechanical proprietary splice connectors may only be used when approved or indicated on the Contract Drawings.
- D. Welding:
 1. Obtain approval by the Engineer prior to welding reinforcing.
 2. Perform welding of rebars in accordance with requirements of AWS D1.4.
 3. Have each welder place an approved identifying mark near each completed weld.
- E. Placing Rebars:
 1. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials that may affect or reduce bond.
 2. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample is not less than required by applicable ASTM specification that governs for the rebar supplied.

3. Rebar support:
 - a. Uncoated rebar:
 - 1) Support rebars and fasten together to prevent displacement by construction loads or placing of concrete.
 - 2) On ground, provide supporting concrete blocks or metal bar supports with bottom plate.
 - a) Do not use concrete blocks to support slab-on-grade reinforcing.
 - 3) Over formwork, provide plastic-coated metal chairs, runners, bolsters, spacers, hangers and other rebar support. Only tips in contact with the forms need to be plastic coated.
4. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, rebars in the upper layers shall be placed directly above rebars in the bottom layer with clear distance between layers to be 1 IN. Place spacer rebars at 3 FT maximum centers to maintain the required 1 IN clear distance between layers.
5. Extend reinforcement to within 2 IN of concrete perimeter edges. If perimeter edge is formed by earth or stay-in-place forms, extend reinforcement to within 3 IN of the edge.
6. To assure proper placement, furnish templates for all column vertical bars and dowels.
7. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer. Do not bend reinforcing by means of heat.
8. Do not tack weld reinforcing.
9. Embed rebars into hardened concrete utilizing adhesive anchor system specifically manufactured for such installation:
 - a. Drill hole in concrete with diameter and depth as required to develop 125 percent of the yield strength of the bar according to manufacturer's requirements.
 - b. Place adhesive in drilled hole.
 - c. Insert rebar into hole and adhesive in accordance with manufacturer's instructions.
 - d. See specifications 05505 for adhesives.

3.02 FIELD QUALITY CONTROL

- A. Reinforcement Congestion and Interferences:
 1. Notify Engineer whenever the specified clearances between rebars cannot be met.
 2. Do not place any concrete until the Engineer submits a solution to rebar congestion problem.
 3. Rebars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
 4. If rebars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of rebars.
 5. No cutting of rebars shall be done without written approval of Engineer.
- B. Employ a testing laboratory to perform and report following:
 1. Review and approve Contractor proposed welding procedures and processes for conformance with AWS D1.4.
 2. Qualify welders in accord with AWS D1.4.
 3. Test three samples of each bar size and each type of weld in accord with AWS D1.4. The tensile strength of each test shall be not less than 125 percent of the required yield strength of the rebar tested.
 4. Conduct nondestructive field tests (radiographic or magnetic particle) on not less than one random sample for each 10 welds. In addition if any welds are found defective, test five previous welds performed by same welder.
 5. Visually inspect each weld for presence of cracks, undercuts, inadequate size and other visible defects.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
- B. Cast-in-place concrete includes the following:
 - 1. Foundations and footings.
 - 2. Slabs-on-grade.
 - 3. Equipment pads and bases.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 2 Section "Portland Cement Concrete Paving" for concrete paving and walks.

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of the Contract and Division 1 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 Engineer.
- C. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI SP-66 (88), □ ACI Detailing manual," 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. Engineer'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 Engineer, including names, sources, and descriptions, as follows:
 - 1. Color finishes.
 - 2. Normal weight aggregates.
 - 3. Reglets.
 - 4. Waterstops.
 - 5. Vapor retarder/barrier.
- F. Laboratory test reports for concrete materials and mix design test. |

CAST-IN-PLACE CONCRETE

03300-1 OF 18

IFB: 06-10-2020

- G. Material certificates in lieu of material laboratory test reports when permitted by Engineer. 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. |

1.4 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: Owner to engage an independent testing laboratory acceptable to Engineer 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. Mockup: Cast mockup of size indicated or as required to demonstrate typical joints, form tie spacing, and proposed surface finish, texture, and color. Maintain sample panel exposed to view for duration of Project, after Architect's acceptance of visual qualities.
1. Demolish mockup and remove from site when directed by Architect. |
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings" and the following: |
1. At least 15 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

2.1 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.
1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I. |

CAST-IN-PLACE CONCRETE

2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
 3. No form tie cone holes. Patching of form tie holes will not be allowed.
- 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 mg/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.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 40 for No. 3 bars, Grade 60 for No. 4 bars and larger, deformed.
- B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.
- D. Deformed-Steel Welded Wire Fabric: ASTM A 497.
- E. Supports for Reinforcement: Bolsters, chairs, ACI approved precast concrete block supports, 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).

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
1. Use one brand of cement throughout Project unless otherwise acceptable to Engineer of Record.
- B. 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 Engineer.
- C. Lightweight Aggregates: ASTM C 330.
1. Nominal maximum aggregate size: 1/4 inch.
- 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: |
 2. Products: Subject to compliance with requirements, provide one of 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: |
 2. Products: Subject to compliance with requirements, provide one of 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: |
 2. Products: Subject to compliance with requirements, provide one of 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: |
 2. Products: Subject to compliance with requirements, provide one of 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:
2. Products: Subject to compliance with requirements, provide one of 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.

2.4 RELATED MATERIALS

- A. Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217-inch-thick (26-gage) 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 (22 gage) with bent tab anchors. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.
- C. Waterstops: Provide flat, dumbbell-type or centerbulb-type waterstops at construction joints and other joints as indicated. Size to suit joints.
- D. Rubber Waterstops: Corps of Engineers CRD-C 513.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. The Burke Co.
 - b. Progress Unlimited.
 - c. Williams Products, Inc.
- E. Polyvinyl Chloride Waterstops: Corps of Engineers CRD-C 572.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. The Burke Co.
 - b. Greenstreak Plastic Products Co.
 - c. W.R. Meadows, Inc.
 - d. Progress Unlimited.
 - e. Schlegel Corp.
 - f. Vinylex Corp.
- F. Sand Cushion: Clean, manufactured or natural sand.
- G. 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 10 mils thick lapped 12" min and sealed at all joints.
- H. Nonslip Aggregate Finish: Provide fused aluminum oxide granules or crushed emery as the abrasive aggregate for a nonslip finish, with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rustproof, nonglazing, and unaffected by freezing, moisture, and cleaning materials.
- I. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- J. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
 1. Waterproof paper.
 2. Polyethylene film.
 3. Polyethylene-coated burlap.
- K. 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. meter when applied at 200 sq. ft./gal.
 1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 mg per liter.
 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 3. Products: Subject to compliance with requirements, provide one of 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.
- L. Water-Based Acrylic Membrane Curing Compound: ASTM C 309, Type I, Class B.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of 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.
- M. 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: |
2. Products: Subject to compliance with requirements, provide one of 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.

N. 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: |
2. Products: Subject to compliance with requirements, provide one of 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.

O. 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: |
2. Products: Subject to compliance with requirements, provide one of 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. Epoxitite Binder 2390, A.C. Horn, Inc.
 - f. Epabond, L&M Construction Chemicals, Inc.
 - g. Concsive Standard Liquid, Master Builders, Inc.

CAST-IN-PLACE CONCRETE

03300-7 OF 18

IFB: 06-10-2020

- 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.

2.5 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 Engineer for preparing and reporting proposed mix designs.
 - 1. **Do not use the same testing agency for field quality control testing.**
 - 2. **Use of fly ash or calcium chloride** will not be permitted in concrete, unless noted otherwise.
- 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 Engineer.
- 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). For slabs on grade, grade beam, loading docks & ramps.
 - 2. 2500-psi, 28-day compressive strength; water-cement ratio, 0.67 maximum (non-air-entrained), 0.54 maximum (air-entrained). For miscellaneous sidewalks and curbs not otherwise called out to have a higher strength.
- 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.
- 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 5 inches.
 - 3. Concrete containing high-range water-reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to site-verified 2-to-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 Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in Work.

2.6 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 (10 deg C).
- 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 admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

2.7 CONCRETE MIXING |

- A. Job-Site Mixing: Mix concrete materials in appropriate drum-type batch machine mixer. For mixers of 1 cu. yd. or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than 1 cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd.
1. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
- B. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.
1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.2 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.

3.3 VAPOR RETARDER/BARRIER INSTALLATION |

- A. General: Place vapor retarder/barrier sheeting in position with longest dimension parallel with direction of pour.
- B. Lap joints 12 inches and seal with manufacturer's recommended mastic or pressure-sensitive tape. |

3.4 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 Engineer.
- 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.

3.5 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. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's printed instructions. |
- F. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact

CAST-IN-PLACE CONCRETE

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." |

G. 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 feet 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 "Joint Sealants."

3.6 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.

3.7 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. |

1. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.8 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 (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) 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 (32 deg C). 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.

3.9 FINISHING FORMED SURFACES |

- A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view

CAST-IN-PLACE CONCRETE

03300-12 OF 18

IFB: 06-10-2020

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 3/4 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. Smooth-Rubbed Finish: Provide smooth-rubbed finish on scheduled concrete surfaces that have received smooth-formed finish treatment not later than 1 day after form removal.
 - 1. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. 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.
- E. 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) 25 (floor flatness) and F(L) 20 (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) 50 (floor flatness) and F(L) 35 (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) 50 (floor flatness) and F(L) 35 (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.
- F. Nonslip Aggregate Finish: Apply nonslip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and where indicated.
1. After completing float finishing and before starting trowel finish, uniformly spread 25 lb of dampened nonslip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified.
2. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose nonslip aggregate.

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 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. 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.

G. 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 (10 deg C) 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 3/4 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. Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- F. Perform structural repairs with prior approval of Engineer for method and procedure, using specified epoxy adhesive and mortar.
- G. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. General: The Owner will employ a testing agency to perform tests and to submit test reports.

- B. Sampling and testing for quality control during concrete placement may include the following, as directed by Engineer.
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 (4 deg C) and below, when 80 deg F (27 deg C) 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.
 - f. For drilled piers, u.n.o., there shall be (1) set of compressive strength test for each 10 cu. Yds.
 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., Engineer 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 03300

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SECTION 03308
CONCRETE, MATERIALS AND PROPORTIONING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete materials, strengths and proportioning for concrete work.
 - 2. Grouting:
 - a. Base plates for columns and equipment.
 - b. Dowels and anchors into concrete.
 - c. Patching cavities in concrete.
 - d. As specified and indicated in the Contract Documents.
- B. Related Section include but are not necessarily limited to:
 - 1. Division 0 – Bidding Requirements, Contract Forms, and Conditions of Contract.
 - 2. Division 1 – General Requirements.
 - 3. Section 03108 – Formwork.
 - 4. Section 03208 – Reinforcement.
 - 5. Section 03311 – Concrete Mixing, Placing, Jointing and Curing
 - 6. Section 03348 – Concrete finishing and Repair of Surface Defects.
 - 7. Section 03350 – Testing.

1.02 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 116R, Cement and Concrete Terminology.
 - b. 207, Mass Concrete.
 - c. 211.1, Standard Practice for Selecting Proportions for Normal and Heavyweight Concrete.
 - d. 211.2, Standard Practice for Selecting Proportions for Normal and Lightweight Concrete.
 - e. 212.3R, Chemical Admixtures for Concrete.
 - f. 224, Control of Cracking in Concrete Structures.
 - g. 226.1, Ground Blast-Furnace Slag as a Cementitious Constituent in Concrete.
 - h. 226.3R, Use of Fly Ash in Concrete.
 - i. 318-05, Building Code Requirements for Structural Concrete.
 - j. 350-06, Environmental Engineering Concrete Structures.
 - 2. American Society for Testing and Materials (ASTM):
 - a. C33, Standard Specification Concrete Aggregates.
 - b. C39, Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens.
 - c. C94, Standard Specification for Ready Mixed Concrete.
 - d. C138, Standard Method of Test for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
 - e. C143, Standard Method of Test for Slump of Portland Cement Concrete.
 - f. C150, Standard Specification for Portland Cement.
 - g. C173, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - h. C192, Standard Method of Making and Curing Concrete Test Specimens in the Laboratory.
 - i. C231, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.

CONCRETE, MATERIALS AND PROPORTIONING

- j. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
- k. C494, Standard Specification for Chemical Admixtures for Concrete.
- l. C618, Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- m. C989, Standard Specification for Ground Iron Blast Furnace Slag for Use in Concrete and Mortars.
- n. C1116, Standard Specification for Fiber - Reinforced Concrete and Shotcrete.
- 3. Corps of Engineers Specification:
 - a. CRD-C621, Specification for Non-Shrink Grout.
- 4. Building Code: International Building Code, 2006 Edition, with all local amendments.

1.03 DEFINITIONS

- A. Words and terms used in these Specifications are defined in Cement and Concrete Terminology ACI 116R.
- B. Mass Concrete: Any placement of structural concrete where the minimum finished dimension placed exceeds 3 FT and the ratio of the finished volume of concrete to the finished surface area is greater than 12 IN.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01330.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's instructions.
 - c. Concrete mix designs as required by Section 03350.
 - 1) Manufacturer and type of proposed admixtures.
 - 2) Manufacturer and type of proposed non-shrink grout and grout cure/seal compound.
 - 3. Certifications:
 - a. Certification of standard deviation value in psi for ready mix plant supplying the concrete.
 - b. Certification that the pozzolan meets the quality requirements stated in this Section, and supplier's certified test reports for each shipment of pozzolan delivered to concrete supplier.
 - c. Certification that the class of coarse aggregate meets the requirements of ASTM C33 for type and location of concrete construction.
 - d. Certification of aggregate gradation.
 - 4. Test reports:
 - a. Cement mill reports for all cement to be supplied.
 - 5. Mass concrete temperature and cracking control:
 - a. See Section 03311 for additional items relating to mass concrete temperature control.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Storage of Materials:
 - 1. Store cement and pozzolan in weathertight buildings, bins, or silos which will exclude moisture and contaminants.
 - 2. Arrange aggregate stockpiles and use in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates.
 - a. Wash coarse aggregates as required herein.
 - 3. Allow sand to drain until it has reached a relatively uniform moisture content before use.
 - 4. Do not use frozen or partially frozen aggregates.
 - 5. Do not use bottom 6 IN layer of stockpiled material in contact with ground.
 - 6. Store admixtures in such a manner as to avoid contamination, evaporation, or damage.
 - a. For those used in form of suspensions or nonstable solutions, provide agitating

- equipment to assure thorough distribution of ingredients.
- b. Protect liquid admixtures from freezing and temperature changes which would adversely affect their characteristics and performance.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Non-shrink grout:
 - a. Master Builders Technology "Masterflow 713."
 - b. Gifford Hill "Supreme Grout."
 - c. U.S. Grout "Five Star Grout."
 - d. Sika "Sika Grout 212."
 - e. L & M, "Crystex."
 - f. Or approved equal.
 - 2. Epoxy grout:
 - a. Ceilcote.
 - b. Exxon Chemical Co.
 - c. Sika.
 - d. U.S. Grout.
 - e. Or approved equal.
- B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

- A. Cement:
 - 1. ASTM C150, Type II or I/II for all concrete.
- B. Fly Ash:
 - 1. ASTM C618, Class F or C.
 - 2. Non-staining.
 - 3. Suited to provide hardened concrete of uniform light grey color.
 - 4. Maximum loss on ignition: 4 percent.
 - 5. Compatible with other concrete ingredients and having no deleterious effects on the hardened concrete.
 - 6. Produced by source approved by the Texas DOT for use in bridge concrete.
 - 7. Cement and fly ash type used shall correspond to that upon which selection of concrete proportions was based in the mix design.
- C. Ground Granulated Blast Furnace Slag (GGBFS)
 - 1. ASTM C989, Grade 120.
 - 2. Non-staining.
 - 3. Compatible with other concrete components.
 - 4. Obtain proposed GGBFS from a source approved by the Texas Department of Transportation for use in reinforced concrete.
 - 5. Admixtures:
 - a. Air entraining: ASTM C260.
 - b. Water reducing, retarding, and accelerating: Conform to ASTM C494, Types A through E, and provisions of ACI 212.3R.
 - c. High range water reducers (superplasticizers):
 - d. Conform to ASTM C494, Types F or G.
 - e. Pozzolan: ASTM C618.
 - 6. Admixtures to be chloride free. Do not use calcium chloride.
 - 7. Provide admixtures of same type, manufacturer and quantity as used in establishing required

concrete proportions in the mix design.

- D. Water:
 - 1. Potable, containing less than 50 ppm of chlorides.
 - 2. Clean and free from deleterious substances.
 - 3. Free of oils, acids and organic matter.
- E. Aggregates for Normal Weight Concrete:
 - 1. ASTM C33.
 - 2. Fine and coarse aggregates to be regarded as separate ingredients.
 - 3. Coarse aggregate:
 - a. For lean concrete, concrete fill, and concrete topping less than 3-IN in thickness: ASTM C33, size number 7 (maximum 1/2 IN).
 - b. For slabs on grade greater than 18 IN thick mass concrete, and foundation mats greater than 18 IN thick: ASTM C33, size number 467 (maximum 1 1/2 IN), or size number 57.
 - c. For all other concrete: ASTM C33, size number 57 (maximum 1 IN) or size number 67 (maximum 3/4 IN).
 - d. Use only washed aggregates.
 - 4. Fine aggregates to be natural, not manufactured.
 - 5. Pozzolan or other additives shall not be used to compensate for alkali reactivity of aggregates.
- F. Maximum total chloride ion content for concrete mix including all ingredients measured as a weight percent of cement:
 - 1. 0.10 for all cast-in-place concrete.
 - 2. 0.06 for precast concrete.
 - 3. Do not use calcium chloride.
- G. Sand Cement Grout (referred to as "Grout" on the Drawings):
 - 1. Approximately 3 parts sand, 1 part portland cement, 6 plus/ minus 1 percent entrained air and water to produce a slump which allows grout to completely fill required areas and surround adjacent reinforcing.
 - a. Provide sand in accordance with requirements for fine aggregate for concrete.
 - 2. Minimum 28-day compressive strength: 3000 psi minimum, but shall be at least strength of parent concrete when used at construction joints for bonding.
- H. Nonshrink Grout:
 - 1. Nonmetallic, noncorrosive, and nonstaining.
 - 2. Premixed with only water to be added in accordance with manufacturer's instructions at jobsite.
 - 3. Grout to produce a positive but controlled expansion. Mass expansion shall not be created by gas liberation or by other means.
 - 4. Minimum 28-day compressive strength: 6500 psi.
 - 5. In accordance with CRD-C621.
- I. Epoxy Grout:
 - 1. Adhesive:
 - a. Ceilcote "HT648" grout.
 - b. Exxon Chemical Company "Escoweld 2505."
 - c. Sika "Sikadur Hi-Mod."
 - d. U S Grout "Five Star Epoxy Grout."
 - e. Or equal.
 - 2. Aggregate:
 - a. Ceilcote "HT648."
 - b. Exxon Chemical Company "Escoweld 2510."
 - c. Sika aggregate.
 - d. U S Grout aggregate.
 - e. Or equal.
 - 3. Aggregate manufacturer shall be the same as the adhesive manufacturer.

CONCRETE, MATERIALS AND PROPORTIONING

4. The aggregate shall be compatible with the adhesive.
 5. Each component to be furnished in separate package for job site mixing.
- J. See Section 03311 for Grout Schedule of use.

2.03 MIXES

A. General:

1. Provide concrete capable of being placed without aggregate segregation and, when cured, of developing all properties specified.
2. All concrete to be normal weight concrete, weighing approximately 145 to 150 LBS per cubic foot at 28 days after placement.
3. All ready-mix concrete shall comply with ASTM C94.
4. Blend in all components and additives at batch plant, unless noted otherwise.
5. Provide fly ash content for ready mixed concrete.

B. Minimum 28-Day Compressive Strengths:

1. Normal weight fill concrete 2,500 psi.
2. Normal weight lean concrete..... 2,500 psi.
3. Pavement, curbs, sidewalks, pipe encasement 3,000 psi.
4. Normal weight all other cast-in-place concrete, unless noted ... 4,000 psi.
5. Mass concrete 4,000 psi.
6. Chemical Building foundations, and where specifically indicated. 4,500 psi.
7. Precast Concrete..... 5,000 psi

C. Air Entrainment:

1. Provide air entrainment in all exterior or fluid-retaining concrete resulting in a total air content percent by volume as follows:
 - a. 1 ½ IN maximum aggregate size: 3 +/- 1 percent total air content.
 - b. 1-inch and ¾ IN maximum aggregate size: 3 +/- 1 percent total air content.
 - c. 1/2 IN maximum aggregate size: 3 +/- 1 percent total air content.
 - d. 3% maximum air for concrete slabs to be trowel-finished.
 - e. Higher air contents may be considered for mass concrete mix design optimization.
 - f. Higher air contents may be proposed by Contractor for workability, subject to approval by Engineer and satisfaction of compressive strength requirements.

D. Slump:

1. 5 IN maximum, 1 IN minimum measured at point of discharge for beams, columns and walls, for mixes without superplasticizer.
2. 8 IN maximum after addition of superplasticizer (reference "Proportioning" paragraph).
3. 4 IN maximum, 1 IN minimum measured at point of discharge into all other concrete construction members.
4. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.
5. Provide additional water at ready mix plant for concrete that is to be pumped to allow for slump loss due to pumping. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified.
6. Slump requirements for mass concrete shall be required in the optimized mix design submitted by Contractor's mass concrete consultant and approved by ENGINEER.

E. Proportioning:

1. General:
 - a. Proportion ingredients to produce a mixture which will work readily into corners and angles of forms and around reinforcement by methods of placement and consolidation employed without permitting materials to segregate or excessive free water to collect on surface.
 - b. Proportion ingredients to produce proper place ability, durability, strength and other required properties.
2. Normal weight concrete minimum cement content and maximum water to cement ratios:

Specified Strength (psi) at 28 days	Minimum Cement Content (Sacks/CY)	Minimum Cement (Lbs/CY)	Maximum Water Cement Ratio By Weight
5,000	7	658	0.40
4,000-4,500 w/1-1/2" Aggr.*	5.7	536	0.42
4,000 – 4,500 w/1" and 3/4" Aggr.	6	564	0.42
3,000 - 2,500	5.5	517	0.48

** The above cement contents may be reduced, together with the maximum W/C ratio, for mass concrete placements. The required compressive strength shall not be reduced. 90-day concrete cylinder tests may be utilized to verify compressive strength for mass concrete mix designs and placements, in lieu of 28-day concrete cylinder tests.*

3. Fly Ash:
 - a. For cast-in-place concrete only, 15 to 20 percent by weight of Portland cement content per cubic yard may be replaced with fly ash at a rate of 1 LB fly ash for 1 LB cement.
4. GGBFS:
 - a. Quantity of GGBFS substitution for cement shall be in accordance with approved mix design for mass concrete.
5. Water reducing, retarding, and accelerating admixtures:
 - a. Use in accordance with manufacturer's instructions.
 - b. Add to mix at batching plant.
6. High range water reducers (superplasticizers):
 - a. Engineer's approval required prior to use.
 - b. Use in accordance with manufacturer's instructions.
 - c. Maximum concrete slump before addition of admixture to be 3 IN. Maximum slump after addition to be 8 IN.
 - d. Reference Section 03311 "Placing of Concrete" for additional requirements.
7. Concrete mix proportioning methods for normal weight concrete:
 - a. Method 1:
 - 1) Used when combination of materials proposed is to be evaluated and proportions selected to be on a basis of trial mixes.
 - 2) Produce mixes having suitable proportions and consistencies based on ACI 211.1, using at least three different water cement ratios or cement contents which will produce a range of compressive strengths encompassing the required average strength.
 - 3) Design trial mixes to produce a slump within 0.75 IN of maximum specified, and for air entrained concrete, air content within 0.5 percent specified.
 - 4) For each water cement ratio or cement content, make at least three compression test cylinders for specified test age, and cure in accordance with ASTM C192. Test for strength at 28 days in accordance with ASTM C39.
 - 5) From results of these tests, plot a curve showing relationship between water cement ratio or cement content and compressive strength.
 - 6) From this curve select water cement ratio or cement content to be used to produce

CONCRETE, MATERIALS AND PROPORTIONING

03308 - 6 OF 8

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required average strength.

- 7) Use cement content and mixture proportions such that maximum water cement ratio is not exceeded when slump is maximum specified.
 - 8) Base field control on maintenance of proper cement content, slump, air content and water cement ratio.
 - 9) See paragraph hereafter for definition of required average strength.
- b. Method 2:
- 1) In lieu of trial mixes, field test records for concrete made with similar ingredients may be used.
 - 2) Use of proposed concrete mix proportions based on field test records subject to approval by Engineer based on information contained in field test records and demonstrated ability to provide the required average strength.
 - 3) Field test records to represent materials, proportions and conditions similar to those specified. Changes in the materials, proportions and conditions within the test records shall have not been more restricted than those for the proposed concrete mix.
 - 4) Field test records to consist of less than 30 but not less than 10 consecutive tests, provided the tests encompass a period of not less than 45 consecutive days.
 - 5) Required concrete proportions may be established by interpolation between the strengths and proportions of two or more test records, each of which meets the requirements of this Section.
8. Required average strength: Required average strength to exceed the specified 28-day compressive strength by the amount determined or calculated in accordance with paragraph 5.3 of ACI 318 using the standard deviation of the proposed concrete production facility as described in paragraph 5.3.1 of ACI 318.
- a. Mass concrete compressive strengths may be based on 90-day results.

2.04 SOURCE QUALITY CONTROL

- A. To assure stockpiles are not contaminated or materials are segregated, perform any test for determining conformance to requirements for cleanliness and grading on samples secured from aggregates at point of batching.
- B. Do not use frozen or partially frozen aggregates.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Perform tests per Section 03350 requirements.
- B. Perform strength test on any concrete to which water has been added at the jobsite.
- C. Reference Section 03311 for grout use schedule.

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SECTION 03311
CONCRETE MIXING, PLACING, JOINTING, AND CURING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Mixing, placing, jointing, and curing of concrete construction.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 – General Requirements.
 - 3. Section 03108 – Formwork.
 - 4. Section 03208 – Reinforcement.
 - 5. Section 03308 – Concrete, Materials, and Proportioning.
 - 6. Section 03348 – Concrete Finishing and Repair of Surfaces Defects.
 - 7. Section 03350 – Testing.
 - 8. Section 07900 – Joint Sealants.
 - 9. Section 15090 – Pipe Support Systems.

1.02 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 116R, Cement and Concrete Terminology.
 - b. 207, Mass Concrete.
 - c. 224, Control of Cracking in Concrete Structures.
 - d. 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - e. 304.2R, Placing Concrete by Pumping Methods.
 - f. 305R, Hot Weather Concreting.
 - g. 306R, Cold Weather Concreting.
 - h. 308, Standard Practice for Curing Concrete.
 - i. 309R, Guide for Consolidation of Concrete.
 - j. 318, Building Code Requirements for Structural Concrete.
 - k. 350-06, Environmental Engineering Concrete Structures.
 - 2. American Society for Testing and Materials (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. C94, Standard Specification for Ready-Mixed Concrete.
 - c. C171, Standard Specification for Sheet Materials for Curing Concrete.
 - d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - e. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
 - f. D1056, Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber.
 - g. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).
 - 3. Corps of Engineers:
 - a. CRD-C572, Standard Specification for Polyvinyl Waterstops.
 - 4. National Ready Mixed Concrete Association (NRMCA):
 - a. Check List for Certification of Ready Mixed Concrete Production Facilities.
- B. Qualifications:
 - 1. Ready Mixed Concrete Batch Plant: Certified by NRMCA.

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01330.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's mixing and installation instructions.
 - 1) Procedure for adding high-range water reducer (as applicable).
 - c. Scaled (minimum 1/8 IN per foot) drawings showing proposed locations of construction joints and joint keyway dimensions.
 - d. Manufacturers and types:
 - 1) Joint fillers.
 - 2) Construction joint bonding agent.
 - 3) Waterstops.
 - 3. Certifications
 - a. Ready mix concrete plant certification.
 - b. Waterstops: Products shipped meet or exceed the physical properties specified.
- B. Samples:
 - 1. Waterstops
 - a. Extruded or molded section: Each size and shape.
 - b. Fabricated intersection fittings: Each size and shape.
 - c. Must be representative in all respects:
 - 1) Materials.
 - 2) Fabrication.
 - 3) Obtain approval before manufacture of sections.
- C. Miscellaneous:
 - 1. Copies of concrete delivery tickets.
 - 2. Description of proposed curing method.
 - 3. Mass Concrete Temperature and Cracking Control:
 - a. The Contractor shall retain a mass concrete placement consultant to determine appropriate procedures to control maximum temperatures and temperature differentials in mass concrete placements. The details of the mass concrete temperature control plan shall be submitted to the Engineer for approval. The mass concrete placement consultant shall have at least 5 years experience in designing concrete temperature control procedures similar to those required for the work.
 - 1) Potential temperature control procedures shall include, but not limited to, mix design optimization, mix design material selection, pre-cooling of concrete, post-cooling of concrete, and use of insulation. Materials available for mix design optimization shall include flyash, GGBFS, blended cements, and water reducers. 90-day concrete cylinder tests may be utilized to verify compressive strength for mass concrete mix designs and placements, in lieu of 28-day concrete cylinder tests.
 - 2) The maximum concrete temperature following placement shall be 150 deg F.
 - 3) The maximum concrete temperature differential between the concrete interior and exterior surface shall be 35 deg F, unless a higher temperature differential can be demonstrated to be acceptable, and approved by the Engineer.
 - 4) Temperature control measures shall be in accordance with ACI 207 and ACI 224.
 - b. Additional Mass Concrete Temperature Control submittal items shall include:
 - 1) Qualifications of the mass concrete placement consultant. The mass concrete temperature control recommendations shall be sealed by a professional engineer registered in Texas.
 - 2) Revised mix designs, as applicable.

- 3) Proposed methods for measuring and monitoring maximum concrete temperatures and maximum temperature differentials to ensure that the requirements for the temperature control plan are met without interruption.
- D. A concrete installation meeting shall be held prior to the initial concrete placement. Attendance will be required of the concrete supplier, contractor's superintendent and foremen responsible for concrete placement, concrete placing representative and testing agency. The agenda will include but is not limited to the following:
1. Scheduling and notification of concrete placements and notification of testing agency.
 2. Delivery time from batch plant and maximum waiting period prior to placing concrete.
 3. Review of approved design mix including the limits of water that can be added and who is authorized to add water.
 4. Additional test cylinders to be made for any load in which water has been added on site.
 5. Curing procedures.
 6. Temperature control.
 7. Test cylinder storage and protection.

1.04 PROJECT CONDITIONS AND MEETINGS

- A. Adjust concrete mix, designs when material characteristics, job conditions, weather, strength test results or other circumstance warrant.
1. Do not use revised concrete mixes until submitted to and approved by concrete supplier and Engineer. At Engineer's request, revised mix design may be subject to additional testing prior to approval. This additional preconstruction testing shall be paid for by Contractor.
- B. Preconstruction Conference
1. Required Meeting Attendees:
 - a. CONTRACTOR including pumping, placing and finishing, and curing subcontractors.
 - b. Ready-mix producer.
 - c. Admixture representative.
 - d. Testing and sampling personnel.
 - e. ENGINEER.
 2. Schedule and conduct prior to incorporation of respective products into Project. Notify ENGINEER of location and time.
 3. Agenda shall include:
 - a. Admixture types, dosage, performance, and redosing at site.
 - b. Mix designs, test of mixes, and Submittals.
 - c. Placement methods, techniques, equipment, consolidation, and form pressures.
 - d. Slump and placement time to maintain slump.
 - e. Finish, curing, and water retention.
 - f. Protection procedures for weather conditions.
 - g. Other specified requirements requiring coordination.
 4. Conference minutes as specified in Division 1.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver:
1. Concrete:
 - a. Prepare a delivery ticket for each load of ready mixed concrete.
 - b. Truck operator shall hand ticket to Contractor at the time of delivery.
 - c. Ticket to show:
 - 1) Mix identification.
 - 2) Quantity delivered.
 - 3) Amount of material in each batch.
 - 4) Outdoor temperature in the shade.
 - 5) Time at which cement was added.
 - 6) Time of delivery.

- 7) Time of discharge.
- 8) Amount of water available to be added at project site (if any), based on water held back during batching and maximum W/C ratio.
- 9) Amount of water added at project site (if any) will be noted on delivery ticket.

1.06 SEQUENCING AND SCHEDULING

- A. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.
 1. Approval of concrete mix design does not relieve Contractor of his responsibility to provide concrete that meets the requirements of this Specification
- B. Do not backfill against walls until concrete has attained the specified 28 day compressive strength, including upper level floors and walls, unless approval is granted in writing by Engineer.

PART 2 - PRODUCTS

2.01 COMPONENTS

- A. Neoprene Expansion Joint Fillers:
 1. Manufacturers:
 - a. Permaglaze.
 - b. Rubatex.
 - c. Williams Products.
 2. Materials:
 - a. Closed cell neoprene.
 - b. ASTM D1056, Class SC, 2 to 5 psi compression deflection, Grade SCE-41.
- B. Asphalt Expansion Joint Fillers:
 1. Manufacturers:
 2. W R Meadows.
 - a. J and P Petroleum Products.
 3. Materials: ASTM D994.
- C. Fiber Expansion Joint Fillers:
 1. Materials: ASTM D1751.
- D. Waterstops, PVC:
 1. Manufacturers
 - a. Greenstreak Plastics Products.
 - b. W R Meadows.
 - c. Vinylex Corp.
 - d. Or equal.
 2. Cast-in-place type: Corp of Engineer's Specification CRD-C572.
 3. Materials; Virgin PVC compound not containing any scrap or reclaimed materials or pigment.
 4. Thickness: 3/8 IN, unless otherwise noted.
 5. Profiles as listed, unless otherwise specified
 - a. 9 IN width: 1/4 x 3/8 IN x 9 IN, with center bulb 3/4 IN ID, 1 1/4 IN OD, similar to Greenstreak Plastic Products Style #718. (Expansion Joints)
 - b. 6 IN width: 3/16 x 3/8 IN x 6 IN with center bulb 1/4 IN ID, 11/16 IN OD, similar to Greenstreak Plastic Products Style #705. (General Use)
 - c. Split Rib: 3/8 IN x 6 IN, similar to Greenstreak Plastic Products Style #724, or 3/8 IN x 4 IN, similar to Greenstreak Plastic Products Style #721. (only use where indicated)
 6. Factory fabricated intersection fittings, to be field butt spliced onto straight runs.
 7. Factory prepunched (12 IN centers, each edge) for wire supports.

8. See Drawings for application and other requirements.
- E. Waterstops, Preformed – Strip Type:
 1. Manufacturers:
 - a. Greenstreak (Hydrotite).
 - b. Adeka Ultra Seal (MC-2010M).
 - c. De Neef (Swellseal Plus).
 2. Nonbentonite composition, hydrophilic.
 3. Manufactured solely for the purpose of preventing water from traveling through construction joints.
 4. Volumetric expansion limited to 3 times maximum.
- F. Pressure Relief Valves:
 1. Acceptable manufacturers:
 - a. Neenah Foundry, Model R-5000 Type C.
 - b. Waterman Industries, Model PRF-15.
 2. Materials:
 - a. Cover: Bronze.
 - b. Body and strainer: Cast-iron.
 - c. Seal ring under cover: Neoprene.
 3. Size:
 - a. Diameter: 6 IN.
 - b. Length: Sufficient length to penetrate the granular/ material at least 2 IN.
- G. Screen for Pressure Relief Valve:
 1. Material: Stainless steel, Type 304.
 2. Wire gage: 16 GA minimum, 12 GA maximum.
 3. Openings: 3/16 IN SQ.
 4. Size: 12 by 12 IN.
- H. Water Swelling Sealant.
 1. Single component, gun applied.
 2. Moisture cured.
 3. Minimum 70% volumetric expansion swelling capability.
 4. Compatible with strip-type waterstop.
- I. Waterstop Injection Hose System:
 1. FUKO by Greenstreak, or approved equal.
 2. Use where shown on the Drawings.
 3. Size of hose as recommended by manufacturer for proposed installation and injection requirements.
- J. Epoxy Construction Joint Bonding Agent.
 1. “Corr-Bond” by Euclid.
 2. “Sika Armatec 110” by Sika Corp.
 3. “CR 246” by Sto.
- K. Sand cement grout, non-shrink grout and epoxy grout: See Section 03308.
- L. Submit requests for substitutions in accordance with Specification Section 01640.

2.02 SOURCE QUALITY CONTROL

- A. The central concrete plant shall conform to the check list for certification of Ready Mixed Concrete Production Facilities of the NRMCA

PART 3 - EXECUTION

3.01 PREPARATION

- A. General:
- B. Complete formwork.
 - 1. See Section 03108.
 - 2. Remove earth, snow, ice, water, and other foreign materials from areas that will receive concrete.
 - 3. Secure reinforcement in place.
 - a. See Section 03208.
 - 4. Position expansion joint material, anchors and other embedded items.
 - 5. Obtain approval of reinforcement and formwork erection and placement prior to concreting.
 - 6. Do not place concrete during rain, sleet, or snow, unless adequate protection is provided and approval is obtained.
 - a. Plan size of crews with due regard for effects of concrete temperature and atmospheric conditions on rate of hardening of concrete as required to obtain good surfaces and avoid unplanned cold joints.
 - b. Do not allow rainwater to increase mixing water nor to damage surface finish.
 - 7. Prepare all construction joints for proper bond per paragraph 3.4C.
 - 8. Remove hardened concrete and foreign materials from inner surfaces of conveying equipment and formwork.
 - 9. Provide slabs and beams of minimum indicated required depth when sloping to drains. For foundations on grade, slope top of subgrade to provide slab of required uniform thickness, unless noted otherwise.
- C. Preparation of Subgrade for Foundations on Ground:
 - 1. Subgrade drained and of adequate and uniform load-bearing nature.
 - 2. Obtain approval of subgrade compaction density prior to placing subbase and/or foundations ground.
 - 3. Maintain subgrade at a temperature above 32 DegF before concrete placing begins for a sufficient amount of time to remove frost.
 - 4. Moisten subgrade and subbase to eliminate absorption. Keep moist at time of concreting. Allow no free-standing water on subgrade or soft or muddy spots when concrete is placed.
- D. Edge Forms and Screeds:
 - 1. Set accurately to produce specified elevations and contours of finished surface.
 - 2. Sufficiently strong to support vibrating screeds or roller pipe screeds, if required.
 - 3. Use strike off templates, or approved vibrating type screeds, to align concrete surfaces to contours of screed strips.

3.02 CONCRETE MIXING

- A. General:
 - 1. Provide all concrete from a central plant conforming to Check List for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.
 - 2. Batch, mix, and transport in accordance with ASTM C94.
- B. Control of Admixtures:
 - 1. Charge admixtures into mixer as solutions.
 - a. Measure by means of an approved mechanical dispensing device.
 - b. Solution considered a part of mixing water.
 - c. Admixtures that cannot be added in solution may be weighed or measured by volume if so recommended by manufacturer.
 - 2. Add separately, when two or more admixtures are used in concrete, to avoid possible interaction that might interfere with efficiency of either admixture, or adversely affect concrete.

3. Complete addition of retarding admixtures within one minute after addition of water to cement has been completed, or prior to beginning of last three quarters of required mixing, whichever occurs first.
- C. Tempering and Control of Mixing Water:
 1. Mix concrete only in quantities for immediate use.
 2. Discard concrete which has set.
 3. Discharge concrete from ready mix trucks within time limit and drum revolutions stated in ASTM C94.
 4. Addition of water at the jobsite:
 - a. See Section 03308 for specified water cement ratio and slump.
 - b. Do not exceed maximum specified water cement ratio or slump.
 - c. Incorporate water by additional mixing equal to at least half of total mixing required.
 - d. Perform strength test on any concrete to which water has been added at the jobsite. See Section 03350.
 - e. Prior to addition of water at the jobsite, a water/cement ratio analysis will be performed by the Contractor from information provided on the delivery ticket. Provided that the total amount of water to meet the maximum water/cement ratio has not been added, the remaining water quantity to meet the maximum water/cement ratio may be added to the mix.
 - f. If the maximum amount of water has been added to the mix or if insufficient data is provided on the delivery ticket to determine the water/cement ratio, then no additional water may be added.

3.03 PLACING OF CONCRETE

- A. General:
 1. Comply with ACI 304R, 304.2R, and 350.
 2. Do not place concrete during rain, sleet or snow, unless adequate protection is provided and approval is obtained.
 3. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
 4. Begin placement only when work of other trades affecting concrete is complete.
 5. Deposit concrete:
 - a. Continuously to avoid cold joints.
 - b. In layers of 12 to 18 IN maximum.
 6. Locate construction joints at locations specified or approved by Engineer.
 - a. Plan size of crews with due regard for effects of concrete temperature and atmosphere conditions to avoid unplanned cold joints.
 7. Place concrete at such a rate that concrete, which is being integrated with fresh concrete, is still workable.
 8. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
 9. Spreaders:
 - a. Temporary:
 - 1) Remove as soon as concrete placing renders their function unnecessary.
 - b. Embedded:
 - 1) Obtain approval of Engineer.
 - 2) Materials: Concrete or metal.
 - 3) Ends of metal spreaders coated with plastic coating 2 IN from each end.
 10. Do not begin placing of concrete in supported elements until concrete previously placed in supporting members is no longer plastic and has been in place at least a minimum of 2 HRS.
 11. Deposit concrete as nearly as practicable in its final position to avoid segregation.
 - a. Maximum free fall: 4 FT.
 - b. Free fall exceeding 4 FT:

- 1) Place concrete by means of hopper, elephant trunk or tremie pipe extending down to within 4 FT or less of surface placed upon.
12. Perform the following operations before bleeding water has an opportunity to collect on surface:
 - a. Spread.
 - b. Consolidate.
 - c. Straightedge.
 - d. Darby or bull float.
- B. High-Range Water Reducers (Superplasticizers):
 1. Manufacturer's representative to instruct the Contractor as to the proper use and dosage of the admixture.
 2. Add superplasticizer to the concrete in the truck mixer at the jobsite.
 3. Perform concrete slump test at the jobsite both prior to and after addition of the admixture to the concrete.
- C. Cold Weather Concrete Placement:
 1. Comply with ACI 306R.
 2. Do not place concrete on substrates that are below 32 DegF or contain frozen material.
 3. Maintain all materials, forms, reinforcement, subgrade and any other items which concrete will come in contact with free of frost, ice or snow at time of concrete placement.
 4. Temperature of concrete when discharged at site:

AIR TEMPERATURE DEGF	MINIMUM CONCRETE TEMPERATURE, DEGF FOR SECTIONS WITH LEAST DIMENSION LESS THAN 12 IN	MINIMUM CONCRETE TEMPERATURE, DEGF FOR SECTIONS WITH LEAST DIMENSION 12 IN OR GREATER
above 30	60	55
0 to 30	65	60
below 0	70	65

5. Heat substrate, forms, and reinforcement so the temperature thereof will be between 45 and 70 DegF, when temperature of surrounding air is 40 DegF or below at time concrete is placed. Remove all frost from substrate, forms and reinforcement before concrete is placed.
6. Combine water with aggregate in mixer before cement is added, if water or aggregate is heated above 90 DegF.
7. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 90 DegF.
8. Do not place slabs on ground if temperature is below 40 DegF or if temperature surrounding the slab will be below 40 DegF before structure is enclosed and heated.
9. Coordinate with mass concrete placement requirements.
- D. Hot Weather Concrete Placement:
 1. Comply with ACI 305R.
 2. Cool ingredients before mixing, or add flake ice or well crushed ice of a size that will melt completely during mixing for all or part of mixing water if high temperature, low slump, flash set, cold joints, or shrinkage cracks are encountered.
 3. Temperature of concrete when placed:
 - a. Not to exceed 90 DegF.

- b. Not so high as to cause:
 - 1) Shrinkage cracks.
 - 2) Difficulty in placement due to loss of slump.
 - 3) Flash set.
 - c. Coordinate with mass concrete placement requirements.
 - 4. Temperature of forms and reinforcing when placing concrete:
 - a. Not to exceed 90 DegF.
 - b. May be reduced by spraying with water to cool below 90 DegF.
 - 1) Leave no standing water to contact concrete being placed.
 - 5. Prevent plastic shrinkage cracking and/or slab curling due to evaporation of moisture.
- E. Consolidating:
 - 1. Consolidate in accordance with ACI 309R except as modified herein.
 - 2. Consolidate by vibration so that concrete is thoroughly worked around reinforcement, embedded items and into corners of forms.
 - a. Eliminate:
 - 1) Air or stone pockets.
 - 2) Honeycombing or pitting.
 - 3) Planes of weakness.
 - 3. Internal vibrators:
 - a. Minimum frequency of 8000 vibrations per minute.
 - b. Insert and withdraw at points approximately 18 IN apart for vibrators 2 to 3 ½ inches in diameter, closer for smaller vibrators.
 - 1) Allow sufficient duration at each insertion to consolidate concrete but not sufficient to cause segregation.
 - 2) For 24 IN and thicker walls, insert vibrators at 6 IN from each form.
 - c. Use in:
 - 1) Beams and girders of framed slabs.
 - 2) Columns and walls.
 - 3) Vibrating concrete around all waterstops.
 - d. Size of vibrators shall be in accordance with Table 5.1.5 of ACI 309R.
 - 4. Obtain consolidation of slabs with internal vibrators, vibrating screeds, roller pipe screeds, or other approved means.
 - 5. Do not use vibrators to transport concrete within forms.
 - 6. Provide spare vibrators on jobsite during all concrete placing operations.
 - 7. Bring a full surface of mortar against form by vibration supplemented if necessary by spading to work coarse aggregate back from formed surface, where concrete is to have an as-cast finish.
 - 8. Use suitable form vibrators located just below top surface of concrete, where internal vibrators cannot be used in areas of congested reinforcing.
 - 9. Prevent construction equipment, construction operations, and personnel from introducing vibrations into freshly placed concrete after the concrete has been placed and consolidated.
- F. Handle concrete from mixer to place of final deposit by methods which will prevent segregation or loss of ingredients and in a manner which will assure that required quality of concrete is maintained.
 - 1. Use truck mixers, agitators, and non-agitating units in accordance with ASTM C94.
 - a. Discharge conveyor runs into equipment specially designed for spreading concrete.
 - 2. Metal or metal lined chutes:
 - a. Slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal.
 - b. Chutes more than 20 FT long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.
 - c. Provide end of each chute with a device to prevent segregation.
 - 3. Pumping or pneumatic conveying equipment:

- a. Designed for concrete application and having adequate pumping capacity.
- b. Control pneumatic placement so segregation is avoided in discharged concrete.
- c. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 IN.
- d. Do not convey concrete through pipe made of aluminum or aluminum alloy.
- e. Provide pumping equipment without Y sections.

3.04 JOINTS AND EMBEDDED ITEMS

A. Construction Joints:

1. Locate joints as indicated on Contract Drawings or as shown on approved shop drawings.
2. Unplanned construction joints will not be allowed. If concrete cannot be completely placed between planned construction joints, then it must be removed.
3. Allow a minimum of 48 hrs before placement of adjoining concrete construction.
4. In general, locate joints near third point of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
5. Locate joints in walls at underside of floors or slabs and at tops of foundations or floor slabs, unless shown otherwise.
6. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
7. Provide roughened construction joints at all non-keyed surfaces and where shown or otherwise indicated on Drawings.
 - a. Clean the previously hardened concrete interface and remove all laitance.
 - b. Intentionally roughen the interface to a full amplitude of 1/4 IN.
 - c. Provide smooth surface as required to install strip type waterstops.
8. Provide continuous keyways where indicated on Drawings. Construction joint keyways shall have the following dimensions, unless shown otherwise on Drawings or directed otherwise by Engineer.
 - a. Wall keyways:
 - 1) Keyway width, not less than 1/3 and not more than 1/2 the wall thickness measured perpendicular to wall faces.
 - 2) Keyway depth to be not less than 1-1/2 IN.
 - 3) Place keyway in wall center unless shown otherwise on Drawings.
 - b. Keyways in footings, foundations, base slabs, and structural or elevated slabs:
 - 1) Keyway height not less than 1/3 and not more than 1/2 the footing or slab thickness.
 - 2) Keyway depth not less than 1-1/2 IN.
 - 3) Keyway in footing or slab center unless shown otherwise on Drawings.

B. Construction Joint Spacing – Unless otherwise specified:

1. General - Structures not intended to contain liquid:
 - a. Wall vertical construction joints:
 - 1) 30 FT maximum centers.
 - 2) At wall intersections, 10 FT maximum from corner.
 - b. Base slab, floor, and roof slab construction joints:
 - 1) Placements to be approximately square.
 - 2) Maximum side dimension of a slab pour to be 50 FT.
2. Structures intended to contain liquids:
 - a. Wall vertical construction joints:
 - 1) 25 FT maximum centers.
 - b. Base slab, floor, and roof slab construction joints:
 - 1) Placements to be approximately square.
 - 2) Maximum side dimension of a slab pour to be 40 FT.
3. See drawings for construction joint locations.

C. Bonding at Construction Joints:

CONCRETE MIXING, PLACING, JOINTING, AND CURING

1. Obtain bond between concrete pours at construction joints. Before new concrete is placed, all construction joints shall be prepared and coated with epoxy bonding adhesive, cement grout, or other Engineer approved bonding product.
 2. General - Use cement grout for all construction joints except as otherwise specified herein.
 - a. Roughen the surface of the hardened concrete to uniformly expose the coarse aggregate.
 - b. Remove laitance, loosened particles of aggregate or damaged concrete at the surface, or at the Contractor's option, use an approved chemical retarder which delays but does not prevent setting of the surface of the mortar in accordance with the manufacturer's recommendations. Retarded mortar shall be removed within 24 HRS after placing to produce a clean exposed aggregate bonding surface.
 - c. Dampen the hardened concrete (but do not saturate or allow standing water) immediately prior to placing of fresh grout.
 - d. Cover the hardened concrete of horizontal joints with a coat of cement grout (see Specification Section 03308).
 - 1) Place grout as thick as possible on vertical surfaces.
 - 2) Place 3 IN layer of grout in bottoms of wall or column lifts immediately before placing specified concrete and at least 1/2 IN thick on other horizontal surfaces. Vibrate grout and first lift of concrete simultaneously.
 - 3) Place fresh concrete before the grout has attained its initial set.
 3. Use epoxy bonding agent for walls and slabs of tanks and structures designed to contain liquids and at all joints in beams, girders, walls, and slabs. Exception: 3 IN of grout shall be used as noted above for all wall/slab and horizontal wall-to-wall joints.
 - a. Joints receiving an adhesive shall be prepared, and the adhesive applied in accordance with the manufacturer's recommendations.
 - b. Epoxy adhesive shall have adequate working life to allow new concrete to be placed while the adhesive has not begun to lose its effectiveness. Otherwise, use alternate Engineer approved bonding method.
- D. Control joints:
1. Shall be located in members as indicated on Drawings.
 2. Time cutting properly with set of concrete, if saw cut joints are required or permitted.
 - a. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw.
 - b. Complete before shrinkage stresses become sufficient to produce cracking.
 - c. For wall control joints, chamfer strips or PVC inserts shall be used in lieu of saw cutting.
- E. Expansion Joints:
1. Do not permit reinforcement or other embedded metal items bonded to concrete (except smooth dowels bonded on only one side of joint) to extend continuously through an expansion joint.
 2. Use neoprene expansion joint fillers at liquid-containing structures.
 3. Seal expansion joints as shown on Drawings. See Section 07900 for additional requirements.
- F. Waterstops:
1. Lap all types of waterstop to create water tight joints.
 2. Do not mix different types of waterstop materials in the same structure without specific approval from the Engineer.
 3. Contractor is responsible for waterstop selection and installation to provide leak-tight joints, to the minimum standard shown in the Contract Documents.
- G. Preformed strip type:
1. Install in a bed of swelling sealant on smooth surface of hardened concrete by use of nails, screws or other means as recommended by manufacturer to prevent movement of waterstop during placement of new concrete.

2. Roughened joints shall be especially prepared during concrete placement to provide smooth surface for proper waterstop installation.
 3. Waterstop to be continuous with splices in accordance with manufacturer's instructions.
 4. Unless otherwise noted, use in joints against existing concrete and where indicated on Drawings.
- H. PVC Waterstops:
1. Position waterstop accurately in forms.
 2. Secure waterstops in correct position using hog rings or grommets spaced 12 IN maximum along the length and passed through the edge of the waterstops. Tie wire to adjacent reinforcing.
 3. Hold horizontal waterstops in place with continuous supports.
 4. Install according to manufacturer's instructions. Do not displace reinforcement from required location.
 5. Waterstops to be continuous.
 6. Splice ends and intersections with perpendicular butt splice using electrical splicing iron in accordance with manufacturer's instructions.
 - a. Use prefabricated "T" and corner fittings.
- I. Injection Hose Waterstop:
1. Install in accordance with manufacturer recommendations.
 2. Manufacturer's representative shall review and approve installation and shall be present on site to supervise injection process.
 3. Only required for use when specifically indicated on the drawings.
- J. Other Embedded Items:
1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its support, prior to initiating concreting.
 - a. Give Contractor, whose work is related to concrete or supported by it, ample notice and opportunity to furnish and install embedded items before concrete placement.
 2. Do not place electrical conduit, drains, or pipes in or through concrete slabs, walls, columns, foundations, beams or other structural members unless approved by Engineer.
- K. Placing Embedded Items:
1. Position expansion joint material, waterstops, and other embedded items accurately.
 2. Support against displacement.
 3. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
 4. Provide adequate means for anchoring waterstop in concrete.
 - a. Provide means to prevent waterstops in the forms from being displaced by the concrete.
 - b. Work concrete under the waterstops by hand, so as to avoid the formation of air and rock pockets, when placing concrete around waterstops.

3.05 FINISHING

- A. See Section 03348.
1. Coordinate mixing and placing with finishing.

3.06 INSTALLATION OF GROUT

- A. Grout Schedule of Use:
1. Sand cement grout:
 - a. General use.
 - b. Construction joint bonding.
 - c. Toppings or fill less than 1-1/2 IN thick.
 2. Non-shrinking non-metallic grout:

- a. Filling form tie holes.
 - b. Under column and beam base plates.
 - c. Under equipment bases.
 - d. Other uses indicated on the Drawings.
 - 3. Epoxy grout:
 - a. Patching cavities in concrete.
 - b. Grouting of equipment base plates where driving motor is 500 HP and above.
 - c. Other uses indicated on the Drawings.
- B. Grout Installation:**
- 1. Sand cement grout:
 - a. Cure grout by one of methods specified.
 - 2. Non-shrink non-metallic grout:
 - a. Clean concrete surface to receive grout.
 - b. Saturate concrete with water for 24 HRS prior to grouting.
 - c. Mix in a mechanical mixer.
 - d. Use no more water than necessary to produce flowable grout.
 - e. Place in accordance with manufacturer's instructions.
 - f. Provide under beam, column, and equipment base plates, and in other locations indicated on the Drawings.
 - g. Completely fill all spaces and cavities below the top of base plates. Do not extend grout to top of metal bases, while tapering at 1:1 beyond this extremity.
 - h. Provide forms where base plates and bed plates do not confine grout.
 - i. Where exposed to view, finish grout edges smooth.
 - j. Where a taper is not possible, finish edges flush at the bottom of the base plate, bed plate, member or piece of equipment.
 - k. Coat exposed edges of grout with cure or seal compound recommended by the grout manufacturer. Alternatively, protect against rapid moisture loss by covering with wet rags or polyethylene sheets; wet cure grout for 7 days minimum.
 - 3. Epoxy grout:
 - a. Mix and place in accordance with manufacturer's instructions.
 - b. Apply only to clean, dry, sound surface.
 - c. Completely fill all cavities without voids.
 - d. Grout base and bed plates as specified for non-shrinking, non-metallic grout.
 - e. Obtain manufacturer's field technical assistance as required to assure proper placement.

3.07 CURING AND PROTECTION

- A. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury immediately after placement, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement, hardening, and compressive strength gain. Follow recommendations of ACI 308 except as modified herein.
- B. Contractor shall satisfactorily prevent temperature induced stresses and cracking during curing mass concrete.
- C. Apply one of the following curing procedures immediately after completion of placement and finishing, for concrete surfaces not in contact with forms. Curing at water retaining structures shall utilize a wet cure or a combination of sheet materials and periodic water application. Curing compounds shall not be used unless a program for their use is approved by the Engineer in writing.
 - 1. Ponding or continuous sprinkling.
 - 2. Application of absorptive mats or fabric kept continuously wet.
 - 3. Application of sand kept continuously wet.
 - 4. Continuous application of steam (not exceeding 150 DegF) or mist spray.
 - 5. Application of waterproof sheet materials, conforming to ASTM C171.
 - 6. Application of other moisture retaining covering as approved.

7. Comply with requirements of mass concrete placement and curing plan for mass concrete.
- D. Curing Concrete In Contact with Forms:
 1. Minimize moisture loss from and temperature gain of concrete placed in forms exposed to heating by sun by keeping forms wet and cool until they can be safely removed.
 2. After form removal, cure concrete until end of time prescribed.
 - a. Use one of methods listed above.
 3. Forms left in place shall not be used as a method of curing in hot weather.
 4. The term "hot weather," where used in these specifications, is defined in ACI 305R.
 5. In hot weather, remove forms from vertical surfaces as soon as concrete has gained sufficient strength so that the formwork is no longer required to support the concrete.
- E. Continue curing for at least 7 days. If one of curing procedures indicated above is used initially, it may be replaced by one of other procedures indicated any time after concrete is 1 day old, provided concrete is not permitted to become surface dry during transition.
- F. Cold Weather:
 1. Follow recommendations of ACI 306R.
 2. Maintain temperature of concrete above 55 Def F for a minimum of 3 days during cold weather. This curing period shall not be reduced.
 3. Use heating, covering, insulating, or housing of the concrete work to maintain required temperature without injury due to concentration of heat.
 4. Do not use combustion heaters unless precautions are taken to prevent exposure of concrete to exhaust gases which contain carbon dioxide.
 5. Interior slabs in areas intended to be heated shall be adequately protected so that frost does not develop in the supporting subgrade.
- G. Hot Weather:
 1. Follow recommendations of ACI 305R.
 2. Make provision for cooling forms, reinforcement and concrete, windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material.
 3. Provide protective measures as quickly as concrete hardening and finishing operations will allow.
- H. Rate of Temperature Change:
 1. Keep changes in temperature of air immediately adjacent to concrete as uniform as possible, during and immediately following curing period.
 2. Do not exceed a temperature change of 5 DegF in any 1 HR or 50 DegF in any 24 HR period.
- I. Protection from Mechanical Injury:
 1. Protect concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration.
 2. Protect finished concrete surfaces from damage by construction equipment, materials, or methods, and by rain or running water.
 3. Do not load self supporting structures in such a way as to overstress concrete.

3.08 FIELD QUALITY CONTROL

- A. Tests in accordance with Section 03350.
 1. Perform a strength test on all concrete to which water has been added at the jobsite.
 - a. Perform strength test after water has been added and additional mixing has been performed.
- B. Field samples of fabricated waterstop fittings (crosses, tees, etc.) will be selected at random by the Engineer for testing by a laboratory at the Owner's expense. When tested, they shall have a tensile strength across the joints equal to at least 600 psi.

- C. Leakage at horizontal and vertical joints containing waterstops will be repaired to stop flowing remaining after 30 days of the water containing structure being filled to its normal operating level. All areas exposed to view will be finished to match surrounding concrete finish after repairs are made.

END OF SECTION

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SECTION 03348
CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete finishing and repair of surface defects.
 - 2. Dry shake hardener applied to surface of concrete slabs.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 03108 - Formwork.
 - 4. Section 03308 - Concrete, Materials and Proportioning.
 - 5. Section 09905 - Painting and Protective Coatings.

1.02 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 116R, Cement and Concrete Terminology.
 - b. 301, Standard Specifications for Structural Concrete.
 - 2. ASTM International (ASTM):
 - a. C150, Standard Specification for Portland Cement.
 - b. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
- B. Mock-Ups:
 - 1. Construct sample wall for each type of wall finish specified for review and acceptance by Engineer.
 - a. Minimum 4 x 4 FT.
 - b. Construct additional sample walls as required until accepted.
 - c. Sample wall constitutes minimum standard of quality for actual construction.
 - d. Maintain sample wall during construction.
 - e. Remove when directed by Engineer.
 - f. Sample wall shall include minimum 2 x 2 FT area of each different wall finish specified.
 - 1) Must be readily identifiable during construction.
 - 2) Sample wall to have sample of patched form tie hole.

1.03 DEFINITIONS

- A. Vertical Surface Defects:
 - 1. Any void in the face of the concrete deeper than 1/8 IN, such as:
 - a. Tie holes.
 - b. Air pockets (bugholes).
 - c. Honeycombs.
 - d. Rock holes.
 - 2. Scabbing:
 - a. Scabbing is defect in which parts of the form face, including release agent, adhere to concrete.
 - 3. Foreign material embedded in face of concrete.
 - 4. Fins 1/16 IN or more in height.

- B. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 1. Installer and applicator are synonymous.
- C. Other words and terms used in these Specifications are defined in ACI 116R.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01330.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Certifications:
 - a. Certification of aggregate gradation.
 - b. Certification that products being used will not interfere with bonding of future floor or wall finishes.
- B. Miscellaneous Submittals:
 - 1. See Section 01330.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's recommendations and requirements for materials used.

1.06 WARRANTY

- A. Provide warranty equal to specified manufacturer's standard warranty for all products used.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Chemical floor sealer, hardener, densifier:
 - a. L & M Construction Chemicals Inc.
 - b. Euclid Chemicals Co.
 - c. Dayton Superior.
 - 2. Consult with structural engineer and project manager when specifying the following products.
 - a. Metallic aggregate dry shake hardeners:
 - 1) Chemrex, Inc.
 - 2) Euclid Chemical Co.
 - b. Heavy-duty metallic aggregate topping:
 - 1) Chemrex, Inc.
 - 2) Euclid Chemical Co.
 - 3. Bonding agents:
 - a. Euclid Chemical Co.
 - b. Master Builders Inc.
 - c. L & M Construction Chemicals Inc.
 - 4. Decorative coating for concrete:
 - a. Thoro System Products "Thoroseal."
- B. No like, equivalent or "or-equal" item {or substitution} is permitted.
- C. Submit requests for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

- A. Chemical Floor Sealer, Hardener, Densifier:
 - 1. Colorless, no VOC, odorless chemical solution containing alkaline siliconates.
 - 2. Will not support bacteria growth.
 - 3. 10-year manufacturer's warranty.
 - 4. Similar to L & M Construction Chemicals Inc. "Seal Hard".
- B. Metallic Aggregate Dry-Shake Slab Hardener:
 - 1. Provide a pre-mixed, ready-for-use metallic aggregate surface hardener, factory proportioned, packed and sealed in moisture-resistant bags and delivered to the jobsite ready to apply.
 - 2. Hardener shall consist of specially processed metallic aggregate, cementitious binder, plasticizer, water-reducing admixtures formulated and processed under stringent quality control of the manufacturer.
 - 3. Approved products:
 - a. "Master-Plate 200" (at 2.00 psf) by Chemrex, Inc. or "Euco-Plate H.D." (at 2.00 psf) by Euclid Chemical Co.
 - b. Curing material: As recommended by metallic aggregate dry-shake slab hardener manufacturer.
- C. Bonding Agent:
 - 1. High solids acrylic latex base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars (not for use as a construction joint bonding adhesive per spec 03311).
 - 2. Euclid Chemical Co. "Flex-Con."
 - 3. Master Builders Inc. "Acryl-Set."
 - 4. L & M Construction Chemicals "Everbond."
 - 5. Thoro System Products "Acryl 60."
- D. Cement:
 - 1. ASTM C150, Type II Portland for areas exposed to sewage.
 - 2. ASTM C150, Type II or I/II Portland elsewhere.
- E. Aggregate:
 - 1. Sand: Maximum size #30 mesh sieve.
 - 2. For exposed aggregate finish surfaces: Same as surrounding wall.
- F. Water: Potable.

2.03 MIXES

- A. Bonding Grout:
 - 1. One part cement to one part aggregate.
 - 2. Mix cement and aggregate.
 - 3. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
 - 4. Add bonding agent/water mixture to cement/aggregate mixture.
 - 5. Mix to consistency of thick cream.
 - 6. Bonding agent itself may be used as bonding grout if approved by manufacturer and Engineer.
- B. Patching Mortar:
 - 1. One part cement to two and one-half parts aggregate by damp loose volume.
 - a. Substitute white Portland cement for a part of gray Portland cement to produce color matching surrounding concrete.
 - 2. Mix cement and aggregate.
 - 3. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.

CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

4. Add only enough bonding agent/water mixture to cement/aggregate mixture to allow handling and placing.
5. Let stand with frequent manipulation with a trowel, until mix has reached stiffest consistency to allow placement.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Repair surface defects within 24 HRS after removal of forms.
 1. Chip, wire brush or abrasive blast to completely open defects down to sound concrete.
 - a. If chipping is necessary, make edges perpendicular to surface or slightly undercut.
 - b. No feathered edges will be permitted.
- B. Repairing Surface Defects:
 1. Fill and repair using patching mortar mix specified in Article 2.3.
 2. Clean surfaces to remove dust, dirt, laitance, form oil, grease, or other contaminants.
 - a. If required by bonding agent manufacturer, etch surfaces with a muriatic acid solution followed by a thorough rinse with clean water.
 - b. Test concrete to determine pH level and continue flushing with clean water until surface pH is within acceptable limits.
 3. Dampen area to be patched and an area at least 6 IN wide surrounding it prior to application of bonding grout.
 4. Brush bonding grout into the surface after the surface water has evaporated.
 5. Allow bonding grout to set for period of time required by bonding agent manufacturer before applying premixed patching mortar.
 6. Fill tie holes and areas where honeycombed or defective concrete has been removed.
 - a. Fill tie holes in liquid containing structures with non-shrink non-metallic grout. See Section 03308.
 - b. Fill all other defects with patching mortar.
 - c. Consolidate grout or mortar into place and strike off so as to leave patch slightly higher than surrounding surface.
 7. Leave undisturbed for at least 60 minutes before finishing level with surrounding surface.
 - a. Do not use metal tools in finishing a patch in a formed wall which will be exposed or coated with other materials.
 8. Keep areas damp for 7 days or in accordance with bonding agent manufacturer's directions.

3.02 INSTALLATION AND APPLICATION

- A. Do not repair surface defects or apply wall or floor finishes when temperature is or is expected to be below 50 DegF.
 1. If necessary, enclose and heat area to between 50 and 70 DegF during repair of surface defects and curing of patching material.
- B. Chemical Floor Sealer, Hardener, Densifier (Type '2'):
 1. Apply to floor areas indicated on Drawings in accordance with manufacturer's recommendations.
 2. Apply at rate recommended by manufacturer.
 3. After final coat of material is applied, remove surplus in accordance with manufacturer's recommendations.
 4. Do not apply to floors scheduled to be painted or receive bonded or adhered flooring.
- C. Concrete Finishes for Vertical Wall Surfaces:
 1. General: Give concrete surfaces finish as specified below after removal of formwork and repair of surface defects.
 2. Finish #1 - As cast rough form finish:
 - a. Selected forming materials are not required.

CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

- b. Prepare surface in accordance with Paragraph 3.1A and repair the following surface defects:
 - 1) Tie holes.
 - 2) Honeycombs deeper than 1/4 IN.
 - 3) Air pockets deeper than 1/4 IN.
 - 4) Rock holes deeper than 1/4 IN.
 - c. Chip or rub off fins exceeding 1/4 IN in height.
 - d. Use at unexposed surfaces such as foundations and backfilled surfaces of walls not to be waterproofed.
 - 3. Finish #2 - Smooth form finish:
 - a. Form facing material shall produce a smooth, hard, uniform texture. Use forms specified for surfaces exposed to view in accordance with Section 03108.
 - b. Prepare surface in accordance with Paragraph 3.1A and repair the following surface defects:
 - 1) Tie holes.
 - 2) Honeycombs deeper than 1/8 IN or larger than 1/8 IN DIA.
 - 3) Air pockets deeper than 1/8 IN or larger than 1/8 IN DIA.
 - 4) Rock holes deeper than 1/8 IN or larger than 1/8 IN DIA.
 - 5) Scabbing.
 - c. Chip or rub off fins exceeding 1/8 IN in height.
 - d. Provide finish for:
 - 1) Inside walls of wet wells, basins, thickeners, tanks, manholes, and pipe trenches, except as noted.
 - 2) Walls being waterproofed or coated with some other material.
 - 3) Exposed surfaces not specified to receive another finish.
 - 4. Finish #3 - NOT USED
 - 5. Finish #5 - Grout cleaned finish:
 - a. Form facing material shall produce a smooth, hard, uniform texture. Use forms specified for surfaces exposed to view in accordance with Section 03108.
 - b. Prepare surface in accordance with Paragraph 3.1A and repair all surface defects.
 - c. All contiguous surfaces to be finished shall be completed and accessible before finishing operation begins.
 - d. Mix one part Portland Cement and one and one-half parts fine sand with sufficient bonding agent/water mixture to produce a grout with the consistency of thick paint.
 - 1) White Portland cement shall be substituted for gray Portland cement to produce a color that matches color of surrounding concrete as determined by trial patch for areas not to be painted.
 - e. Wet surface of concrete to prevent absorption of water and uniformly apply grout.
 - f. Immediately after applying grout mix, scrub the surface with a cork float or stone to coat surface and fill remaining air holes, etc.
 - g. While grout is still plastic, remove all excess grout by working surface with rubber float or sack.
 - h. After the surface whitens from drying, rub vigorously with clean burlap.
 - i. Keep final finish damp for a minimum of 36 HRS after final rubbing.
 - j. Provide this finish on all surfaces which are to be painted, all exterior, exposed vertical surfaces, or to remain as grout cleaned finish, or as noted on the Drawings.
 - 1) Inside of thickeners, basins and other concrete tankage: provide finish on inside of structure to 1 FT below process operating level.
 - k. Construct mock-up per Article 1.2.
 - 6. Finish #6 – NOT USED
 - 7. Finish #7 – NOT USED
- D. Exterior concrete surfaces to be painted:
 - 1. All exterior concrete surfaces scheduled to receive grout cleaned finish at water-bearing structures shall be painted with two coats of acrylic coating such as “Modac Acrylic Texture Coating Smooth” as manufactured by Modac Products Company, Inc., or approved

CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

equal. Color shall be selected by Owner. The scope of painting shall include all surfaces scheduled to receive a grout cleaned finish as defined herein.

- E. Related Unformed Surfaces (Except Slabs):
 - 1. Strike smooth tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
 - 2. Float surface to a texture consistent with that of formed surfaces.
 - a. If more than one finish occurs immediately adjacent to unformed surface, provide surface with most stringent formed surface requirement.
 - 3. Continue treatment uniformly across unformed surfaces.
- F. Concrete Finishes for Horizontal Slab Surfaces:
 - 1. General: Tamp concrete to force coarse aggregate down from surface. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains. Dusting of surface with dry cement or sand during finishing processes not permitted.
 - 2. Unspecified slab finish: When type of finish is not indicated, use following finishes as applicable:
 - a. Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
 - b. Surfaces intended to receive roofing, or waterproofing membranes:
 - 1) Floated Finish.
 - c. Floors: Troweled finish.
 - d. Garage floors and ramps: Broom or belt finish.
 - e. Exterior slabs, sidewalks, platforms, steps and landings, not covered by other finish materials: Broom or belt finish.
 - f. All slabs to receive a floated finish before final finishing.
 - 3. Scratched slab finish: After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, roughen surface with stiff brushes or rakes before final set.
 - 4. Floated finish:
 - a. After concrete has been placed, consolidated, struck off, and leveled, do no further work until ready for floating.
 - b. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operations. Use wood or cork float.
 - c. During or after first floating, check planeness of entire surface with a 10 FT straightedge applied at not less than two different angles.
 - d. Cut down all high spots and fill all low spots to produce a surface with Class B tolerance throughout.
 - e. Refloat slab immediately to a uniform texture.
 - 5. Troweled finish:
 - a. Float finish surface to true, even plane.
 - b. Power trowel, and finally hand trowel.
 - c. First troweling after power troweling shall produce a smooth surface which is relatively free of defects, but which may still show some trowel marks.
 - d. Perform additional trowelings by hand after surface has hardened sufficiently.
 - e. Final trowel when a ringing sound is produced as trowel is moved over surface.
 - f. Thoroughly consolidate surface by hand troweling.
 - g. Leave finished surface essentially free of trowel marks, uniform in texture and appearance and plane to a Class A tolerance.
 - h. On surfaces intended to support floor coverings, remove any defects that would show through floor covering by grinding.
 - i. Do not power trowel concrete slabs with more than 3% entrained air.
 - 6. Broom or belt finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom or burlap belt across surface.
 - 7. Underside of concrete slab finish: Match finish as specified for adjacent vertical surfaces.
 - a. If more than one finish occurs immediately adjacent to underside of slab surface, provide surface with most stringent formed surface requirement.

CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

3.03 FIELD QUALITY CONTROL

- A. Horizontal slab finishes will be accepted provided:
 - 1. Applicable specification requirements are satisfied.
 - 2. Water does not pond in areas sloped to drain.
 - 3. Gap between a 10 FT straightedge placed anywhere and the finished surface does not exceed:
 - a. Class A tolerance: 1/8 IN.
 - b. Class B tolerance: 1/4 IN.
 - c. Class C tolerance: 1/2 IN.
 - 4. Accumulated deviation from intended true plane of finished surface does not exceed 1/2 IN.
 - 5. Accuracy of floor finish does not adversely affect installation and operation of movable equipment, floor supported items, or items fitted to floor (doors, tracks, etc.).
- B. Unacceptable finishes shall be replaced or, if approved in writing by Engineer, may be corrected provided strength and appearance are not adversely affected. High spots to be removed by grinding and/or low spots filled with a patching compound or other remedial measures to match adjacent surfaces.

3.04 PROTECTION

- A. All horizontal slab surfaces receiving applied toppings or sealer compound shall be kept free of traffic and loads for minimum of 10 days following installation of topping or compound.

END OF SECTION

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SECTION 03350

TESTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Materials and concrete testing as required to establish concrete mix design.
 - 2. Testing of concrete during construction for compliance with Contract Documents.
 - 3. In-place testing of concrete, if required.
 - 4. Mortar, grout for masonry, and concrete masonry unit testing as required by Division 4.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 03208 - Reinforcement.
 - 4. Section 03308 - Concrete, Materials and Proportioning.
 - 5. Section 03311 - Concrete Mixing, Placing, Jointing, and Curing.
 - 6. Division 05 – Structural Steel.

1.02 RESPONSIBILITY AND PAYMENT

- A. Owner and Contractor each provide and pay for certain testing services:
 - 1. Owner shall retain the services of a qualified Testing Agency to perform testing services for the following:
 - a. Testing of concrete, mortar, grout for masonry, concrete masonry units and other cement-containing products produced for incorporation into the work during the construction of the Project for compliance with the Contract Documents.
 - 2. Contractor shall retain the services of a qualified Testing Agency to perform testing services for the following:
 - a. Testing of materials and mixes proposed by the Contractor for compliance with the Contract Documents and retesting in the event of changes.
 - b. Additional testing or retesting of materials or mortar, grout for masonry, concrete masonry units, concrete or other cement-containing products occasioned by their failure, by test or inspection, to meet requirements of the Contract Documents.
 - c. Strength testing on any concrete due to excess water addition.
 - d. In-place testing of concrete as may be required by Engineer when strength of structure is considered potentially deficient.
 - e. Other testing services needed or required by Contractor such as:
 - 1) Field curing of test specimens and testing of specimens for determining when forms, form shoring, or reshoring may be removed.
- B. Payment:
 - 1. All required concrete, mortar, grout for masonry and concrete masonry unit testing services to be paid for by the City of Edinburg.

1.03 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. T260, Standard Method of Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials.
 - 2. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete.

3. ASTM International (ASTM):
 - a. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - c. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - d. C138, Standard Method of Test for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
 - e. C143, Standard Test Method for Slump of Hydraulic Cement.
 - f. C172, Standard Practice for Sampling Freshly Mixed Concrete.
 - g. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - h. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - i. C567, Standard Test Method for Unit Weight of Structural Lightweight Concrete.
 - j. C780, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - k. C1019, Standard Test Method for Sampling and Testing Grout.
 - l. E329, Standard Specifications for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
- B. Qualifications:
 1. Testing Agency:
 - a. Meeting requirements of ASTM E329.
 - b. Provide evidence of recent inspection by Cement and Concrete Reference Laboratory of National Bureau of Standards, and correction of deficiencies noted.

1.04 DEFINITIONS

- A. Testing Agency: An independent professional testing firm or service hired by Contractor or by Owner to perform testing and analysis services on materials, mixes, structures, and other items as directed, and as provided in the Contract Documents.

1.05 SUBMITTALS

- A. Shop Drawings:
 1. See Section 01330.
 2. Product technical data including:
 - a. Concrete materials and concrete mix designs proposed for use. Include results of all testing performed to qualify materials and to establish mix designs. Place no concrete until approval of mix designs has been received in writing. Submittal for each concrete mix design to include:
 - 1) Sieve analysis and source of fine and coarse aggregates.
 - 2) Test for aggregate organic impurities.
 - 3) Proportioning of all materials.
 - 4) Type of cement with mill certificate for the cement.
 - 5) Brand, quantity and class of fly ash proposed for use along with other submittal data as required for fly ash by Section 03308.
 - 6) Slump.
 - 7) Brand, type and quantity of air entrainment and any other proposed admixtures.
 - 8) 28-day compression test results and any other data required by Section 03308 to establish concrete mix design.
 3. Certifications:
 - a. Testing Agency qualifications. (Contractor-retained testing agency, if different from Owner's)
 4. Test results:

- a. Strength test results on concrete placed during construction including slump, air content, and concrete temperature.
- b. Strength test results on concrete core samples of in-place construction if required.
- c. Results of load testing in-place concrete construction when load testing is required.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.01 TESTING SERVICES TO BE PERFORMED BY CONTRACTOR'S TESTING AGENCY

- A. Review and test Contractor's proposed materials for compliance with the Contract Documents.
- B. Review and test Contractor's proposed concrete mix design(s).

3.02 DUTIES AND AUTHORITIES OF OWNER'S TESTING AGENCY

- A. Testing Agency to inspect, sample and test materials and production of concrete as required by these Contract Documents and by Engineer. When it appears that any material furnished or work performed by Contractor fails to fulfill requirements of the Contract Documents, Testing Agency to report such deficiency to Engineer and Contractor.
- B. Testing Agency to report all test and inspection results to Engineer and Contractor immediately after they are performed. All test reports to include exact location in the work at which batch represented by a test was deposited. Reports of strength tests to include detailed information on storage and curing of specimens prior to testing.
- C. Limited Authority of Testing Agency: Any Testing Agency or agencies and their representatives retained by Contractor or Owner for any reason are not authorized to revoke, alter, relax, enlarge, or release any requirement of Contract Documents, nor to reject, approve or accept any portion of the Work.

3.03 RESPONSIBILITIES AND DUTIES OF CONTRACTOR

- A. Provide necessary testing services for qualification of proposed materials and establishment of concrete mix design(s).
- B. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no way relieve Contractor of responsibility to furnish materials and construction in full compliance with Contract Documents.
- C. To facilitate testing and inspection, perform the following:
 - 1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at site.
 - 2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and proper curing of test specimens on site for first 24 HRS as required by ASTM C31.
- D. Notify Engineer and Owner's Testing Agency sufficiently in advance of operations (minimum of 24 HRS) to allow completion of quality tests for assignment of personnel and for scheduled completion of quality tests.

3.04 EVALUATION OF CONCRETE, GROUT OR MORTAR TEST RESULTS

- A. Test results for standard molded and cured test cylinders to be evaluated separately for each mix design. Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards. For evaluation of potential strength and uniformity, each mix design shall be represented by at least three strength tests. A strength test shall be the average of two cylinders from the same sample tested at 28 days.

- B. Acceptance:
 - 1. Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:
 - a. Average of all sets of three consecutive strength tests equal or exceed the required specified 28-day compressive strength.
 - b. No individual strength test falls below the required specified 28-day compressive strength by more than 500 psi.

3.05 TESTING OF CONCRETE-IN-PLACE

- A. In-place testing of concrete may be required by Engineer when strength of structure is considered potentially deficient as specified in Paragraph 3.7D.
- B. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in the structure or for selecting areas to be cored. Such tests shall not be used as a basis for acceptance or rejection.
- C. Core Tests:
 - 1. Where required, obtain and test cores in accordance with ASTM C42. If concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 DegF, relative humidity less than 60 percent) for 7 days before test then test dry. If concrete in structure will be wet or subjected to high moisture atmosphere under service conditions, test cores after immersion in water for at least 40 HRS and test wet. Testing wet or dry to be determined by Engineer.
 - 2. Take three representative cores from each member or area of concrete in place that is considered potentially deficient. Location of cores shall be determined by Engineer so as least to impair strength of structure. If, before testing, one or more of cores shows evidence of having been damaged subsequent to or during removal from structure, damaged core shall be replaced.
 - 3. Concrete in area represented by a core test will be considered adequate if average strength of three cores is equal to at least 85 percent of specified strength and no single core is less than 75 percent of specified strength.
 - 4. Fill core holes with nonshrink grout and finish to match surrounding surface when exposed in a finished area.

3.06 ACCEPTANCE

- A. Completed concrete work which meets applicable requirements will be accepted without qualification.
 - 1. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.
 - 2. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Contract Documents. In this event, modifications may be required to assure that concrete work complies with requirements. Modifications, as directed by Engineer, to be made at no additional cost to Owner.
- B. Dimensional Tolerances:
 - 1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be considered potentially deficient in strength and subject to modifications required by Engineer.
 - 2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be rejected and excess material subject to removal. If removal of excess material is permitted, accomplish in such a manner as to maintain strength of section and to meet all other applicable requirements of function and appearance.
 - 3. Concrete members cast in wrong location may be rejected if strength, appearance or function of structure is adversely affected or misplaced items interfere with other construction.

4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed to view, may be rejected. Repair or remove and replace if required.
 5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or appearance is not adversely affected. High spots may be removed with a grinder, low spots filled with a patching compound, or other remedial measures performed as permitted or required.
- C. Appearance:
1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely affect appearance as required by specified finish shall be repaired by approved methods.
 2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in the opinion of the Engineer, the defects impair the strength or function of the member.
- D. Strength of Structure:
1. Strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control strength of structure, including but not necessarily limited to following:
 - a. Low concrete strength as specified in Article 3.5.
 - b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at variance with requirements in Section 03208 or requirements of the Contract Drawings or approved shop drawings.
 - c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
 - d. Curing time and procedure not meeting requirements of these Specifications.
 - e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
 - f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
 - g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to result in deficient strength.
 2. Structural analysis and/or additional testing may be required when strength of structure is considered potentially deficient.
 3. Core tests may be required when strength of concrete in place is considered potentially deficient.
 4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with Chapter 20 of ACI 318.
 5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
 6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

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SECTION 03458
WATERPROOFING MEMBRANES FOR STRUCTURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Furnish and place waterproofing membranes on concrete and steel bridge decks of railroad and other types of structures.

1.02 MEASUREMENT AND PAYMENT

- A. Payment: Unless otherwise specified on the plans, the work performed, materials furnished, equipment, labor, tools, and incidentals will not be paid for directly but will be considered subsidiary to pertinent Items.

1.03 REFERENCES

- A. ASTM D 6134 - Standard Specification for Vulcanized Rubber Sheets Used in Waterproofing Systems
- B. TxDOT Departmental Material Specifications
 - 1. DMS-6300 - Waterproofing

1.04 SUBMITTALS

- A. Conform to Specification 01 33 00 - Submittal Procedures.
- B. Submit laboratory reports prepared by an independent testing laboratory stating that materials used comply with requirements of this Specification.
- C. Submit certification from supplier that materials and equipment used to produce and deliver material comply with this Specification.
- D. For waterstops, submit product information sufficient to indicate compliance with this Specification, including manufacturer's descriptive literature and specifications.

PART 2 - PRODUCTS

2.01 MATERIALS TO BE FURNISHED

- A. Furnish waterproofing materials listed below in accordance with DMS-6300, "Waterproofing":
 - 1. asphalt for mopping above ground,
 - 2. asphalt for mopping below ground
 - 3. asphaltic primer,
 - 4. treated cotton fabric,
 - 5. self-adhering polyethylene,
 - 6. coal-tar-modified urethane,
 - 7. rubberized asphalt with preformed board membrane,
 - 8. asphalt plank,
 - 9. asphalt mat,
 - 10. rubberized asphalt with plastic film,
 - 11. asphaltic panels,
 - 12. plastic cement, and
 - 13. cold asphalt base emulsion.
- B. Furnish butyl rubber membrane and ethylene-propylene-diene terpolymer (EPDM) sheeting in accordance with ASTM D 6134. Deliver materials requiring sampling and testing to the work site a minimum of 3 weeks before use. When authorized, materials for waterproofing may be tested and approved before delivery to the worksite.

2.02 TYPES

- A. Provide the following types of waterproofing as shown on the plans or as directed.
1. Type 1
 - a. Butyl rubber membrane applied to a surface with a proper adhesive without protective planking and in accordance with the details shown on the plans. Provide a minimum thickness of 1/16 in. unless otherwise shown on the plans.
 2. Type 2
 - a. A single asphaltic primer coat and 1 mopping of asphalt.
 3. Type 3
 - a. A single asphaltic primer coat and 2 moppings of asphalt. When shown on the plans, supplement with 2 layers of treated cotton fabric with a third mopping of asphalt placed over the outer layer of fabric at construction joints of foundation structures.
 4. Type 4
 - a. Self-adhering polyethylene with a rubberized asphalt mastic material.
 5. Type 5
 - a. Single-component, coal-tar-modified urethane coating.
 6. Type 6
 - a. Self-adhering built-up membrane of rubberized asphalt formed on a preformed board with cold-applied asphaltic primer.
 7. Type 10
 - a. Any of Type 1, Type 4, Type 5, or Type 6 waterproofing.
 8. Type RR-1
 - a. Butyl rubber or EPDM membrane with a protective course of asphalt plank or asphalt mat of the specified thickness.

PART 3 - EXECUTION

3.01 GENERAL

- A. Store waterproofing material in a manner that will prevent damage. Keep material dry at all times, and store in a warm area before using in cold weather and out of direct sunlight in hot weather. Store asphalt planks, asphalt mats, and asphaltic panels in a manner that will prevent warping and breaking. Provide a wood float finish to concrete decks and other unformed concrete surfaces to be waterproofed. Cure concrete surfaces to be waterproofed for at least 7 days before applying waterproofing.
- B. Ensure that steel or concrete deck surfaces to be waterproofed are clean, dry, smooth, and free of fins, sharp edges, and loose material. Use grinders, if necessary, to remove protrusions that would puncture waterproofing membrane. Ensure surfaces are free of contaminants such as form release agents, wax base curing compounds, oil, and grease. If these contaminants are present, remove them by abrasive blast cleaning. Ensure that there are no depressions or pockets in horizontal surfaces of finished waterproofing. Unless otherwise required in the plans, fill expansion joints and other grooves with plastic cement conforming to the requirements of DMS-6300, "Waterproofing." Ensure that joints are dry and clean when filled. Overfill slightly to allow for shrinkage in drying.
- C. Sweep, vacuum, or air-blow the area to be waterproofed thoroughly to remove dust, dirt, and loose foreign material. After the deck is clean, maintain it in a clean condition until completion of waterproofing. Do not allow vehicular or equipment traffic on the bridge after the deck waterproofing work has started until after the work is complete and an adequate ballast cushion has been placed on the deck. Protect the waterproofing against damage from any source.
- D. Use asphalt for mopping below ground as defined in DMS-6300, "Waterproofing," when asphalt waterproofing is shown as a protection for back of abutments, retaining walls, or footings. Use asphalt for mopping above ground as defined in DMS-6300 for waterproofing on bridge decks.

3.02 INSTALLATION

A. Type 1

1. Do not apply waterproofing in wet weather or when the ambient temperature is below 50°F. Ensure that the rubber membrane is free from punctures, pockets, or folds.
2. Turn the membrane into drainage holes and castings without break. Take special care to make the waterproofing effective along the sides and ends of members to be waterproofed.
3. Install the butyl rubber membrane by first applying the adhesive as recommended by the membrane manufacturer. Install the adhesive to the surface to be waterproofed and at necessary splices, in a solid area extending approximately 36 in. back from the edges. Apply the membrane by pressing it firmly and uniformly in place against the previously applied adhesive, avoiding wrinkles and buckles. Make splices, laps, and flashing in accordance with the membrane manufacturer's recommended procedures.

B. Type 2

1. Place the asphalt primer at least 24 hr. before the asphalt mopping. Ensure that the primer is dry before the mopping. Work in the primer to give a uniform coating. Heat the asphalt for mopping in kettles equipped with armored thermometers, but do not heat above 350°F. Stir the asphalt frequently while heating. Apply the mop coating at a rate of at least 4 gal. per 100 sq. ft. of surface. If imperfections appear in the coating, apply additional coatings until the imperfections are corrected.

C. Type 3

1. Place the asphalt primer at least 24 hr. before the asphalt mopping. Ensure that the primer is dry before the mopping. Work in the primer to give a uniform coating. Heat the asphalt for mopping in kettles equipped with armored thermometers, but do not heat above 350°F. Stir the asphalt frequently while heating. Use a minimum coverage rate for each mop coating of 4 gal. per 100 sq. ft. of surface. If imperfections appear in the coating, apply additional coatings until the imperfections are corrected.
2. At construction joints, mop the surfaces to be waterproofed in sections. Lay a 15-in.-wide strip of cotton fabric on the first mopping while the asphalt is still hot and press into place. Apply subsequent moppings to completely cover and seal the cotton fabric. Do not make the end laps of the cotton fabric less than 12 in. unless otherwise shown on the plans.

D. Type 4

1. Unwrap the roll of waterproofing and press the adhesive surface into contact with the concrete horizontally. Secure the free end and then unroll slowly, using hand pressure to smooth the membrane into place and to help make a tight bond with the concrete. Overlap adjacent strips a minimum of 1 in. over the previously laid strip. Backfilling may be started as soon as the initial horizontal strip has been applied.

E. Type 5

1. Apply waterproofing in 2 coats to produce a minimum cured film thickness of 1/16 in. Unless otherwise shown on the plans, the application may be made using a roller, squeegee, brush, or spray equipment. Apply the second coat within 16 hr. after the initial coat. Follow the manufacturer's instructions with regard to the maximum time allowed between coats and any treatment of the initial coat required if this maximum time is exceeded. The minimum ambient temperature at the time of application of the waterproofing is 40°F. Do not begin backfilling until the second coat of waterproofing has cured sufficiently to prevent damage by the backfilling operation.

F. Type 6

1. Apply the primer at a rate of 1 gal. per 100 sq. ft. of surface or at the rate recommended by the manufacturer if different. Allow to dry to a tacky surface before placing the waterproofing membrane. Apply the primer and waterproofing membrane board panels only when the substrate temperature is above 50°F.

2. Seal joints by centering 6-in. gusset tape over the joint and pressing firmly into position. Roll in the panels and jointing tape with sufficient pressure to assure maximum adhesion, conformance to substrate, and elimination of air bubbles. Follow the manufacturer's recommendations for installation.
3. Begin backfilling as soon as the application of the waterproofing is complete. Complete backfilling within 48 hr. after the waterproofing material is applied to a non-horizontal surface.

G. Type RR-1

1. Apply waterproofing to dry surfaces and only when the ambient temperature is above 50°F. Ensure that the butyl rubber or EPDM membrane is free from punctures, pockets, or folds. Turn the membrane into drainage castings without break. Take special care to make the waterproofing effective along the sides and ends of girders and at stiffeners, gussets, etc. Fill grooves with plastic cement. Install the butyl rubber or EPDM membrane by first applying the adhesive as recommended by the membrane manufacturer to ballast retainers, ends of deck, and at necessary splices in a solid area extending from the edges back about 36 in. or as shown on the plans. Apply the membrane and press it firmly and uniformly in place against the previously applied adhesive, avoiding wrinkles and buckles. Make splices, laps, and flashing in accordance with the membrane manufacturer's recommended procedures.
2. Place the protective cover as soon as practicable after placement of the membrane. Clean the membrane surface of dirt and other foreign material before placing the cover material. Apply a coating of cold asphalt emulsion over the membrane at a minimum rate of 4 gal. per 100 sq. ft. of surface. Place the asphalt plank or mat on the coating of cold asphalt emulsion.
3. Unless otherwise specified in the plans, provide a minimum thickness of protection of 1 in., consisting of asphalt plank or asphalt mat. Coat the edges and ends of adjacent planks already laid with cold asphalt emulsion as successive planks are laid. Lay the planks tightly against those previously laid so the emulsion will completely fill the joints and be squeezed out the top. Fill any joints not completely full after planks have been laid with emulsion. When 2 layers of planks are used to obtain the required 1-in. cover thickness, offset the vertical joints of the second layer at least 4 in. transversely and 1 ft. longitudinally from the joints in the lower layer.
4. Apply asphalt mat protection in the same manner except stagger the longitudinal butt joints in a single layer by approximately 2 ft. When more than 1 thickness of asphalt mat is required, follow the same procedure with all vertical joints offset by at least 1 ft. Place a follow-up coating of asphalt emulsion approximately 6 in. wide over all joints of the top layer.
5. Use asphalt for mopping above ground as defined in DMS-6300, "Waterproofing," where deck waterproofing is carried over the back wall and down the back of the abutment for only several feet to provide a proper flashing for the deck waterproofing.

END OF SECTION

SECTION 05131
STRUCTURAL ALUMINUM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural aluminum including the fabrication and erection of framing and bracing members, including connections.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Division 3 - Concrete.
 - 4. Section 05505 - Metal Fabrications.
 - 5. Section 05522 - Aluminum Railings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Aluminum Association (AA):
 - a. SAS-30, Standard Specifications for Aluminum Structures.
 - b. ASD1, Aluminum Standards and Data.
 - c. ED-33, Engineering Data for Aluminum Structures.
 - 2. American Institute of Steel Construction (AISC):
 - a. Manual of Steel Construction.
 - 3. American National Standards Institute (ANSI):
 - a. B18.2, Square and Hexagon Bolts and Nuts.
 - b. B18.22.1, Plain Washers.
 - 4. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. B210, Standard Specification for Aluminum-Alloy Drawn Seamless Tubes.
 - c. B211, Standard Specification for Aluminum-Alloy Bar, Rod, and Wire.
 - d. B221, Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
 - e. B241, Standard Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
 - f. B247, Standard Specification for Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
 - g. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Shapes.
 - h. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - i. F467, Standard Specification for Nonferrous Nuts for General Use.
 - j. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
 - k. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 5. American Welding Society (AWS):
 - a. D1.2, Structural Welding Code Aluminum.
 - 6. Building Code: 2006 International Building Code (IBC-06) with all local amendments.
- B. Qualifications:
 - 1. For welding aluminum: Qualify welding procedures and welding operators in accordance with AWS D1.2. Welding operators to have been qualified during the 12-month period prior to commencement of welding.

2. Connections and members not detailed on the Drawings shall be designed by a registered professional Structural Engineer in the state where the Project is located.

1.3 SUBMITTALS

- A. Shop Drawings:
 1. See Section 01330.
 2. Fabrication and/or layout drawings:
 - a. Erection plans and details of each piece including connection details:
 - 1) Show all cuts, copes and holes.
 - 2) Indicate all shop and field welds using AWS symbols.
 - 3) Indicate all shop and field bolts.
 - 4) Reviewed and sealed by Professional Engineer retained by Contractor to verify conformance with design criteria stipulated in the Contract Documents.
 - b. Complete shop drawings for all of the work showing clearly all pieces, details, connections, materials and shop-applied coatings.
 - c. Prepare complete erection drawings showing the location and marks of all pieces.
 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 4. Certifications.
 - a. Certificates of compliance with standards specified for all major components and fasteners incorporated into work.
 - b. Copies of current welding certificates for each welder assigned to perform welding indicating compliance with testing specified by AWS.
 5. Test reports.
 - a. Certified copies of mill tests.
 - b. Manufacturer's load test and temperature sensitivity data for expansion anchor bolt and adhesive anchor bolts.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Expansion anchor bolts: See Section 05505.
 2. Adhesive anchor bolts: See Section 05505.
- B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 MATERIALS

- A. Alloy 6061-T6, 32,000 psi tensile yield strength minimum.
 1. ASTM B209 for sheets and plates.
 2. ASTM B210 for tubes.
 3. ASTM B221 and B308 for shapes: Beams, channels, angles.
 4. ASTM B247 for forgings.
- B. Alloy 6063-T5 or T6, 15,000 psi tensile yield strength minimum.
 1. ASTM B221 and B429 for bars, rods, wires, and pipes.
- C. Aluminum Bolts and Nuts: ASTM F467 and F468 of alloy 2024-T4 (62,000 psi tensile strength minimum).
- D. Bolts and Nuts for Fastening Aluminum to Structural Steel: Stainless steel complying with ASTM F593, Type 316 with a minimum yield strength of 30,000 psi and a minimum tensile strength of 75,000 psi.

- E. Washers: Same material and alloy as found in bolts and nuts with which the washers are to be used.
- F. Electrodes for Welding Aluminum: AWS D1.2 filler alloy 5356 or alternate if approved by Engineer.
- G. Expansion Anchor Bolts and Adhesive Anchor Bolts for Fastening to Concrete:
 - 1. Stainless steel, type 316.
 - 2. Provide minimum edge distance cover and spacing as recommended by manufacturer or as indicated on Drawings.
 - 3. See Section 05505 for additional information.

2.3 DESIGN CRITERIA

- A. Where final design of members and connections for any portion of structure is not indicated, perform final design of such members and connections.
- B. Final designs of members and connections shall conform to AA "Aluminum Design Manual" and to details and requirements shown on Drawings.
 - 1. Design loads for members and connections shall be as shown on the Drawings.

2.4 FABRICATION

- A. Fabrication of bolted and welded connections of aluminum work shall be in accordance with AA "Aluminum Design Manual".
- B. Contractor to be solely responsible for correctness of all shop and field fabrication and fit. Verify field conditions and dimensions prior to fabrication.
- C. Fabricate aluminum work and assemble in shop to greatest extent possible. Make splices only where indicated or approved.
- D. Provide connections as indicated. Where not indicated, design and provide connections in accordance with requirements of this Section. One-sided or other types of eccentric connections are not acceptable unless indicated on Contract Drawings or approved on shop drawings.
- E. Drill or punch holes at right angles to surface of metal. Do not make or enlarge holes by burning. Provide holes clean and free of torn or ragged edges. Use tools which will make a 1/16 IN bevel to remove outside burrs resulting from drilling or punching operations.
 - 1. Punch or drill for field connections and for attachment of work by other trades.
- F. Cope at 45 degrees corners of stiffener plates at junction of member flanges with webs.
- G. Welding: Weld connections to members in shop and bolt connections in field. Perform welding using electrodes of filler alloy 5356. Perform welding in accordance with AWS D1.2. Use only welding procedures and welding operators qualified in accordance with requirements of paragraph 1.2 B "Qualifications".
- H. Form to shapes indicated with straight lines, true angles and smooth curves. Grind smooth all rough welds and sharp edges.
 - 1. Round all corners to approximately 1/8 IN radius.
- I. Finish: Mill finish as fabricated.

PART 3 - EXECUTION

3.1 ERECTION

- A. Contractor is solely responsible for safety. Construction means and methods and sequencing of work is prerogative of the Contractor. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g. until decks and diagonal bracing or rigid connections are installed.

1. Partially complete structural members shall not be loaded without an investigation by the Contractor.
 2. Until all elements of the permanent structure and lateral bracing system are complete, provide temporary bracing designed, finished and installed by the Contractor.
- B. Bolting:
1. Protect bolt threads from damage.
 2. Rest bolt heads and nuts squarely against surfaces.
 3. Where bolt heads or nuts rest on beveled surfaces having slope greater than 1 in 20 with plane normal to bolt axis, provide beveled washers to give full bearing to head and nut.
 4. Correct poor matching of holes by drilling to next larger size and use larger diameter bolt
 5. Connect aluminum members to:
 - a. Aluminum members using 3/4 IN DIA aluminum bolts of alloy 2024-T4.
 - b. Structural steel using 3/4 IN DIA stainless steel bolts.
 - c. Concrete or masonry using stainless steel expansion anchor bolts or adhesive anchor bolts unless shown otherwise. Provide dissimilar materials protection.
- C. Welding: Field welding of aluminum is not allowed unless indicated on Drawings.
- D. Correct fabrication errors and damaged members in shop. Do not use cutting torch in shop or in field to cut any members, to correct fabrication errors, or to cut openings.
- E. Provide templates for anchors, bolts, and other items to be installed in other work.
- F. Field Assembly: Tolerances shall comply with AISC "Manual of Steel Construction" Ninth Edition. Before members are assembled, thoroughly clean all bearing surfaces and surfaces that will be in permanent contact. After assembly, carefully align all members of each frame or assembly and accurately adjust until final, correct and true location is achieved. As work progresses, securely fasten in place.
1. Provide full length members without splices.
 2. Securely tighten and leave in place all erection bolts used in welded construction, unless removal is required.
- G. Set beam and column baseplates accurately, as indicated on nonshrink grout, in accordance with Division 3.
1. If not indicated, provide minimum of 1 IN grout thickness under base plates.
 2. Set and anchor each base plate to proper line and elevation.
 - a. Use aluminum wedges, shims, or setting nuts for leveling and plumbing columns and beams. Tighten anchor bolts.
 - b. Fill space between bearing surface and bottom of base plate with nonshrink grout. Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout.
 - c. Do not remove wedges or shims and where they protrude, cut off flush with edge of base plate.
- H. Temporary Protection: Suitably protect aluminum surfaces against lime mortar stains, discoloration, surface abrasion and other construction abuses..
- I. Contact with Dissimilar Materials: Where aluminum surfaces will be embedded in concrete, built into masonry, or in contact with steel, concrete, masonry, or other dissimilar materials, coat the aluminum surfaces.

END OF SECTION

SECTION 05505

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be supplied under work of other Specification Sections.
 - 2. Design of all temporary bracing not indicated on Drawings.
 - 3. Design of systems and components, including but not limited to:
 - a. Stairs.
 - b. Landings.
 - c. Ladders.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Division 3 - Concrete.
 - 4. Section 05120 - Structural Steel.
 - 5. Section 05522 - Aluminum Railings.
 - 6. Section 05521 - Pipe and Tube Railings
 - 7. Section 09905 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Aluminum Association (AA):
 - a. ADM-1, Aluminum Design Manual.
 - b. 45, Designation System for Aluminum Finishes.
 - 2. American Association of State Highway and Transportation Officials (AASHTO):
 - a. Standard Specification for Highway Bridges.
 - 3. American Institute of Steel Construction (AISC):
 - a. Manual of Steel Construction - Allowable Stress Design (ASD).
 - b. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
 - 4. American National Standards Institute (ANSI):
 - a. A14.3, Ladders - Fixed - Safety Requirements.
 - 5. ASTM International (ASTM):
 - a. A6, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - b. A36, Standard Specification for Carbon Structural Steel.
 - c. A47, Standard Specification for Ferritic Malleable Iron Castings.
 - d. A48, Standard Specification for Gray Iron Castings.
 - e. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - f. A108, Standard Specification for Steel Bars, Carbon and Alloy, Cold Finished.
 - g. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - h. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - i. A197, Standard Specification for Cupola Malleable Iron.
 - j. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

- k. A276, Standard Specification for Stainless Steel Bars and Shapes.
- l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- m. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- n. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- o. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
- p. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- q. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- r. A536, Standard Specification for Ductile Iron Castings.
- s. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
- t. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- u. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- v. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
- w. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- x. A786, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
- y. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
- z. A992, Standard Specification for Steel for Structural Shapes.
- aa. B26, Standard Specification for Aluminum-Alloy Sand Castings.
- bb. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- cc. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- dd. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- ee. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
- ff. B632, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
- gg. F467, Standard Specification for Nonferrous Nuts for General Use.
- hh. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
- ii. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- jj. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- 6. American Welding Society (AWS):
 - a. A5.1, Standard Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - b. D1.1, Structural Welding Code Steel.
 - c. D1.2, Structural Welding Code Aluminum.
- 7. National Association of Architectural Metal Manufacturers (NAAMM):
 - a. AMP 510, Metal Stairs Manual.
 - b. MBG 531, Metal Bar Grating Manual.
- 8. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
- 9. Research Council on Structural Connections (RCSC):
 - a. Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts, referred to herein as Specification for Structural Joints.

10. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.
- B. Qualifications:
 1. Qualify welding procedures and welding operators in accordance with AWS.
 2. Fabricator shall have minimum of 10 years experience in fabrication of metal items specified.
 3. Engineer for contractor-designed systems and components: Professional structural engineer licensed in the State of Texas.

1.3 DEFINITIONS

- A. Installer or Applicator:
 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 2. Installer and applicator are synonymous.
- B. Hardware: As defined in ASTM A153.
- C. Galvanizing: Hot-dip galvanizing per ASTM A123 or ASTM A153 with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01330 for requirements for the mechanics and administration of the submittal process.
 2. Fabrication and/or layout drawings and details:
 - a. Submit drawings for all fabrications and assemblies.
 - 1) Include erection drawings, plans, sections, details and connection details.
 - b. Identify materials of construction, shop coatings and third party accessories.
 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Provide manufacturer's standard allowable load tables for the following:
 - 1) Grating and checkered plate.
 - 2) Expansion anchor bolts.
 - 3) Adhesive anchor bolts.
 - 4) Castings, trench covers and accessories.
 - 5) Metal (Modular) framing systems.
 4. Contractor designed systems and components, including but not limited to, stairs, landings and ladders:
 - a. Certification that manufactured units meet all design loads specified.
 - b. Shop Drawings and engineering design calculations:
 - 1) Indicate design live loads.
 - 2) Sealed by a professional structural engineer.
 - 3) Engineer will review for general compliance with Contract Documents.
- B. Miscellaneous Submittals:
 1. See Specification Section 01330 for requirements for the mechanics and administration of the submittal process.
 2. Certification of welders and welding processes.
 - a. Indicate compliance with AWS.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and handle fabrications to avoid damage.
- B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Abrasive stair nosings (embedded in concrete stairs):
 - a. American Safety Tread.
 - b. Balco.
 - 2. Headed studs and deformed bar anchors:
 - a. Nelson Stud Welding Div., TRW Inc.
 - b. Stud Welding Products, Inc.
 - 3. Expansion anchor bolts:
 - a. Hilti Inc.
 - b. Simpson Strongtie.
 - 4. Epoxy adhesive anchor bolts:
 - a. Hilti Inc.
 - b. Simpson Strongtie.
 - 5. Self-tapping concrete anchors:
 - a. ITW Buildex.
 - 6. Castings, trench covers and accessories:
 - a. Neenah Foundry Co.
 - b. Deeter Foundry Co.
 - c. Barry Craft Construction Casting Co.
 - d. McKinley Iron Works.
 - 7. Aluminum ladders:
 - a. Any manufacturer capable of meeting the requirements of this Specification Section.
 - 8. Galvanizing repair paint:
 - a. Clearco Products Co., Inc.
 - b. ZRC Products.
 - 9. Metal (Modular) framing system:
 - a. Unistrut Building Systems.
 - b. B-Line Systems.
 - c. Kindorf.
 - d. Metal Products Div., USG Industries, Inc.
 - e. Mono-Systems, Inc.
 - 10. Ladder safety extension post:
 - a. Bilco.
 - 11. Ladder fall protection system:
 - a. DBI/SALA.
 - b. Miller Equipment.
 - c. North Specialty Products.
- B. Submit request for substitution in accordance with Specification Section 01640.

2.2 MATERIALS

- A. Steel:
 - 1. Structural:

- a. W-shapes and WT-shapes: ASTM A992, Grade 50.
 - b. All other plates and rolled sections: ASTM A36.
 2. Pipe: ASTM A53, Types E or S, Grade B or ASTM A501.
 3. Structural tubing:
 - a. ASTM A500, Grade B (46 ksi minimum yield).
 4. Bolts, nuts and washers, high strength:
 - a. ASTM A325.
 - b. Galvanized, ASTM A153. Where noted on Drawings.
 - c. Provide two (2) washers with all bolts.
 5. Bolts and nuts:
 - a. ASTM A307, Grade A.
 - b. Galvanized, ASTM A153. Where noted on Drawings.
 6. Welding electrodes: AWS D1.1, E70 Series.
 7. Steel forgings: ASTM A668.
- B. Iron:
 1. Ductile iron: ASTM A536.
 2. Gray cast iron: ASTM A48 (minimum 30,000 psi tensile strength).
 3. Malleable iron: ASTM A47, ASTM A197.
- C. Stainless Steel:
 1. Minimum yield strength of 30,000 psi and minimum tensile strength of 75,000 psi.
 - a. Bars, shapes: ASTM A276, Type 304 or 316.
 - b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 304 or 316.
 - c. Strip, plate and flat bars: ASTM A666, Type 304 or 316, Grade A.
 - d. Bolts and nuts: ASTM F593, Type 303, 304 or 316.
 2. Minimum yield strength of 25,000 psi and minimum tensile strength of 70,000 psi.
 - a. Strip, plate and flat bar for welded connections, ASTM A666, Type 304L or 316L.
 3. Welding electrodes: In accordance with AWS for metal alloy being welded.
- D. Aluminum:
 1. Alloy 6061-T6, 32,000 psi tensile yield strength minimum.
 - a. ASTM B221 and ASTM B308 for shapes including beams, channels, angles, tees and zees.
 - b. Weir plates, baffles and deflector plates, ASTM B209.
 2. Alloy 6063-T5 or T6, 15,000 psi tensile yield strength minimum.
 - a. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
 3. ASTM B26 for castings.
 4. ASTM F468, alloy 2024 T4 for bolts.
 5. ASTM F467, alloy 2024 T4 for nuts.
 6. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.
- E. Washers: Same material and alloy as found in accompanying bolts and nuts.
- F. Embedded Anchor Bolts:
 1. Building anchor bolts:
 - a. ASTM F1554, Grade 55 with weldability supplement S1 or ASTM A36 for threaded rods galvanized.
 - b. ASTM A307, Grade A for headed bolts galvanized.
 2. All other anchor bolts: Type 304 or 316 stainless steel with matching nut and washer.
- G. Expansion Anchor Bolts and Adhesive Anchor Bolts:
 1. Stainless steel, Type 304, 314 or 316.
 2. Provide minimum edge distance cover and spacing as recommended by manufacturer, or as indicated on Drawings whichever is larger.
 - a. Minimum embedment as recommended by manufacturer or eight (8) diameters of bolt, whichever is larger.

- b. Notify Engineer if required depth of embedment cannot be achieved at a particular anchor bolt location.
Follow manufacturer's recommendations for installation and torque.
- 3. Expansion anchor bolts:
 - a. "Kwik Bolt TZ," "HAD Undercut Anchor," "HSL-3 heavy duty Expansion Anchor," by Hilti, Inc.
 - b. "Torq-Cut Self Undercutting Anchor," "Strong Bolt Anchor," by Simpson Strong Tie.
- 4. Adhesive anchor bolts:
 - a. HIT HY 150 Adhesive Anchor by Hilti (only approved for masonry and non-structural applications).
 - b. "Set-XP" by Simpson Strong Tie.
 - c. "RE 500-SD" by Hilti, Inc.
- 5. Self-tapping concrete anchors:
 - a. "Tapcon" by ITW Buildex.
 - b. "Kwick-Conn II" by Hilti.
 - c. 1/4 IN DIA with 5/16 IN hex head.
 - 1) Minimum embedment as recommended by manufacturer.
- 6. Adhesive anchors and expansion anchors:
 - a. Anchors that secure items of a structural nature shall be approved for use in cracked concrete and seismic loading, shall be approved for design using an LRFD methodology such as Appendix D in ACI 318, and shall be permitted for such use by the Building Code.
- H. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.
- I. Deformed Bar Anchors: ASTM A496 with a minimum yield strength of 70,000 psi and a minimum tensile strength of 80,000 psi.
- J. Iron and Steel Hardware: Galvanized in accordance with ASTM A153 when required to be galvanized.
- K. Galvanizing Repair Paint:
 - 1. High zinc dust content paint for regalvanizing welds and abrasions.
 - 2. ASTM A780.
 - 3. Zinc content: Minimum 92 percent in dry film.
 - 4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."
- L. Dissimilar Materials Protection: See Specification Section 09905.

2.3 MANUFACTURED UNITS

- A. Ladders:
 - 1. Material:
 - a. Aluminum. Unless otherwise noted.
 - 2. Rails:
 - a. Maximum 3 x 2 IN heavy-duty rectangular tubing or channel, with minimum thickness of 0.125 IN or 1-1/2 IN nominal diameter schedule 80 pipe.
 - b. Spacing: Nominal 18 IN from centerline of rails except at top.
 - 1) Minimum clear distance between rails to be 16 IN.
 - c. Brackets for wall supported units: Provide 3/8 x 2-1/2 IN x length required angle brackets welded to side rails with punched holes for 3/4 IN bolts.
 - 1) Maximum spacing: 4 FT OC.
 - d. For floor supported units provide 3/8 x 2-1/2 x 4 IN rectangular bracket or 3/8 x 6 x 6 IN square plate welded to rails with punched holes for 3/4 IN bolts.
 - 1) Provide wall brackets on floor supported units if vertical run is over 4 FT.
 - 3. Rungs:

- a. Minimum 1 IN DIA or 1 IN square extruded, with integral serrated non-slip finish on all sides.
 - b. Shop or field-applied grit tape and cap type non-slip finish is not acceptable.
4. Minimum distance from centerline of rung to wall or any obstruction: 7 IN.
5. Rung spacing:
 - a. Uniform, 12 IN.
 - b. Top rung shall be level with landing or platform.
 - c. Spacing of bottom rung from grade or platform may vary but shall not exceed 14 IN.
6. Deflector plate:
 - a. For aluminum ladders: Minimum .0625 IN aluminum plate, ASTM B209.
 - b. For stainless steel ladders: Minimum .0625 IN stainless steel plate, ASTM A666.
 - c. For steel ladders: Minimum .0625 IN steel plate, ASTM A6.
 - d. Profile as shown on Drawings.
 - e. Fabricate to shapes and sizes required to meet OSHA Standards.
7. Provide ladder cage where shown on the Drawings.
 - a. Cage construction shall meet all requirements of OSHA Standards and this Specification Section:
 - 1) Hoops: Minimum 1/4 x 2 IN bar at 48 IN OC spacing.
 - 2) Vertical bars: Minimum 1/4 x 1-1/2 IN bar.
 - 3) All connections shall be welded.
 - 4) Construct cage of same materials as the ladder on which it is mounted.
 - 5) Mount cage on ladder by welding or bolting with stainless steel bolts, nuts and washers.
 - a) On bolted attachments, the bolt, nut or washer shall not affect a person's ability to grasp the ladder rail.
 - b. Landing construction shall meet all requirements of OSHA Standards and this Specification Section.
 - 1) Landing platform: Minimum 1-1/2 IN non-slip grating.
 - 2) Structural support: Channel or tubular sections with bracing, plates, angles, etc., to support guardrail and grating and to support landing off the side of the structure.
 - 3) Guardrail: See specification Section 05522.
 - 4) All connections shall be welded or bolted using stainless steel bolts, nuts and washers.
 - 5) Construct landing, railing and all supports of same material as the ladder.
 - 6) Landing platform and supporting structure shall be designed for not less than 100 psf plus a concentrated load of 300 LBS with a maximum deflection of 1/300 of span under a superimposed live load of 100 psi.
 - 7) Attach grating to structure using stainless steel clips and bolts at 24 IN OC maximum spacing.
8. As a minimum, design ladder in accordance with OSHA Standards, ANSI A14.3, and applicable Building Codes.
 - a. Ladders shall be designed to support a minimum concentrated live load of 200 LBS.
 - b. Maximum allowable stresses per AISC Specification and AA Specification.
 - c. Maximum lateral deflection: Side rail span/240 when lateral load of 100 LBS is applied at any location.
9. Construction:
 - a. Fully welded type.
 - b. All welds to be full penetration welds, where applicable.
 - c. All ladders of a particular material shall have consistent construction and material shapes and sizes unless detailed otherwise on the Drawings.
 - d. Provide cap at top and bottom of side rails.
 - e. Rungs shall not extend beyond the outside face of the siderail.
 - f. The side rails of through ladder extension shall extend 42 IN above the top rung or landing and shall flare out on each side to provide a clearance of 24 IN centerline to centerline of rails.

10. Finish:
 - a. Aluminum: Anodized (dry, exposed installations). Mill (wet or concealed installations).
 - 1) Color: AA-M10C22A41 clear.
 - b. Stainless steel: Satin.
 11. Ladder safety extension post:
 - a. Telescoping tubular aluminum section that automatically locks into place when fully extended.
 - b. Non-ferrous corrosion-resistant spring and hardware.
 - c. Factory assembled with all hardware necessary for mounting to ladder.
 - d. Bilco "LadderUp" safety post.
 12. Ladder fall protection system:
 - a. Extruded aluminum safety rail.
 - 1) Safety rail shall extend from within 3 FT of base of ladder to top of ladder side rails.
 - b. Extruded aluminum trolley with brake.
 - 1) Ice guard.
 - c. Full body harness with adjustable leg straps, backpad, and front dee ring.
 - d. Miller Equipment "SURETRACK."
 - e. Provide all components required for a complete OSHA approved operating system.
- B. Bollards:
1. 8 IN DIA extra strength steel pipe, ASTM A53.
 - a. Galvanized and painted.
 - b. See Specification Section 09905 for painting requirements.
 2. Minimum 48 IN projection above ground.
 3. Minimum 48 IN embedment in concrete.
- C. Abrasive Stair Nosings:
1. Two (2) component consisting of an embedded subchannel, installed with the concrete pour, and an abrasive tread plate to be installed later.
 2. 6063-T5 extruded aluminum, mill finished and heat treated.
 3. Complete with concrete anchors and tread plate securing screws.
 4. Tread plate:
 - a. Extruded aluminum.
 - b. Solid epoxy abrasive filler.
 - 1) Color: Safety yellow.
 5. Balco "DXH-330."
 6. Length:
 - a. Concrete stairs:
 - 1) 4 IN less than overall stair width.
 - 2) Where tread mounted railing post occurs, hold nosing back 4 IN clear from railing centerline.
 - b. Concrete landings at metal stairs: 4 IN less than clear width between stringers.
- D. Metal Stairs:
1. Fabricated as indicated.
 2. Treads: Grating as specified.
 - a. Provide integral corrugated non-slip nosing.
 3. Risers:
 - a. Grating treads: Solid plate attached to trailing edge of tread as shown on Drawings.
 4. Landings:
 - a. Grating as specified.
 - b. Provide integral corrugated non-slip nosing at edge acting as stair tread/nosing.
 - c. Nosing at concrete landing:
 - 1) 1/4 IN bent checkered plate with 1/2 IN x 6 IN headed studs at 18 IN OC.
 - a) See Drawings for configuration.

- b) Provide same material as other stair components.
 - 2) Abrasive stair nosing.
 - 5. Fabricate and design stair, platforms and landings, and all connections to support a 100 psf uniform live load or a concentrated load of 1000 LBS, whichever requires the stronger component.
 - 6. Design, fabricate, and install in compliance with NAAMM AMP 510 and applicable codes.
 - 7. Handrails and guardrails: Refer to Specification Section 05522.
 - 8. Material:
 - a. Aluminum.
- E. Stairs, Concrete Filled Steel Pan:
- 1. Fabricated as indicated.
 - a. ASTM A36 steel.
 - 2. Treads: Minimum 14 GA pans with self-furring metal lath welded in pan.
 - 3. Risers: Minimum 14 GA.
 - 4. Landings: minimum 10 GA pans with angle supports as required to support loading indicated and concrete.
 - a. Provide self-furring metal lath reinforcing welded in the pan.
 - 5. Fabricate and design stair, platforms and landings, and all connections to support a 100 psf uniform live load or a concentrated load of 300 LB, whichever requires the stronger component.
 - 6. Design, fabricate, and install in compliance with NAAMM AMP 510 and applicable codes.
 - 7. Form surface of nosings with slip-resistant materials or provide separate slip-resistant nosings.
 - 8. Handrails and guardrails: Refer to Specification Section 05521.
 - 9. Galvanized entire assembly after fabrication.
- F. Aluminum Checkered Plate:
- 1. Conform to ASTM B632.
 - a. Diamond pattern: Use one (1) pattern throughout Project.
 - b. Material: Type 6061-T6.
 - 2. Design live load:
 - a. 100 psf, uniform load.
 - b. 300 LBS concentrated load on 4 IN square area.
 - c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
 - d. Maximum deflection: 1/300 of span under a superimposed live load of 50 psf.
 - 3. Reinforce as necessary with aluminum angles.
 - 4. Plate sections:
 - a. Maximum 3 FT wide.
 - b. Minimum 1/4 IN thick.
 - c. Maximum 75 LBS per section if required to be removable.
 - 5. Provide joints at center of all openings unless shown otherwise.
 - a. Reinforce joints and openings with additional angles to provide required load carrying capacity.
 - 6. Unless shown otherwise, frame for openings with aluminum checkered plate cover:
 - a. Aluminum support angles:
 - 1) 3 x 2 x 1/4 IN minimum size with long leg vertical.
 - 2) 5/8 IN DIA adhesive anchor bolts spaced at maximum of 24 IN OC along each side with not less than two (2) anchor bolts per side.
 - b. Aluminum concrete insert seats:
 - 1) 2 x 2 x 1/4 IN minimum size.
 - 2) Auto-welded studs or strap anchors at 18 IN OC with not less than two (2) studs or anchored per side.
 - c. Drill and tap frame to receive 3/8 IN DIA aluminum cap screws at not more than 24 IN OC with not less than two (2) screws per side.

- G. Aluminum Grating:
 - 1. NAAMM MBG 531.
 - 2. Bearing bars: Rectangular, 1-1/2 x 3/16 IN at 1-3/16 IN OC spacing.
 - a. See drawings for specific grating sizes by locations.
 - 3. Cross bars:
 - a. Welded, swaged or pressure locked to bearing bars:
 - b. Maximum 4 IN/OC spacing.
 - 4. Top edges of bars: Serrated.
 - 5. Removable grating sections: Not wider than 3 FT and not more than 75 LBS.
 - 6. Standard mill finish.
 - 7. Ends and perimeter edges: Banded.
 - 8. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 IN high toe plate.
 - 9. Provide joints at openings between individual grating sections.
 - 10. Clips and bolts: Stainless steel.
 - 11. Seat angles: Aluminum.
- H. Heavy-Duty Castings, Trench Covers, and Accessories:
 - 1. Prefabricated, cast iron ASTM A48 or ductile iron ASTM A536 or cast aluminum ASTM B26.
 - 2. Design load: AASHTO HS-20 wheel loading for indicated span.
 - 3. Machine horizontal mating surfaces.
- I. Access Cover:
 - 1. Tank type manhole frame and solid lid: ASTM A48 or ASTM A536, cast iron.
 - 2. Unless shown otherwise, design of cover shall be such that top of frame extends several inches above slab to prevent surface water from entering tank.
 - 3. Equip lid with four (4) stainless steel screws to secure lid to frame.
- J. Loose Lintels:
 - 1. Steel, ASTM A36 or ASTM A572 Grade 50, sizes as indicated on Drawings.
 - 2. Hot-dip galvanized per ASTM A123.
- K. Metal (Modular) Framing System:
 - 1. Materials:
 - a. Interior dry non-corrosive areas: Hot-dipped galvanized.
 - b. Interior wet or corrosive areas: Aluminum or stainless steel.
 - c. Exterior: Aluminum or Stainless steel.
 - 2. Channels and inserts:
 - a. Minimum 0.080 IN aluminum.
 - b. Channels to have one (1) side with a continuous slot with inturned lips.
 - 3. Fittings: Same material as system major components.
 - 4. Nuts:
 - a. Toothed grooves in top of nuts to engage the inturned lips of channel.
 - b. Same material as system major components.
 - 5. End caps:
 - a. At each exposed end of each piece mounted on walls, or guardrails, or suspended from framing 7 FT or less above the floor or platform.
 - 1) Plastic for all exposed ends 7 FT or more above floor or platform.
 - 2) Plastic or metallic for all other exposed ends.
 - 6. Finishes:
 - a. Stainless steel: Satin.
 - b. Aluminum:
 - 1) Mill.
 - 2) Paint aluminum in contact with dissimilar metals in accordance with Specification Section 09905.

7. See Specification Section 06610 for fiberglass reinforced plastic modular framing.
- L. Hose Rack:
 1. Fabricate in accordance with details indicated on the Drawings.
 - a. Grind smooth all welds after fabrication.
 2. Provide U-bolt mounting to fit size of member being mounted to.
 3. Provide stainless steel fasteners, anchor bolts and U-bolts.
 4. Material: Stainless steel.

2.4 FABRICATION

- A. Verify field conditions and dimensions prior to fabrication.
- B. Form materials to shapes indicated with straight lines, true angles, and smooth curves.
 1. Grind smooth all rough welds and sharp edges.
 - a. Round all corners to approximately 1/16 IN nominal radius.
- C. Provide drilled or punched holes with smooth edges.
 1. Punch or drill for field connections and for attachment of work by other trades.
- D. Weld Permanent Shop Connections:
 1. Welds to be continuous fillet type unless indicated otherwise.
 2. Full penetration butt weld at bends in stair stringers and ladder side rails.
 3. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming to AWS A5.1.
 4. Weld aluminum in accordance with AWS D1.2.
 5. All headed studs to be welded using automatically timed stud welding equipment.
 6. Grind smooth welds that will be exposed.
- E. Conceal fastenings where practicable.
- F. Fabricate work in shop in as large assemblies as is practicable.
- G. Tolerances:
 1. Rolling:
 - a. ASTM A6.
 - b. When material received from the mill does not satisfy ASTM A6 tolerances for camber, profile, flatness, or sweep, the Contractor is permitted to perform corrective work by the use of controlled heating and mechanical straightening, subject to the limitations of the AISC Specifications.
 2. Fabrication tolerance:
 - a. Member length:
 - 1) Both ends finished for contact bearing: 1/32 IN.
 - 2) Framed members:
 - a) 50 FT or less: 1/16 IN.
 - b) Over 50 FT: 1/8 IN.
 - b. Member straightness:
 - 1) Compression members: 1/1000 of axial length between points laterally supported.
 - 2) Non-compression members: ASTM A6 tolerance for wide flange shapes.
 - c. Specified member camber (except compression members):
 - 1) 50 FT or less: Minus 0/plus 1/2 IN.
 - 2) Over 50 FT: Minus 0/plus 1/2 IN (plus 1/8 IN per 10 FT over 50 FT).
 - 3) Members received from mill with 75 percent of specified camber require no further cambering.
 - 4) Beams/trusses without specified camber shall be fabricated so after erection, camber is upward.
 - 5) Camber shall be measured in fabrication shop in unstressed condition.
 - d. At bolted splices, depth deviation shall be taken up by filler plates.
 - 1) At welded joints, adjust weld profile to conform to variation in depth.

- 2) Slope weld surface per AWS requirements.
- e. Finished members shall be free from twists, bends and open joints.
 - 1) Sharp kinks, bends and deviation from above tolerances are cause for rejection of material.
- H. Fabricate grating, checkered plate, stairs, ladders and accessories using aluminum unless shown otherwise on Drawings.
 - 1. Finish:
 - a. Aluminum: Mill finished unless scheduled or otherwise specified or, if approved by Engineer, finished in manufacturer's standard.
 - b. Coat surfaces in contact with dissimilar materials.
 - 1) See Specification Section 09905.
 - 2. See Specification Section 09905 for preparation and painting of ferrous metals and other surfaces.
- I. Maximum tolerance for difference in depth between checkered plate or grating depth and seat or support angle depth: 1/8 IN.
- J. Distance between edge of grating or checkered plate and face of embedded seat angle or face of wall or other structural member shall be 1/4 IN.
 - 1. Tolerance per NAAMM MBG 531.
- K. Passivate stainless steel items and stainless steel welds after they have been ground smooth, where indicated on Drawings.
 - 1. ASTM A967.

2.5 SOURCE QUALITY CONTROL

- A. Surface Preparation:
 - 1. Refer to Specification Section 09905 for surface preparation requirements.
- B. Shop Applied Paint Coating Application:
 - 1. Refer to Specification Section 09905 for painting requirements.
- C. Meet structural requirements of Specification Section 05120 for inspection and testing items of structural nature.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide items to be built into other construction in time to allow their installation.
 - 1. If such items are not provided in time for installation, cut in and install.
- B. Prior to installation, inspect and verify condition of substrate.
- C. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
 - 1. Field welding aluminum is not permitted unless approved in writing by Engineer.

3.2 INSTALLATION

- A. Set metal work level, true to line, plumb.
 - 1. Shim and grout as necessary.
- B. Bolt Field Connections: Where practicable, conceal fastenings.
- C. Grind welds smooth where field welding is required.
- D. Field cutting grating or checkered plate to correct fabrication errors is not acceptable.
 - 1. Replace entire section.

- E. Remove all burrs and radius all sharp edges and corners of miscellaneous plates, angles, framing system elements, etc.
- F. Unless noted or specified otherwise:
 - 1. Connect steel members to steel members with 3/4 IN DIA ASTM A325 high strength bolts.
 - 2. Connect aluminum to aluminum with 3/4 IN DIA aluminum bolts.
 - 3. Connect aluminum to structural steel using 3/4 IN DIA stainless steel bolts.
 - a. Provide dissimilar metals protection.
 - 4. Connect aluminum and steel members to concrete and masonry using stainless steel expansion anchor bolts or adhesive anchor bolts unless shown otherwise.
 - a. Provide dissimilar materials protection.
 - 5. Provide washers for all bolted connections.
 - 6. Where exposed, bolts shall extend a maximum of 3/4 IN and a minimum of 1/2 IN above the top nut.
 - a. If bolts are cut off to required maximum height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nuts.
- G. Install and tighten ASTM A325 high-strength bolts in accordance with the AISC Manual of Steel Construction - Allowable Stress Design (ASD).
 - 1. Provide hardened washers for all ASTM A325 bolts.
 - a. Provide the hardened washer under the element (nut or bolt head) turned in tightening.
 - b. Provide bearing type connection unless otherwise required to be slip-critical.
- H. After bolts are tightened, upset threads of ASTM A307 unfinished bolts or anchor bolts to prevent nuts from backing off.
- I. Secure metal to wood with lag screws of adequate size with appropriate washers.
- J. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing.
 - 1. Provide full penetration welded splices where continuity is required.
- K. Provide each fabricated item complete with attachment devices as indicated or required to install.
- L. Anchor such that work will not be distorted nor fasteners overstressed from expansion and contraction.
- M. Set beam and column base plates accurately on nonshrink grout as indicated on Drawings.
 - 1. See Division 3 Specification Sections for non-shrink grout.
 - 2. Set and anchor each base plate to proper line and elevation.
 - a. Use metal wedges, shims, or setting nuts for leveling and plumbing columns and beams.
 - 1) Wedges, shims and setting nuts to be of same metal as base plate they support.
 - 2) Tighten nuts on anchor bolts.
 - b. Fill space between bearing surface and bottom of base plate with nonshrink grout.
 - 1) Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout.
 - c. Do not remove wedges or shims.
 - 1) Where they protrude, cut off flush with edge of base plate.
 - d. Fill sleeves around anchor bolts solid with non-shrink grout.
- N. Tie anchor bolts in position to embedded reinforcing steel using wire.
 - 1. Tack welding prohibited.
 - a. Coat bolt threads and nuts with heavy coat of clean grease.
 - 2. Anchor bolt location tolerance:
 - a. 1/16 IN.
 - b. Provide steel templates for all column anchor bolts.
- O. Install bollards in concrete as detailed.

1. Fill pipe with concrete and round off at top.
- P. Provide abrasive stair nosings in each tread and landing of all concrete stairs and at each concrete stair landing having metal stair structure attaching to the concrete landing.
 1. Center stair nosings in stair width.
 2. Coordinate nosings with railing vertical posts.
 - a. Maintain 2 IN clear between end of nosing and edge of railing base plate.
- Q. Accurately locate and place frames for openings before casting into floor slab so top of plate is flush with surface of finished floor.
 1. Keep screw holes clean and ready to receive screws.
- R. Attach grating to end and intermediate supports with grating saddle clips and bolts.
 1. Maximum spacing: 2 FT OC with minimum of two (2) per side.
 2. Attach individual units of aluminum grating together with clips at 2 FT OC maximum with a minimum of two (2) clips per side.
- S. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09905.
- T. Repair damaged galvanized surfaces in accordance with ASTM A780.
 1. Prepare damaged surfaces by abrasive blasting or power sanding.
 2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions.
- U. Anchor ladder to concrete or masonry structure with minimum 3/4 IN stainless steel adhesive anchor bolts with minimum 6 IN embedment.
 1. When anchoring into cavity wall construction, provide minimum 6 IN embedment into concrete or masonry back-up wall.
 - a. At each anchor location, provide sleeve between back face of veneer and cavity face of concrete or masonry back-up wall.
 - b. Cut cavity insulation as required and seal around sleeve.
 - 1) Sleeve to be 1 IN DIA schedule 40 stainless steel tubing, TP-304L, ASTM A269.
 - a) Minimum wall thickness to be .065 IN.
 - 2) Continuously weld 4 x 4 x 1/4 IN Type 304 stainless steel, ASTM A666 flange onto each end of pipe.
 - a) Drill 1 IN hole in flange to match pipe.
 - b) Attach sleeve to concrete or masonry back-up with 1/4 IN self-tapping concrete anchors.
 - 3) Grout solid, area around bolt where bolt penetrates veneer.
 - 4) Accurately locate sleeves to align with bolt locations on ladder.
 2. When anchoring into masonry, fill masonry cores with grout at anchor locations and each masonry core within 8 IN of anchor.
- V. Install deflector plate at bottom of roof hatch opening as indicated on Drawings.
 1. Install in accordance with applicable OSHA Standards.
- W. Install ladder safety extension post in accordance with manufacturers instructions.
 1. Mount device opposite the climbing side.
 2. Provide ladder safety extension device for all ladders unless noted otherwise.
- X. Anchor ladder to metal stud walls using minimum 1/2 IN stainless steel bolts, nuts and washers.
 1. Verify that stud wall has been provided with adequate backing to accept ladder anchors.
- Y. Mount ladder fall protection system with rail offset from ladder side rail approximately 3 IN.
 1. Provide bracket at top of fall protection rail attached to ladder side rail to help stabilize the fall protection rail.

3.3 FIELD QUALITY CONTROL

- A. Tolerances shall meet structural requirements of Specification Section 05120 for erecting items of structural nature.
- B. Tolerances for non-structural items (unless otherwise noted on the Drawings):
 - 1. Frame placement, after assembly and before welding or tightening.
 - a. Deviation from plumb, level and alignment: 1 in 500, maximum.
 - b. Displacement of centerlines of columns: 1/2 IN maximum, each side of centerline location shown on Drawings.

3.4 CLEANING

- A. After erection, installation or application, clean all miscellaneous metal fabrication surfaces of all dirt, weld slag and other foreign matter.
- B. Provide surface acceptable to receive field applied paint coatings specified in Specification Section 09905.

END OF SECTION

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SECTION 05511

METAL STAIRS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preassembled steel stairs with concrete-filled treads.
 - 2. Steel tube railings attached to metal stairs.
 - 3. Steel tube handrails attached to walls adjacent to metal stairs.
- B. Related Sections:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - 2. Division 3 Section 03308 "Concrete, Materials and Proportioning" for concrete fill for stair treads and platforms.
 - 3. Division 5 Section 05521 "Pipe and Tube Railings" for pipe and tube railings.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Uniform Load: 100 lbf/sq. ft..
 - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to $L/720$ inch.
- B. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.

1.3 ACTION SUBMITTALS

- A. Product Data: For metal stairs and the following:
 - 1. Prefilled metal-pan stair treads.
 - 2. Precast concrete treads.
 - 3. Epoxy-resin-filled stair treads.
 - 4. Nonslip aggregates and nonslip-aggregate finishes.
 - 5. Abrasive nosings.
 - 6. Metal floor plate treads.
 - 7. Paint products.
 - 8. Grout.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes:

1. Stair treads with nonslip-aggregate surface finish.
2. Abrasive nosings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs and railings.
 1. Test railings according ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 1. Ornamental Stairs: Architectural class.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

- E. Wire Rod for Grating Crossbars: ASTM A 510.
- F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- G. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25, unless another grade is required by design loads; exposed.
- H. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30, unless another grade is required by design loads.
- I. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 coating, structural steel, Grade 33, unless another grade is required by design loads.
- J. Expanded-Metal, Carbon Steel: ASTM F 1267, Type I (expanded), Class 1 (uncoated).
 - 1. Style Designation: 1-1/2 number 10.
- K. Woven-Wire Mesh: Intermediate-crimp, pattern, 2-inch woven-wire mesh, made from 0.135-inch nominal diameter wire complying with ASTM A 510.

2.3 ABRASIVE NOSINGS

- A. Cast-Metal Units: Cast iron, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. American Safety Tread Co., Inc.
 - b. Balco Inc.
 - c. Barry Pattern & Foundry Co., Inc.
 - d. Granite State Casting Co.
 - e. Safe-T-Metal Company, Inc.
 - f. Wooster Products Inc.
 - 2. Configuration: Cross-hatched angle-shaped units, same depth as bar-grating treads and 1 to 1-1/2 inches wide.
 - 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. ACL Industries, Inc.
 - b. American Safety Tread Co., Inc.
 - c. Amstep Products.
 - d. Armstrong Products, Inc.
 - e. Balco Inc.
 - f. Granite State Casting Co.
 - g. Wooster Products Inc.
 - 4. Nosings: Two-piece units, 3 inches wide, with subchannel for casting into concrete.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- C. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
- D. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

2.4 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs and stairs indicated to be galvanized..
- D. Machine Screws: ASME B18.6.3.
- E. Lag Screws: ASME B18.2.1.
- F. Plain Washers: Round, ASME B18.22.1.
- G. Lock Washers: Helical, spring type, ASME B18.21.1.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 9 painting Sections and Division 9 Section "High-Performance Coatings."
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
- I. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
- J. Welded Wire Fabric: ASTM A 185/A 185M, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated.

2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.

3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint..
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.7 STEEL-FRAMED STAIRS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Alfab, Inc.
 2. American Stair, Inc.
 3. Sharon Companies Ltd. (The).
- B. Stair Framing:
 1. Fabricate stringers of steel tubes.
 - a. Provide closures for exposed ends of tube stringers.
 2. Construct platforms of steel plate or channel or tube headers and miscellaneous framing members as needed to comply with performance requirements.
 3. Weld stringers to headers; weld framing members to stringers and headers.
 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness not less than 0.067 inch or as indicated.
 1. Steel Sheet: Uncoated cold-rolled steel sheet unless otherwise indicated.
 2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 3. Shape metal pans to include nosing integral with riser.
 4. Attach abrasive nosings to risers.

5. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.8 STAIR RAILINGS

- A. Comply with applicable requirements in Division 5 Section **05521** "Pipe and Tube Railings".
 1. Fabricate newels of square steel tubing and provide newel caps as shown.
 2. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
 3. Connect posts to stair framing by direct welding unless otherwise indicated.
- B. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
 1. Rails and Posts: as detailed..
 2. Mesh Infill: Woven wire mesh crimped into 1-by-1/2-by-1/8-inch steel channel frames. Orient wire mesh with wires horizontal and vertical.
- C. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- D. Form changes in direction of railings as follows:
 1. As detailed.
 2. By bending or by inserting prefabricated elbow fittings.
- E. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 1. Connect posts to stair framing by direct welding unless otherwise indicated.
 2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
 3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.9 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.

- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning." minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:
 - 1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."
- E. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- G. Place and finish concrete fill for treads and platforms to comply with Division 3.
 - 1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.
- H. Install precast concrete treads with adhesive supplied by manufacturer.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
- B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonmetallic, nonshrink grout unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in "Division 9 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 05521
PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Steel pipe and tube railings.
- B. Related Sections:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - 2. Division 5 Section 05511 "Metal Stairs" for steel tube railings associated with metal stairs.
 - 3. Division 5 Section 05505 "Metal Fabrications"

1.02 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
- B. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.03 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Fittings and brackets.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.07 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Pipe and Tube Railings:
 - a. Pisor Industries, Inc.
 - b. Wagner, R & B, Inc.; a division of the Wagner Companies.

2.02 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.03 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

PIPE AND TUBE RAILINGS

05521 - 2 OF 8

IFB: 06-10-2020

- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- E. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch woven-wire mesh, made from 0.135-inch nominal diameter wire complying with ASTM A 510.

2.04 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.05 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Shop Primers: Provide primers that comply with Division 9 painting Sections.
- E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- F. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- G. Shop Primer for Galvanized Steel: Cementitious galvanized metal primer complying with MPI#26.

- H. Intermediate Coats and Topcoats: Provide products that comply with Division 9 painting Sections.
- I. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- J. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- K. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.06 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form changes in direction as follows:
 - 1. As detailed.
- J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- P. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.
 - 1. Orient wire mesh with wires horizontal and vertical.
- Q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.07 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.08 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
 - 2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
 - 3. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 4. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - 5. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
 - 1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Railings Indicated to Receive Primers Specified in Division 9. : SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Do not apply primer to galvanized surfaces.
- G. Shop-Painted Finish: Comply with Division 9.
1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.02 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.04 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.05 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.
- B. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt .
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
 - 4. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
 - 5. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.06 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.07 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

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SECTION 05522
ALUMINUM RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum handrail, stair rail and guardrail.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 05505 - Metal Fabrications.
 - 4. Section 09905 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
 - 2. ASTM International (ASTM):
 - a. B108, Standard Specification for Aluminum-Alloy Permanent Mold Castings.
 - b. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - c. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
 - d. B247, Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
 - e. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 - f. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 3. American Welding Society (AWS):
 - a. C5.5, Recommended Practices for Gas Tungsten Arc Welding.
 - b. D1.2, Structural Welding Code Aluminum.
 - 4. National Association of Architectural Metal Manufacturers (NAAMM):
 - a. AMP 521, Pipe Railing Systems Manual.
 - 5. U. S. Department of Justice, Architectural and Transportation Barriers Compliance Board (Access Board):
 - a. Americans with Disabilities Act (ADA):
 - 1) Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - 6. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
 - 7. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2012 Edition including all amendments, referred to herein as Building Code.
- B. Qualifications:
 - 1. Qualify welding procedures and welding operators in accordance with AWS and ASME Section IX.

1.3 DEFINITIONS

- A. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.
- B. Handrail: A railing provided for grasping with the hand for support.
- C. Railing: A generic term referring to guardrail, handrail and/or stair rails.
- D. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at handrail height and serving the function of a handrail.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01330 for requirements for the mechanics and administration of the submittal process.
 - 2. Fabrication and/or layout drawings:
 - a. Drawings showing profile, location, sections and fabrication details including all welding information of each railing.
 - b. Type and details of anchorage.
 - c. Location and type of expansion joints.
 - d. Materials of construction, shop coatings and all third-party accessories.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation details.
 - 4. Certification that railings have been designed and fabricated to meet the loading requirements specified.
 - 5. Calculations for all proposed deviations from the Specification.
 - a. Calculations shall be performed, sealed, signed and dated by a registered professional structural engineer licensed in the State of **Texas**.
 - b. Calculations shall be specific to this Project and shall include all assumptions, references and design interpretations used to achieve the results obtained by the Engineer.
 - c. Reduction in load criteria is not acceptable as reason for deviation from sizes indicated in the Specification.
- B. Miscellaneous Submittals:
 - 1. See Specification Section 01330 for requirements for the mechanics and administration of the submittal process.
 - 2. Certification of welders and welding procedures indicating compliance with AWS requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver and handle railings to preclude damage.
- B. Store railings on skids, keep free of dirt and other foreign matter which will damage railings or finish and protect against corrosion.

1.6 WARRANTY

- A. Provide PVDF coating manufacturer's standard 10 year warranty against finish, fading, chipping, cracking and peeling.
 - 1. Repair of finish shall be done using same material, application method and color to match surrounding railings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Welded railing systems:
 - a. Any manufacturer meeting this Specification Section.
- B. Submit request for substitution in accordance with Specification Section **01360**.

2.2 MATERIALS

- A. Alloy 6061-T6, 32,000 psi tensile yield strength minimum.
 - 1. ASTM B209 for sheets and plates.
 - 2. ASTM B221 and ASTM B308 for shapes - beams, channels, angles, tees, and zeos.
 - 3. ASTM B247 for forgings.
- B. Alloy 6063-T5 or T6, 15,000 psi tensile yield strength minimum.
 - 1. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
- C. Cast Fittings: Aluminum, ASTM B108.
- D. Shims: Aluminum of same alloy as component being shimmed.
- E. Fasteners: See Specification Section 05505.
- F. Expansion and Adhesive Anchors: See Specification Section 05505.
- G. Electrodes for Welding:
 - 1. Aluminum: AWS D1.2.
 - 2. Filler alloy 5356 or 4043.

2.3 FABRICATION

- A. General:
 - 1. Verify field conditions and dimensions prior to fabrication.
 - 2. For fabrication of items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
 - a. Remove blemishes by grinding and buffing or by welding and grinding, prior to cleaning, treating and application of surface finishes.
 - 3. Form exposed work with smooth, short radius bends, accurate angles and straight edges.
 - a. Ease exposed edges to a radius of approximately 1/32 IN.
 - b. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - c. Drill or punch holes with smooth edges.
 - 4. Form exposed connections with flush, smooth, hairline joints, using stainless steel or aluminum splice locks to splice sections together or by welding.
 - a. Ease the edges of top rail splices and expansion joints and remove all burrs left from cutting.
 - 5. Provide for anchorage of type indicated on Drawings or as required by field conditions.
 - a. Drill or punch holes with smooth edges.
 - 6. Design railings and anchorage system in accordance with NAAMM AMP 521 to resist loading as required by Building Code.
 - 7. Custom fabricate railings to dimensions and profiles indicated.
 - a. Fabricate handrail mounted to wall or to guardrail vertical posts using minimum 1-1/4 IN nominal diameter Schedule 40 pipe.
 - b. Fabricate all guardrail top rails using minimum 2 IN nominal diameter Schedule 40 pipe.

- c. Fabricate all guardrail vertical posts using minimum 2 IN nominal diameter Schedule 40 pipe.
 - 1) Guardrail vertical posts that are to be side-bracket mounted to a vertical concrete surface or metal structure shall use Alloy 6063-T6.
 - d. All intermediate rails shall be fabricated using minimum 1-1/2 IN nominal diameter Schedule 40 pipe.
 - 1) Where details are not indicated, set horizontal rails and vertical pickets to requirements of the Building Code, ADAAG or OSHA Standards, whichever requires the more restrictive design.
 - e. Space vertical posts as required by loading requirements but not more than 4 FT on center.
 - f. Space handrail brackets as required by loading requirements but not more than 4 FT on center.
 - g. Base plate for vertical guardrail posts mounted to top of concrete surface:
 - 1) 3/8 x 6 x 6 IN square plate.
 - 2) Predrilled to accept four (4) anchors.
 - 3) Provide a 2 IN DIA x 8 IN long solid aluminum rod welded to the base plate.
 - 4) Fit the vertical post over the solid rod and weld the post to the base plate.
 - h. Base plate for vertical guardrail post mounted to flange of metal structure:
 - 1) 3/8 x 3 x 8 IN plate.
 - 2) Predrilled to accept two (2) fasteners.
 - 3) Provide a 2 IN DIA x 8 IN long solid aluminum rod welded to the base plate.
 - 4) Fit the vertical post over the solid rod and weld the post to the base plate.
 - i. Mounting bracket for vertical guardrail post mounted to vertical concrete surface or web of metal structural member:
 - 1) Pair of 3/8 IN angles or bent plates.
 - 2) Predrilled to accept two (2) fasteners each.
 - 3) Weld angles or bent plates to vertical posts.
 - j. Provide 3/8 IN x 4 IN flat bar toeboards or 1/4 IN minimum thickness x 4 IN high extruded toeboard with stiffener ribs on back side at all elevated walkways, platforms and stair landings, and where indicated on the Drawings or required by OSHA Standards.
- 8. Fit exposed ends of guardrails and handrails with solid terminations.
 - a. Return ends of handrail to wall, but do not attach to wall.
 - b. Where guardrail terminates at a wall, provide a vertical post located 4 IN off the wall to center of post.
 - 9. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly of units at project site.
- B. Finish: Mill.
- C. Railing Fabrication:
- 1. All railings are to be welded systems.
 - 2. Use wire welding for all joints.
 - 3. All welding to be continuous in accordance with AWS C5.5 and AWS D1.2.
 - a. All welded railing joints shall have full penetration welds unless noted otherwise.
 - 4. All exposed welds to be ground smooth and flush to match and blend with adjoining surfaces.
 - a. NAAMM AMP 521, Type 2.
 - 5. No ragged edges, surface defects, or undercutting of adjoining surfaces will be accepted.
 - 6. Finishing joints with filler is not acceptable.
 - 7. Provide flush weld fittings using locking weld connectors or coped drive-on connectors.
- D. Install weeps to drain water from hollow sections of railing at exterior and high humidity conditions.
- 1. Drill 1/4 IN weep hole in railings closed at bottom:
 - a. 1 IN above walkway surface at bottom of posts set in concrete.

- b. 1 IN above solid aluminum rod at posts having base plate.
 - c. At low point of intermediate rails.
 - d. Do not drill weep holes:
 - 1) In bottom of base plate.
- E. Expansion Joints:
 - 1. Joints to be designed to allow expansion and contraction of railing and still meet design loads required.
 - a. Top rail splices and expansion joints shall be located within 8 IN of post or other support.
 - b. Where railings span building or tank expansion joints; provide a railing expansion joint in the span crossing the building or tank expansion joint.
 - 2. Provide expansion joints in any continuous run exceeding 20 FT in length.
 - a. Space expansion joints at not more than 40 FT on center.
 - 3. Provide minimum 0.10 IN of expansion joint for each 20 FT length of top rail for each 25 DegF differential between installation temperature and maximum design temperature.
 - a. Maximum expansion joint width at time of installation shall not exceed 3/8 IN.
 - 1) Provide additional expansion joints as required to limit expansion joint width.
 - 4. Provide slip-joint with internal sleeve.
 - a. Extend slip joint min 2 IN beyond joint at maximum design width.
 - b. Fasten internal sleeve securely to one side
 - 1) Provide allen-head set screw located in bottom of rail.
 - 2) Rivets or exposed screw heads are not acceptable.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to installation, inspect and verify condition of substrate.
- B. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
 - 1. Field welding aluminum is not permitted unless approved in writing by Engineer.

3.2 INSTALLATION

- A. Install handrails and guardrails to meet loading requirements of the Building Code.
- B. Install products in accordance with manufacturer's instructions.
- C. Set work accurately in location, alignment and elevation; plumb, level and true.
 - 1. Measure from established lines and items which are to be built into concrete, masonry or similar construction.
- D. Align railings prior to securing in place to assure proper matching at butting and expansion joints and correct alignment throughout their length.
 - 1. Provide shims as required.
- E. Install proper sized expansion joints based on temperature at time of installation and differential coefficient of expansion of materials in all railings as recommended by manufacturer.
 - 1. Lubricate expansion joint splice bar for smooth movement of railing sections.
- F. Provide removable railing sections where indicated on Drawings.
- G. Attach handrails to walls or guardrail with brackets designed for condition:
 - 1. Provide brackets which provide a minimum 1-1/2 IN clearance between handrail and nearest obstruction.
 - a. Handrails shall not project more than 4-1/2 IN into required stairway width.

- 2. Anchor handrail brackets to concrete or masonry walls with 1/2 IN stainless steel adhesive anchors with stainless steel hex head bolts.
- H. Anchor railings to concrete with minimum 1/2 IN stainless steel adhesive anchors with stainless steel bolts, nuts and washers unless noted otherwise in the Contract Documents.
 - 1. Where exposed, bolts shall extend minimum 1/2 IN and maximum 3/4 IN above the top nut.
 - a. If bolts are cut off to required height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nut.
 - b. Bevel the top of the bolt after cutting to provide a smooth surface.
- I. Anchor railings to metal structure with minimum 3/4 IN stainless steel bolts, nuts and washers.
- J. Install toeboards to fit tight to the walking surface.
 - 1. Notch toeboards at base plates or other obstructions.
 - 2. Bottom of toeboard shall not exceed 1/4 IN above walking surface.
- K. Coat aluminum in contact with dissimilar metal or concrete in accordance with Specification Section 09905.
- L. Provide railings as required for stair construction identified in Specification Section 05505.

END OF SECTION

SECTION 09905
PAINTING AND PROTECTIVE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. High performance industrial coatings (HPIC).
 - 2. Architectural paints (AP).
 - 3. Special coatings (SC).
 - 4. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a complete System specified in this Specification Section.
 - 5. Stains and varnishes.
 - 6. Minimum surface preparation requirements.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 03348 - Concrete Finishing and Repair of Surface Defects.
 - 4. Section 04220 - Concrete Masonry.
 - 5. Section 05505 - Metal Fabrications.
 - 6. Section 10400 - Identification Devices.
 - 7. Section 11005 - Equipment: Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
 - b. D4259, Standard Practice for Abrading Concrete.
 - c. D4261, Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.
 - d. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
 - e. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - f. D6386, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
 - g. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - h. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - 2. Environmental Protection Agency (EPA).
 - 3. National Association of Pipe Fabricators (NAPF):
 - a. 500-03-04, Abrasive Blast Cleaning for Ductile Iron Pipe.
 - b. 500-03-05, Abrasive Blast Cleaning for Cast Ductile Iron Fittings.
 - 4. National Bureau of Standards (NBS):
 - a. Certified Coating Thickness Calibration Standards.
 - 5. National Fire Protection Association (NFPA):
 - a. 101, Life Safety Code.
 - 6. National Sanitation Foundation International (NSF).
 - 7. Steel Door Institute/American National Standards Institute (SDI/ANSI):
 - a. A250.10, Test Procedure and Acceptance Criteria For Prime Painted Steel Surfaces for Steel Doors.

8. The Society for Protective Coatings (SSPC):
 - a. PA 2, Measurement of Dry Paint Thickness with Magnetic Gages.
 - b. SP 1, Solvent Cleaning.
 - c. SP 2, Hand Tool Cleaning.
 - d. SP 3, Power Tool Cleaning.
 - e. SP11, Power Tool Cleaning to Bare Metal
 - f. SP 16, Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals.
9. The Society for Protective Coatings/NACE International (SSPC/NACE):
 - a. SP 5/NACE No. 1, White Metal Blast Cleaning.
 - b. SP 6/NACE No. 3, Commercial Blast Cleaning.
 - c. SP 7/NACE No. 4, Brush-off Blast Cleaning.
 - d. SP 10/NACE No. 2, Near-White Blast Cleaning.
 - e. SP 12/NACE No. 5, Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultrahigh Pressure Water Jetting Prior to Recoating.
 - f. SP 13/NACE No. 6, Surface Preparation of Concrete.
- B. Qualifications:
 1. Coating manufacturer's authorized representative shall provide written statement attesting that applicator has been instructed on proper preparation, mixing and application procedures for coatings specified.
 2. Applicators shall have minimum of 10 years' experience in application of similar products on similar project.
 - a. Provide references for minimum of three (3) different projects completed in last five (5) years with similar scope of work.
 - b. Include name and address of project, size of project in value (painting) and contact person.
- C. Miscellaneous:
 1. Furnish paint through one (1) manufacturer unless noted otherwise.
 2. Coating used in all corridors and stairways shall meet requirements of NFPA 101 and ASTM E84.
- D. Deviation from specified mil thickness or product type is not allowed without written authorization of Engineer.
- E. Material shall not be thinned unless approved, in writing, by paint manufacturer's authorized representative.

1.3 DEFINITIONS

- A. Installer or Applicator:
 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 2. Installer and applicator are synonymous.
- B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the Specification Section where the product is specified or in Specification Section 11005.
- C. Corrosive Environment: Immersion in, or not more than 6 IN above, or subject to condensation, spillage or splash of a corrosive material such as water, wastewater, or chemical solution; or exposure to corrosive, caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or solutions with pH range of 5 to 9.
 1. For purposes of this Specification Section, corrosive environments include:
 - a. Chemical Building.

- D. Highly Corrosive Environment: Immersion in, or not more than 6 IN above, or subject to condensation, spillage or splash of a highly corrosive material such as water, wastewater, or chemical solution; or exposure to highly corrosive, caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or solutions with pH range below five (5) or above nine (9).
- E. Exposed Exterior Surface:
 - 1. Surface which is exposed to weather but not necessarily exposed to view as well as surface exposed to view.
 - 2. Exterior surfaces are considered corrosive environment.
 - a. The following areas are considered highly corrosive:
 - 1) All chemical unloading stations and areas within 10 FT-0 IN of containment areas.
 - 2) All chemical unloading station containment areas.
 - 3) All areas within a 6 FT radius of chemical tank vents.
- F. Finished Area: An area that is listed in or has finish called for on Room Finish Schedule or is indicated on Drawings to be painted.
- G. Immersion Surface:
 - 1. Any surface immersed in water or some other liquid.
 - 2. Surface of any pipe, valve, or any other component of the piping system subject to condensation including the pipe support system.
- H. Paint includes the following:
 - 1. High performance industrial coatings (HPIC) include: Epoxies, urethanes, vinyl ester, waterborne vinyl acrylic emulsions, acrylates, silicones, alkyds, acrylic emulsions and any other coating listed as a HPIC.
 - 2. Architectural paints (AP) include: Acrylic latex coatings.
 - 3. Special coatings (SC) include: Water-based pigmented resin particles suspended in aqueous solution.
 - 4. Stains and varnish include: Alkyd stain and polyurethane varnish.
- I. Surface Hidden from View: Surfaces such as those within pipe chases, surfaces between top side of ceilings (including drop-in tile ceilings) and underside of floor or roof structures above, surfaces under overhanging walkways if over five feet above adjacent walking surfaces
- J. AP: Architectural paints.
- K. HPIC: High performance industrial coatings.
- L. SC: Special coatings.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01330 for requirements for the mechanics and administration of the submittal process.
 - 2. Applicator experience qualifications.
 - a. No submittal information will be reviewed until Engineer has received and approved applicator qualifications.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's application instructions.
 - c. Manufacturer's surface preparation instructions.
 - d. If products being used are manufactured by Company other than listed {in the MATERIALS Article of this Specification Section}, provide complete individual data sheet comparison of proposed products with specified products including application procedure, coverage rates and verification that product is designed for intended use.
 - e. Contractor's written plan of action for containing airborne particles created by blasting operation and location of disposal of spent contaminated blasting media.
 - f. Coating manufacturer's recommendation on abrasive blasting.

- g. Manufacturer's recommendation for universal barrier coat.
 - h. Manufacturer's recommendation for providing temporary or supplemental heat or dehumidification or other environmental control measures.
 - 4. Manufacturer's statement regarding applicator instruction on product use.
 - 5. Certification that High Performance Coating Systems proposed for use have been reviewed and approved by Senior Corrosion Specification Specialist employed by the coating manufacturer.
- B. Samples:
 - 1. Manufacturer's full line of colors for Engineer's preliminary color selection.
 - 2. After preliminary color selection by Engineer provide two (2) 3 x 5 IN samples of each final color selected.
- C. Operation and Maintenance Manuals:
 - 1. See Specification Section 01340 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content of Operation and Maintenance Manuals.
- D. Miscellaneous Submittals:
 - 1. See Specification Section 01330 for requirements for the mechanics and administration of the submittal process.
 - 2. Approval of application equipment.
 - 3. Applicator's daily records:
 - a. Submit daily records at end of each week in which painting work is performed unless requested otherwise by Engineer's on-site representative.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in original containers, labeled as follows:
 - 1. Name or type number of material.
 - 2. Manufacturer's name and item stock number.
 - 3. Contents, by volume, of major constituents.
 - 4. Warning labels.
 - 5. VOC content.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, only the following manufacturers are acceptable:
 - 1. High performance industrial coatings:
 - a. Tnemec.
 - b. ICI Devco.
 - c. Carboline Protective Coatings.
 - d. Sherwin Williams.
 - e. Dampney Company, Inc.
 - f. PPG Industries/Amercoat.
 - 2. Architectural paints:
 - a. PPG Industries/Amercoat.
 - b. Sherwin Williams.
 - c. ICI.
 - 3. Special coatings:
 - a. Surface Protection Industries, Int. (SPII).
 - 4. Stains and varnish:
 - a. Stains:
 - 1) Fuller-O'Brien.

- 2) Old Masters.
 - 3) PPG Industries/Amercoat.
 - b. Varnish:
 - 1) Rez.
 - 2) MinWax.
- B. Submit request for substitution in accordance with Specification Section 01640.
- 1. Product VOC content will be an important factor when determining acceptability of substitution.

2.2 MATERIALS

- A. For unspecified materials such as thinner, provide manufacturer's recommended products.
- B. Paint Systems - General:
- 1. P = prime coat.
 - 2. F1, F2 . . . Fn = first finish coat, second finish coat . . . nth finish coat, color as selected by Engineer.
 - 3. If two (2) finish coats of same material are required, Contractor may, at his option and by written approval from paint manufacturer, apply one (1) coat equal to mil thickness of two (2) coats specified.
- C. HPIC products listed in the MATERIALS Article, Paint Systems paragraph are manufactured by Tnemec.
- 1. Products of other listed manufacturers are acceptable for use providing the product is of the same generic resin, requires comparable surface preparation, has comparable application requirements, meets the same VOC levels or better, provides the same finish and color options and will withstand the atmospheric conditions of the location where it is to be applied.
 - 2. AP products listed in the MATERIALS Article, Paint Systems paragraph are manufactured by PPG Paints.
 - 3. SC products listed in the MATERIALS Article, Paint Systems paragraph are manufactured by Surface Protection Industries, Int. (SPII).
- D. Paint Systems (Systems not shown are not used):
- 1. HPIC SYSTEM #1 - Polyamidoamine Epoxy Primer with Polyamidoamine Epoxy or Waterborne Acrylic Polyurethane Finish Coat(s).
 - a. Prime coat:
 - 1) P1 = 1 coat, 3 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 4 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b) F2 = 1 coat, 4 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - 2) Exterior:
 - a) F1 = 1 coat, 4 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b) F2 = 1 coat, 3 mils, Series 740 UVX (Polyfunctional Hybrid Urethane).
 - 2. HPIC SYSTEM #2 - Zinc-Rich Urethane Primer with Polyamidoamine Epoxy or Waterborne Acrylic Polyurethane Finish Coat(s).
 - a. Prime coat:
 - 1) P1 = 1 coat, 3 mils, Series 90G-1K97 Tneme-Zinc (Zinc-Rich Urethane).
 - b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 6 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).

- b) F2 = 1 coat, 6 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - 2) Exterior:
 - a) F1 = 1 coat, 6 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b) F2 = 1 coat, 3 mils, Series 740 UVX (Polyfunctional Hybrid Urethane).
- 3. HPIC SYSTEM #3 - Polyamidoamine Epoxy Primer with Polyamidoamine Epoxy or Waterborne Acrylic Polyurethane Top Coat(s).
 - a. Prime coat:
 - 1) P1 = 1 coat, 3 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 3 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - 2) Exterior:
 - a) F1 = 1 coat, 3 mils, Series 740 UVX (Polyfunctional Hybrid Urethane).
- 4. HPIC SYSTEM #4 - Zinc-Rich Urethane Primer with Polyamidoamine Epoxy or Waterborne Acrylic Polyurethane Top Coat(s).
 - a. Prime coat:
 - 1) P1 = 1 coat, 2.5 mils, Series 90G-1K97 Tneme-Zinc (Zinc-Rich Urethane).
 - b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 3 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - 2) Exterior:
 - a) F1 = 1 coat, 3 mils, Series 740 UVX (Polyfunctional Hybrid Urethane).
- 5. HPIC SYSTEM #5 - Modified Polyamidoamine Epoxy Primer with Polyamidoamine Epoxy or Waterborne Acrylic Polyurethane Top Coat(s).
 - a. Prime coat:
 - 1) P1 = 1 coat, 4.0 mils, Series 135 Chembuild (Modified Polyamidoamine Epoxy).
 - b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 2.5 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - 2) Exterior:
 - a) F1 = 1 coat, 3.0 mils, Series 740 UVX (Polyfunctional Hybrid Urethane).
- 6. HPIC SYSTEM #5.1 - Cycloaliphatic Amine Epoxy Primer with Aliphatic Polyester Polyurethane Top Coat(s).
 - a. Prime coat:
 - 1) P1 = 1 coat, 10 mils, Series 104 H.S. Epoxy (Amine Epoxy).
 - b. Finish coat:
 - 1) F1 = 1 coat, 3.0 mils, Series 290 CRU (Aliphatic Polyester Polyurethane).
- 7. HPIC SYSTEM #6 - Modified Polyamidoamine Epoxy Primer with Polyamidoamine Epoxy or Waterborne Acrylic Polyurethane Top Coat(s).
 - a. Prime coat:
 - 1) P1 = 1 coat, 4 mils, Series 135 Chembuild (Modified Polyamidoamine Epoxy).
 - b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 4 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - 2) Exterior:
 - a) F1 = 1 coat, 3 mils, Series 740 UVX (Polyfunctional Hybrid Urethane).
- 8. HPIC SYSTEM #7 - Zinc-Rich Urethane Primer with Polyamidoamine Epoxy or Waterborne Acrylic Polyurethane Top Coat(s).
 - a. Prime coat:

- 1) P1 = 1 coat, 2.5 mils, Series 90G-1K97 Theme-Zinc (Zinc-Rich Urethane).
- b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 5 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - 2) Exterior:
 - a) F1 = 1 coat, 3.0 mils, Series 740 UVX (Polyfunctional Hybrid Urethane).
- 9. HPIC SYSTEM #8 - Air Dry Silicone Copolymer Primer with Silicone Copolymer Top Coat.
 - a. Prime coat:
 - 1) P1 = 1 coat, 2.0 mils, Dampney Thurmalox 260C Series (Air Dry Silicone Copolymer).
 - b. Finish coat:
 - 1) Interior or exterior:
 - a) F1 = 1 coat, 2.0 mils, Dampney Thurmalox 260C Series (Air Dry Silicone Copolymer).
- 10. HPIC SYSTEM #9 - Modified Polyamidoamine Epoxy.
 - a. Prime coat:
 - 1) P1 = 1 coat, 4 mils, Series 135 Chembuild (Modified Polyamidoamine Epoxy).
- 11. HPIC SYSTEM #10 - Modified Silicone Co-Polymer Primer with Modified Silicone Co-Polymer Top Coat(s).
 - a. Prime coat:
 - 1) P1 = 1 coat, 4.0 to 5.0 mils, Dampney Thurmalox 225 HD (Modified Silicone Co-Polymer).
 - b. Finish coat(s):
 - 1) F1 = 1 coat, 2.5 to 3.0 mils, Dampney Thurmalox 230C.
- 12. HPIC SYSTEM #11 - Zinc-Rich Aromatic Urethane Primer.
 - a. Prime coat:
 - 1) P1 = 1 coat, 3.0 mils, 90-97 Theme-Zinc (Zinc-Rich Urethane).
- 13. HPIC SYSTEM #12 - HDP Acrylic Polymer Primer and Top Coat.
 - a. Prime coat:
 - 1) P1 = 1 coat, 2.5 mils, Series 1029 Enduratone (HDP Acrylic Polymer).
 - b. Finish coat:
 - 1) Interior:
 - a) F1 = 1 coat, 2.5 mils, Series 1029 Enduratone (HDP Acrylic Polymer).
- 14. HPIC SYSTEM #13 - Modified-Acrylate Elastomer Primer and Top Coat.
 - a. Prime coat:
 - 1) P1 = 1 coat, 8 mils, Series 156 Enviro-Crete (Modified-Acrylate Elastomer).
 - b. Finish coat:
 - 1) Exterior:
 - a) F1 = 1 coat, 8 mils, Series 156 Enviro-Crete (Modified-Acrylate Elastomer).
- 15. HPIC SYSTEM #14 - Waterborne Modified Polyamine Epoxy Primer with Specialized Acrylate Waterborne Top Coats.
 - a. Prime coat:
 - 1) P1 = 1 coat, 1.5 mils, Series 151 Elasto-Grip FC (Waterborne Modified Polyamine Epoxy).
 - b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 4.0 mils, Series 113 H.B. Theme-Tufcoat (Waterborne Acrylic Epoxy).
 - b) F2 = 1 coat, 4.0 mils, Series 113 H.B. Theme-Tufcoat (Waterborne Acrylic Epoxy).
- 16. HPIC SYSTEM #15 - Polyamidoamine Epoxy Primer with Polyamidoamine Epoxy Top Coat.
 - a. Prime coat:

- 1) P1 = 1 coat, 4 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b. Finish coat:
 - 1) Interior:
 - a) F1 = 1 coat, 6 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b) F2 = 1 coat, 6 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
17. HPIC SYSTEM #16 – Waterborne Cementitious Acrylic with Waterborne Acrylic Epoxy Topcoat(s).
- a. Prime coat:
 - 1) P1 = 1 coat, 60 to 80 SF/GAL/coat, Series 130 Envirofill (Waterborne Cementitious Acrylic).
 - b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 4.0 mils, Series 113 H.B. Tneme-Tufcoat (Waterborne Acrylic Epoxy).
 - b) F2 = 1 coat, 4.0 mils, Series 113 H.B. Tneme-Tufcoat (Waterborne Acrylic Epoxy).
18. HPIC SYSTEM #17 – Waterborne Cementitious Acrylic with Modified-Acrylate Elastomer Topcoat(s).
- a. Prime coat:
 - 1) P1 = 1 coat, 60 to 80 SF/GAL/coat, Series 130 Envirofill (Waterborne Cementitious Acrylic).
 - b. Finish coat(s):
 - 1) Exterior:
 - a) F1 = 1 coat, 6.0 mils, Series 156 Enviro-Crete (Modified-Acrylate Elastomer).
 - b) F2 = 1 coat, 6.0 mils, Series 156 Enviro-Crete (Modified-Acrylate Elastomer).
19. HPIC SYSTEM #18 - Modified Alkyd Primer with HDP Acrylic Polymer Top Coat(s).
- a. Prime coat:
 - 1) P1 = 1 coat, 2.5 mils, Series 10 Tnemec Primers (Modified Alkyd).
 - b. Finish coat(s):
 - 1) Interior or exterior:
 - a) F1 = 1 coat, 2.5 mils, Series 1029 Enduratone (HDP Acrylic Polymer).
 - b) F2 = 1 coat, 2.5 mils, Series 1029 Enduratone (HDP Acrylic Polymer).
20. HPIC SYSTEM #19 - Polyamidoamine Epoxy Coating.
- a. Prime coat:
 - 1) P1 = 1 coat, 5 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
21. HPIC SYSTEM #21 - Modified Polyamidoamine Epoxy.
- a. Prime coat:
 - 1) P1 = 1 coat, 5 mils, 135-1243 Chembuild (Modified Polyamidoamine Epoxy).
22. HPIC SYSTEM #22 - Modified Polyamine Epoxy Primer with Modified Polyurethane Top Coat(s).
- a. Prime coat:
 - 1) P1 = 1 coat, 16 mils, Series 22 Pota-Pox 100 (Modified Polyamine Epoxy).
 - b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 25 mils, Series 264 Elasto-Shield (Modified Polyurethane).
 - b) F2 = 1 coat, 25 mils, Series 264 Elasto-Shield (Modified Polyurethane).
23. HPIC SYSTEM #23 - Zinc-Rich Urethane Potable Water Approved Primer with Polyamine Epoxy Potable Water Approved Top Coats.
- a. Prime coat:
 - 1) P1 = 1 coat, 3 mils, Series 94 H₂O Hydro-Zinc (Zinc-Rich Urethane).
 - b. Finish coat(s):
 - 1) Interior:
 - a) F1 = 1 coat, 25 mils, Series 22 Pota-Pox 100 (Modified Polyamine Epoxy).

24. HPIC SYSTEM #24 - Vinyl Ester Primer with Vinyl Ester Top Coat.
 - a. Prime coat:
 - 1) P1 = 1 coat, 17 mils, Series 120-5002 Vinester (Vinyl Ester).
 - b. Finish coat:
 - 1) F1 = 1 coat, 17 mils, Series 120-5001 Vinester (Vinyl Ester).
25. HPIC SYSTEM #27 - Waterborne Cementitious Acrylic Blockfiller with Modified-Acrylate Elastomer Top Coats.
 - a. Prime coat:
 - 1) P1 = 1 coat, 60 to 80 SF/GAL/coat, Series 130 Envirofill (Waterborne Cementitious Acrylic).
 - b. Finish coat:
 - 1) Exterior:
 - a) F1 = 1 coat, 6.0 mils, Series 156 Enviro-Crete (Modified-Acrylate Elastomer).
 - b) F2 = 1 coat, 6.0 mils, Series 156 Enviro-Crete (Modified-Acrylate Elastomer).
26. HPIC SYSTEM #29 - Waterborne Epoxy-Amine Adduct Primer and Top Coat.
 - a. Prime coat:
 - 1) P1 = 1 coat, 4 mils, Series 287 Enviro-Tread (Waterborne Epoxy-Amine Adduct).
 - b. Finish coat:
 - 1) Interior:
 - a) F1 = 1 coat, 4 mils, Series 287 Enviro-Tread (Waterborne Epoxy-Amine Adduct).
27. HPIC SYSTEM #31 - Polyamidoamine Epoxy Primer and Intermediate Coat with Waterborne Polyester Polyurethane Top Coat with Glass Beads mixed in for slip resistance.
 - a. Prime coat:
 - 1) P1 = 4 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b. Finish coats:
 - 1) Exterior and interior:
 - a) F1 = 4 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b) F2 = 3 mils minimum (thickness as required to cover glass beads), Series 291 CRU (Waterborne Polyester Polyurethane).
 - c. Slip resistance:
 - 1) Blend coarse glass beads into first finish coat (F1) at rate required to provide a medium slip resistant texture.
 - a) Refer to accepted mock-up panel.
 - 2) Apply second finish coat (F2) at minimum 3 mil DFT.
 - a) Apply additional coats of F2 product as required to achieve the non-slip texture per the accepted mock-up panel.
 - d. Glass beads: TNEMEC Product #211-212 Coarse Glass Beads.
28. HPIC SYSTEM #32 - Modified Polyamine Epoxy Patching Compound/Filler with Polyamidoamine Epoxy Top Coat.
 - a. Patching/filling coat:
 - 1) P/F1 = 1 coat, 60 to 80 SF/GAL/coat, Series 215 Surfacing Epoxy (Modified Polyamine Epoxy).
 - b. Finish coat:
 - 1) Interior:
 - a) F1 = 1 coat, 175 to 200 SF/GAL/coat, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b) F2 = 1 coat, 175 to 200 SF/GAL/coat, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
29. HPIC SYSTEM #33 - Waterborne Vinyl Acrylic Primer with Water-base Acrylic-Emulsion Top Coat.
 - a. Prime coat(s):
 - 1) P1 = 1 coat, 2.0 mils, Series 51-792 PVA Sealer.
 - b. Finish coat(s):
 - 1) Interior and exterior:

- a) F1 = 1 coat, 2.5 mils, Series 6 Tneme-Cryl.
- 30. HPIC SYSTEM #34 - Polyamidoamine Epoxy Primer with Polyamidoamine Epoxy Top Coat (with silica sand broadcast for slip resistance).
 - a. Prime coat:
 - 1) P1 = 1 coat, 5 mils, Series N69 Hi-Build Epoxoline II.
 - b. Slip resistance:
 - 1) Blend dry, washed 30 to 50 mesh silica sand into first finish coat (F1) at rate required to provide a {light} {medium} {heavy} slip resistant finish.
 - c. Finish coat:
 - 1) F1 = 1 coat, 4 mils, Series N69 Hi-Build Epoxoline II.
 - 2) F2 = 1 coat, Series N69 Hi-Build Epoxoline II.
 - a) F2 coat mil thickness is to be as required to achieve non-slip texture specified.
- 31. HPIC SYSTEM #35 - Polyamine Novolac Epoxy Primer with Polyamine Novolac Epoxy Top Coat.
 - a. Prime coat:
 - 1) P1 (horizontal surface) = 1 coat, 10 to 12 mils, Series 282 Tneme-Glaze.
 - 2) P1 (vertical surface) = 1 coat, 8 to 10 mils, Series 282 Tneme-Glaze.
 - b. Finish coat:
 - 1) F1 (horizontal surface) = 1 coat, 10 to 12 mils, Series 282 Tneme-Glaze.
 - 2) F1 (vertical surface) = 1 coat, 8 to 10 mils, Series 282 Tneme-Glaze.
- 32. HPIC SYSTEM #36 - Epoxy Modified Surfacer/Filler with Polyamine Novolac Epoxy Top Coats.
 - a. Filler/surfacer coat:
 - 1) Filler = 1 coat, 0.0625 IN thick, Series 218 Mortar Clad.
 - b. Prime coat:
 - 1) P1 (horizontal surface) = 1 coat, 10 to 12 mils, Series 282 Tneme-Glaze.
 - 2) P1 (vertical surface) = 1 coat, 6 to 8 mils, Series 282 Tneme-Glaze.
 - c. Finish coat:
 - 1) F1 (horizontal surface) = 1 coat, 10 to 12 mils, Series 282 Tneme-Glaze.
 - 2) F1 (vertical surface) = 1 coat, 6 to 8 mils, Series 282 Tneme-Glaze.
- 33. HPIC SYSTEM #37 - Epoxy Modified Surfacer/Filler with Modified Aliphatic Amine Epoxy Mortar Intermediate Coat and Modified Polyamine Epoxy Top Coat(s) - (Over New Concrete).
 - a. Prime coat:
 - 1) P1 = 1 coat, 0.0625 IN thick, Series 218 Mortar Clad.
 - b. Liner:
 - 1) L1 = 1 coat, 1/8 IN or 125 mils, Series 434 Perma-Shield H₂S (Modified Aliphatic Amine Epoxy Mortar).
 - c. Finish coat:
 - 1) F1 = 1 coat, 20 mils, Series 435 Perma-Glaze (Modified Polyamine Epoxy).
- 34. HPIC SYSTEM #38 - Modified Polyamine Epoxy Primer with Epoxy Modified Mortar Filler/Surfacer Repair Coat with Modified Aliphatic Amine Epoxy Mortar Intermediate Coat and Modified Polyamine Epoxy Top Coat(s) - (Over Existing Concrete).
 - a. Prime coat - for exposed reinforcing steel (when applicable):
 - 1) P1 = Prime all exposed reinforcing, 1 coat, 4 mils, Series N69 Hi-Build Epoxoline II (Polyamidamine Epoxy).
 - b. Filler/surfacer (for voids over 1/4 IN in depth):
 - 1) Filler/surfacer: 1 coat, thickness as required to patch damaged area but not to exceed manufacturer's recommended thickness, Series 219 Mortar Cast (Water Based Epoxy Modified Cement).
 - c. Filler/surfacer (for voids up to 1/4 IN in depth):
 - 1) Filler/surfacer: 1 coat, skim coat all surfaces but not to exceed 1/4 IN, Series 218 Mortar Clad (Epoxy Modified Mortar).
 - d. Liner:

-
- 1) L1 = 1 coat, 1/8 IN or 125 mils, Series 434 Perma-Shield H₂S (Modified Aliphatic Amine Epoxy Mortar).
 - e. Finish coat:
 - 1) F1 = 1 coat, 20 mils, Series 435 Perma-Glaze (Modified Polyamine Epoxy).
 - 35. AP SYSTEM #39 - Architectural Paints (AP).
 - a. Cross Linked Acrylic, PPG Manor Hall "Timeless" Series.
 - b. Prime coat:
 - 1) P1 = 1 coat, 3 mils, Interior PVA Drywall Primer.
 - c. Finish coat:
 - 1) Interior:
 - a) F1 = 1 coat, 1.5 to 2.5 mils, PPG Manor Hall "Timeless" Series, Pearl finish.
 - b) F2 = 1 coat, 1.5 to 2.5 mils, PPG Manor Hall "Timeless" Series, Pearl finish as needed for complete coverage.
 - 36. SC SYSTEM #40 - Special Coatings (SC).
 - a. Water-based coating having pigmented resin particles suspended in an aqueous solution.
 - b. Prime coat:
 - 1) For new gypsum board surfaces:
 - a) P1 = Zo-Cryl Sealer 92.
 - 2) For new concrete and concrete masonry surfaces:
 - a) For unfilled concrete and concrete masonry surfaces:
 - (1) Zo-Cryl Sealer 92.
 - (a) P1 = 1 coat, 60-80 SF/GAL, Series 54-562 Fine Masonry Filler (Modified Epoxy).
 - b) For filled concrete and concrete masonry surfaces.
 - (1) Zo-Prime Block Filler 96.
 - (a) P2 = Z95 Primer.
 - c. Finish coat:
 - 1) For new gypsum board surfaces:
 - a) F1 = Zolatone water-based coating.
 - (1) Color to be selected by Engineer.
 - 2) For new unfilled concrete and concrete masonry surfaces:
 - a) F1 = Zolatone water-based coating.
 - (1) Color to be selected by Engineer.
 - 3) For new filled concrete and concrete masonry surfaces:
 - a) F1 = Zolatone water-based coating.
 - (1) Color to be selected by Engineer.
 - 37. SYSTEM #41 - Touch-up of galvanized surfaces not requiring a top coat.
 - a. Refer to Specification Section 05505.
 - 38. SYSTEM #42 - Alkyd wood stain with water-based polyurethane varnish top coats.
 - a. Apply washcoat uniformly to wood at manufacturer's recommended application rate.
 - b. Wood stain: Color to be selected.
 - c. First coat of water-based polyurethane varnish: Gloss.
 - d. Second coat of water-based polyurethane varnish: Satin.
 - e. Third coat of water-based polyurethane varnish: Satin.
 - 39. HPIC SYSTEM #43 - Polyamidoamine Epoxy Primer with Polyamidoamine Epoxy Top Coat.
 - a. Prime coat:
 - 1) P1 = 1 coat, 3 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - b. Finish coat:
 - 1) Interior:
 - a) F1 = 1 coat, 3 mils, Series N69 Hi-Build Epoxoline II (Polyamidoamine Epoxy).
 - 40. HPIC SYSTEM #44 - Modified Aromatic Moisture-Cured Polyurethane Primer with Hydrophobic Aromatic Moisture-Cured Polyurethane Top Coat(s).

- a. Prime coat:
 - 1) P1 = 1 coat, 3 mils, Series 1 Omnithane (Modified Aromatic Moisture-Cured Polyurethane Primer).
 - b. Finish coat(s):
 - 1) F1 = 1 coat, 8 mils, Series 446 Perma-Shield-MCU.
 - 2) F2 = 1 coat, 8 mils, Series 446 Perma-Shield-MCU.
41. HPIC SYSTEM #45: RTV Silicone Rubber Water Repellent and Graffiti Protectant
- a. Prime coat:
 - 1) P1 = 1 coat, Series 626 Dur A Pell GS applied at a rate to saturate and provide 4" to 6" rundown.
 - b. Finish coat:
 - 1) F1 = 1 coat, Series 626 Dur A Pell GS applied at a rate to saturate and provide 4" to 6" rundown.

PART 3 - EXECUTION

3.1 ITEMS TO BE PAINTED

- A. General:
 - 1. Paint the following surfaces in a corrosive or highly corrosive area, whether exposed to view or not:
 - a. Concrete and/or concrete masonry units.
 - b. Conduit.
 - c. Ducts.
 - d. Galvanized metal surfaces.
- B. Exposed Exterior Surfaces including:
 - 1. Smooth face, concrete block (standard grey), un-galvanized equipment supports, and pipe supports.
 - 2. Piping, valves, fittings, and hydrants and supports.
 - a. Field welded connections of factory painted piping.
 - b. Pipe.
 - 3. Ductwork and supports.
 - a. Duct.
 - 4. Conduit, device boxes, junction boxes and covers, pull boxes and covers and supports when attached to a surface required to be painted.
 - 5. Exterior and interior surfaces of ferrous metal tankage.
 - 6. Miscellaneous ferrous metal surfaces.
 - 7. Hollow metal doors and frames.
 - 8. Steel pipe bollards.
 - 9. Steel lintels.
 - 10. Steel components of concrete lintels (plain or galvanized).
 - a. Steel components shall be completely painted (with both prime and finish coats) prior to installing in the wall.
 - 11. Exposed wood.
 - 12. Structural steel.
 - 13. Steel joists (including bridging).
 - 14. Steel trusses (including bridging).
 - 15. Field welded connections of factory painted structural steel.
 - 16. Galvanized metal surfaces, when specifically indicated to be painted
 - 17. Copper and brass surfaces.
 - 18. Gypsum board soffits.
 - 19. Gas appliance flue vents and cast iron pipe plumbing vents.
- C. Interior Finished Areas:

1. Refer to Room Finish Schedule on Drawings.
2. If room is scheduled in the Room Finish Schedule, the space is considered to be a finished area, therefore, paint all appurtenant surfaces within the space unless specifically noted not to be painted in the Contract Documents.
 - a. If walls are not required to be painted, appurtenant concrete surfaces are not required to be painted unless specifically noted otherwise.
 - b. Appurtenant surfaces include:
 - 1) Concrete columns, equipment pads, pipe supports, and equipment supports, underside of overhead concrete slabs which are exposed, semi-exposed or concealed from view but still exposed to the adjacent atmosphere.
 - 2) Piping, valves, fittings and hydrants and supports.
 - a) All bituminous coated ductile iron pipe to have coating completely removed prior to painting.
 - b) Field welded connections of factory painted piping.
 - c) Pipe.
 - 3) Ductwork and supports.
 - a) Duct.
 - 4) Conduit, device boxes, junction boxes and covers, pull boxes and covers and supports when mounted on surface required to be painted.
 - 5) Miscellaneous ferrous metal surfaces.
 - 6) Hollow metal doors and frames.
 - 7) Ferrous metal angle supports at top of masonry walls.
 - 8) Steel lintels.
 - 9) Steel components of concrete lintels (plain or galvanized).
 - a) Steel components shall be completely painted (with both prime and finish coats) prior to installing in the wall.
 - 10) Structural steel.
 - a) May include: Pipe supports, duct supports, monorail beam extensions from inside a building and supporting structure, canopy structures, as well as other structural steel items.
 - 11) Steel trusses (including bridging).
 - 12) Steel joists (including bridging).
 - 13) Field welded connections of factory painted structural steel.
 - 14) Galvanized metal surfaces specifically noted to be painted.
 - 15) Outside of ferrous metal tankage.
 - a) The following tankage is to be painted:
 - (1) Hydropneumatic surge tank(s).
 - (2) Air receiver tank(s).
 - (3) Air separator tank(s).
 - (4) Boiler expansion tank(s).
 - (5) Compression tank(s).
 - (6) Expansion tank(s).
 - 16) Exposed woodwork.
 - 17) Exposed metal roof deck specifically noted to be painted.
 - 18) Steel pipe bollards.
 - 19) Gypsum board bulkheads.
 - 20) Unit heater flue piping.

D. Surfaces in Areas Not Considered Finished:

 1. Paint following surfaces in areas not considered as finished area:
 - a. Piping, valves, fittings, and hydrants and supports.
 - b. Miscellaneous ferrous metal surfaces.
 - c. Steel lintels.
 - d. Steel components of concrete lintels (plain or galvanized).
 - 1) Steel components shall be completely painted (with both prime and finish coats) prior to installing in the wall.

- e. Galvanized metal surfaces specifically noted to be painted.
- f. Inside and outside of ferrous metal tankage.
- g. Hollow metal doors and frames.

3.2 ITEMS NOT TO BE PAINTED

- A. General: Do not paint items listed in this Article unless specifically noted in the Contract Documents to be painted.
- B. Items with Approved Factory Finish: These items may require repair of damaged painted areas or painting of welded connections.
- C. Electrical Equipment:
 - 1. Do not field paint electrical equipment except where painting is specifically stated elsewhere in these Contract Documents, or where the equipment is subject to a corrosive environment and is specifically noted to be painted.
- D. Other Items:
 - 1. Stainless steel surfaces except:
 - a. Piping where specifically noted to be painted.
 - b. Banding as required to identify piping.
 - 2. Aluminum surfaces except:
 - a. Where specifically shown in the Contract Documents.
 - b. Where in contact with concrete.
 - c. Where in contact with dissimilar metals.
 - 3. Fiberglass surfaces except:
 - a. Fiberglass piping where specifically noted to be painted.
 - b. Piping supports where specifically noted to be painted.
 - 4. Interior of pipe, ductwork, and conduits.
 - 5. Moving parts of mechanical and electrical units where painting would interfere with the operation of the unit.
 - 6. Code labels and equipment identification and rating plates.
 - 7. Exterior concrete or precast concrete surfaces.
 - 8. Face brick. Ceramic tile. Porcelain tile unless specifically noted. Quarry tile. All natural stone. Plastic laminate. Window stool material. Solid surface material. Hardwood doors. Aluminum doors and frames. Hardwood trim. Laboratory casework and countertops. Fiberglass doors and frames. Stainless steel doors and frames.
 - 9. Glass masonry. Prefaced masonry. Pre-colored masonry (exterior face). Aluminum windows, curtainwall and storefront framing systems.
 - 10. Pipe jacketing.
 - 11. Concealed surfaces of precolored masonry.
 - 12. Structural steel or steel deck required to be fireproofed.
 - 13. Clad aluminum, clad steel, anodized aluminum, PVDF coated aluminum and PVDF coated steel.
 - 14. Prefinished wood doors.
 - a. Provide touch-up painting to damaged areas of prefinished surfaces.
 - 15. Steel deck, unless specifically noted to be painted in these Contract Documents.
 - 16. Standing seam metal roof, fascia, trim, and roof accessories.
 - 17. Contact surfaces of friction-type connections.
 - 18. Metal soffit.
 - 19. Galvanized steel items, unless specifically noted to be painted.
 - 20. Bituminous coated ductile iron pipe.
 - a. See the ITEMS TO BE PAINTED Article, Interior Finished Areas paragraph of this Specification Section.

3.3 SCHEDULE OF ITEMS TO BE PAINTED AND PAINTING SYSTEMS

- A. Concrete:

1. Interior cast-in-place and interior precast surfaces (other than prefinished panels):
SYSTEM #15.
 - a. Includes walls, beams, slabs, columns, ceilings, pedestals, pilasters, etc.
 2. Exterior cast-in-place and exterior precast surfaces (other than prefinished panels) , in areas indicated on the Drawings to be painted: SYSTEM #13.
 3. Interior surfaces of concrete potable water storage tanks requiring NSF approval:
SYSTEM #22.
 4. Interior of open top concrete chemical containment areas and sumps, tanks and boxes subject to corrosive or highly corrosive environment and not requiring NSF approval:
SYSTEM #36.
 5. Interior of newly constructed enclosed concrete tanks subject to hydrogen sulfide gas exposure, severe wastewater environments and high abrasion areas: SYSTEM #37.
 6. Interior of existing enclosed concrete tanks damaged by corrosive action that are being refurbished: SYSTEM #38.
 7. Parking lot stripping on exterior concrete pavement **and** asphalt pavement: SYSTEM #45.
- B. Concrete Masonry Units:
1. Interior smooth faced, grey standard (heavy) weight: SYSTEM #16 .
 2. Exterior smooth faced grey standard (heavy) weight: SYSTEM #27.
 3. Exterior rough faced grey standard (heavy) weight: SYSTEM #17.
 4. Interior face of exterior precolored standard (heavy) weight: SYSTEM #16 .
 5. Interior smooth face of exterior prefaced masonry units: SYSTEM #32.
 6. Exterior face of fence: SYSTEM #45
- C. Wood:
1. Interior Paint: SYSTEM #18.
 2. Interior stain and varnish: SYSTEM #42.
- D. Steel:
1. Structural:
 - a. Immersion or non-immersion surfaces subject to highly corrosive environment:
SYSTEM #24.
 - b. Immersion surfaces subject to corrosive environment and not requiring NSF approval:
SYSTEM #2.
 - c. Immersion surfaces subject to corrosive or highly corrosive environment requiring NSF approval: SYSTEM #23.
 - d. Non-immersion surfaces subject to corrosive environment: SYSTEM #7.
 - e. All other surfaces (non-corrosive dry environment): SYSTEM #1.
 2. Joists:
 - a. Exposed: SYSTEM #6.
 - b. Above lay-in acoustical or suspended GWB ceiling: SYSTEM #9.
 3. Potable water storage tanks and all ferrous metal items subject to contact with potable water requiring NSF approval: SYSTEM #23.
 - a. Includes all ferrous metal surfaces subject to splash, spillage, vapor, condensation or other chronic potable water exposure.
 - b. Also includes ferrous metal surfaces within concrete potable water storage tankage requiring NSF approval.
 - c. Exterior surfaces of potable water storage tanks: SYSTEM #7.
- E. Miscellaneous ferrous metals (non-corrosive dry environment): SYSTEM #1.
1. Not for coating galvanized steel, steel (hollow metal) doors, steel (hollow metal) door and window frames, and products with approved factory finishes.
- F. Ferrous metals subject to corrosive environment: SYSTEM #2.
1. Includes ferrous metal components of equipment located in corrosive environments such as, and, sluice gates, slide gates, bare steel handrails and guardrails, piping, stairs, tank or equipment bridges, pumps, and similar items.

- 2. Does not include items subject to contact with potable water.
- G. Ferrous metals subject to highly corrosive environment: SYSTEM #35.
 - 1. Includes ferrous metal components of equipment located in highly corrosive environments , sluice gates, slide gates, piping, tank or equipment bridges, pumps and similar items.
 - 2. Does not include items subject to contact with potable water.
- H. Galvanized Metals:
 - 1. Field touch-up where top coat is required: SYSTEM #3, prime and first finish coat only.
 - a. Prime paint only the damaged area.
 - 2. Assembled galvanized steel items: SYSTEM #3.
 - 3. Field touch-up of galvanized surfaces not requiring a finish top coat: SYSTEM #41.
 - a. Paint only damaged areas.
 - 4. Galvanized pipe bollards: SYSTEM #3.
- I. Steel (hollow metal) doors and frames primed in the factory in accordance with SDI/ANSI A250.10.
 - 1. For doors and frames in non-corrosive environments: SYSTEM #5.
 - 2. For doors and frames in corrosive or highly corrosive environments: SYSTEM #5.1.
 - a. Specifically including all chemical room door openings having fiberglass reinforced plastic doors with hollow metal frames.
- J. Steel equipment with existing paint coating or factory-applied prime or finish coating not complying with this Specification Section: SYSTEM #5.
 - 1. Includes equipment specifically indicated in the Contract Documents to be painted.
 - 2. Factory-applied coats to remain.
 - 3. Steel skin of overhead, industrial bi-fold and sliding doors.
- K. Non-ferrous metals (except galvanized): SYSTEM #3.
 - 1. Includes copper, brass, aluminum and aluminum flashing specifically indicated on the Drawings to be painted.
- L. Plastic Surfaces:
 - 1. PVC, FRP, and CPVC surfaces: SYSTEM #3.
 - a. Includes tankage and piping.
- M. Electrical Conduit:
 - 1. Galvanized: SYSTEM #3.
 - 2. PVC coated: SYSTEM #3.
- N. Pipe, Valves, and Fittings:
 - 1. Bare steel pipe bollards: SYSTEM #2.
 - 2. Steel, cast-iron, and uncoated ductile iron: SYSTEM #2.
 - 3. Stainless steel: SYSTEM #1.
 - 4. Brass and bronze: SYSTEM #3.
 - 5. Steel aeration piping: SYSTEM #8.
- O. Pipe and duct insulation: SYSTEM #12.
- P. Aluminum buried in concrete, between dissimilar metals and dissimilar materials: SYSTEM #19.
- Q. Aluminum colored pipe thread touch-up, and aluminum colored finish where top coat is not required: SYSTEM #21.
 - 1. Not for coating aluminum material.
- R. Steel pipe, ducts, and equipment subject to maximum high temperatures of 400 DegF: SYSTEM #8.
- S. Emergency generator engine exhaust piping: SYSTEM #10.

- T. Interior gypsum board gypsum plaster surfaces abuse resistant panels:
SYSTEM #14.
- U. Field painting of fusion bonded epoxy coated piping, valves, couplings, etc.: SYSTEM #43.

3.4 PREPARATION

- A. General:
 - 1. Verify that atmosphere in area where painting is to take place is within paint manufacturer's acceptable temperature, humidity and sun exposure limits.
 - a. Provide temporary heating, shade and/or dehumidification as required to bring area within acceptable limits.
 - 1) Provide temporary dehumidification equipment properly sized to maintain humidity levels required by paint manufacturer.
 - 2) Provide clean heat with heat exchanger type equipment sufficient in size to maintain temperature on a 24 HR basis.
 - a) Vent exhaust gases to exterior environment.
 - b) No exhaust gases shall be allowed to vent into the space being painted or any adjacent space.
 - 2. Prepare surfaces to be painted in accordance with coating manufacturer's instructions and this Specification Section unless noted otherwise in this Specification Section.
 - a. Where discrepancy between coating manufacturer's instructions and this Specification Section exists, the more stringent preparation shall be provided unless approved otherwise, in writing, by the Engineer.
 - 3. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of coating to surface.
 - 4. Adhere to manufacturer's recoat time surface preparation requirements.
 - a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional coating in accordance with manufacturer's published recommendations.
 - 1) Minimum SSPC SP 7/NACE No. 4 unless otherwise approved by Engineer.
- B. Protection:
 - 1. Protect surrounding surfaces not to be coated.
 - 2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.
- C. Prepare and paint before assembly all surfaces which are inaccessible after assembly.
- D. Wood:
 - 1. Sandpaper smooth, then dust.
 - 2. Seal all knots, pitch and resinous sapwood after priming coat has dried.
 - 3. Putty nail holes and minor defects to match wood color.
- E. Ferrous Metal:
 - 1. Prepare ductile iron pipe in accordance with pipe manufacturer's recommendations and NAPF.
 - a. All piping, pumps, valves, fittings and any other component used in the water piping system that requires preparation for painting shall be prepared in accordance with requirements for immersion service.
 - 1) Pipe: NAPF 500-03-04.
 - 2) Fittings: NAPF 500-03-05
 - b. Prepare all areas requiring patch painting in accordance with recommendations of manufacturer and NAPF.
 - c. Remove bituminous coating per piping manufacturer, paint manufacturer and NAPF recommendations.
 - 1) The most stringent recommendations shall apply.
 - 2. Complete fabrication, welding or burning before beginning surface preparation.

- a. Chip or grind off flux, spatter, slag or other laminations left from welding.
 - b. Remove mill scale.
 - c. Grind smooth rough welds and other sharp projections.
 3. Solvent clean in accordance with SSPC SP 1 or detergent and low-pressure water clean in accordance with SSPC SP 12/NACE No. 5 all surfaces scheduled to receive additional SSPC surface preparation.
 4. Surfaces subject to corrosive or highly corrosive environment and all surfaces subject to immersion service:
 - a. Near-white blast clean in accordance with SSPC SP 10/NACE No. 2.
 5. All interior and exterior structural steel not included in corrosive, highly corrosive or immersion service surfaces:
 - a. Minimum commercial blast clean in accordance with SSPC SP 6/NACE No. 3.
 6. Surfaces subject to high temperatures.
 - a. Heat in excess of 600 DegF: SSPC SP 10/NACE No. 2.
 - b. Heat in excess of 200 DegF but less than 600 DegF: SSPC SP 6/NACE No. 3.
 7. Surfaces of steel joists and steel trusses:
 - a. Commercial blast clean the major portion of the truss in accordance with SSPC SP 6/NACE No. 3.
 - b. Power tool or hand tool clean tight connection areas and other difficult to access areas in accordance with SSPC SP 2 or SSPC SP 3.
 8. Steel surfaces scheduled to receive SYSTEM #24 or #35:
 - a. White metal blast clean in accordance with SSPC SP 5/NACE No. 1.
 - b. Provide 2-1/2 to 3 mil anchor profile for SYSTEMS #24 and #35.
 9. All fusion bonded epoxy coated surfaces identified to be field painted:
 - a. Remove all traces of gloss finish by sanding or by abrasive brush blasting.
 - b. Clean surface after removing gloss finish to remove sanding or blasting residue.
 10. Restore surface of field welds and adjacent areas to original surface preparation.
 11. Black iron piping: Remove surface varnish by solvent or waterjet and detergent cleaning or brush-off blast cleaning in accordance with SSPC SP 7/NACE No. 4.
- F. Hollow Metal:
1. Clean in accordance with SSPC SP 1 or SSPC SP 12/NACE No. 5 and in accordance with hollow metal manufacturer.
- G. Galvanized Steel and Non-ferrous Metals:
1. Solvent clean in accordance with SSPC SP 1 followed by brush-off blast clean in accordance with SSPC SP 16 to remove zinc oxide and other foreign contaminants.
 - a. Provide uniform 1 mil profile surface.
- H. Gypsum Wallboard and Abuse Resistant Panels:
1. Repair minor irregularities left by finishers.
 2. Avoid raising nap of paper face on gypsum wallboard.
 3. Verify moisture content is less than 8 percent before painting.
- I. Concrete:
1. Cure for minimum of 28 days.
 2. Verify that concrete surfaces have been cleaned and that voids have been patched in accordance with Specification Section 03348.
 - a. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
 3. Mechanically abrade concrete surfaces in accordance with ASTM D4259 as recommended by coating manufacturer.
 4. Abrasive blast concrete surfaces in accordance with SSPC SP 13/NACE No. 6 to provide profile recommended by coatings manufacturer.
 5. Test pH of surface to be painted in accordance with ASTM D4262.
 - a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable range.

- b. Retest pH until acceptable results are obtained.
 - 6. Verify that moisture content of surface to be painted is within coating manufacturer's recommended acceptable limits.
 - a. Test moisture content of surface to be coated in accordance with ASTM D4263.
 - b. After remedial measures have been taken to lower or raise moisture content, retest surface until acceptable results are obtained.
- J. Concrete Unit Masonry:
 - 1. Cure for minimum of 28 days.
 - 2. Remove all mortar spatters and protrusions.
 - 3. Verify that concrete unit masonry surfaces have been cleaned in accordance with Specification Section 04220 and ASTM D4261.
 - 4. Test pH of surface to be painted in accordance with ASTM D4262.
 - a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable limits.
 - b. Retest pH until acceptable results are obtained.
 - 5. Verify that moisture content of surface to be painted is within coating manufacturer's recommended acceptable limits.
 - a. Test moisture content of surface to be coated in accordance with ASTM D4263.
 - b. After remedial measures have been taken to lower or raise moisture content, retest surface until acceptable range is obtained.
- K. Preparation by Abrasive Blasting:
 - 1. All abrasive-blasted ferrous metal surfaces shall be inspected immediately prior to application of paint coatings.
 - a. Inspection shall be performed to determine cleanliness and profile depth of blasted surfaces and to certify that surface has been prepared in accordance with these Specifications.
 - 2. Schedule the abrasive blasting operation so blasted surfaces will not be wet after blasting and before painting.
 - 3. Perform additional blasting and cleaning as required to achieve surface preparation required.
 - a. Prior to painting, reblast surfaces allowed to set overnight and surfaces that show rust bloom.
 - b. Surfaces allowed to set overnight or surfaces which show rust bloom prior to painting shall be reinspected prior to paint application.
 - 4. Profile depth of blasted surface: Not less than 1 mil or greater than 2 mils unless required otherwise by coating manufacturer.
 - 5. Provide compressed air for blasting that is free of water and oil.
 - a. Provide accessible separators and traps.
 - 6. Confine blast abrasives to area being blasted.
 - a. Provide shields of polyethylene sheeting or other such barriers to confine blast material.
 - b. Plug pipes, holes, or openings before blasting and keep plugged until blast operation is complete and residue is removed.
 - 7. Protect nameplates, valve stems, rotating equipment, motors and other items that may be damaged from blasting.
 - 8. Reblast surfaces not meeting requirements of these Specifications.
 - 9. Abrasive blasting media may be recovered, cleaned and reused providing Contractor submits, for Engineer's review, a comprehensive recovery plan outlining all procedures and equipment proposed in reclamation process.
 - 10. Properly dispose of blasting material contaminated with debris from blasting operation not scheduled to be reused.
- L. All Plastic Surfaces and Non-Ferrous Surfaces Except Galvanized Steel:
 - 1. Sand using 80-100 grit sandpaper to scarify surfaces.

3.5 APPLICATION

A. General:

1. Thin, mix and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
 - a. Application equipment must be inspected and approved in writing by coating manufacturer.
 - b. Hollow metal shall be spray applied only.
2. Temperature and weather conditions:
 - a. Do not paint surfaces when surface temperature is below 50 DegF unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and paint manufacturer's authorized representative.
 - b. Avoid painting surfaces exposed to hot sun.
 - c. Do not paint on damp surfaces.
3. Immediately after surface has been inspected, apply structural steel and miscellaneous steel and steel joist and steel truss prime coat in the factory.
 - a. Finish coats shall be applied in the field.
 - b. Prime coat referred to here is prime coat as indicated in this Specification.
 - 1) Structural steel and miscellaneous steel and steel joist and steel truss prime coating applied in factory (shop) as part of Fabricator's standard rust inhibiting and protection coating is not acceptable as replacement for specified prime coating.
4. Provide complete coverage to mil thickness specified.
 - a. Thickness specified is dry mil thickness.
 - b. All paint systems are "to cover." In situations of discrepancy between manufacturer's square footage coverage rates and mil thickness, mil thickness requirements govern.
 - c. When color or undercoats show through, apply additional coats until paint film is of uniform finish and color.
5. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
6. Apply materials under adequate illumination.
7. Evenly spread to provide full, smooth coverage.
8. Work each application of material into corners, crevices, joints, and other difficult to work areas.
9. Avoid degradation and contamination of blasted surfaces and avoid intercoat contamination.
 - a. Clean contaminated surfaces before applying next coat.
10. Smooth out runs or sags immediately, or remove and recoat entire surface.
11. Allow preceding coats to dry before recoating.
 - a. Recoat within time limits specified by coating manufacturer.
 - b. If recoat time limits have expired re-prepare surface in accordance with coating manufacturer's printed recommendations.
12. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
13. Coat all aluminum in contact with dissimilar materials.
14. When coating rough surfaces which cannot be backrolled sufficiently, hand brush coating to work into all recesses.
15. When applying coatings over acoustical concrete block units, do not spray apply.
 - a. Apply by roller.
16. Backroll concrete and masonry and gypsum board and abuse resistant panel and wood surfaces with a roller if paint coatings are spray applied.

B. Prime Coat Application:

1. Prime all surfaces indicated to be painted.
 - a. Apply prime coat in accordance with coating manufacturer's written instructions and as written in this Specification Section.
2. Ensure field-applied coatings are compatible with factory-applied coatings.
 - a. Ensure new coatings applied over existing coatings are compatible.

- b. Employ services of coating manufacturer's qualified technical representative.
 - 1) Certify through material data sheets.
 - 2) Perform test patch.
- c. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.
- d. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using appropriate paint system listed in the MATERIALS Article, Paint Systems paragraph of this Specification Section.
 - 1) All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.
 - 2) If coatings are removed and surface is reprepared by Contractor, NACE certified coatings inspector shall inspect and approve surface in writing prior to recoating and shall provide continuous observation and certification of new coating.
- 3. SC application:
 - a. Prime new gypsum board surfaces using sealer as recommended by manufacturer.
 - b. Apply at rate per manufacturer's recommendation.
 - c. Prime and fill new concrete and masonry using sealer coat as recommended by manufacturer followed by modified epoxy filler as specified.
 - d. Prime filled concrete and masonry surfaces with primer at rates and as recommended by manufacturer.
- 4. Prime ferrous metals embedded in concrete to minimum of 1 IN below exposed surfaces.
- 5. Back prime all wood scheduled to be painted, prior to installation.
- 6. Wood trim to receive stain and varnish:
 - a. Apply wash coat uniformly to wood at manufacturer's recommended application rates.
 - b. Apply wood stain per manufacturer's instructions.
 - 1) Color to be selected.
- 7. After application of primer to gypsum board surfaces, inspect surface and repair in accordance with the PREPARATION Article of this Specification Section.
 - a. Re-prime repaired surfaces to uniform finish before application of finish coat(s).
- 8. Apply zinc-rich primers while under continuous agitation.
- 9. Ensure abrasive blasting operation does not result in embedment of abrasive particles in paint film.
- 10. Brush or spray bolts, welds, edges and difficult access areas with primer prior to primer application over entire surface.
- 11. Touch up damaged primer coats prior to applying finish coats.
 - a. Restore primed surface equal to surface before damage.
- 12. All surfaces of steel lintels and steel components of concrete lintels used in wall construction shall be completely painted with both prime and finish coats prior to placing in wall.
- C. Finish Coat Application:
 - 1. Apply finish coats in accordance with coating manufacturer's written instructions and in accordance with this Specification Section; manufacturer instructions take precedent over these Specifications.
 - 2. Varnish:
 - a. Apply first coat of varnish: Gloss.
 - 1) Allow to dry a minimum of 48 HRS.
 - b. Apply second and third coats of varnish: Satin.
 - 1) Allow a minimum of 48 HRS between each coat.
 - c. Lightly sand between coats as required then dust clean.
 - 3. Touch up damaged finish coats using same application method and same material specified for finish coat.
 - a. Prepare damaged area in accordance with the PREPARATION Article of this Specification Section.

4. Broadcast abrasive aggregate into top coat of floor coatings as required to achieve degree of skid resistance desired by the Owner.

3.6 COLOR CODING

- A. Color and band piping in accordance with the OWNERS color coding, including the use of premium colors, or applicable.
 1. Band piping using maximum of three (3) different colors at 20 FT maximum centers.
 2. Factory painted piping shall be color banded in the factory per the Schedule in the OWNERS color coding.
 3. Place bands:
 - a. Along continuous lines.
 - b. At changes in direction.
 - c. At changes of elevation.
 - d. On both sides of an obstruction (e.g., wall, ceiling) that painted item passes through.
 4. Band width for individual colors (pipe diameter measured to outside of insulation, if applicable):
 - a. Piping up to 8 IN DIA: 2 IN minimum.
 - b. Piping greater than 8 IN up to 24 IN DIA: 4 IN minimum.
 - c. Piping greater than 24 IN up to 48 IN DIA: 6 IN minimum.
 - d. Piping greater than 48 IN DIA: 8 IN minimum.

3.7 FIELD QUALITY CONTROL

- A. Contractor to provide protection for surfaces painted with epoxy coatings to prevent chalking.
 1. Surfaces showing chalking will not be accepted regardless of condition of paint film.
- B. Maintain Daily Records:
 1. Record the following information during application of each coat of paint applied:
 - a. Date, starting time, end time, and all breaks taken by painters.
 - b. For exterior painting:
 - 1) Sky condition.
 - 2) Wind speed and direction.
 - c. Air temperature.
 - d. Relative humidity.
 - e. Moisture content and surface temperature of substrate prior to each coat.
 - f. Provisions utilized to maintain work area within manufacturer's recommended application parameters including temporary heating, ventilation, cooling, dehumidification and provisions utilized to mitigate wind blown dust and debris from contaminating the wet paint film.
 - g. Record environmental conditions, substrate moisture content and surface temperature information not less than once every four (4) hours during application.
 - 1) Record hourly when temperatures are below 50 DegF or above 100 DegF.
 2. Record the following information daily for the paint manufacturer's recommended curing period:
 - a. Date and start time of cure period for each item or area.
 - b. For exterior painting:
 - 1) Sky conditions.
 - 2) Wind speed and direction.
 - c. Record environmental conditions not less than once every 12 hours.
 - 1) Record once every four (4) hours when ambient temperature is below 35 DegF.
 - d. Provisions utilized to protect each item or area and to maintain areas within manufacturer's recommended curing parameters.
 3. Format for daily record to be computer generated.
- C. Measure wet coating with wet film thickness gages.
- D. Measure coating dry film thickness in accordance with SSPC PA 2 using Mikrotest gage calibrated against NBS "Certified Coating Thickness Calibration Standards."

1. Engineer may measure coating thickness at any time during project to assure conformance with these Specifications.
- E. Measure surface temperature of items to be painted with surface temperature gage specifically designed for such.
- F. Measure substrate humidity with humidity gage specifically designed for such.
- G. Provide wet paint signs.

3.8 CLEANING

- A. Clean paint spattered surfaces.
 1. Use care not to damage finished surfaces.
- B. Upon completion of painting, replace hardware, accessories, plates, fixtures, and similar items.
- C. Remove surplus materials, scaffolding, and debris.

3.9 SCHEDULE

- A. Pipe Bollards: 35GR-Black with 02SF-Safety Yellow stripping diagonally 4 IN wide and 8 IN on center.
- B. Parking lot stripping: 11WH-White.

END OF SECTION

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SECTION 15069
REINFORCED CONCRETE PIPE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Reinforced concrete pipe and materials and for constructing precast concrete pipe intake or precast concrete sewer mains, laterals, stubs and inlet leads. The pipes shall be of the sizes, strengths and dimensions shown on the plans and shall include all connections to new or existing pipes, sewers, manholes, inlets, headwalls and other appurtenances and jointing materials as may be required to complete the work.

1.2 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include cost of such work incidental to work being performed

1.3 REFERENCES

- A. ASTM C 76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- B. ASTM C 361 - Reinforced Concrete Low Head Pressure Pipe
- C. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe.
- D. ASTM C 497 - Method of Testing Concrete Pipe, Sections, or Tile.
- E. ASTM C 506 - Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe
- F. ASTM C 507 - Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.
- G. ASTM C 655 - Reinforced Concrete D-load Culvert, Storm Drain and Sewer Pipe.
- H. ASTM C 822 - Standard Definitions and Terms Relating to Concrete Pipe and Related Products.
- I. ASTM C 877 - Standard Specification for External Sealing Bands for Non Circular Concrete Sewer, Storm Drain, and Culvert Pipe.

1.4 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit complete product data for pipe, fittings and gaskets for approval. Indicate conformance to appropriate reference standards.
- C. Submit certificates by a testing laboratory, hired and paid by the manufacturer, that concrete pipes meet applicable standards when tested in accordance with appropriate reference standards.
- D. For jacking pipe, submit drawings and data describing grouting port design and closure procedures when required by Section 02431 - Tunnel Grout, including liner repair, as applicable.

PART 2 - PRODUCTS

2.1 REINFORCED CONCRETE PIPE

- A. Circular precast reinforced concrete pipe shall conform to requirements of ASTM C 76. Joints shall be rubber gasketed conforming to ASTM C 443.
- B. Circular precast reinforced low head concrete pipe shall conform to requirements of ASTM C 361. Joints shall be rubber gasketed conforming to ASTM C 443.
- C. Precast reinforced concrete arch pipe shall conform to the requirements of ASTM C 506. Joints shall conform to ASTM C 877.
- D. Precast reinforced concrete elliptical pipe, either vertical or horizontal, shall conform to the requirements of ASTM C 507 for Class VE-III for vertical or Class HE-III for horizontal. Joints shall be rubber gaskets conforming to ASTM C 877.
- E. Precast reinforced concrete D-load pipe shall conform to the requirements of ASTM C 655.
- F. The minimum design for precast reinforced concrete pipe arch or elliptical pipe shall conform to Table A or B:

TABLE A * Arch Pipe			
Design Size	Equiv. Dia. In.	Rise In.	Span In.
1	18	13 1/2	22
2	21	15 1/2	26
3	24	18	28 1/2
4	30	22 1/2	36 1/4
5	36	26 5/8	43 3/4
6	42	31	51 1/8
7	48	5/16	58 1/2
8	54	36	65
9	60	40	73
10	72	45	88
		54	

TABLE B * Horizontal Elliptical Pipe			
Design Size	Equiv. Dia. In.	Rise In.	Span In.
1	18	14	23
2	24	19	30
3	27	22	34
4	30	24	38
5	33	27	42
6	36	29	45
7	39	32	49
8	42	34	53
9	48	38	60
10	54	43	68

*Minimum height of cover required is one (1) foot.

*Maximum height of cover is eight (8) feet.

TABLE C CIRCULAR PIPE (CLASS, D-LOAD EQUIVALENTS) ASTM C 76 & ASTM C 655	
C76	C655
CLASS I	800D-LOAD
CLASS II	1000D-LOAD

REINFORCED CONCRETE PIPE

CLASS III	1350D-LOAD
CLASS IV	2000D-LOAD
CLASS V	3000D-LOAD

2.2 GASKETS

- A. When no contaminant is identified, furnish rubber gasket conforming to ASTM C 443 for circular reinforced concrete pipe and rubber gasket conforming to ASTM C 877 for reinforced concrete elliptical pipe.
- B. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed sewer, shall have the following gasket materials for the noted contaminants:
- C. Material required for specific contaminants.

CONTAMINANT	GASKET MATERIAL REQUIRED
Petroleum (diesel, gasoline)	Nitrile Rubber
Other Contaminants	As recommended by the pipe manufacturer

2.3 SOURCE QUALITY CONTROL

- A. Perform at least 1 hydrostatic test on 2 pipes joined together to test a joint for each pipe size. When straight pipe joints are deflected to form curves, test a joint with the maximum deflection with said testing to be in accordance with ASTM C 443.
- B. Dye check welds in fittings.
- C. Perform 3-edge bearing D-load physical test (external load crushing strength test) per ASTM C 497, if specified in Piping Schedule

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install pipe in accordance with Section 15060
- B. Laying Pipe: Assemble and join joints in accordance with the manufacturer's published instructions for the type of joint. When assembled, check the position of each rubber gasket with a feeler gauge. Capture rubber gaskets so gaskets cannot be forced out of intended position because of hydrostatic pressure or forced in when making joints during pipe laying.
- C. Installation on Straight-Way:
 - 1. Unless approved otherwise in the shop drawings submittal-approval stage, pipe joints shall be installed within the following tolerances.
 - a. Concrete Joints: $\pm 1/2$ inch from manufacturer's reference mark on pipe, the center of which references the designed joint point.
 - b. Steel Joints: $\pm 1/4$ inch from manufacturer's reference mark on pipe, the center of which references the designed joint point.
 - c. Manufacturer shall use tighter tolerance if necessary to produce a testable joint.

2. Joint Marks:

- a. In addition to other pipe markings specified in the Specifications, each pipe delivered to the site shall be marked by manufacturer to indicate the designed joint depth required for joint integrity and as tested in the plant hydraulic testing of the pipe and joints, as follows:
 - 1) A mark at the tope at centerline.
 - 2) A mark at each side at spring line.
 - 3) The mark shall be the width of specified joint tolerance, with middle of mark representing design point.
 - 4) Failure to place pipe section within tolerance shall be grounds to reject placed pipe regardless of join pressure test.

D. Installation of Curves:

1. In general, and where indicated on the Drawings, make horizontal and/or vertical curves using pipe with beveled joints. Use slight deflections in the joints of straight pipe for other cases.
 - a. Do not exceed 5 degrees total angular deflection at a joint for beveled pipe or less if recommended by the pipe manufacturer.
 - b. Maximum joint opening: Do not exceed 3/4 inch for 36 inch pipe and smaller, and 1 inch for pipe larger than 36 inch, or less if recommended by pipe manufacturer.
2. Where necessary, make short length pipes for curves of shorter radius than can be made with beveled pipe of usual length.

E. Joint Cushions: Use protective joint cushions furnished by pipe manufacturer to protect joint and barrel during selected jacking procedures.

3.2 REPAIR

- A. Repair damaged pipe in accordance with ASTM C 361 except use epoxy bonding agent to bond mortar to concrete.

3.3 SCHEDULES

- A. Pipe Schedule: As indicated on drawings

END OF SECTION

SECTION 15110

HEAVY DUTY STAINLESS STEEL SLUICE GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sluice gates, operators, and appurtenances necessary to construct and install hydraulic control equipment as shown on the Drawings.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

- 1. Include cost of work and materials provided under this section in the pay items of which this work is a component, gateway structures as applicable.

B. Reserved.

1.03 GENERAL

- A. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer.
- B. Gates and operators shall be supplied (unless otherwise noted in the Drawings to be provided by the Owner) with all the necessary parts and accessories indicated on the Drawings, specified, or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.
- C. Gates shall be furnished (unless otherwise noted in the Drawings to be provided by the Owner) and installed complete with adhesive anchor bolts, operating stem, gate lift operator and other appurtenances as specified or needed to make a complete and operable installation.
- D. Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of the latest American Water Works Association C561 standards.
- E. Gates supplied under this section shall be Heavy-Duty Stainless Steel Sluice Gates manufactured by RW Gate Company (basis of design) or Waterman USA or as identified on the Drawings. Gate manufacturer shall meet or exceed the requirements of the specification listed herein.
- F. Contractor to provide the gate manufacturer with details and field measurements regarding the existence of and the condition of the wall thimbles or wall pipes. If the wall thimble or wall pipe mounting flange is flush with the wall, the Contractor may need to drill through the mounting flange of the existing cast iron wall thimble or wall pipe and the concrete behind the mounting flange to allow the new gates to be mounted with adhesive anchors. If the wall thimble or wall pipe mounting flange is deteriorated, suitable non-shrink grout shall be used to seal between the gate frame and wall thimble. If the gates are to be pipe flange mounted and the flange is suitable for usage, a gasket and/or mastic can be used to seal between the gate frame and pipe flange. If the pipe flange extends from the wall and is deemed to be unusable, the pipe flange shall be cut off flush and the gate shall be wall mounted with adhesive anchors and non-shrink grout. In this scenario, in the round structures, round back stainless steel sluice gates shall be provided. The frame shall be curved to match the diameter of the structure and the gate may need to be oversized to ensure the anchors are mounted in suitable concrete.

HEAVY DUTY STAINLESS STEEL SLUICE GATES

1.04 SUBMITTALS

- A. Conform to the requirements of Section 01 33 00 – Submittal Procedures.
- B. The Contractor shall submit, complete engineering design calculations in compliance with AWWA standards latest edition.

1.05 PERFORMANCE REQUIREMENTS

- A. Leakage: Sluice gates shall be substantially watertight under the design head conditions. Under the design seating head, the leakage shall not exceed 0.05 US gallon per minute per foot of seating perimeter. Under the design unseating head, the leakage for heads of 20 feet or less shall not exceed 0.1 US gallon per minute per foot of perimeter. For unseating heads greater than 20 feet, the allowable leakage shall not exceed the rate per foot of perimeter specified by the following equations:

MAXIMUM ALLOWABLE LEAKAGE

Gallons per minute per foot of perimeter = $0.10 + (0.0025 \times (\text{unseating head in feet} - 20))$

- B. Design Head: Sluice gates shall be designed to withstand the design head shown in the Drawings. If the head is not indicated in the Drawings, the gate manufacturer shall assume the head is to the top of the structure in both the seating head and unseating head direction.
- C. Seal Performance Test: Gate sealing systems shall be tested through a cycle test in an abrasive environment and shall show that the leakage requirements are still obtained after 25,000 cycles with a minimum deterioration.

1.06 QUALITY ASSURANCE

- A. The manufacturer shall have experience in the production of substantially similar equipment, and shall show evidence of satisfactory operation in at least 50 installations. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of American Welding Society.
- B. The fully assembled gates shall be shop inspected, tested for operation and leakage, and adjusted before shipping. There shall be no assembling or adjusting on the job site other than for the lifting mechanism.

PART 2 MATERIALS AND EQUIPMENT

2.01 SLUICE GATES

- A. All materials used in the construction of the gates and appurtenances shall be the best suited for the application.
 - 1. General. Gates, stems, lifts and other appurtenances shall be the size, type, and material and construction as shown on the Drawings and specified herein. Gates shall meet the requirements of AWWA Specifications C561 (latest version) or as modified herein. Gates shall be RW Gate Company Heavy-Duty Stainless Steel Sluice Gates (Model RW1000-S RW) or approved equal. All component parts shall be of the type of material shown, and interchangeable where size and material are the same without grinding, chipping or special fitting in the field. The gates shall be the product of one manufacturer having five or more years of experience in the manufacture of similar gates for similar use. All sluice gate parts, including lift, shall be designed for the heads shown with a minimum safety factor of five. Gates shall be either self-contained or non

HEAVY DUTY STAINLESS STEEL SLUICE GATES

self-contained of the rising stem, non-rising or telescopic stem configuration as indicated in the Drawings.

2. Frame and Guide Rails. The frame and guide rails shall be fabricated from 316L stainless steel with a minimum material thickness of 1/4-inch. Wall mounted guides shall have a minimum weight of 13 pounds per foot. Guide extensions shall be of the C-channel shape or similar for rigidity and shall have a minimum weight of 6 pounds per foot. The portion of the guide where the anchor bolts penetrate shall have a minimum thickness of 1/2-inch. Self-adjusting, UV stabilized UHMWPE seals shall be provided in the guides and across the top seal member when top sealing is required. An EPDM flush bottom invert seal shall be mounted to the invert member. The invert seal shall be held in place with 316 stainless steel attachment bolts. The seal system shall be completely self-adjusting. No wedges or pressure pads are allowed. All seats and seals shall be field replaceable and shall be mounted with 136 stainless steel attachment bolts.
3. Slide or Cover. The slide shall be constructed of 316L stainless steel and shall be reinforced to restrict deflection to 1/720 of the span or 1/16-inch, whichever is less. The stem connector shall consist of two structural members and will have a two bolt connection for the stem. The portion of the slide that engages the frame shall have a minimum thickness of 1/2-inch.
4. Guides and Seals. The guides shall be made of ultra high molecular weight polyethylene (UHMWPE) and shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position.
 - a. Side and top seals shall be made of UHMWPE of the self-adjusting type. A continuous compression cord shall ensure contact between the UHMWPE guide and the gate in all positions. The sealing system shall maintain efficient sealing in any position of the slide and allow the water to flow only below the slide plate.
 - b. The flush bottom seal shall be made of resilient EPDM set into the bottom member of the frame and held with 316 stainless steel attachment bolts.

B. Lift Assemblies.

1. General. Sluice gates shall be operated manually by handwheel-operated gearboxes or crank-operated gearboxes with pedestal floor stands or bench stands as required. Each lift shall be provided with a threaded cast bronze lift nut to engage the threaded portion of the stem. The lift nut shall have a machined flange, fitted above and below with thrust ball or roller bearings. Lifts having a reduction greater than 6:1 shall be two-speed. A maximum effort of 40 lbs. pull on handwheel or crank, shall operate the gates under the specified operating head. The gears, when required, shall be steel with machine-cut teeth. Pinion gears shall be supported by ball or roller bearings. The lift mechanism shall be totally enclosed within a cast iron housing adequately provided with lubrication fittings. The pedestal shall be fabricated 316L stainless steel. The crank shall be of cast aluminum with a revolving nylon handle and shall be removable. The crank shall be a maximum of 15" long. All lifts for rising stems shall be provided with a transparent butyrate plastic stem cover with mylar strip position indicator. Non-rising stem gates shall be provided with a counter type position indicator unless extension stems, valve boxes, or T-handle wrenches make an indicator impractical. Hand wheels and crank input shafts shall be approximately 36" from the operating floor unless otherwise shown. The word "open" shall be cast onto the housing or handwheel indicating direction of rotation to open the gate.

2. Stem and Couplings. Stems shall have a minimum diameter of 1-1/2-inches. Operating stems shall be of a size to safely withstand, without buckling or permanent distortion, stresses induced by normal operating forces. Stems shall be fabricated from round bar stock of 316 stainless steel and shall be provided with machine rolled, full depth acme threads. Stub threads are not acceptable. Stems composed of two or more sections shall be joined by stainless steel couplings threaded and keyed or bored and bolted to stem sections. In section, couplings shall be stronger than the stems. Rising stems with manual lifts shall be provided with adjustable limit nuts or stop collars above and below the floor stand lift nut to prevent over travel of the gate in either direction.
 3. Stem Guides. Stem guides shall be 316L stainless steel and shall be provide with UV stabilized, UHMWPE bushings, and mounted on 316L stainless steel brackets. Guides shall be adjustable in two directions and shall be so constructed that when properly spaced they will hold the stem in alignment and still allow enough play to permit easy operation. Stem guide spacing shall be as recommended by the manufacturer, but in no case shall it exceed an l/r ratio of 200. Brackets shall be attached to the wall by anchor bolts and sufficient strength to prevent twisting or sagging under load.
 4. Stem Cover. Rising stem gates shall be provided with a clear butyrate stem cover. The stem cover shall have a cap and condensation vents and a clear mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.
- C. Self-Contained Gates with Rising & Non-Rising Stems. When a self-contained gate is specified, a heavy yoke shall be provided. The yoke shall be constructed of two C-channels. Angles are not acceptable for yoke members. On non-rising stems gates the nut pocket shall be provided on the top of the slide so that the stem does not project into the waterway when the gate is fully opened. The thrust generated by gate operation shall be transferred to the yoke by the stem thrust collar or lift. When the operating floor is above the self-contained gate, a stem extension of 316 stainless steel shall be coupled to the operating stem with a bronze coupling or cast iron stem extension bracket. Operation shall be by a T-handle wrench or floor stand, shown on the plans and gate schedule. In a T-handle arrangement the stem extension shall be supported by at least one stem guide or a floor box with integral guide embedded in the operating floor.
- D. Flushbottom Sluice Gates. When a flushbottom closure is specified, a resilient EPDM seal shall be attached to the frame so that it is flush with the invert. The seal shall be held in place by a 316 stainless steel attachment bolts.
- E. Painting. All cast iron parts of the sluice gate (not bearing or sliding contact) and stem guides shall be factory painted.
- F. Shop Testing. The completely assembled gate and hoist shall be separately shop-operated to insure proper assembly and operation. The gate shall be adjusted so that a .004" thick gauge will not be admitted at any point between frame and cover seating surfaces. All gates and equipment shall be inspected and approved by a qualified shop inspector prior to shipment.
- G. Warranty. All heavy duty sluice gates and appurtenances supplied under this specification shall be warrantied for a period of not less than ten (10) years from date of final completion. Warranty shall cover workmanship and performance.

PART 3 EXECUTION

3.01 STORAGE AND INSTALLATION

HEAVY DUTY STAINLESS STEEL SLUICE GATES

15110-4 OF 6

IFB: 06-10-2020

- A. Contractor shall store and install the sluice gates and equipment in accordance with the installation manual furnished by the gate manufacturer. After installation, the completely assembled gate, stem, guides and lift shall be operated through one full cycle to demonstrate satisfactory operation. Such adjustments as necessary will be made until operation is approved by the Resident Project Representative. When required by the Resident Project Representative, the gate shall be subjected
- 3.02 FIELD TESTS
- A. Following the completion of each gate installation, the gates shall be operated through at least two complete open/close/open cycles. If an electric or hydraulic operator is used, limit switches shall be adjusted following the manufacturer's instructions. Gates shall be checked for leakage by the contractor after installation.

END OF SECTION

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