Project Manual

Town of Pecos City, Texas

Pecos Transfer Station Design

February 2018

PSC Project # 01984116

PARKHILLSMITH&COOPER

Project Manual

Town of Pecos City, Texas

Pecos Transfer Station Design

PARKHILL SMITH & COOPER, INC. F-560
STATE OF TEXAS
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LICENSED
PROFESSIONAL ENGINEER

2/20/18

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PARKHILLSMITH&COOPER

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DESIGN PROFESSIONAL RESPONSIBILITY

The specification sections authenticated by my seal and signature are limited in the following:

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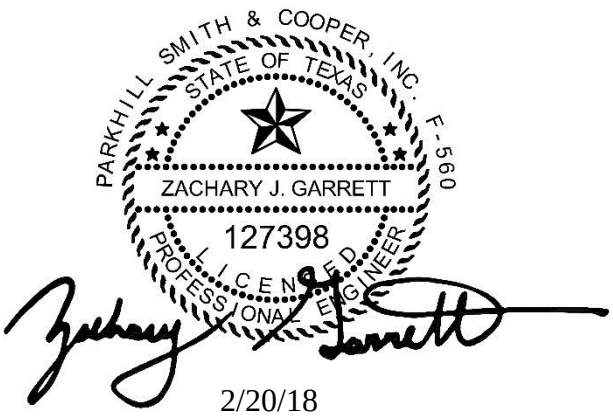
03300 Cast in Place Concrete



2/20/18

DESIGN PROFESSIONAL RESPONSIBILITY

The specification sections authenticated by my seal and signature are limited in the following:

DIVISION 08 – DOORS AND WINDOWS

08331 Overhead Coiling Doors

DIVISION 13 – SPECIAL CONSTRUCTION

13121 Pre-Engineered Buildings

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DESIGN PROFESSIONAL RESPONSIBILITY

The specification sections authenticated by my seal and signature are limited in the following:

DIVISION 16 - ELECTRICAL

16000	Electrical General Provisions
16111	Conduit
16123	Wire and Cable
16130	Boxes
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16170	Grounding and Bonding
16190	Supporting Devices
16195	Electrical Identification
16441	Enclosed Switches
16470	Panelboards
16670	Surge Protective Device
16990	Electrical System Testing and Startup

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SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Project description, permits, and licenses.
   2. Access to site and Contractor use of premises.
   3. Coordination requirements and drawings.
   4. Preconstruction meeting and warranty.

B. Related Sections:
   1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Identification: Town of Pecos City, Pecos Transfer Station Design.

B. Location: Pecos, Texas.

C. Verbal Summary. Without force or effect on requirements of Contract Documents, a brief description of Project, is:
   1. Earthwork excavation, filling, and grading to elevations shown on contract plans.
   2. Subgrade preparation to grades shown on plans.
   3. Heavy-duty asphalt pavement and concrete ramp and road as shown on plans.
   4. Cast-in-place concrete retaining walls/push walls and segmental retaining walls, building footings, tipping floor, tunnel floor, white goods storage area, and bollards. Installation of metal building and beam supports, doors, rollup doors, roof vents, and translucent panels.
   5. Installation of septic tank, 6-inch HDPE storm drain pipe, grate drain, 4-inch water line, 3-inch hose bib connection, and slot drains.
   6. Excavation of detention basins.
   7. Electrical system for metal building.
   8. Provide erosion control.
   9. Install facility signage.

1.3 DEFINITIONS

A. Furnish: Supplying products to project site, delivering ready for unloading and replacing damaged and rejected products.

B. Install: Placing products in work ready for intended use, including unloading, unpacking, handling, storing, assembling, installing, erecting, placing, applying, anchoring, working, finishing, curing, protecting, cleaning, and similar operations.

C. Provide: Furnish and install products.

D. Indicated: Shown, noted, scheduled, specified, or drawn, somewhere in contract documents.

1.4 REGULATORY REQUIREMENTS

A. Submit copies of all permits, licenses, and similar permissions obtained, and receipts for fees paid, directly to Owner.

1.5 ACCESS TO SITE AND USE OF PREMISES

A. Space available to Contractor for performance of work, exclusively or in conjunction with others performing other construction as part of project, is restricted to area shown on site plan of Contract Drawings unless Contractor arranges to use additional space with Owner. An additional staging area available, if required.
B. Provide signs adequate to direct visitors. Do not install, or allow to be installed, signs other than specified sign(s) and signs identifying principal entities involved in project.

1.6 PROTECTION OF EXISTING UTLITIES AND STRUCTURES

A. Contractor shall prevent damage to, and be liable for any damage, maintenance, and protection of lines and structures as shown on drawings or otherwise brought to Contractor attention. Contractor shall not cut, remove, change, or disturb any existing lines, except as provided by plans and specifications, without express permission of Owner, of any such line. Utility adjustments or relocations accomplished by Owner of each utility, except for water and sewer or as otherwise shown on drawings.
B. Existing easements on west side of project site, contains an overhead electric line. Contractor required to coordinate with respective utility companies before access within easement. Overhead electric line owned by Texas-New Mexico Power Co.

1.7 OWNER OCCUPANCY

A. Owner will occupy site during construction for conducting normal operations.
B. Cooperate with Owner to minimize conflict and facilitate Owner operations.
C. Schedule Work to accommodate requirement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SECURITY PROCEDURES

A. Limit access to site to persons involved in work.
B. Provide secure storage for materials Owner made payment and are stored onsite.
C. Secure completed work as required to prevent loss.
D. Secure site by fencing, security guards, or other means to prevent damage, theft, safety hazards, or other problems onsite.
E. Contractor must provide a security guard at gate entrance all times Contractor is onsite or accepting shipment of materials.

3.2 COORDINATION

A. If necessary, inform each party involved in writing, of procedures required for coordination, including requirements for giving notice, submitting reports, and attending meetings. Inform Owner when coordination of work required.
B. See other requirements in other portions of Contract Documents.
C. Prepare coordination drawings specified in product sections.
   1. Where space is limited, show plan and cross-section dimensions of space available.
   2. Coordinate shop drawings prepared by separate entities.

3. Show installation sequence when necessary for proper installation.

D. Coordinate utility adjustments where applicable.

3.3 WARRANTY

A. Contractor warrants 100 percent of project for one year after date of final acceptance of work.

B. On the 11th month from date of final acceptance, Owner's representative will schedule an annual Inspection in Contractor presence, to inspect for defects and assessment of work performed. Repair any work Owner's representative considers defective.

C. Contractor shall remedy any defects in workmanship and pay for any/all damages of any nature whatsoever resulting in defects, at no cost to Owner.

END OF SECTION

SECTION 01019 - CONTRACT CONSIDERATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Schedule of Values, Application for Payment, and change procedures.
B. Related Sections:
   1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 SCHEDULE OF VALUES

A. Submit printed schedule on Engineer-approved Contractor form or electronic media printout.
B. Submit Schedule of Values in duplicate within five days after receiving the bid tabulation.
C. Revise schedule to list approved Change Orders, with each Application for Payment.

1.3 PROJECT DURATION DEFINITIONS

A. Substantial Completion: When the new Transfer Station has been satisfactorily constructed and all related work complete. Work associated with Project shall be substantially complete within 150 calendar days of Notice to Proceed.
B. Final Completion: When remaining punchlist items are completed and within 30 days of Substantial Completion.

1.4 APPLICATION FOR PAYMENT

A. Submit payment application to Engineer through Engineer’s Info-Exchange website.
B. Payment Period is as defined in Owner-Contractor agreement.
C. Waiver of liens from subcontractor.
D. Stored materials invoices.
E. Receipted invoices for previously-stored materials.

1.5 CHANGE PROCEDURES

A. Engineer advises of minor changes in Work not involving an adjustment to Contract Sum/Price or Contract Time as authorized by General Conditions, by issuing work directive change.
B. Engineer may issue Proposal Request including detailed description of proposed change with supplementary/revised Drawings and specifications, change in Contract Time for executing change. Contractor prepares and submits estimate within seven days.
C. Contractor may propose change by submitting request for change to Engineer, describing proposed change and full effect on Work. Include statement describing reason for change and effect on Contract Price and Contract Time with full documentation and statement describing effect on Work by separate or other contractors. Document any requested substitutions per Section 01330 – Submittal Procedures.
D. Stipulated Price Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for a Change Order, as Engineer approves.
E. Construction Change Authorization: Engineer may issue directive on Work Directive Change, signed by Owner, instructing Contractor to proceed with change in Work, for subsequent inclusion in Change Order. Document describes changes in Work and designates method of determining any change in Contract Price or Contract Time. Promptly execute change.

F. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Engineer determines change allowable in Contract Price and Contract Time as provided in Contract Documents.

G. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and substantiate costs for changes in Work.

H. Change Order Forms: As specified by Owner.

I. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in General Conditions of the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01025 – MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Bid price on each item, as stated in proposal, includes furnishing all labor, superintendence, machinery, equipment, and materials necessary or incidental to complete various items of work per plans and specifications. Cost of work or materials shown on plans or called for in specifications and no separate payment made, shall be included in prices on various items.

1.2 REQUIREMENTS

A. Unit or lump sum price bid on each item, as stated in proposal, includes furnishing all labor, superintendence, machinery, equipment, and materials necessary or incidental to complete various items of work per plans and specifications.

B. Actual amount of work done and materials furnished under unit price items may differ from estimated quantities. Basis of payment for unit price work and materials will be actual amount of work done and material furnished, as measured by Engineer. All estimated quantities for unit price bid items stipulated in bid proposal are approximate and used only:
   1. as basis for estimating cost of work, and
   2. to compare bids submitted for work.

C. All measurements and payments based on completed and accepted work performed per Drawings, Specifications, and contract bid prices. All incidental work and subsidiary items whether shown or listed for measurement or payment, not paid for separately, but included in payment for bid items stated in contract and shall be full compensation for all labor, equipment, materials, testing, and incidentals necessary to perform work per Contract Documents.

D. Cost of work or materials shown on Drawings, called for in Specifications, and no separate payment made, shall be included in bid price for various items associated. Contractor claim for extra compensation for required item but not shown on Drawings or described in Specifications, not considered.

E. Interconnections between various items of equipment and control system will likely require coordination and interface devices such as but not limited to, couplings, flanges, reducers, converters, conduit, relays, contacts, wiring, etc., whether these items are shown on Drawings. General Contractor holds responsibility to provide necessary coordination and interface devices at no additional cost to Owner.

1.3 MOBILIZATION/DEMOBILIZATION (Bid Item 1)

A. Payment made for mobilizing and demobilizing all equipment, tools, insurance, bonds, and other job-related items to and from job site. Price will be on lump sum basis and include all equipment, labor, materials, superintendence, and incidentals necessary to become fully mobilized at start of project and demobilized when work is complete. Bid item will be paid 50-percent for mobilization and 50-percent for demobilization. This bid item shall not exceed 5 percent of contract price. Mobilization-related expenses include Contractor cost for:
   1. obtaining construction staging area;
   2. obtaining storage areas for equipment and construction office facilities;
   3. obtaining and setting up construction office facilities;
   4. obtaining and paying for electric power required for construction;

5. providing sanitary facilities for construction personnel;
6. obtaining and paying for water needed for construction;
7. providing and maintaining dust control over project working area; and
8. all other incidentals required for Contractor to complete mobilization.

1.4 TESTING ALLOWANCE FOR CONTRACTOR CERTIFIED QUALITY AUDITOR (CQA) (Bid Item 2)

A. Allowance for Contractor CQA shall be paid under this testing allowance. Contractor responsible for paying any fees to CQA incurred by Owner for testing. This will be a pass-through cost provided from Owner. No mark-up allowed. Once cost is received from Owner, Contractor will provide a check to Owner payable to CQA.

1.5 EXCAVATION (Bid Item 3)

A. Payment made for providing all labor, equipment, materials, supplies, etc., necessary to excavate detention ponds and site to elevations and grades shown on plans to receive building, access roads, and detention ponds. Payment made for total excavation on a per cubic yard of excavation. **Contractor** must provide survey control baseline survey before beginning work and finish survey measurements to verify amount of excavation for payment purposes. Subgrade preparation to receive concrete structures or roads and surveys are incidental to this bid item.

1.6 EMBANKMENT/STRUCTURAL FILL (Bid Item 4)

A. Payment made for providing all labor, equipment, materials, supplies, etc., necessary to fill site to elevations and grades shown on plans to receive building, access roads, and detention ponds. Payment made for actual measured cubic yardage of embankment/structural fill. Based on the geotechnical study, existing site soils are suitable for reuse as structural fill. **Contractor** must provide survey control baseline survey before beginning work and finish survey measurements to verify amount of fill for payment purposes. Subgrade preparation, including two layers of geo grid per the geotechnical study, to receive concrete structures or roads and surveys are incidental to this bid item.

1.7 CONCRETE RAMP (Bid Item 5)

A. Payment made for providing and installing 8-inch concrete pavement, 6-inch aggregate base course, and preparation of 12-inch of subgrade on a per square yard basis. Payment includes all costs associated with providing all labor, equipment, embankment, excavation, materials, reinforcement, and supervision necessary to install pavement sections to grades shown on plans and per specifications.

1.8 SITE ASPHALT PAVEMENT (Bid Item 6)

A. Payment made for providing and installing 3-inch HMAC Type B pavement, 12-inch crushed aggregate base course Type A, and preparing 12-inch subgrade on a per square yard basis. Payment includes all costs associated with providing labor, equipment, embankment, excavation, materials, and superintendence necessary to install pavement sections to grades shown on plans and per Specifications.

1.9 CAST-IN-PLACE CONCRETE BUILDING FOOTINGS (Bid Item 7)

A. Payment made for providing and installing concrete building footings on a cubic yard basis. Payment includes all costs associated with providing all labor, equipment, materials, supervision, excavation, fine grading, curing, welding, reinforcement, control joints, backfill, and all other appurtenances necessary to install building footings as shown on plans and per specifications.

1.10 SEGMENTAL RETAINING WALLS (Bid Item 8)

A. Payment made for providing and installing segmental retaining walls on a linear foot basis. Payment includes all costs associated with providing all labor, equipment, materials, supervision, excavation, fine grading, curing, welding, select backfill, painted steel posts and rails, steel embed plates, control joints, backfill, and all other appurtenances necessary to install retaining walls as shown on plans and per specifications. Gravel (drainage aggregate) is incidental to this bid item.

1.11 CAST-IN-PLACE 14-FOOT AND 22.5-FOOT CONCRETE RETAINING WALL-/PUSH WALL-REINFORCED CONCRETE (Bid Item 9)

A. Payment made for providing and installing continuously-reinforced concrete retaining wall/push wall on a cubic yard basis, installed. Payment includes all costs associated with providing all labor, equipment, embankment, excavation, materials, testing, reinforcing, finishing, curing, sawing, sealing, labor, and equipment necessary to complete work necessary to install pavement sections to grades shown on plans and per specifications. Gravel (drainage aggregate) is incidental to this bid item.

1.12 TIPPING FLOOR- AND TUNNEL FLOOR- REINFORCED CONCRETE PAVEMENT (Bid Item 10)

A. Payment made for providing and installing continuously-reinforced concrete paving on a cubic yard basis, installed. Payment also made for providing and installing 8-inch concrete pavement, 6-inch aggregate base course, and preparation of 12-inch of subgrade on a per square yard basis. Payment includes all costs associated with providing all labor, equipment, embankment, excavation, materials, testing, reinforcing, finishing, curing, sawing, sealing, labor, and equipment necessary to complete work necessary to install pavement sections to grades shown on plans and per specifications. Top width of tipping floor and tunnel floor used as basis for measurement for payment purposes.

1.13 GRATE DRAIN (Bid Item 11)

A. Payment made for providing and installing a grate drain as shown on plans on a linear foot basis. Price includes all material, labor, supplies, equipment, and superintendence necessary to install the grate drain as specified on plans.

1.14 THREE-SIDED BUILDING (Bid Item 12)

A. Payment made for installing new transfer station building, complete and in place, on a lump sum basis. Payment for furnishing and installing three-sided, clear-span, metal building, roof, roof vents, translucent panels, bollards, roll-up doors, and doors, as shown on plans and specifications. Payment includes all costs associated with providing all labor, equipment, materials, and supervision necessary to install per drawings and specifications.

1.15 6-INCH STORM DRAIN LINE (Bid Item 13)

A. Payment made for providing and installing 6-inch HDPE profile wall gravity storm drain line as shown on plans on a linear foot basis. Payment includes all costs associated with providing labor, equipment, materials, and supervision necessary to install per drawings and specifications. All fittings and connections are incidental to this bid item.

1.16 SEPTIC SYSTEM (Bid Item 14)

A. Payment made for providing all labor, equipment, materials, supplies, and superintendence necessary to install new septic system, complete and in place, as shown on plans and specifications. Price includes septic tank, manhole fittings, manhole cover, sump, and drainage. Payment made on a lump sum basis.

1.17 4-INCH WATER LINE WITH 3-INCH HOSE BIB (Bid Item 15)

A. Payment made for providing and installing 4-inch C-900 waterline, capped on the end, as shown on plans on a linear foot basis. Payment includes all costs associated with providing labor, equipment, materials, and supervision necessary to install per Drawings and Specifications. All fittings, 3-inch hose bib connection, and other connections are incidental to this line item.

1.18 ELECTRICAL WORK (Bid Item 16)

A. Payment made for electrical site improvements on a lump sum basis. Electrical work includes grounding system, meter can, main disconnects, fusible/non-fusible disconnects, electrical rack, distribution panels, in-ground pullboxes, trenching and backfill, wires/cables, conduits, interior and exterior light fixtures with photocell, receptacles, light switches, installation of other electrical items indicated on Contract Drawings, and all associated terminations. Payment includes full compensation for complete performance of work per Drawings and Specification provisions.

1.19 EROSION CONTROL (Bid Item 17)

A. Payment made for providing, installing, and maintaining erosion control measures as shown on plans on a lump sum basis and includes:
   1. preparing formal Stormwater Pollution Prevention Plan (SWPPP) by Texas-licensed professional engineer;
   2. submitting and obtaining approval of formal SWPPP from required governing agencies;
   3. furnishing, installing, and maintaining approved SWPPP for project duration;
   4. implementing and maintaining best management practices (BMPs) and good housekeeping for control of drainage run-off over project area;
   5. silt-fences;
   6. soil stabilization;
   7. hay-bales; and
   8. other incidentals required for Contractor to complete and implement SWPPP requirements.

1.20 FACILITY SIGNAGE (Bid Item 18)

A. Payment made for installing site signage on per each basis. Payment includes all costs associated with providing all labor, equipment, materials, and supervision necessary to install site signage. Such payment shall be complete compensation for complete performance of Work per Drawings and Specification provisions. Coordinate any additional signage with Owner.

PART 2 - PRODUCTS

2.1 ALTERNATES

A. Alternates quoted on Proposal forms will be reviewed and accepted or rejected at Owner option. Accepted alternates will be identified in Owner-Contractor agreement.
B. Coordinate related work and modify surrounding work as required.
C. Schedule of Alternates:
   1. Alternate No. 1: Install stepdown concrete retaining wall instead of segmental retaining wall outside of building.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01039 - COORDINATION AND MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes coordination, field engineering, site mobilization conference, and
A. preinstallation meetings.
B. Related Sections:
   1. Other Division 01 Specification Sections apply to Work of this Section.
   2. Division 16 – Electrical.

1.2 COORDINATION

A. Coordinate scheduling, submittals, and Work of various Specification sections to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
C. Coordinate space requirements and installation of mechanical and electrical work 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, maintenance, and repairs.
D. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
E. Large Apparatus: Contractor shall bring any large device to install in any building space, too large to permit access through windows, doorways, or shafts, to the job and place in space before enclosing structure is complete.
F. Coordinate items requiring electrical connections with Division 16 for:
   1. Voltage.
   2. Phase.
   3. Ampacity.
   4. Number and size of wires.
   5. Wiring diagrams.
   6. Starter size, details, and location.
   7. Control devices and details.
G. Coordinate completion and clean up of Work of separate Section in preparation for Substantial Completion and for portions of work designated for Owner’s occupancy.

1.3 FIELD ENGINEERING

A. Control datum for survey is shown on Drawings.
B. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

1.4 SITE MOBILIZATION CONFERENCE

A. Engineer will schedule a conference at Project site prior to Contractor occupancy.

B. Attendance Required: Engineer and Contractor's project manager, jobsite superintendent, and major subcontractors.

C. Agenda:
   1. Submission of insurance certificates.
   2. Distribution of Contract Documents.
   3. Submit list of subcontractors and products, Schedule of Values, and progress schedule.
   4. Designate personnel representing the parties in Contract and Engineer.
   5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   6. Scheduling.
   7. Use of premises by Owner and Contractor.
   8. Owner's requirements and partial occupancy.
   9. Construction facilities and controls provided by Owner, if any.
   10. Temporary utilities provided by Owner, if any.
   11. Survey layout.
   12. Security and housekeeping procedures.
   13. Schedules and Coordination.
   14. Procedures for testing.
   15. Procedures for maintaining record documents.
   16. Requirements for start-up of equipment.
   17. Inspection and acceptance of equipment put into service during construction period.

D. Engineer or representative will record meeting minutes and distribute copies within three days after meeting to participants and those affected by decisions made.

1.5 BIWEEKLY MEETINGS

A. Hold biweekly meetings at work area on a day agreeable to all parties. At minimum, meeting will be attended by Contractor, major subcontractors, and Engineer. The meeting is to:
   1. Review work activity and location for the week.
   2. Discuss Contractor's personnel assignment for the week.
   3. Review previous week's activity.
   4. Review work schedule.
   5. Discuss possible problem areas and situations.
   6. Review submittals schedule and status of submittals.
   7. Review off-site fabrication and delivery schedules.
   8. Maintenance of progress schedule.
   9. Corrective measures to regain projected schedules.
   10. Planned progress during succeeding work period.
   11. Coordination of projected progress.
   12. Maintenance of quality and work standards.
   13. Effect of proposed changes on progress schedule and coordination.
   14. Review status of “as-built” drawings prepared by Contractor to ascertain Contractor is keeping “as-built” drawings **current**.
   15. Other business relating to Work.

B. Engineer or representative will record meeting minutes and distribute copies within three days after meeting to participants and those affected by decisions made.

1.6 PREINSTALLATION MEETING

A. When required in individual Specification sections, convene a preinstallation meeting at work site prior to commencing work of Section.
B. Require attendance of parties directly affecting, or affected by, work of specific Section.
C. Notify Engineer four days in advance of meeting date.
D. Prepare agenda and preside at meeting.
   1. Review conditions of installation, preparation, and installation procedures.
   2. Review coordination with related work.
E. Engineer or representative will record meeting minutes and distribute copies within three days after meeting to participants and those affected by decisions made, with three copies to Engineer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01090 - REFERENCE STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes quality assurance and schedule of references.
B. Related Sections:
   1. Other Division 01 Specification Sections apply to Work of this Section.

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 date for receiving bids.
C. Obtain copies of standards when required by Contract Documents.
D. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
E. Contractual relationship of parties to Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.3 SCHEDULE OF REFERENCES

AA Aluminum Association
818 Connecticut Avenue, N.W.
Washington, DC 20006

AABC Associated Air Balance Council
1000 Vermont Avenue, N.W.
Washington, DC 20005

AASHTO American Association of State Highway and Transportation Officials
444 North Capitol Street, N.W.
Washington, DC 20001

ACI American Concrete Institute
Box 19150, Reford Station
Detroit, MI 48219

ADC Air Diffusion Council
230 North Michigan Avenue
Chicago, IL 60601

AGA American Gas Association
1515 Wilson Blvd.
Arlington, VA 22209

AGC	Associated General Contractors of America 1957 E Street, N.W. Washington, DC 20006
AGMA	American Gear Manufacturers Association 1500 King Street, Suite 201 Alexandria, VA 22314
AI	Asphalt Institute Asphalt Institute Building College Park, MD 20740
A.I.A.	American Institute of Architects 1735 New York Avenue, N.W. Washington, DC 20006
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
AMCA	Air Movement and Control Association 30 West University Drive Arlington Heights, IL 60004
ANSI	American National Standards Institute 1430 Broadway New York, NY 10018
ARI	Air-Conditioning and Refrigeration Institute 1501 Wilson Boulevard Arlington, VA 22209
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329
ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017
ASTM	ASTM, International 1916 Race Street Philadelphia, PA 19103

AWS	American Welding Society 550 LeJeune Road, N.W. Miami, FL 33135
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
BHMA	Builders' Hardware Manufacturer Association 60 East 42nd Street, Room 511 New York, NY 10165
BIA	Brick Institute of America 11490 Commerce Park Drive Reston, VA 22091
CDA	Copper Development Association 57th Floor, Chrysler Building 405 Lexington Avenue New York, NY 10174
CLFMI	Chain Link Fence Manufacturers Institute 1101 Connecticut Avenue, N.W. Washington, DC 20036
CPSC	Consumer Product Safety Commission 1111 Eighteenth Street, NW Washington, DC 20207
CRSI	Concrete Reinforcing Steel Institute 933 Plum Grove Road Schaumburg, IL 60195
DHI	Door and Hardware Institute 7711 Old Springhouse Road McLean, VA 22102
EJCDC	Engineers' Joint Contract Documents Committee American Consulting Engineers Council 1015 15th Street, N.W. Washington, DC 20005
EJMA	Expansion Joint Manufacturers Association 25 North Broadway Tarrytown, NY 10591
FGMA	Flat Glass Marketing Association 3310 Harrison White Lakes Professional Building Topeka, KS 66611

FM	Factory Mutual System 1151 Boston-Providence Turnpike / P.O. Box 688 Norwood, MA 02062
FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) Washington Navy Yard, Bldg. 197 Washington, DC 20407
ICBO	International Conference of Building Officials 5360 S. Workman Mill Road Whittier, CA 90601
IEEE	Institute of Electrical and Electronics Engineers 345 East 47th Street New York, NY 10017
IES	Illumination Engineering Society of North America 345 East 47th Street New York, NY 10017
IMIAC	International Masonry Industry All-Weather Council International Masonry Institute 815 15th Street, N.W. Washington, DC 20005
ML/SFA	Metal Lath/Steel Framing Association 221 North LaSalle Street Chicago, IL 60601
NAAMM	National Association of Architectural Metal Manufacturers 221 North LaSalle Street Chicago, IL 60601
NBS	National Bureau of Standards (U.S. Department of Commerce) Gaithersburg, MD 20234
NCMA	National Concrete Masonry Association P.O. Box 781 Herndon, VA 22070
NEBB	National Environmental Balancing Bureau 8224 Old Courthouse Road Vienna, VA 22180
NEC	National Electrical Code (by NFPA)

NECA	National Electrical Contractors Association 7315 Wisconsin Avenue Bethesda, MD 20814
NEMA	National Electrical Manufacturers Association 2101 'L' Street, N.W. Washington, DC 20037
NFPA	National Fire Protection Association Battery March Park Quincy, MA 02269
NPCA	National Paint and Coating Association 1500 Rhode Island Avenue N.W. Washington, D.C. 20005
NRCA	National Roofing Contractors Association 8600 Bryn Mawr Avenue Chicago, IL 60631
NSF	National Sanitation Foundation 3475 Plymouth Road P.O. Box 1468 Ann Arbor, MI 47106
NSWMA	National Solid Wastes Management Association 1730 Rhode Island Ave., N.W. Washington, DC 20036
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) Government Printing Office Washington, D.C. 20402
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077
PS	Product Standard U. S. Department of Commerce Washington, DC 20203
RMA	Rubber Manufacturer's Association 1400 K Street, N.W. Washington, D.C. 20005
SDI	Steel Deck Institute P.O. Box 9506 Canton, OH 44711

S.D.I.	Steel Door Institute 712 Lakewood Center North 14600 Detroit Avenue Cleveland, OH 44107
SIGMA	Sealed Insulating Glass Manufacturers Association 111 East Wacker Drive Chicago, IL 60601
SJI	Steel Joist Institute 1205 48th Avenue North, Suite A Myrtle Beach, SC 29577
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 8224 Old Court House Road Vienna, VA 22180
SSPC	Steel Structures Painting Council 4400 Fifth Avenue Pittsburgh, PA 15213
UL	UL, Inc. 333 Pfingston Road Northbrook, IL 60062
WRI	Wire Reinforcement Institute 8361 A Greensboro Drive McLean, VA 22102
W.W.P.A.	Woven Wire Products Association 2515 N. Nordica Avenue Chicago, IL 60635

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01230 – ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.
B. Related Requirements:
   1. Other Division 01 Specification Sections apply to Work of this section.

1.2 DEFINITIONS

A. Alternate: Amount proposed by bidders stated on Bid Form for certain work defined in bidding requirements added to or deducted from base bid amount if Owner decides to accept corresponding change in amount of construction to complete or in products, materials, equipment, systems, or installation methods described in Contract Documents.
   1. Alternates described herein are part of Work only if enumerated in Agreement.
   2. Cost or credit for each alternate is net addition to or deduction from Contract Sum to incorporate alternate into Work. No other adjustments made to Contract Sum.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of alternate into Project. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for complete installation whether indicated as part of alternate.
B. Notification: Immediately following award of Contract, notify each party involved, in writing, of each alternate status. Indicate if alternates are accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
C. Execute accepted alternates under same conditions as other work of Contract.
D. Schedule of Alternates is included at the end of this Section. Specifications referenced in schedule contain requirements for materials necessary to achieve Work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Stepdown Concrete Retaining Wall
   1. Payment made for providing and installing concrete retaining wall on a cubic yard basis. Payment includes all costs associated with providing all labor, equipment, materials, supervision, excavation, fine grading, curing, welding, painted steel posts and rails, steel embed plates, control joints, backfill, and all other appurtenances necessary to install retaining wall as shown on plans and per Specifications..

END OF SECTION

SECTION 01300 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Project Information Management and Coordination.
   2. Field surveying and Building Layout.
   3. Preconstruction, progress, and preinstallation meetings.
   4. Request for information and site mobilization.
   5. Cutting and Patching.

B. Related Sections:
   1. Other Division 01 Specification Sections apply to Work of this Section.
   2. Division 16 – Electrical.

1.2 PROJECT INFORMATION MANAGEMENT

A. Administration and exchange of project information accomplished through Engineer's web-based Newforma® Info Exchange.

B. Project information exchanged through Newforma® Info Exchange site includes but not limited to:
   1. Product Submittals.
   2. Requests for Information (RFI).
   3. Applications for Payment.
   4. Schedules.
   5. Construction Change Requests (CCRs).
   6. Closeout Documents.
   7. Construction Document Files:
      a. Weather Days.
      b. Electronic File Requests.
      c. Correspondence.
      d. Test Reports.
      e. Meeting Minutes.
      f. Field Reports.

1.3 COORDINATION

A. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

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

C. Coordinate space requirements and installation of mechanical and electrical work 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, maintenance, and repairs.

D. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

E. Large Apparatus: Contractor shall bring to the job any large piece to install in any space in building and too large to permit access through windows, doorways, or shafts, and place in space before enclosing structure.

F. Coordinate items requiring electrical connections with Division 16 for:
   1. Voltage;
   2. Phase;
   3. Ampacity;
   4. Number and size of wires;
   5. Wiring diagrams;
   6. Starter size, details, and location;
   7. Control devices and details.

G. Coordinate completion and cleanup of Work of specification sections in preparation for Substantial Completion and for portions of Work designated for Owner occupancy.

H. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not per Contract Documents, to minimize disruption of Owner activities.

1.4 FIELD SURVEYING AND BUILDING LAYOUT

A. Employ land surveyor registered in Texas and acceptable to Engineer to locate and protect survey control and reference points.

B. Control datum for survey is shown on Drawings.

C. Verify setbacks and easements, confirm drawing dimensions and elevations.

D. Provide field surveying services. Establish elevations, lines, and levels, utilizing recognized surveying practices.

E. Submit copy of registered site drawing and certificate signed by land surveyor that elevations and locations of Work are per Contract Documents.

1.5 PRECONSTRUCTION MEETING

A. Owner will schedule meeting.

B. Attendance Required: Owner, Engineer, Contractor, and major subcontractors.

C. Agenda set by Owner and may include:
   1. Submission of executed bonds and insurance certificates.
   2. Distribution of Contract Documents.
   3. Submit lists of subcontractors and products, Schedule of Values, and progress schedule.
   4. Designation of personnel representing parties in Contract and Engineer.
   5. Procedures and processing field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, RFI, and Contract closeout procedures.
   6. Review Notice to Proceed (NTP) and Substantial Completion Dates.
   7. Workmen’s identification.
   8. Surface drainage requirements (SWPPP).
   9. Scheduling.
      a. Use of premises by Owner and Contractor.
      b. Owner requirements and partial occupancy.
      c. Construction facilities and controls provided by Owner.
      d. Construction progress meetings.
      e. Survey and building layout.
      f. Security and housekeeping procedures.
      g. Procedures for testing and sampling.
      h. Procedures for maintaining record documents.
      i. Third-party geotechnical testing and sampling.

j. Requirements for start-up of equipment and operation times.

10. Record minutes and transmit copies within three business days after meeting to participants, Engineer, and those affected by decisions made.
11. Scheduling activities of Construction Material Testing (CMT) lab.

1.6 REQUEST FOR INFORMATION (RFI)

A. Contractor shall use Engineer's Newforma® Info Exchange website when submitting RFI. Only Contractor can submit RFIs to Engineer. RFI requests from subcontractors or material suppliers not considered.
B. All information indicated on RFI provided by Contractor shall be complete before request is uploaded to Engineer's Newforma® Info Exchange website. Requests with incomplete information not accepted. Submission of complete RFI request by Contractor does not constitute RFI until Engineer makes determination. If Engineer determines request cannot be answered with information provided in Contract Documents, Engineer will assign an RFI tracking number. Requests determined by Engineer not an RFI, returned to Contractor electronically and deleted from Engineer's electronic tracking software without assigned an RFI tracking number. Transmittal document returning denied RFI request will be provided with response indicating action taken by Contractor.
C. RFIs may contain more than one item when items are related. Otherwise, only one item addressed on each RFI request.
D. Engineer's response to RFI will be in writing and issued to Contractor and Owner electronically via Engineer's Newforma® Info Exchange website.
E. Responses from Engineer will not change any requirement of Contract Documents. If Contractor believes an RFI response causes change to Contract, Contractor shall give written notice to Engineer per requirements in Contract. Written notice includes specific reasons and order of magnitude of Cost and/or Time Contractor deems appropriate based on Engineer's RFI response. Contractor's written notice does not constitute Change Order, but provides basis for further review and discussion with Engineer.

1.7 PROGRESS MEETINGS

A. Engineer schedules and administers bi-weekly meetings throughout progress of Work, at minimum.
B. Arrange meetings when scheduled to take place at building site.
C. Attendance Required: Job superintendent, major subcontractors and suppliers, and Engineer, as appropriate to agenda topics for each meeting.
D. Agenda:
   1. Review minutes of previous meetings.
   2. Review of Work progress.
   3. Field observations, problems, and decisions.
   4. Identify problems which impede planned progress.
   5. Review submittals schedule and status of submittals.
   6. Review off-site fabrication and delivery schedules.
   7. Maintenance of progress schedule.
   8. Corrective measures to regain projected schedules.
   9. Planned progress during succeeding work period.
   10. Coordinate projected progress.
   11. Maintenance of quality and work standards.
   12. Effect of proposed changes on progress schedule and coordination.
   13. Other business relating to Work.
E. Record minutes and distribute copies within to Contractor, Engineer, Owner, participants, and those affected by decisions made.

1.8 PREINSTALLATION MEETING

A. When required in individual specification Sections, convene preinstallation meeting where determined before commencing work of Section.
B. Require attendance of parties directly affecting, or affected by, work of specific Section.
C. Notify Engineer four days in advance of meeting date.
D. Prepare agenda and preside at meeting.
   1. Review conditions of installation, preparation, and installation procedures.
   2. Review coordination with related work.
E. Record minutes and distribute copies within three days after meeting to participants, with three copies to Engineer.

PART 2 - PRODUCTS

2.1 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Motors: Specific motor type specified in individual specification sections.
B. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.
C. Cord and Plug: Provide minimum 6-foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length specified in individual specification sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
B. Examine and verify specific conditions described in individual specification sections.
C. Verify utility services are available, of correct characteristics, and in correct location.

3.2 PREPARATION

A. Clean substrate surfaces before applying next material or substance.
B. Seal cracks or openings of substrate before applying next material or substance.
C. Apply any manufacturer required or recommended substrate primer, sealer, or conditioner before applying any new material or substance in contact or bond.

3.3 CUTTING AND PATCHING

A. Employ skilled and experienced installer to perform cutting and patching.
B. Submit written request in advance of cutting or altering elements, affecting:
   1. Structural integrity of element.
   2. Integrity of weather-exposed or moisture-resistant elements.
   3. Efficiency, maintenance, or safety of element.
   4. Visual qualities of sight-exposed elements.
   5. Work of Owner or separate contractor.
C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and:
   1. Fit several parts together, integrate with other Work.
   2. Uncover Work to install or correct ill-timed Work.

3. Remove and replace defective and non-conforming Work.
4. Remove samples of installed Work for testing.
5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

D. Execute work to avoid damage to other Work and provide proper surfaces to receive patching and finishing.
E. Cut rigid materials using masonry saw or core drill.
F. Restore Work with new products per requirements of Contract Documents.
G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection. For assembly, refinish entire unit.
J. Identify any hazardous substance or condition exposed during Work to Engineer for decision or remedy.

END OF SECTION

SECTION 01330 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Submittal procedures and resubmittal requirements.
   2. Construction progress schedules and proposed products list.
   3. Shop drawings, product data, samples, and design data.
   4. Test reports, certificates, erection drawings, and construction photographs.
   5. Manufacturers' instructions and field reports.

B. Related Sections:
   1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 SUBMITTAL PROCEDURES

A. Submit for Engineer review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Produce copies and distribute per this Article and for record documents purposes described in Section 01700 – Execution Requirements.

C. Transmit each submittal separately with Contractor-standard transmittal letter including Contractor name, address, and phone number. Each submittal to contain only one specification section.

D. Sequentially number transmittal forms using Section number or Contractor’s sequential numbering system.

E. Identify Project, Contractor, subcontractor, supplier, pertinent drawing sheet, detail number(s), and specification Section number, appropriate to submittal.

F. Transmittal should certify Contractor reviewed and verified products required, field dimensions, adjacent construction Work, and coordination of information, per requirements of Work and Contract Documents.

G. Schedule submittals to expedite Project, and deliver to Engineer. Coordinate submission of related items.

H. For each submittal for review, allow 14 days excluding delivery time to/from Contractor.

I. Identify variations from Contract Documents and product or system limitations detrimental to successful performance of completed Work. All information, comments, field verifications, responses or other notations marked on submittals by Contractor, use blue or green colors only.

J. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

K. Submittals not requested will not be recognized or processed.

L. Format:
   1. Submit all submittals digitally using PDF file extension. Each submittal to be a single PDF file including transmittal letter. Multiple files for same submittal, not accepted.
   2. Submittals in any other format, including ZIP files, will be rejected.
   3. Hard copies not accepted.
   4. To ensure each page is legible, PDF pages of drawings shall be same size/scale as hard copy. Where applicable, provide scale symbols to indicate scale. Illegible submittals will be rejected.
   5. Submittals will be uploaded to Engineer’s Info Exchange website.

M. Submittal procedures described apply to Construction Progress Schedule, Products List, Shop Drawings, Product Data, Samples (actual samples and digital files of same), Design

Data, Test Reports, Certificates, Manufacturer's Instructions and Field Reports, Erection Drawings, and any other type of submittal submitted to Engineer.

1.3 MASTER SUBMITTAL REGISTRY

A. Submit Master Submittal Registry for review within 15 calendar days of Notice to Proceed.
B. Submittal Registry includes itemized listing of all submittals proposed for Project, date when Contractor will submit each, and notification of any critical lead time submittals requiring expedited review to maintain Project schedule.

1.4 RESUBMITTAL REQUIREMENTS

A. Revise and resubmit submittals, as required, to meet requirements as specified and noted on submittal reviews.
B. Mark as *Resubmittal*.
C. Reuse original transmittal number and supplement with sequential alphabetical or numeric suffix for each resubmittal.
D. Engineer shall review each submittal and one respective resubmittal at no cost to Contractor. Costs associated with resubmittal reviews beyond one resubmittal is Contractor responsibility.

1.5 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial progress schedule for Engineers review within 15 days after date established in Notice to Proceed.
B. Revise and resubmit as required.
C. Submit revised schedule with each Application for Payment, identifying changes since previous version.
D. Submit a horizontal bar chart with separate line for each section of Work, identifying first work day of each week.
E. Indicate product/material manufacturer's lead-time for delivery to site. Include as separate line for each product/material.
F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.
G. Indicate estimated percentage of completion for each item of Work at each submission.
H. Dates reviewed submittals required from Engineer. Indicate decision dates for selection of finishes. Submit separate schedule of submittal dates for:
    1. Shop drawings.
    2. Product data.
    3. Samples.
    4. Owner-furnished products
    5. Products identified under Allowances.
I. Determine appropriate lead times to allow manufacturing and delivery of products/material for incorporation into Work. Indicate product/material manufacturer lead time for manufacturing and delivery to site. Include separate line for each product/material. Failure to timely submit and process submittals and ordering products/materials for delivery to site, not grounds for approval of substitutions for other products/materials.
J. Indicate delivery dates for products and materials approved through submittal.
K. Revisions to Schedules:
    1. Indicate progress of each activity to date of submittal and projected completion date of each activity.
    2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.

3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, proposed, and effect including effect of changes on schedules of separate contractors.

1.6 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Notice to Proceed, submit complete list of major products proposed for use, with name of product manufacturer, trade name, and model number.
B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.7 SHOP DRAWINGS

A. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
B. Printable Image Size: Minimum 8 1/2 x 11 inches and maximum 22 x 34 inches.
C. Draw details to a minimum scale of 1/2 inches equals 1 foot.
D. Draw site plans to same scale indicated on Contract Drawings.
E. Draw all other plans to minimum 1/8 inch equals 1 foot scale.
F. Construction Documents (electronic or paper format) issued by Engineer cannot be used in creating and developing shop drawings. Exception: Electronic files containing floor plans or site plans purchased from Engineer may be used as “backgrounds” for Contractor, subcontractors, sub-subcontractors, and material suppliers in Shop Drawing process.
G. Electronic Files:
   1. Electronic AutoCAD drawing files are available for purchase from Engineer upon request. Cost of files plus applicable taxes:
      a. 1 - 3 sheets $100.00 per sheet.
      b. 4 - 6 sheets $400.00 flat fee.
      c. 7 - 9 sheets $500.00 flat fee.
   2. Only Contractor, subcontractors, and/or sub-subcontractors may purchase electronic file. Electronic file provided in software release currently used by Engineer. File provided via Engineer’s Info Exchange website.
   3. Before file delivery, purchaser shall sign Electronic File Transfer Release Form. Payment for electronic file shall occur upon delivery of file to purchaser.
   4. Electronic file used only for production of information required by project and not used in any other form (in whole or part).
   5. In creation and publication of Shop Drawings, under no circumstances shall design professionals’ seals or title block of drawings, be reproduced. All shop drawings must be original works from Contractor, subcontractors, sub-subcontractors, and material suppliers.

1.8 PRODUCT DATA

A. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturer-standard data to provide information unique to Project.
B. Include recommendations for application and use, and reference to compliance with specified standards of trade associations and testing agencies.
C. Include notation of special coordination requirements for interfacing with adjacent work and building utilities where applicable.
D. After review, distribute per Article 1.2 - Submittal Procedures, and provide copies for Record Documents described in Section 01700 - Execution Requirements.

1.9 DESIGN DATA

A. Submit for Engineers knowledge as contract administrator or Owner.
B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.10 TEST REPORTS

A. Submit for Engineer knowledge as contract administrator or Owner.
B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.11 CERTIFICATES

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Engineer.
B. Indicate material/product conforms to/exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
C. Certificates may be recent or previous test results on material/product, but must be acceptable to Engineer.

1.12 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit manufacturer-printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing.
B. Identify conflicts between manufacturer instructions and Contract Documents.
C. Indicate special procedures, conditions requiring special attention and environmental criteria required for application or installation.

1.13 MANUFACTURER'S FIELD REPORTS

A. Submit reports for Engineer’s benefit as contract administrator or Owner.
B. Submit report within 30 days of observation to Engineer for information.
C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.14 ERECTION DRAWINGS

A. Submit drawings for Engineer benefit as contract administrator or Owner.
B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
C. Data indicating inappropriate/unacceptable Work, may be subject to action by Engineer or Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01356 - STORMWATER POLLUTION PREVENTION MEASURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes, where required, Contractor-developed Stormwater Pollution Prevention Plan (SWPPP), Notice of Intent (NOI), and storm water pollution prevention measures shown on drawings. Contractor responsible for fines or penalties assessed by appropriate regulatory agency for failure to make required inspections, properly document inspections, and/or adequately implement and adjust stormwater pollution prevention measures where SWPPP is implemented.

B. Related Sections:

1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 SUBMITTALS

A. Inspection Reports.

1.3 EROSION AND SEDIMENT CONTROLS

A. Implement structural measures to divert flows from exposed soils, temporarily store flows, or otherwise limit run-off and discharge of pollutants from exposed areas of site. Implement structural practices timely during construction process to minimize erosion and sediment runoff.

B. Stabilized Ingress/Egress

1. Install stabilized access to and from construction site as soon as practical where SWPPP required.
2. In all cases, Contractor shall ensure any soil tracked off-site is cleaned from existing roads, alleys, and any adjacent properties as soon as possible. Contractor or other responsible party to check for pollutants (mud, silt, sand, cement, construction materials, etc.) tracked or washed off-site, and perform necessary clean-up measures end of each work day.

C. Silt Fences/Diversion Berms: Where necessary, Contractor provides silt fences and/or diversion berms as temporary structural practice to minimize erosion and sediment runoff. Properly install silt fences and/or diversion berms to effectively retain sediment immediately after completing each phase of work where erosion would occur in sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading).

D. Sand/Gravel Bags: Contractor may provide sand/gravel bags as temporary structural practice to minimize erosion and sediment runoff. Properly place bags to effectively retain sediment immediately after completing each phase of work (e.g., clearing and grubbing, excavation, embankment, and grading) in each independent runoff area (e.g., after clearing and grubbing in an area between ridge and drain, place bags as work progresses, remove/replace/relocate bags as needed for work to progress in drainage area). Sand/gravel bags must remain in good condition or replace.

E. Site Stabilization

1. Contractor shall disturb least amount of site area as possible.
2. Stabilization measures may include any of the following measures:
   a. temporary or permanent seeding or sodding,
   b. mulching,
   c. geotextiles,

d. vegetative buffer strips,
e. paving.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 STORMWATER POLLUTION PREVENTION PLAN

A. SWPPP only required if limits of disturbance exceed 1.0 AC. **Limits of disturbance for project will exceed 1.0 AC in size. Contractor to prepare and submit bid accordingly.**
B. When limits of disturbance exceed 1 AC, Contractor is responsible for meeting requirements of TPDES. (Contractor shall develop SWPPP, file NOI, and implement SWPPP measures).
C. Contractor to prepare completed Construction Site Notice form per requirements of the State's general permit for stormwater discharges from construction sites (where SWPPP required).
D. Continually update SWPPP (where required) as necessary to reflect current and changing conditions onsite. Use additional measures not specifically shown in SWPPP to control erosion from leaving site.

END OF SECTION

SECTION 01400 - QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Quality assurance and control of installation.
   2. Tolerances and references.
   3. Move-up requirements.
   4. Inspection and testing laboratory services.
   5. Manufacturer’s Field Services.
   6. Examination and preparation.

B. Related Sections:
   1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 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' instructions, including each step, in sequence.
C. If manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
D. Perform work by persons qualified to produce workmanship of specified quality.
E. Verify field measurements are as indicated on Shop drawing or as instructed by Manufacturer.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
B. Comply with manufacturers' tolerances. If manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
C. Adjust products to appropriate dimensions; position before securing in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or required by applicable codes.
B. Conform to reference standard by date of issue current on date of Contract Documents except where a specific date is established by Code.
C. Obtain copy of standards when required by specification section.
D. Neither contractual relationship, duties, nor responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.5 INSPECTION AND TESTING LABORATORY SERVICES

A. Contractor performs all quality control testing to assure construction meets project specifications. Once Contractor is satisfied he meets specification requirements, he coordinates with Owner representative for quality assurance (QA) testing.
B. Owner will appoint, employ, and pay for services of independent firm to perform quality assurance testing.
C. Contractor or independent firm will perform inspections, tests, and other services specified in individual specification Sections and as required by Engineer.
D. Contractor or independent firm will submit reports to Engineer, in triplicate, indicating observations, test results, and compliance/non-compliance with Contract Documents.
E. Same independent firm shall perform retesting required because of non-conformance to specified requirements on Engineer instructions. **Payment for retesting charged to Contractor.**

1.6 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification Sections, require material, product suppliers, or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up equipment, test, adjust, and balance equipment as applicable, and initiate instructions when necessary.
B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer subject to approval of Engineer.
C. Report observations and site decisions or instructions given to applicators or installers supplemental or contrary to manufacturer-written instructions.
D. Refer to Section 01330 - Submittal Procedures, Article 1.13 - Manufacturers' Field Reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
B. Verify existing substrate is capable of structural support or attachment of new Work applied or attached.
C. Examine and verify specific conditions described in individual specification sections.
D. Verify utility services are available, of correct characteristics, and in correct locations.

END OF SECTION

SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Temporary Utilities: Electricity, water, and sanitary facilities.
   2. Temporary Controls: Barriers, enclosures, fencing, protection of Work, security, and water control.
   3. Construction Facilities: Field offices, storage sheds, vehicular access, parking, progress cleaning, and project identification.
   4. Removal of utilities, facilities, and controls.

B. Related Sections:
   1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 CONSTRUCTION ENTRANCE

A. Contractor shall coordinate with Owner and use operations entrance for site ingress/egress.

1.3 TEMPORARY ELECTRICITY

A. Contractor shall coordinate with electric company to provide service for temporary power.
B. Owner will not pay cost of energy used. Exercise measures to conserve energy.
C. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required by Contractor operations. Provide flexible power cords as required.
D. Provide main service disconnect and overcurrent protection at convenient location per NEC.

1.4 TEMPORARY WATER SERVICE

A. Contractor shall make own arrangements for supply of employee potable drinking water and keep such supply available all times.
B. Water used for construction and testing furnished by Contractor.
C. Contractor must provide a means, at Contractor expense, to pump water from source and load water transport vehicles.
D. Owner will not pay cost of water used. Exercise measures to conserve water.

1.5 TEMPORARY SANITARY FACILITIES

A. Contractor provides adequate toilet facilities for use by his personnel and maintain clean and sanitary facilities throughout construction period. Facilities to be conveniently located for use by personnel and entire area maintained clean and sanitary. After completion of work, remove all temporary toilet facilities from site.

1.6 INSPECTION AND TESTING LABORATORY SERVICES

A. Contractor performs quality control testing as necessary on subgrade and other aspects of project to ensure compliance with project specifications.
B. Owner will appoint, employ, and pay for services of independent firm to perform inspection and quality assurance testing on general construction.

C. Independent firm performs inspections, tests, and other services specified in individual specification Sections and as required by Owner or designated representative.
D. Independent firm will submit reports to Owner or designated representative, in triplicate, indicating observations, results of tests, and indicating compliance or noncompliance with Contract Documents.
E. Same independent firm shall perform retesting required because of nonconformance to specified requirements on instructions by Owner or designated representative. Payment for rework and retesting charged to Contractor.

1.7 EMPLOYEE RESIDENTIAL OCCUPANCY

A. Not allowed on Owner's property.

1.8 VEHICULAR ACCESS

A. Construct temporary all-weather access roads from public thoroughfares to serve construction area, width and loadbearing capacity to accommodate unimpeded traffic for construction purposes.
B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
C. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.
D. Location as indicated on Drawings.
E. Provide unimpeded access for emergency vehicles. Maintain 20-foot-wide driveways with turning space between and around combustible materials.
F. Provide and maintain access to fire hydrants and control valves free of obstructions.
G. Provide means of removing mud from vehicle wheels before entering onsite paved areas and public streets.
H. Use designated existing on-site roads for construction traffic.
I. Provide security guard at main entrance all times Contractor is onsite.
J. Provide route including clearance of existing utilities. Use steel plates onsite for drivable surfaces and excavation protection.

1.9 PARKING

A. Provide temporary graded surface parking areas to accommodate construction personnel.
B. Locate as indicated on Drawings.
C. When site space not adequate, provide additional off-site parking.
D. Use of designated existing onsite streets and driveways for construction traffic, not permitted.
E. Use of designated areas of existing parking facilities by construction personnel, not permitted.
F. Do not allow heavy or tracked vehicles or construction equipment in parking areas.
G. Maintenance: Maintain traffic and parking areas in sound condition.
H. Removal, Repair:
    1. Remove temporary materials and construction at Substantial Completion.
    2. Repair existing facilities damaged by use, to original condition.
I. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.10 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain a clean and orderly site.

B. Remove waste materials, debris, and rubbish from site and dispose off-site at intervals as required to maintain clean site.

1.11 BARRIERS/TRAFFIC CONTROL

A. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
B. Protect site improvements including but not limited to pavements, walkways and drainage structures from damage. Replace damaged site improvements to original condition.
C. Protect non-owned vehicular traffic, stored materials, and structures from damage.
D. Furnish all necessary traffic control signs and flag personnel. Contractor establishes parking area where approved by Engineer and Owner.

1.12 SECURITY/WORKING HOURS

A. Security Program:
   1. Protect Work existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
   2. Initiate program to have security guard at construction entrance Contractor is on site.
   3. Maintain program throughout construction period.
B. Entry Control:
   1. Restrict entrance of persons and vehicles into Project site.
   2. Allow entrance only to authorized persons with proper identification.
   3. Maintain log of workers and visitors, make available to Owner on request.
   4. Contractor will control entrance of persons and vehicles related to Owner's operations.
C. Working Hours: Normal hours of operation for landfill are 8 a.m. to 5 p.m., Monday – Friday, and 8 a.m. to 4 p.m. Saturday. Contractor allowed to work beyond landfill normal working hours of operation. Contractor responsible for coordinating with Owner and securing site when doing so.

1.13 STORMWATER CONTROL

A. Grade site to drain.
B. Maintain excavations free of water.
C. Provide, operate, and maintain pumping equipment.
D. Protect site from puddling and running water.
E. Provide water barriers as required to protect site from soil erosion.

1.14 DUST CONTROL

A. Execute Work to minimize raising dust from construction operations.
B. Provide positive means to prevent airborne dust from dispersing into atmosphere.

1.15 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow. Prevent erosion and sedimentation.
B. Minimize surface area of bare soil exposed at one time.
C. Provide temporary measures including berms, dikes, and drains, and other devices to prevent water flow that would result in erosion.
D. Construct fill by selective placement to avoid erosive surface silts or clays.

E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.16 POLLUTION CONTROL

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

1.17 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in specifications.
B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.

1.18 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary above grade or buried utilities, equipment, facilities, and materials as soon as permanent facilities are utilized.
B. Remove underground installations to minimum 2-foot depth. Grade site as indicated.
C. Clean and repair damage caused by installation or use of temporary work.
D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01560 - ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Environmental protection requirements.
   2. Protection of natural, historical, and archaeological resources.
   3. Erosion and sediment control measures.
   4. Control and dispose solid and sanitary wastes.
   5. Dust control.

B. Related Sections:
   1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 REFERENCES

A. These publications form part of this specification to extent referenced and are referred to by basic designation only:
   1. 29 CFR 1910-Subpart G: Occupational Health and Environmental Control.
   2. COE EP-1165-2-304: 1976 Flood Plain Regulations for Flood Plain Management.

1.3 DEFINITIONS

A. Sediment: Soil and other eroded debris and transported by runoff water or wind.

B. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, agricultural operations, and community activities.

C. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass, crockery, metal, lumber, and cans.

D. Debris: Combustible and noncombustible wastes such as ashes and waste materials resulting from construction or maintenance and repair work, leaves, and tree trimmings.

E. Chemical Wastes: This includes salts, acids, alkalies, herbicides, pesticides, organic chemicals, and spent products which serve no purpose.

F. Sanitary Wastes: Sewage.

G. Garbage: Wastes characterized as domestic sanitary sewage. Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

H. Oily Waste: Petroleum products and bituminous materials.

1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

A. Provide and maintain, during life of contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions developing during construction of permanent or temporary environmental features associated with project. Comply with federal, state, and local regulations pertaining to environment, including but not limited to water, air, and noise pollution.

B. Best Management Practices (BMPs)
   1. Waste Materials: Collect and store all waste materials including construction debris, in securely-lidded metal dumpster. No construction material buried onsite. Transit dumpster to comply with ordinance 18.52.010 (enclosure and removal of waste materials

during construction.) Empty dumpster as necessary or required by Ordinance 9.04 (solid waste management) and haul trash to licensed landfill.

2. Hazardous Waste. In case of potential hazardous spill, Contractor takes immediate action, contacts fire department, and TCEQ. These (and other) products are considered hazardous:
   a. paint,
   b. acids for cleaning masonry surfaces,
   c. cleaning solvents,
   d. asphalt products,
   e. chemical additives for spill stabilization,
   f. curing compounds, and
   g. additives.
3. Sanitary Waste: Licensed, sanitary waste management contractor collects all from construction portable units as necessary or required, Chapter 18.08 (building code). All waste material is Contractor responsibility.
4. Spill Prevention. Use these practices to reduce risk of spills or other accidental exposures of materials to stormwater runoff:
   a. Good Housekeeping
      1) Store only enough products required for job.
      2) Neatly store materials onsite in orderly manner.
      3) Keep products in original container.
      4) Do not mix substances with another or as recommended by manufacturer.
      5) Use entire contents of product before disposing container.
      6) Follow manufacturer recommendations for proper use and disposal.
   b. Hazardous Products
      1) Keep products in original container if possible.
      2) Retain original labels, product information and MSDS.
      3) Dispose surplus product per manufacturer-, local-, or state-recommended methods.
   c. Petroleum Products: Monitor all onsite vehicles for leaks and receive regular preventive maintenance to reduce chance of spills. Store petroleum in labeled, tightly-sealed containers. Apply any asphalt substances used onsite per manufacturer recommendation.
5. Spill Control Practices:
   a. Clearly post manufacturer-recommended methods for spill cleanup and make site personnel aware of procedures.
   b. Keep materials and equipment necessary for spill cleanup onsite in material storage area.
   c. Immediately clean up all spills upon discovery.
   d. Spill area to be well ventilated and appropriate clothing worn.
   e. Report any spill to appropriate governmental agency.
   f. Take measures to prevent spill from reoccurring.
6. Maintenance and Inspection Procedures: Inspect all pollution prevention measures at least once a month and following a storm event of 0.5 inches or more. Inspect BMPs and pollution control procedures for adequacy. Record result of site inspections and keep onsite.
7. Remarks: Construct disposal areas, stockpiles, and haul roads to minimize and control amount of sediment entering receiving waters or streambeds. Contractor shall construct construction staging areas and vehicle maintenance areas to minimize pollutant runoff.

C. Stormwater Pollution Prevention Plan (SWPPP)
   1. Contractor shall understand and sign certification statement relating to National Pollutant Discharge Elimination System (NPDES).
   2. Contractor shall install erosion control measures as follows:
      a. Install silt fencing or temporary berms before construction.
      b. Place temporary swales and desilting basins where necessary to convey stormwater run-off.
      c. Provide stabilized construction entrance to reduce vehicle-tracking sediments. Daily sweep paved street adjacent to site entrance to remove any excess mud, dirt, or rock tracked from site.
      d. Owner responsible for insuring all erosion control methods inspected monthly or after every erodible rainfall (0.5 inch or more). Make any necessary repairs or cleanup to maintain effectiveness of erosion control at that time.
      e. Provide temporary berm at toe of slope and lot line at time of grading.
   3. Listed measures are recommendations only. Contractor sees NPDES requirements met.

D. Perform preconstruction survey of project site with Engineer assess existing environmental conditions in and adjacent to site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

A. Preserve natural resources within project boundaries and outside limits of permanent work. Restore to equivalent or improved condition upon work completion. Confine construction activities to within limits of work indicated or specified.
   1. Land Resources: Except in areas to clear, do not remove, cut, deface, injure, or destroy trees or shrubs without Engineer permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless Engineer authorizes. Where attach ropes, cables, or guys authorized, Contractor responsible for any resultant damage.
      a. Protection: Protect existing trees to remain and injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. By approved excavation, remove trees with 30 percent or more of root systems destroyed.
      b. Replacement: Remove trees and other landscape features scarred or damaged by equipment operations, and replace with equivalent, undamaged trees and landscape features. Obtain Engineer approval before replacement.
      c. Temporary Construction: Remove traces of temporary construction facilities (haul roads, work areas, structures, temporary structure foundations, excess or waste material stockpiles, and other signs of construction). Grade temporary roads, parking areas, and similar temporarily used areas to conform with surrounding contours.
   2. Water Resources/Oily Wastes: Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. Surround all temporary fuel oil or petroleum storage tanks with temporary earth berm of sufficient size and strength to contain contents of tanks in event of leakage or spillage.

3. Fish and Wildlife Resources: Do not disturb fish and wildlife, alter water flows, or otherwise significantly disturb habitat adjacent to project and critical to survival of fish and wildlife, except as indicated or specified.

3.2 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

A. Carefully protect in-place and report immediately to Engineer, historical and archaeological items or human skeletal remains discovered in course of work. Stop work in immediate area of discovery until Engineer directs work to resume. If historical and archaeological resources such as artifacts (stone tools), features (stone walls), deposits (sea shells and charcoal stained soil), human bones, and other cultural remains are encountered, stop portion of work and notify Engineer immediately. Within 36 hours, Owner will determine if change pursuant to Contract should be issued or direct Contractor to proceed without change. No adjustment in contract price or completion time allowed for delays not exceeding 36 hours from Contractor is notified to stop work. Owner retains ownership and control over historical and archaeological resources.

3.3 EROSION AND SEDIMENT CONTROL MEASURES

A. Burning off groundcover, not permitted.

B. Borrow Areas: Manage and control borrow areas to prevent sediment from entering nearby streams or lakes. Restore areas, including outside borrow areas, disturbed by borrow/haul operations. Restoration includes grading, replacing topsoil, and establishing permanent vegetative cover.

C. Protection of Erodible Soils: Immediately finish earthwork brought to final grade, as indicated or specified. Immediately protect side and back slopes upon completing rough grading. Plan and conduct earthwork to minimize duration of exposure of unprotected soils.

D. Temporary Protection of Erodible Soils: Mechanically-retard and control rate of runoff from construction site, including constructing diversion ditches, benches, and berms to retard and divert runoff to protected drainage courses.

3.4 CONTROL AND DISPOSE SOLID AND SANITARY WASTES

A. Pick up solid wastes and place in regularly-emptied containers. Do not prepare, cook, or dispose food on project site. Prevent contamination of site of other areas when handling and disposing wastes. On completion, leave areas clean. Control and dispose waste.

1. Dispose Rubbish and Debris: Dispose per requirements specified in area as Owner directs. Dispose rubbish in licensed landfill provided all rules for disposal are followed.
2. Garbage Disposal: Place garbage in approved containers and move to pick-up point or disposal area, where directed.

3.5 DUST CONTROL

A. Contractor fully responsible for dust control along all haul roads and in project area. Always keep dust down, including during nonworking periods. Sprinkle or treat with dust suppressants, soil at site, haul roads, and other areas disturbed by operations.

END OF SECTION

SECTION 01600 - PROGRESS SCHEDULES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Work shall be executed with progress required to prevent delay to other contractors, contract milestones, or general Project completion.
   2. Contractor provides a statement to Engineer describing his computerized scheduling capability for review and approval. This statement shall include, at minimum:
      a. Identification, qualifications, and experience of member(s) of the Contractor's scheduling staff or any other consultant's staff.
      b. References not less than two previous projects which Contractor/Consultant hs utilized computerized CPM scheduling, not less than one-quarter of value of present contract.
      c. Name and description of project management software and computer hardware to utilize on this Contract.

B. Related Sections:
   1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 CONSTRUCTION SCHEDULE

A. Contractor shall show sequence and interdependence of activities required for complete performance of all Work. Contractor's Construction Schedule shall begin with date of Notice to Proceed and conclude with date of Final Completion of Contract. Float or slack time accrues to Owner’s benefit but is a resource available to both parties as needed to meet contract milestones and Contract completion date. Accordingly, no time extensions granted nor delay damages paid until delay occurs extending Work beyond Contract completion date.

B. Pursuant to Float Sharing requirements of Contract Documents:
   1. use of float suppression techniques such as preferential sequencing, use of lead/lag logic restraints, extended activity times, or imposed dates; and
   2. use of Float Time disclosed or implied by use of alternate float suppression techniques shall be shared to proportionate benefit of Owner, Contractor, and Contractor's subcontractors.

C. Comments made by Engineer on Contractor's Construction Schedule during review will not relieve Contractor from compliance with requirements of Contract Documents. Review is only for general conformance with schedule concept of Project and general compliance with information given in Contract Documents."

1.3 SUBMITTALS

A. Contractor shall submit the following items as specified:
   1. Overall schedule.
   2. Scheduled reports.
   3. Progress Reports.

1.4 PROGRESS OF WORK

A. Contractor shall execute work at such times and on such parts of Project, and with such forces, materials, and equipment, to assure completion in time established by Contract.

B. Activity Coordination: To ensure consistency with General Contractor's breakdown of work and nomenclature, each subcontractor shall work in concert with General Contractor throughout all aspects of schedule development.

C. Activities

1. Work activities comprising Contractor's Construction Schedule shall be of sufficient detail to assure adequate planning and execution of Work so schedules provide appropriate basis for monitoring and evaluating Work progress. Work activity requires time and resources (manpower, equipment, and/or material) to complete.
2. Show information in such detail that duration times of activities will normally range from one to 15 calendar days; however, no activity shall have more than 30 calendar days' duration for any onsite operation. Engineer may approve selected exceptions where sub-networks used. Selection and number of Contractor's construction activities are subject to Engineer review.
3. If Engineer requests, Contractor, at his sole expense, shall provide highly detailed short-term schedules for specific crucial items (work-arounds, start-up, etc.)

1.5 SCHEDULE

A. Preliminary Network Analysis: Within 15 calendar days after date of Award of Contract, Contractor shall submit a preliminary network analysis indicating Contractor's planned operations for first 60 days after Notice to Proceed. This should also indicate Contractor's general approach to remainder of Work and cost of activities expected to complete or partially complete before submittal and review of completed network analysis.

B. Completed Network Analysis: Within 45 calendar days after date of Award of Contract or 10 days after Notice to Proceed, whichever is earlier, Contractor shall submit a completed CPM network analysis including diagrams, mathematical analysis, and computer printouts, as determined in consultation with Engineer. This analysis is for review and acceptance as a condition precedent to approval of first pay application.

C. Detailed Network Diagram: Contractor's Construction Schedule shall include time-scaled network diagrams based on calendar days. Network diagrams shall be Critical Path Method (CPM) precedence format and show sequence and interdependence of activities required for complete Work performance. Show a calendar on all sheets.

D. Plot each activity so beginning and completion dates of said activity can be accurately determined by graphical comparison with calendar scale.

1.6 SCHEDULED REPORTS

A. Contractor shall prepare schedule listings of network diagram information in tabular format, sorted according to early start, within responsibility, or as directed by Engineer.

B. Schedule listings shall show activity numbers, description, responsibility, total duration in work days, percent complete, early-start date, late-start date, early-finish date, and total float for each activity in network diagram.

C. Overall schedule and subsequent revisions shall reflect actual Project progress. Contractor shall sign and submit one reproducible and three copies of initial Overall Schedule and each revision.

D. If initial submittal or a subsequent revision does not meet requirements specified, Contractor shall revise overall schedule and resubmit until Engineer accepts. Failure to submit and adequately update Overall Schedule and schedule reports, will be considered cause for withholding partial payments otherwise due under Contract.

1.7 PROGRESS REPORTS

A. Once biweekly on a date mutually agreed upon by Contractor, Owner's representative, and Engineer, a meeting will be held for the schedule to be reviewed. Immediately before the meeting, Contractor shall obtain necessary information to update overall schedule to reflect progress to date and furnish sufficient copies of updated schedule for review.

B. Schedule provided by Contractor at biweekly meetings with Engineer and Owner shall be a detailed, two-week look-ahead schedule for Work to perform during current week and subsequent week period. Contractor shall update this schedule biweekly with copies available for biweekly meetings. Contractor shall invite subcontractors to participate in biweekly meetings, or as requested by Engineer.

C. In updating the schedule, progress will be reviewed:
   1. To identify those activities started and completed during previous period.
   2. For remaining duration, from date of update, required to complete each activity started but not completed.
   3. For review of durations for activities not yet started.
   4. For addition of Change Orders and proposed sequencing changes to network diagram and schedule listings.

D. At least once a month, and utilizing data accumulated during previous joint Owner-Engineer-Contractor reviews, Contractor shall revise network diagram and generate updated schedule reports.

E. When submitting revised scheduling documents, they shall accompany a written narrative report:
   1. describing amount of progress since last revision in terms of activities started, continuing, and completed;
   2. describing problem areas, current and anticipated delay factors, and estimated impact on performance of other activities and completion dates; and
   3. explaining corrective action taken or proposed.

1.8 MAINTAINING SCHEDULE

A. If Contractor fails to complete an activity by latest scheduled completion date at any time during Project, (late completion will impact end date of Work past Contract substantial completion due date), Contractor shall submit plans to reorganize work force to return to original schedule for Owner’s review and approval within seven calendar days.

B. Contractor will add equipment, construction forces, and increase working hours if operations fall behind schedule at any time.

C. Addition of equipment or construction forces, increasing working hours, or other method, manner, or procedure to return to contractually-required completion date, is not justification for an increase in Contract Price or treated as acceleration.

D. Contractor shall plan, schedule, and coordinate construction operations and activities to facilitate Work progress.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01700 - EXECUTION REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Closeout procedures and final cleaning.
   2. Starting of systems and hazardous materials affidavits.
   3. Project record documents and operation and maintenance data.
   4. Spare parts, maintenance products, and product warranties.

B. Related Requirements:
   1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 CLOSEOUT PROCEDURES

A. Submit written certification Contract Documents was reviewed, Work inspected, and Work is complete per Contract Documents and ready for Engineers review.
B. Provide electronic submittals to Engineer required by authorities having jurisdiction.
C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
D. Submit all closeout documents electronically in OCR (Optical Character Recognition)/PDF format.
E. Contractor to submit closeout documents via the PSC Newforma Info Exchange website.
F. At Owner request, Contractor provides hard copy of Closeout Documents in three-ring binders.

1.3 FINAL CLEANING

A. Execute final cleaning before final inspection.
B. Clean equipment to sanitary condition.
C. Replace filters of operating equipment.
D. Clean debris from roofs, gutters, downspouts, and drainage systems.
E. Clean site. Sweep paved areas, rake clean, landscaped surfaces.
F. Remove waste and surplus materials, rubbish, and construction facilities from site.
G. Repair, patch, and touch-up marred surfaces to match adjacent finishes.
H. Remove waste and surplus materials, rubbish, and construction facilities as Engineer directs.

1.4 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.
B. Notify Engineer seven days before start-up of each item.
C. Verify each piece of equipment or system is checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
E. Verify wiring and support components for equipment are complete and tested.
F. Execute start-up under supervision of applicable Contractor personnel per manufacturer instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative, present at site to inspect, check, and approve equipment or system installation before start-up, and supervise placing equipment or system in operation.
H. Submit written report per Section 01330 – Submittal Procedures, equipment or system is properly installed and functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel two weeks before date of final inspection.
B. Demonstrate Project equipment instructed by qualified manufacturer's representative knowledgeable about Project.
C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each equipment item at scheduled time and equipment location.
E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
F. Required instruction time for each item of equipment and system is specified in individual sections.

1.6 TESTING, ADJUSTING, AND BALANCING

A. Testing, adjusting and balancing performed per requirements specified.
B. Owner will appoint, employ, and pay for services of independent firm to perform testing, adjusting, and balancing.

1.7 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.
B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
F. Prohibit traffic from landscaped areas.

1.8 HAZARDOUS MATERIALS AFFIDAVITS

A. Contractor, each subcontractor, sub-subcontractor, and material/product supplier, to provide notarized affidavit declaring hazardous materials were not incorporated into construction of or delivered to Project.
B. Hazardous materials include asbestos, lead polychlorinated biphenyl (PCB), prohibited termite eradication chemicals or any substance of any proportion determined or suspected by an agency of federal or state government to create a health hazard.
C. Provide table of contents listing all affidavits in alphabetical order.

D. Prepare cover page with printed title "*Affidavits of Non-Incorporated Hazardous Materials*," title of project, project address, owner's name, address, and phone and date of Construction Completion.
E. Provide one complete set of information in OCR/PDF format.
F. Submit before Application for Final Payment.
G. Submit via the PSC Newforma Info Exchange Website

1.9 PROJECT RECORD DOCUMENTS

A. Record actual revisions to Work and maintain onsite, one set of these record documents:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to Contract.
   5. Reviewed Shop Drawings, Product Data, and Samples.
   6. Complete set of MSDS sheets for all materials.
   7. Manufacturer's instruction for assembly, installation, and adjusting.
B. Ensure entries are complete and accurate, enabling future reference by Owner.
C. Store record documents separate from documents used for construction.
D. Record information concurrent with construction progress, not less than weekly.
E. Specifications: Legibly mark and record at each product section description of actual products installed, including:
   1. Manufacturer name, product model, and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda, Change Orders, RFI responses, and other modifications.
F. Record Drawings and Shop Drawings. Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.
   6. Changes made by Addenda, Change Order, RFI responses, and other modifications.
   7. Submit in OCR/PDF format via the PSC Newforma Info Exchange website.
   8. Submit electronic copy of reviewed, approved submittals on CD.
G. Material Safety Data Sheets (MSDS):
   1. Comply with most current requirements of Department of State Health Services, Texas Asbestos Health Protection Rules (TAHPR), Title 25., Health Services, Part I, Chapter 295-Occupational Health, § 295.34-*Asbestos Management in Facilities and Public Buildings*, paragraph (i) at minimum and as outlined.
   2. Submit MSDS on **all** products used in construction of Project.
   3. Submit MSDS electronically in 8 1/2- x 11-inch format text pages.
   4. Prepare cover page with printed title "*Material Safety Data Sheets (MSDS)*," title of project, project address, owners name, address, and phone, and date of Construction Completion.
   5. Internally subdivide contents with page dividers, organized into CSI format shown in Project Manual.
   6. Prepare a table of contents (TOC), listing each Division heading and material/product under each heading by manufacturer and material/product name.

7. Submit one complete set of information in OCR /PDF format.
8. Submit via the PSC Newforma Info Exchange website.
9. Submit electronic information with Application for Final Payment and include **all** MSDS for materials/products delivered or installed in Project.
10. Failure to submit updated electronic MSDS documents will cause Application for Final Payment held by Engineer (not submitted to Owner for processing) until updated electronic MSDS documents received and reviewed for compliance by Engineer.

H. Submit documents to Engineer with claim for final Application for Payment.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit data electronically in 8 1/2- x 11-inch text pages, OCR/PDF format.
B. Prepare cover page with printed title "*Operation and Maintenance Instructions*," title of project.
C. Internally subdivide contents with page dividers, logically organized as described:
   1. Drawings: Provide in OCR/PDF format
   2. Contents: Prepare TOC for each file (if multiple files), with each product or system description identified, in three parts as follows:
      a. Directory, listing names, addresses, and phone numbers of Engineer, Contractor, subcontractors, and major equipment suppliers.
      b. Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and phone numbers of subcontractors and suppliers. Identify:
         1) Significant design criteria.
         2) List of equipment.
         3) Parts list for each component.
         4) Operating instructions.
         5) Maintenance instructions for equipment and systems.
      c. Project documents and certificates, including:
         1) Shop drawings and product data.
         2) Air and water balance reports.
         3) Certificates.
         4) Scanned copies of warranties IN OCR/PDF format.
D. Submit one complete set of information in OCR/PDF format.
E. Submit electronic documents with Application for Final Payment.
F. Submit via the PSC Newforma Info Exchange website.

1.11 MANUAL FOR MATERIALS AND FINISHES

A. Submit in OCR/PDF format of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return electronic file with comments.
B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within 10 days after acceptance.
C. Submit one electronic copy of completed volumes 15 days before final inspection. Draft copy to review and return by final inspection, with Engineer comments. Revise content of electronic document set as required before final submission.
D. Submit electronic documents of revised final volumes in final form within 10 days after final inspection.
E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations.

F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
G. Moisture Protection and Weather-Exposed Products: Include product data listing applicable reference standards, chemical composition, installation details, and recommendations for inspections, maintenance, and repair.
H. Additional Requirements: As specified in individual product specification sections.
I. Include listing in TOC for design data, with fly sheet
J. Submit via the PSC Newforma Info Exchange website.

1.12 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit in OCR/PDF format of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return with comments.
B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit electronic documents within 10 days after acceptance.
C. Submit electronic copy of completed volume(s) 15 days before final inspection. Draft copy to review and return by final inspection, with Engineer comments. Revise content of electronic document set as required before final submission.
D. Submit electronic documents in OCR/PDF format of revised final volumes in final form within 10 days after final inspection.
E. Each Item of Equipment and Each System: Include description of unit/system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
F. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications by label machine.
G. Include color-coded wiring diagrams as installed.
H. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.
I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions. Include:
   1. Servicing and lubrication schedule and list of lubricants required.
   2. Manufacturer-printed operation and maintenance instructions.
   3. Sequence of operation by controls manufacturer.
   4. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
   5. Control diagrams by controls manufacturer as installed.
   6. Contractor's coordination drawings, with color coded piping diagrams as installed.
   7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
   8. List of original manufacturer's spare parts, current prices, and recommended quantities maintained in storage.
   9. Test and balancing reports as specified in Section 01400 – Quality Control.
J. Additional Requirements: As specified in individual product specification sections.
K. Include listing in TOC for design data, with dividers.
L. Submit via the PSC Newforma Info Exchange website.

1.13 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in specifications.
B. Deliver to Project site and place in Owner-directed location. Obtain receipt before final payment.
C. Submit receipts signed by Owner or letter stating Contractor delivered extra products to Owner.

1.14 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed by responsible subcontractors, suppliers, and manufacturers, within 10 days after completion of applicable item of work.
B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
C. Verify documents are in proper form, contain full information, and notarized.
D. Co-execute submittals when required.
E. Include TOC.
F. Submit one complete set of information in OCR/PDF format for review.
G. Submit before Application for Final Payment.
H. Time of Submittals:
    1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
    2. Make other submittals within 10 days after Date of Substantial Completion, before final Application for Payment.
    3. For items of Work acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.15 MAINTENANCE SERVICE

A. Furnish service and maintenance of components indicated in specifications during warranty.
B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 02010 - SUBSURFACE INVESTIGATION

PART 1 - GENERAL

1.1 GEOTECHNICAL STUDY

A. AMEC Foster Wheeler Environment & Infrastructure, Inc. took soil borings September 1, 2017 throughout Project area to determine design parameters for installation of Transfer Station. These borings represent conditions encountered in the bore hole on the date of boring, determined by normal geotechnical techniques.

B. The geotechnical report is available for informational purposes only and not part of Contract Documents. Any interpretations or conclusions drawn from information presented, is at Contractor's sole risk.

C. Soil borings are available for prospective bidders to review under Appendix A of the Project Manual.

D. If Contractor requires more information concerning soil conditions or groundwater at these or other locations, Contractor shall obtain information at his own expense.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 02100 – SITE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Preparing jobsite for construction operations by removing and disposing all obstructions from rights-of-way and designated easements where removal is not otherwise provided for in Drawings and Specifications. Such obstructions include abandoned structures and utility lines, fences, trees, shrubs, vegetation, curbs, gutters, sidewalks, driveways, pavement, concrete and stone rubble, rubbish, and all other miscellaneous debris.
   2. Contractor furnishes all materials, equipment, tools, labor, superintendence, and incidentals required to perform work as indicated on Drawings, required by Engineer, and specified herein.

B. Related Requirements:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 02221 – Excavating, Backfilling, and Compacting for Utilities.

1.2 PAYMENT

A. Payment for all work covered in this section included as part of unit price per unit as indicated in Proposal. Such payment shall be complete compensation for complete performance of work per Drawings and Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 OBSTRUCTIONS OTHER THAN VEGETATION

A. Remove all concrete, pavement, fences, rubble, trash, and miscellaneous debris to 1 foot below natural ground. Backfill all remaining holes with material meeting requirements for fill and backfill material per Section 02221 – Excavating, Backfilling, and Compacting for Utilities, then tamp as Engineer directs. Contractor shall complete this operation by blading, bulldozing, or other approved methods so jobsite is free of holes, ditches, and other abrupt changes in elevation and irregular contour.

B. Remove abandoned storm sewers, culverts, sanitary sewers, conduits, and water pipes over 3 inches in diameter, lying in path of construction, from limits of construction and plug with concrete to form tight closure. All debris and/or rubble from removing abandoned item from path of construction, removed from site at no cost to Owner.

3.2 CLEARING

A. Clearing consists of removing and disposing trees and other vegetation as well as down timber, snags, brush, and rubbish within working areas to clear as shown in Drawings. Protect individual trees, groups of trees, or other vegetation not required to remove and

occurring outside earthwork area, against unnecessary cutting, breaking, or skinning roots, skinning and brushing bark, or smothering trees by stockpiling construction materials or excavated materials within drip lines.

3.3 GRUBBING

A. Remove stumps, matted roots, and roots larger than 2 inches in diameter from within 6 inches of surface of areas fills are constructed, except in roadways. Remove described materials within 18 inches of finished subgrade of roadways in cut or fill sections. Fill areas disturbed by grubbing as specified in Section 02221 – Excavating, Backfilling, and Compacting for Utilities.

3.4 DISPOSAL

A. Contractor shall dispose all material removed from jobsite in a manner satisfactory to Engineer. Disposal of materials removed from jobsite also per all local, state, and federal government regulations.

END OF SECTION

SECTION 02110 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes preparing jobsite for construction operations by removing and disposing all obstructions from right-of-way and designated easements, where removal of such obstructions is not otherwise provided for in plans and specifications.
   1. Obstructions include abandoned structures and utility lines, fences, trees, shrubs, vegetation, curbs, gutters, sidewalks, driveways, pavement, concrete and stone rubble, rubbish, and all miscellaneous debris.
   2. Obstructions other than vegetation includes all concrete, pavement, fences, rubble, trash, and miscellaneous debris and to be removed to 1 foot below natural ground. All remaining holes to be backfilled with material meeting requirements for fill and backfill material as stipulated in Section 02201 - Excavating, Grading, and Subgrade Preparation, then tamped as Engineer directs. Contractor completes this operation by blading, bulldozing, or other approved methods so jobsite is free of holes, ditches, and other abrupt changes in elevation and irregularities of contour.
   3. Abandoned storm sewers, culverts, sanitary sewers, conduits, and water pipes over 3 inches in diameter shall be plugged with concrete to form tight closure.

B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 02201 - Excavating, Grading, and Subgrade Preparation.

1.2 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or darker shade of brown, gray, red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch in diameter; and free of weeds, roots, and other deleterious materials.

1.3 MATERIALS OWNERSHIP

A. Except for materials to stockpile or remain Owner property, cleared materials become Contractor property and removed from site.

1.4 SUBMITTALS

A. Record Drawings: Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items to salvage and store on Owner's premises where indicated.
C. Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.1 GENERAL

A. Contractor furnishes all materials, equipment, tools, labor, superintendence, and incidentals required to perform Work as indicated on Drawings, directed by Engineer, and specified.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.
B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
C. Protect existing site improvements to remain from damage during construction. Restore damaged improvements to original condition, as acceptable to Owner.

3.2 UTILITIES

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions, then only after arranging to provide temporary utility services per requirements:
   1. Notify Engineer not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Engineer’s written permission.

3.3 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps, obstructions, and grubbing roots.
   1. Do not remove trees, shrubs, and other vegetation to remain or relocated.
   2. Cut minor roots and branches of trees to remain in a clean and careful manner where roots and branches obstruct installation of new construction.
   3. Completely remove stumps, roots, obstructions, and debris extending to 18 inches below exposed subgrade.
   4. Use only hand methods for grubbing within drip line of remaining trees.
B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork indicated. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer to density equal to adjacent original ground.

3.4 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths encountered to prevent intermingling with underlying subsoil or other waste materials. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Harvest all existing topsoil on site affected by grade changes and/or construction and stockpile to provide minimum 6-inch topsoil depth after compaction in all areas to receive lawns, grasses, or exterior plants. Harvest topsoil during site clearing before cut/fill operations if topsoil quantities insufficient to provide 6-inch depth. Supplement with imported topsoil approved by Engineer.

D. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

   1. Limit height of topsoil stockpiles to 72 inches.
   2. Do not stockpile topsoil within drip line of remaining trees.
   3. Stockpile surplus topsoil and allow re-spreading deeper topsoil.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated. Unless existing full-depth joints coincide with demolition line, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.6 DISPOSAL

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose off Owner's property.

END OF SECTION

SECTION 02201 - EXCAVATION, GRADING, AND SUBGRADE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes all excavation, filling, and grading in connection with new facility access roads and Transfer Station. Refer to structural sections for structure foundation. Excavation, filling, and grading shall conform to lines and grades as shown on plans. Contractor furnishes all materials, equipment, tools, labor, superintendence, and incidentals necessary to complete Work per Drawings and as specified herein.

B. Related Sections:

1. Division 01 Specification Sections apply to Work of this Section.

PART 2 - PRODUCTS

2.1 EMBANKMENT

A. Construct embankment to lines and grades as shown on plans or directed by Engineer, in approximately horizontal layers. Only place suitable material, approved by Engineer, as embankment. Contractor shall obtain borrow source if necessary to complete embankment areas. Material shall meet ASTM D2487 soil classification groups SP and SM, free of rock or gravel larger than 1 inch in any dimension, debris, waste or vegetation. Material shall have a PI less than 12. Scarify existing surface where placing fill to depth of approximately 12 inches before placement of any fill material, to bond fill to existing surface. Remove and replace any unsuitable subgrade materials below finished subgrade excavation with suitable materials. No separate payment for removing and replacing such materials will be made and shall be incidental to subgrade preparation.

B. Placing and Compacting: After existing surface is prepared, deposit acceptable fill material in loose layers, wet, and thoroughly mix to uniform optimum moisture content. Spread material in uniform layer and compact to required density by any method, type, and size of equipment to give required compaction. Depth of layers depend upon type of sprinkling and compacting equipment used. Add water to maintain optimum conditions during compaction, if required. If material contains excess moisture from rain or other sources, defer rolling until optimum conditions reached. Place succeeding layers in like manner. If "crust" forms on any layer before succeeding layer is placed, scarify surface before placing additional fill material. Remove and replace material in soft places which develop under compaction, with other, acceptable, material so uniform density is obtained throughout fill. Compact areas not accessible to rolling equipment by hand tamping or other approved methods to density equal to remainder of Work. Under paved or concrete areas, compact material to 95 percent maximum density or as shown on plans, within ±2 percent optimum moisture, as determined by ASTM D1557.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavation consists of removing all material where subgrade or finished grade is below existing ground. Contractor shall dispose excess excavated material not required, or otherwise unsuitable, for making necessary fills for items in this project, as directed by Engineer, in

approved waste areas. No additional compensation made for hauling or disposing waste material or excess excavation.

B. Existing Pavement, Curbs, Gutters, Sidewalks, Etc.: Classify all existing pavement, concrete curbs, trees, grass, or other organic materials removed as excavation as waste material and do not incorporate in fills unless specific direction to do so given by Engineer. Where sidewalks removed, avoid damage to that portion of walk not requiring removal. Dispose waste material as provided herein.

C. Finishing: All excavation shall be to lines and grades shown on plans. Any excavation below such grade, and consequential filling to established grade, shall be at Contractor expense Contractor. Neatly finish excavation beyond ends of intersection stubs, between curb and property line, or other transition areas, to lines and grades shown on plans or established by Engineer.

D. Damage to Existing Pavement, Curbs, Utilities, Etc.: In all excavation work, avoid damage to existing pavement, curbs, utilities, and other such installations. Should installations be damaged by Contractor's forces or equipment, replace or repair, as directed, at Contractor expense .

E. Unclassified Excavation: All material excavated as part of this project shall be classified as Unclassified Excavation. Excavate to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

3.2 EXCAVATION FOR STRUCTURES

A. Conform to elevations and dimensions shown within a tolerance of ±0.10 foot, and extend a sufficient distance from footings and foundations to permit placing and removal of concrete form work, installation of services, other construction, and inspection.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade, trim bottoms to require lines and before placing reinforcement and concrete. Compact base as herein specified.

3.3 DEWATERING

A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

B. Do not allow water to accumulate in excavations. Remove water to prevent softening foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavation.

C. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

3.4 COLD WEATHER PROTECTION

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.5 SUBGRADE FINISHING

A. Accurately finish subgrade to lines, grades, and cross sections as shown on plans or established in field. Bring subgrade in cut areas to grade by blading or hand grading. Compact surface d with approved pneumatic roller followed by approved three-wheel roller until it presents a uniform compacted appearance. Compact subgrade in fill areas with an approved pneumatic roller. Follow the final rolling of last layer deposited by blading and rolling with three-wheel roller as described.

B. Compact entire subgrade area to 95 percent maximum density and within ±2 percent optimum moisture, as determined by ASTM D1557. Compact areas inaccessible to rolling by other approved methods to produce same compaction. Maintain moisture in material, by sprinkling as required, during this operation.

C. Accurately form warped sections, valley gutters, and other irregularities in section as shown on plans or established in field, in subgrade during finishing operation. Subgrade shall be checked by "teeing" from gutter-to-gutter on cross section and valley gutters by straightedge, longitudinally. Contractor shall furnish a satisfactory straightedge, if required. Correct variations more than 0.05 inch from true grade or true cross sections by loosening, adding, or removing material, reshaping and recompacting area affected. Set "Blue tops" to finished subgrade elevations where elevations cannot be checked as stated.

3.6 ROLLING EQUIPMENT

A. Pneumatic rollers consist of not less than nine pneumatic-tired wheels, running on two axles so rear group of tires will not follow in the tracks of forward group, and mount in rigid frame provided with a loading platform or body suitable for ballast loading. Front axle shall rotate around a king pin located so roller may be turned within a minimum circle. Roller, under working conditions, shall have effective rolling width of approximately 60 inches and give minimum 325-pound/inch compression of width of tire tread. Draw roller by suitable pneumatic-tired tractor or self-propelled type.

B. Three-wheel roller shall be self-propelled, weighing not less than 10 tons and provide a compression on rear wheels not less than 325 pounds/linear inch of width. Rear wheels shall be flat, have a diameter not less than 48 inches, and a width not less than 20 inches.

3.7 QUALITY CONTROL

A. One field density test for each lift required for each 500 square yards of prepared subgrade surface.

B. One field density for every 50 linear feet along wall foundations.

END OF SECTION

SECTION 02221 - EXCAVATING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes excavating, backfilling, and compacting trenches for pipe, pipe accessories, and other utilities. No separate pay items for excavating, backfilling, and compacting trenches. Contractor corrects over-excavation not at Engineer direction, at Contractor expense. OSHA regulations and Part 3 of this section apply to all excavation and trenching. Materials related to backfill of utilities. Included are:
   1. “Concrete” sand.
   2. Native soil materials.
   3. Topsoil.
   4. Borrow material.
   5. Crushed stone.

B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 02201 - Excavation, Grading, and Subgrade Preparation.
   3. Section 02730 – Pipe Installation.

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

C. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as Engineer directs. Authorized additional excavation and replacement material paid for per Contract provisions for changes in Work.
   2. Bulk Excavation: Excavation more than 10 feet wide and more than 30 feet long.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without Engineer direction. Unauthorized excavation and remedial work directed by Engineer, without additional compensation.

D. Fill: Soil materials used to raise existing grades.

E. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cubic yard or more in volume exceeding standard penetration resistance of 100 blows per 2 inches when tested by a geotechnical testing agency, per ASTM D1586.

F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

G. Subgrade: Uppermost surface of excavation or top surface of fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

1.3 REFERENCES

A. ASTM C33 - Specification for Concrete Aggregate.

B. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.

C. ASTM C123 - Test Method for Lightweight Pieces in Aggregate.
D. ASTM C131 - Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
E. ASTM C136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.
F. ASTM C142 - Test Method for Clay Lumps and Friable Particles in Aggregates.
G. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3).
H. ASTM D1140 - Test Method for Amount of Materials in Soils Finer Than No. 200 Sieve.
I. ASTM D2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).
J. ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
K. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
L. ASTM D4643 - Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
M. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.
N. TxDOT Tex-104-E - Test Method for Determination of Liquid Limit of Soils (Part 1).
O. TxDOT Tex-106-E - Test Method - Methods of Calculating Plasticity Index of Soils.
P. 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 description of source, material classification, product description, production method, and application of backfill materials.
C. Submit test results for samples of off-site backfill materials.
D. For each delivery of material, provide delivery ticket including source location.

1.5 TESTS

A. Perform tests of sources for off-site backfill material.
B. Verification tests of backfill materials performed per Division 01.

PART 2 - PRODUCTS

2.1 TRENCHES

A. Excavate pipe trenches to lines and grades shown on drawings or as Engineer establishes. Before excavation begins in paved areas, cut or saw existing pavement to neat line by methods meeting Engineer approval. Maximum width of trench from pipe invert to top of trench as detailed on Limits of Excavation and indicated on Contract Drawings. Procedures for treatment of trench walls as prescribed by trench safety system. In some areas of limited right-of-way, or when necessary to protect existing facilities, slope of trench wall is limited. Where necessary to stay within maximum width limits at top of pipe, adequately brace and sheet trench. Contractor fully responsible for any damage to adjacent structures due to inadequate trench wall supporting devices.
B. Where special pipe bedding material not required, excavate trench to an even grade so bottom of pipe will rest on bottom of trench throughout entire length of pipe. In obtaining a true and even grade, wet excavated trench bottom as necessary to facilitate compaction. Compact bottom of trench by mechanical means to consolidate all loose material disturbed during excavation. No compaction tests required on bottom of trench; however, compact

entire width and length of trench so no loose material remains. Correct any part of trench excavated below grade by filling with approved materials and thoroughly compacting. If clay, rock, or other unyielding material encountered in bottom of trench, remove to 6 inches below grade, refill with selected materials, and compact to minimum 90 percent maximum density ±2 percent optimum moisture per ASTM D1557 to specified grade.

C. Dig bell holes of ample dimensions at each joint to permit jointing pipe made properly and prevent pipe from resting on or supported by bell.

D. Use trench-digging machinery to make trench excavations except in places where doing so would cause damage to existing structures above or below ground. In such instances, employ hand methods. Contractor locates all existing underground lines, whether shown on drawings, sufficiently in advance of trenching operations to prevent any damage thereto. Take extreme care to prevent damage. Contractor fully responsible for damage to any such lines. Contractor potholes and locates all utility lines at least 1,000 feet ahead of pipeline placement operations to allow Engineer minimum four working days to initiate any necessary changes in alignment and/or grade of pipeline.

E. No classification of excavated materials and all materials encountered shall be excavated as required. Protect adjacent structures from damage by construction equipment. Stockpile excavated material alongside of trench per approved trench safety plan, not endangering work. Within street rights-of-way, remove excavated material as necessary from street to allow traffic to pass safely. Excavated material not allowed to be stockpiled in street or public rights-of-way.

F. Excavate for manholes as required, providing space for constructing structure and trench safety system, if applicable.

G. Explosives not permitted.

2.2 MATERIAL DESCRIPTIONS

A. “Concrete” Sand:

1. Coarse-grained, well-graded, sand (natural, manufactured, or combination) per ASTM C33 requirements.
2. Gradation to conform to ASTM C136 and these limits:

Sieve	Percent Passing
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

B. Native Soil Material for Backfill: Provide backfill material free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon, or other contamination.

C. Topsoil:

1. Provide topsoil material free of stones greater than 3 inches, free of roots, waste, trash, debris, organic material, unstable material, non-soil matter, hydrocarbon, or other contamination.
2. Clear surface of rock and other debris before planting.
3. Use top 3 feet of excavated material for topsoil backfill. Set material aside to prevent mixing with other excavated material. Topsoil required only in non-paved areas.

D. Borrow: All borrow material must be approved by Engineer.

E. Crushed Stone (alternate backfill to native material): Free of waste, trash, debris, organic material, unstable material, or other non-gravel matter.

2.3 MATERIAL TESTING

A. Ensure material selected, produced, and delivered to project meets applicable specifications and is of sufficiently 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 minimum three samples for each source and material type. Tests samples of processed materials from current production representing material to be delivered. Tests verify materials meet specification requirements. Repeat qualification test procedures each time source characteristic changes or planned change in source location or supplier. Qualification tests include, as applicable:

1. Gradation: Complete sieve analyses reported regardless of specified control sieves. Range of sieves from largest particle through No. 200 sieve.
2. Plasticity of material passing No. 40 sieve.
3. Los Angeles abrasion wear of material retained on No. 4 sieve.
4. Clay lumps.
5. Lightweight pieces.
6. Organic impurities.

C. Production Testing: Provide reports to Engineer from an independent testing laboratory that backfill materials placed in Work meet applicable specification requirements.

D. Native material requires testing only when questionable material encountered.

PART 3 - EXECUTION

3.1 TRENCH EXCAVATION SAFETY SYSTEM

A. This item covers requirements for Contractor to provide design and construction of trench safety system for all trenches excavated. Contractor required to install trench system to provide safe excavation of all trenches exceeding a depth of 5 feet as per OSHA standards. Contractor and all subcontractors hold duty and responsibility to be familiar and comply with all requirements of Public Law 91-596, 29 U.S.C. Specs. 651 et Seq., Occupational Safety and Health Act of 1970 (OSHA), and all amendments thereto, and enforce and comply with all provisions of this act. In addition, on projects where trench excavation exceeds 5 feet, Contractor and all subcontractors to comply with all requirements of 29 C.F.R. secs., and 1926.652 and 1926.653, OSHA Safety and Health Standards, more fully described herein.

B. Description:

1. Trench Safety Systems required for construction of all trench excavation utilized in project, including all additional excavation and backfill necessitated by safety system. Trench Safety Systems to be suitable for constructing pipelines, utilities, etc., installed below grade and sufficient to fully protect public or private property including other existing utilities and structures below or above grade. Trench Safety Systems include, but not limited to, sloping side of excavation, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering, or diversion of water to provide adequate drainage.
2. Contractor responsible for design of systems and procedures like sheet piling, shoring, or other means of temporary support to protect existing buildings, streets, highways, water conveying structures, and any other structures. In case of existing

utilities, Contractor may elect, at his cost, to remove utilities under stipulated condition removal and subsequent replacement of utilities meet with approval of Engineer, Owner, utility owner, and all agencies having jurisdiction of structure or property. In all cases, Contractor fully responsible for protection of public or private property and for any person(s) who, as a result of Contractor's work, may be injured.

3. Successful, responsible bidder required to submit three sets of trench excavation plans with trench safety system for Owner review within 15 consecutive days after Award of Contract.
4. Plans must be designed and sealed by a Texas-licensed Engineer with professional experience in geotechnical engineering. Contractor responsible for obtaining borings and soil analysis as required for design and preparation of trench excavation plan and trench safety system. Design trench excavation plan and trench safety system per OSHA standards and regulations.
5. No trenching more than 5 feet below existing grade allowed until trench excavation plan is reviewed and returned to Contractor. Any changes in trench excavation plan after initiation of construction will not cause an Extension of Time or Change Order, but such changes will require same review process as original excavation plan.
6. Contractor accepts sole responsibility for compliance with all applicable safety requirements. Review is only for general conformance with OSHA safety standards, and review of trench excavation plan does not relieve Contractor of any construction means, methods, technique, or procedures. Any property damage or bodily injury, including death that arises from trench excavation plan, shall remain sole responsibility and liability of Contractor.

C. Construction Methods: Trench Safety Systems accomplished per detailed specifications in provisions of Excavations, Trenching, and Shoring, OSHA Standards, 29 CFR, Part 1926, Subpart P, as amended, including proposed Rules published in Federal Register (Vol. 54, No. 209) Tuesday, October 31, 1989, or subsequent revisions. Sections incorporated into specifications by reference include Sections 1926-650 through 1926-653. Legislation enacted by Texas Legislature (H.B. No. 662 and H.B. No. 665) regarding Trench Safety Systems, is hereby also incorporated, by reference, into specifications.

D. Safety Program:

1. Contractor to submit safety program specifically for construction of trench excavations together with trench excavation plans for Trench Safety Systems. Trench safety program shall be per OSHA Standards governing presence and activities of individuals working in and around trench excavation.
2. Contractors have three generally accepted methods, or combinations thereof, to meet OSHA Standards for Trench Excavation:
   a. Utilization of Trench Box.
   b. Shoring, Sheeting, and Bracing Methods.
   c. Sloping, Benching.
3. Contractor electing to utilize Trench Box must submit physical dimensions, materials, position in trench, expected loads, and strength. Licensed Engineer to design Trench Box.
4. Contractor electing to utilize Shoring, Sheeting, and Bracing must submit dimensions and materials of all uprights, stringers, cross-bracing, and spacing required to meet OSHA requirements, all designed by a licensed Engineer.
5. Contractor utilizing Sloping and Benching methods, to have methods designed by a licensed Engineer.
6. Safety Program must indicate which areas Plan is utilized.
7. No delay claims permitted for Contractor delay in gaining safety program approval.

E. Inspection:
   1. Contractor provides a qualified person to daily inspect Trench Safety Systems to ensure systems meet OSHA requirements. Contractor provides person's name as part of post-bid, pre-award Key Personnel Qualifications submittal. Contractor maintains permanent record of daily inspections.
   2. If evidence of possible cave-ins or slides is apparent, cease all work in trench until Contractor takes necessary precautions to safeguard personnel entering trench. Contractor holds sole duty, responsibility, and prerogative, not Owner or Owner's designated representative, to determine specific applicability of designed trench safety systems to each field condition encountered on project.

F. Indemnification:
   1. Contractor shall indemnify and hold harmless Owner, employees, and agents, from all damages, costs (including without limitation, legal fees, court costs, and cost of investigation), judgments, or claims, by anyone, including workers or the public, for injury or death of persons resulting from collapse or failure of trenches constructed under this contract.
   2. Contractor acknowledges and agrees this indemnity provision provides indemnity for Owner in case claims are made Owner is negligent either by act or omission in providing for trench safety, including but not limited to inspections, failure to issue stop work orders, and hiring Contractor.

G. Emergencies: In an emergency situation which may threaten or affect safety or welfare of persons or property, Contractor acts at discretion to prevent possible damage, injury, or loss. Any additional compensation or extension of time claimed for such action, considered in view of emergency cause and per general conditions.

H. OSHA Safety and Health Regulation Part 1926.

I. Open Trench Restriction:
   1. Stringing out pipeline ahead of trenching operations in street right-of-way limited to linear footage of pipeline installed in one day's work. Do not string out pipeline or store in street right-of-way any longer than one day. Except where otherwise specified, indicated on Plans, or accepted in writing by Engineer, maximum length of open trench, where construction is in any stage of completion, shall not exceed lengths as set forth. "Open trench," for purpose of this description, includes excavation, pipe laying, backfilling, and pavement replacement. Descriptions under area designations are general in nature and may be amended in writing by Engineer due to particular/peculiar field conditions:
      a. Business District Areas: 300 linear feet.
      b. Residential Areas: One block or 300 linear feet, whichever is less.
      c. Undeveloped Areas: 1,000 linear feet (open trench shall not exceed length of one day's pipe laying).
   2. Contractor to complete backfilling all trenches before removing dewatering operations from area to prevent possibility of pipe flotation.
   3. Excavated areas considered "open trench" until all pavement replacements are made or all trenches outside of pavement replacement areas are backfilled, compacted, and replaced to original condition per these Contract Documents. Trenches across streets shall be completely backfilled, and temporary or permanent pavement placed within 48 hours after laying pipe.
   4. Contractor provides substantial steel plates, properly secured in place, with adequate trench bracing used to bridge across trenches at street and alley crossings and at commercial and residential driveways, where trench backfill and temporary patches not completed before end of Contractor's regular working hours. Always provide safe and convenient passage for pedestrians. Engineer may designate enclosed or

railed passage for safe access of pedestrian traffic at any location adjacent to construction activities as necessary. **Always maintain access to fire stations, fire hydrants, schools, hospitals, EMS, emergency response, homes, and businesses**.

3.2 SOURCES

A. Use of material encountered in trench excavations is acceptable, provided applicable specification requirements are satisfied. If excavation material is not acceptable, provide from another approved source. Use top 3 feet of excavated material as topsoil.
B. Identify off-site sources for backfill materials at least 21 days ahead of intended use.
C. Materials subjected to inspection or additional verification testing after delivery. Reject materials not meeting requirements of specifications. Do not use material which, after approval, is unsuitable for use due to segregation, mixing with other materials, or contamination.

3.3 MATERIAL HANDLING

A. Establish temporary stockpile locations in areas shown on plans for practical material handling and control.
B. Consolidate pea gravel upon placement by using rodding or pneumatic vibratory methods. Use shovel slicing as necessary to ensure filling voids, around and under pipe haunches, and spaces between corrugations.

3.4 BEDDING

A. Bedding and bedding zone for pipe as specified in applicable portions of Section 02730 – Pipe Installation.

3.5 BACKFILLING

A. Backfill all trenches as soon as practicable after pipe is installed with specified bedding condition. Backfill trench as soon as practicable after laying and jointing pipe, completion of bedding, and completion of structures.
B. Material: Backfill material immediately adjacent to pipe or bedding material to meet gradation requirements as Geotechnical Engineer recommends. Material to be free from rocks, boulders, clay, or other unsuitable material(s).
C. Placement of Backfill:
   1. If bedding requirements do not require bedding zone material to top or above pipe, carefully place first lift of backfill material under and around pipe and thoroughly compact by mechanical tamps to springline of pipe. When first lift is compacted by mechanical tamps, compact second lift shall be to 1 foot above top of pipe as specified. Placing each lift dependent upon diameter of pipe, in no case shall lift exceed 8 inches thick based upon loose measure. Backfill remainder of trench in the following manner:
      a. Place backfill material in trench in layers not to exceed 8 inches, moisten or aerate as necessary to obtain optimum moisture, and compact with approved mechanical-compaction equipment until required density obtained. Do not use vibratory rollers in city streets. Depending upon mechanical-compaction equipment used, Engineer may allow Contractor to lay thicker lifts. Based upon density requirements of contract, if Contractor can achieve passing density tests with thicker lifts than 8 inches by loose measure, he first submits proposed method of compaction, type of equipment, and desired lift thickness.

Engineer determines if Contractor's proposed methods are acceptable. In utilizing existing spoil for backfill material, any spoil containing obvious and excessive amounts of clay and/or large cobbles (+3 inches), not acceptable in any zone. Engineer determines if excavated spoil is acceptable for backfill material.

2. Density requirements:
   a. For all backfill in areas to pave, obtain a density not less than 95 percent per ASTM D1557 from top of subgrade to 18 inches below top of subgrade. Obtain density of 90 percent per ASTM D1557 from 18 inches below top of subgrade to top of pipe bedding zone.
   b. For all backfill not in paved areas, obtain a density not less than 90 percent per ASTM D1557 from top of pipe bedding zone to ground surface.
   c. Jetting method of water tamping or water ponding method, not allowed.
   d. Slamming excavator bucket down on backfill is not acceptable for compaction. Contractor to use sheepsfoot wheel rollers or other approved mechanical-compaction techniques.

D. Field Quality Control:
   1. Take field densities of backfill every 250 linear feet of pipe installation, per ASTM D1557, at the following depths:
      a. One-third pipe height.
      b. Springline.
      c. Top of pipe.
      d. Every lift thereafter to ground surface.
   2. Additionally, obtain one moisture density curve for each type of material used per ASTM D1557, one sieve analysis, and one plasticity index for each type of imported material used per ASTM C136 and D4318.

E. Backfill and Maintenance:
   1. Following completion of backfilling, Contractor will maintain a satisfactory trench surface until completion and acceptance of finished project. Maintenance includes blading as necessary, filling depressions caused by settlement, and other work required to keep areas and roads in satisfactory condition.
   2. Contractor repairs any settlement which occurs before and during one-year warranty period, at his expense.

3.6 TOLERANCES

A. Top Surface of Backfilling Under Paved Areas: ±1/2 inch from required elevations.
B. Top Surface of General Backfilling: ±1 inch from required elevations.

3.7 FIELD QUALITY CONTROL

A. Production Verification Testing: Owner's testing laboratory provides verification testing on backfill materials, as Division 01 outlines. Take samples at source or production plant, as applicable.
B. Perform compaction testing per ASTM D1556, D1557, D2167, D2922, D3017, and Engineer discretion.
C. Backfill Loose Lifts = 12-inch maximum.
D. Density Requirements: Trench below subgrade = 95 percent ASTM D1557.
E. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

F. Frequency of Tests: One test per 250 linear feet of trench, at lift level chosen by Engineer representative.

END OF SECTION

SECTION 02222 - EXCAVATING, BACKFILLING, AND COMPACTING FOR PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes earthwork required to prepare ground surfaces upon which roadway pavement and concrete items such as curbs, gutters, sidewalks, driveways and drainage structures are to be constructed. The work shall include removal and disposal of any unacceptable or excess materials and any necessary dewatering or rock excavation. The Contractor shall furnish all materials, equipment, tools, labor, superintendence and incidentals required to perform the work as indicated on the drawings, as required by the Engineer, and as specified herein.

B. Scope:

1. Work performed to prepare ground surfaces in areas where roadway pavement or concrete curbs, gutters, sidewalks, drainage structures, and/or similar items are removed or damaged during construction of pipeline and accessories and need reconstructed or repaired. Preparation ground surfaces include all necessary grading excavating, filling, backfilling, borrowing and stockpiling material, disposing unacceptable or excess material, wetting, compacting, shaping, and rolling.
2. Perform Work to dimensions, typical sections, lines, and grades indicated on drawings, established by Engineer, and per specifications.
3. Contractor responsible to fully inform himself as to site conditions and materials encountered before submitting Proposal. Contractor includes all costs of preliminary investigations, performing Work covered by this section, and includes any necessary dewatering or rock excavation.
4. Explosives not permitted.

C. Related Sections:

1. Division 01 Specification Sections apply to Work of this Section.
2. Section 02201 – Excavation, Grading, and Subgrade Preparation.
3. Section 0222l - Excavating, Backfilling, and Compacting for Utilities.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL

A. Fill and backfill material shall be free of any organic or deleterious substances and not contain cobbles or lumps over 3 inches in diameter. Material shall not contain more than 20 percent by dry weight of material passing No. 200 sieve. Fill material shall show low shrinkage or swelling when subjected to changes in moisture content, and plasticity index not exceed 12.

B. Suitability of potential fill material determined by grain size analysis and tests for liquid limit, plastic limit, and shrinkage performed per ASTM D522, D423, D424, and D427, respectively.

C. Site soils considered suitable for engineered fill provided all criteria are met. Do not use rubble material, frozen soil, or deposits of clay to compromise any part of engineered fill. Dispose undesirable materials encountered during excavation, at Contractor expense. Dispose all excess excavation not reused as backfill at Contractor expense.

D. Do not place frozen material in fills, backfills, nor during compaction when freshly placed material would become frozen.

E. Two-Sack Cement Stabilized Material: Where shown on plans, Contractor to use two-sack cement stabilized material to fill trench from l2 inches below bottom of pavement. Before use, Contractor submits mix proportions to Engineer for approval.

F. Perform filling and backfilling as necessary to prepare ground surfaces to typical sections, lines, and grades shown on Drawings or established by Engineer.

2.2 BORROW

A. If sufficient suitable material not available from excavated areas at job site, Contractor provides additional suitable materials as required to complete backfills and construct all fills to typical sections, lines, and grades shown on Drawings or established by Engineer. Contractor obtains additional material from owners of outside borrow areas.

B. Contractor responsible for locating sources of material and obtaining right to excavate and remove material. All costs of providing borrow material, including payment of royalties, developing source of borrow, excavating, and hauling material to job site, paid by Contractor at no cost to Owner.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. Moisten and compact base of excavations to dry density, no less than 95 percent of maximum as determined by ASTM Dl556 or D2l67. Place fill material in lifts not exceeding 8 inches (loose measure) in depth, then compact. Moisture content of material to be uniform and within ±2 percent of optimum, as determined by ASTM Dl557. Water shall not pool or jet onto in-place fill, but distribute uniformly over surface.

B. Compact fill material only with approved pneumatic or tamping equipment. Do not use self-propelled or heavy-duty vibratory compaction equipment next to previously-completed buildings or structures. Compact each lift of fill material to dry density not less than 95 percent of maximum as determined by ASTM Dl557 or D2l67.

C. Control of filling operations consists of field inspection and testing to determine each lift of fill is compacted to required density. Should any lift or portion of lift not conform to density requirements, scarify, wet, if necessary, then recompact until required density obtained.

3.2 GRADING AND EXCAVATING

A. Work consists of removing all materials to dimensions, typical sections, lines, and grades shown on Drawings or established by Engineer. Work includes:
   1. Removing all materials encountered regardless of the nature;
   2. Removing materials unsuitable for use in subgrades;
   3. Fills and backfills;
   4. Stockpiling suitable soils to use in fills or backfills; and
   5. Satisfactory disposal of unsuitable soil, vegetation, debris, or other deleterious materials encountered within areas of excavation.

B. Grade all areas involved in construction as shown on Drawings or required by Engineer. Shape areas to drain away from construction area and maintain free of trash and debris until final completion of Work.

C. If unsuitable soils (clay, silty sands, trash, etc.) are exposed at depths excavation is required by Contract Drawings, remove as Engineer requires. Contractor bears full cost of excavation required to remove unacceptable materials and fill in areas with acceptable material. Contractor may review available boring logs and perform additional soils investigations, at his expense, to ascertain if removal of undesirable soils or trash in any other areas of pipeline routes is required.

D. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without Engineer's written authorization. Unauthorized excavation and remedial work performed outside contract limits and not authorized by Engineer, is at Contractor expense.

E. Suitably slope excavation walls at minimum l l/2 to l and/or as further detailed in Section 0222l - Excavating, Backfilling, and Compacting for Utilities, so slope assures bank stability. Contractor responsible for always maintaining safe embankment slopes during work.

F. Before placing fill or backfill, Engineer inspects and approves all excavations and potential fill materials. Underlay excavation by natural, non-expansive soils and not by undesirable soil materials or clay soils.

G. After excavation to required elevation or before placing fill, scarify upper 6 inches of excavated area and compact to required density.

3.3 SUBGRADE

A. After completing excavation or filling and backfilling, prepare surfaces of excavated or filled areas as subgrade for pavement base course or for constructing concrete items. Subgrade to be thickness shown on Drawings. Remove any clay encountered within 2 feet of pavement surface and replace with engineered fill.

B. Subgrade shall be scarified, plowed, or otherwise loosened, then wetted, shaped, and rolled with approved rollers. Continue rolling until density not less than 95 percent obtained. Test as outlined in ASTM Dl557, method selected by Testing Laboratory and approved by Engineer.

C. When achieving required compaction, finish subgrade to lines and grades as shown on plans or required by Engineer. Keep subgrade in good condition as required, safe for traffic until two-sack cement stabilized material is placed. Periodically wet subgrade as required to maintain density and keep down dust from traffic. Contractor ensures subgrade continues to maintain same density as the day it passed, and remains finished to lines and grades as shown on plans and required by Engineer. If not, reestablished all requirements at no cost to Owner. Requirements pertaining to subgrade also applies to Base Course when commencing Paving (HMAC).

3.4 PAYMENT

A. Payment made for all work covered in this section included with unit price per unit for Pavement (HMAC) as shown in Proposal. Such payment shall be complete compensation for complete performance of work per drawings and specification provisions.

END OF SECTION

SECTION 02230 - BASE COURSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes constructing flexible base course beneath transfer station building and building ramp. Contractor furnishes all materials, equipment, tools, labor, superintendence, and incidentals for complete construction of base course per drawings and specifications.

B. Related Sections:

1. Division 01 Specification Sections apply to Work of this Section.
2. Section 02201 – Excavating, Grading, and Subgrade Preparation.

PART 2 - PRODUCTS

2.1 FLEXIBLE BASE COURSE

A. Flexible base course constructed upon compacted subgrades specified in Section 02201 – Excavating, Grading, and Subgrade Preparation. Base course roads constructed in one or more courses in conformity with typical sections shown on drawings and lines and grades established.

B. Base courses constructed in locations indicated on Drawings, as necessary to reconstruct or repair pavement damaged, or removed during construction of pipeline and accessories.

2.2 MATERIAL

A. Material shall be crushed and consist of durable particles of stone mixed with approved binding material. Base material to be screened, partially screened, or otherwise manipulated, before crushing so all soil, clay, and other objectionable material is removed. Take samples for testing material before compaction operations.

2.3 GRADING

A. When properly slaked and tested by standard AASHTO Methods, flexible material meets requirements of TxDOT Item 247, Flexible Base, Type A, Grades 1 or 2.

2.4 MATERIAL SOURCE

A. Material sources per TxDOT Item 247.

2.5 CONSTRUCTION METHODS

A. Construction methods per TxDOT Standard Specification Construction Methods, Item 247.

PART 3 - EXECUTION

3.1 COMPACTION

A. Compact base course to within 98 - 100 percent of maximum dry density per ASTM D1557

3.2 TESTING FREQUENCY

A. Take one in-place density every 200 linear feet of retaining wall per ASTM D6938.

END OF SECTION

SECTION 02301 - EARTHWORK FOR STRUCTURAL PURPOSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Preparing subgrades for slabs-on-grade.
   2. Excavating and backfilling for buildings and structures.
   3. Drainage course for concrete slabs-on-grade.
   4. Excavating and backfilling trenches for utilities and pits for buried utility structures.
   5. Excavating well hole to accommodate elevator-cylinder assembly.

B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 02832 - Concrete Segmental Retaining Wall Systems.
   3. Section 03300 - Cast-in-Place Concrete: Granular course if placed over vapor retarder and beneath the slab-on-grade.
   4. Geotechnical Report
      a. If conflicts exist between requirements shown herein and the Geotechnical Report, most stringent applies.
      b. Over-excavation, extent of over-excavation, soil scarification and recompacting subbase, installing engineered fill, fill compaction, etc., as outlined in the October 4, 2017 Geotechnical Study provided by Amec Foster Wheeler Project No. 1737192035, found in Appendix A.

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Aggregate layer placed over excavated subgrade in trench before laying pipe.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Aggregate layer supporting slab-on-grade to minimize upward capillary flow of pore water.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

F. Fill: Soil materials used to raise existing grades.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

H. Subgrade: Uppermost surface of excavation or top surface of fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

I. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation and remedial Work directed by Engineer, without additional compensation.

J. Utilities: Onsite underground pipes, conduits, ducts, cables, and underground services within buildings.

1.3 ACTION SUBMITTALS

A. Product Data for each type of the following manufactured products required:
   1. Controlled low-strength material, including design mixture.
   2. Warning tapes.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.
B. Material Test Reports: For each onsite and borrow soil material proposed for fill and backfill as follows:
   1. Classification per ASTM D2487.
   2. Laboratory compaction curve per ASTM D698.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earthmoving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
B. Improvements on Adjoining Property: Obtain Owner authority for performing earthmoving indicated on property adjoining Owner's property before award of Contract. Do not proceed with Work on adjoining property until directed by Engineer.
C. Utility Locator Service: Notify for area where Project is before earthmoving operations.
D. NO earthmoving operations until temporary erosion- and sedimentation-control measures, specified in Section 01500 - Temporary Facilities and Controls, are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Backfill, drainage, leveling pad, etc. for Section 02832 – Concrete Segmental Retaining Wall Systems, may be controlled by system manufacturer. Verify controlling requirements.
B. See Geotechnical Study in Appendix A.
C. Provide borrow soil materials when sufficient satisfactory soil materials not available from excavations.
D. Bedding Course: Naturally- or artificially-graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
E. Drainage Course: Narrowly-graded mixture of washed crushed stone, crushed, or uncrushed gravel; ASTM D442.

Sieve Size (Square Openings)	Percent Passing By Dry Weight
1 inch	100
3/4 inch	85 - 100
No. 4	45 - 95
No. 200	0 - 8

F. Drainage base should have plasticity index no greater than 12 when tested per ASTM 4318. Coarse aggregate should have percent of wear, when subjected to

Los Angeles abrasion test (ASTM C131), of no greater than 50. Granular base should be compacted to at least 95-percent ASTM D1557 maximum dry density.

G. Sand: ASTM C33; fine aggregate.

H. Impervious Fill: Clayey gravel and sand mixture able to compact to dense state.

2.2 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from:
   1. Portland Cement: ASTM C150, Type I.
   2. Fly Ash: ASTM C618, Class C or F.
   3. Normal-Weight Aggregate: ASTM C33, 3/4-inch nominal maximum aggregate size.
   4. Foaming Agent: ASTM C869.
   5. Water: ASTM C94/C94M.
   6. Air-Entraining Admixture: ASTM C260.

B. Produce conventional-weight, controlled low-strength material with 140-psi compressive strength when tested per ASTM C495.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured to mark and identify underground utilities, 6 inches wide, 4 mils thick, continuously inscribed with utility description, colored as:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Phone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with utility description, with metallic core encased in protective jacket for corrosion protection, detectable by metal detector when tape buried up to 30 inches deep; colored as:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Phone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthmoving operations.

B. Protect and maintain erosion and sedimentation controls during earthmoving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface- and groundwater from entering excavations, ponding on prepared subgrades, and flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations nor use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in Contract Sum or Time authorized for rock excavation or removal of obstructions. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a ±1-inch tolerance . If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and inspections.

B. Excavations for Footings, Foundations, and Slabs: See Appendix A.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide 12-inch clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

C. Trench Bottoms: Excavate and shape to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

   1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped-sand backfill.
   3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on undisturbed subgrade.
   4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

A. Notify Engineer when excavations reach required subgrade.
B. If Engineer determines unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Use lean concrete fill, with 28-day compressive strength of 2,500 psi, when approved by Engineer. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing :
   1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing and inspecting underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring, bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally-supported walls.
B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.
B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 03300 - Cast-in-Place Concrete.
D. Backfill voids with satisfactory soil while removing shoring and bracing.
E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to 12 inches over pipe or conduit. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along full length of piping or conduit to avoid damage or displacing piping or conduit. Coordinate backfilling with utilities testing.

F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to 12 inches over pipe or conduit. Coordinate backfilling with utilities testing.
G. Place and compact final backfill of satisfactory soil to final subgrade elevation.
H. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
I. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
B. Place and compact fill material in layers to required elevations:
   1. Under building slabs, use engineered fill.
   2. Under footings and foundations, use engineered fill.
C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent optimum moisture content.
   1. Do not place backfill or fill soil material on muddy, frozen, frosty, or icy surfaces .
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material exceeding optimum moisture content by 2 percent and too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Reference geotechnical data in Appendix A.

3.15 GRADING

A. Uniformly grade areas to smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
B. Grading inside Building Lines: Finish subgrade to 1/2-inch tolerance when tested with 10-foot straightedge.

3.16 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.
B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as:
   1. Install vapor barrier on prepared subgrade per manufacturer-written instructions, overlapping sides and ends.
   2. Place drainage course 6 inches or less in compacted thickness in single layer vapor barrier.
   3. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent maximum dry unit weight per ASTM D698.

3.17 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage qualified special inspector to perform these special inspections:
   1. Determine before placing fill, site is prepared in compliance with requirements.
   2. Determine fill material and maximum lift thickness comply with requirements.
   3. Determine, at required frequency, in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthmoving only after test results for previously-completed Work comply with requirements.

D. Footing Subgrade: At least one test of each soil stratum performed to verify design-bearing capacities. Subsequent verification and approval of other footing subgrades based on visual comparison of subgrade with tested subgrade when approved by Engineer.

E. Testing agency will test compaction of soils in place per ASTM D1556, D2167, D2922, and D2937, as applicable. Tests performed at the following locations and frequencies:
   1. Building Slab Areas: At subgrade and each compacted fill and backfill layer, at least one test for every 2,000 square feet or less of paved area or building slab, but no fewer than three tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills not achieved degree of compaction specified, scarify, moisten, and/or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction obtained.

3.18 PROTECTION

A. Protect graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially-completed surfaces become eroded, rutted, settled, or lose compaction from subsequent construction operations or weather conditions. Scarify or remove and replace soil material to depth as directed by Engineer. Reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing. Restore appearance, quality, and condition of finished surfacing to match adjacent Work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSE SURPLUS AND WASTE MATERIALS

A. Transport surplus satisfactory soil to designated storage areas on Owner property. Stockpile or spread soil as directed by Engineer. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose off Owner property.

END OF SECTION

SECTION 02600 – SCHEDULE OF PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:
1. Division 01 Specification Sections apply to Work of this Section.
2. Section 02610 – Pipe, Valves, and Fitting Materials.

1.2 SCHEDULE OF PIPE

A. Use approved pipe in constructing all pipelines and connections. Only pipe considered for use are listed. All pipe of like sizes shall be same type and class. Acceptable types and classes of pipe approved for various items of work are shown in the following table. See Section 02610 - Pipe, Valves, and Fitting Materials, for other requirements.

SIZE AND USE	TYPE AND CLASS
6-inch Storm Sewer Line	HDPE Profile Wall Pipe
4-inch Water Line	PVC, AWWA C-900 DR 18, Solid Wall, Blue

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 02605 - STORM SEWER JUNCTION BOXES AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes junction boxes and accessories.
B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 03300 - Cast In Place Concrete.

1.2 JUNCTION BOXES

A. Junction boxes used for gravity storm sewer lines, as shown in Drawings.
   1. Junction boxes for pipes 48 inches and smaller, shall be standard precast junction boxes installed per details shown in Drawings.
   2. Junction Boxes with pipe larger than 48 inches in diameter shall be cast in place.
B. Contractor supplies and installs junction boxes and all appurtenances.

PART 2 - MATERIALS

2.1 FRAMES AND COVERS

A. Manhole frame and cover shall be cast iron of weight, dimensions, and pattern per Public Service Board Standards as indicated on Drawings. Casting shall be made from superior quality, gray cast iron per requirements of ASTM A48 (latest revision). A suitable designation is cast on cover as indicated on Drawings. Mating surfaces shall be machined to provide snug fit of cover and frame.

2.2 JUNCTION BOX CONNECTORS

A. All pipe openings in precast junction boxes base sections and risers connecting to flexible pipe shall have watertight compression type flexible pipe to manhole connector per requirements of ASTM C923, as manufactured by Kor-N-Seal, Link Seal, A-Lok ,or equal.
B. Place 12-inch concrete collars in all pipe openings in precast junction box base sections and risers connecting to reinforced concrete pipe.

2.3 CONCRETE

A. Concrete for manhole foundations shall be Class "A1" concrete specified in Section 03300 - Cast In Place Concrete.

2.4 PRECAST CONCRETE JUNCTION BOXES

A. Junction box riser and conical sections designed for use in storm sewer systems, diameter shown on plans, reinforced concrete, per ASTM C478, except as modified herein.
B. Rings shall be available in various lengths of from 1 - 4 vertical feet.
C. Steps or rungs not required.
D. Conical sections shall be concentric or eccentric as indicated on Drawings, adapted to ring at one end.

E. Concrete shall have minimum allowable compressive strength at 28 days of 4,000 pounds per square inch for ring sections and conical sections. All cement shall be Portland complying with ASTM C150, Type V (Sulfate Resistant).

F. Engineer reserves the right to inspect manufacturing process any time, make tests on materials used, and have cores cut out of completed manholes for compressive strength testing and placement of reinforcement.

G. Installation:

1. Construct manholes where shown on plans or as required by Engineer per details shown on plans and specified herein. After completing excavation and compacting subgrade, place concrete base or bottom. When concrete sufficiently sets, proceed with riser work.
2. Compact subgrade under precast manhole bases to 95 percent density per ASTM D1557.

2.5 PRECAST JUNCTION BOXES

A. Junction Boxes shall be precast.

Junction Box	Type	Precast Riser Diameter	Precast Top
B	Precast	72 Inches	Concentric Cone
C	Precast	84 Inches	Concentric Cone

B. Junction box frame and cover shall be cast iron of weight, dimensions, and pattern shown on plans. Casting shall be made from superior quality, gray cast iron per requirements of ASTM A48 (latest revision).

C. All pipe openings in manhole base sections and risers shall have compression-type flexible pipe to junction box connector per requirements of ASTM C923, as manufactured by A-Lok Products Corp., or equal.

D. Concrete for junction box foundations as well as concrete and reinforcement for inlet shall be as specified in Section 3300 – Cast-In-Place Concrete.

E. Engineer or designated representative reserves the right to inspect manufacturing process any time, make tests on materials used, and have cores cut out of completed manholes for compressive strength testing and placement of reinforcement.

F. Installation: Construct junction boxes where shown on plans, as directed by Engineer or designated representative, per details shown on plans and specified herein. After excavation is complete, pour concrete base or bottom. When concrete sufficiently sets, riser work may proceed. After junction box riser is complete, neatly form invert in bottom of junction box with concrete. Invert shall have true curve as large a radius as size of junction box will permit and given smooth trowel finish.

G. Compact subgrade under manhole bases to 95 percent density per ASTM D1557.

H. Construct inlets for various sized lines at locations and per details shown on plans and specified herein.

I. Install steel inlet units in conjunction with construction of concrete curb and gutter. Before placing concrete, secure grate support frames in position. Openings for inlets as indicated on plans shall be formed in conjunction grates frames. Place concrete for inlets using care to secure thoroughly-compacted concrete around inlet castings, formed openings, and recesses without displacement of inlet units in forms. Fabricate inlet grate and grate framing from HMRS conforming to ASTM A36 steel.

J. Steel castings conform to requirements of specifications for "*Mild to Medium Strength Carbon Steel Castings for General Application*," ASTM A27, Grade 70-36, furnished unless otherwise specified.

PART 3 - PAYMENT

3.1 PAYMENT

A. Payment made for all work covered in this section with contract unit price per unit for junction boxes or inlets as shown in proposal. No separate payment made for compliance with this section.

END OF SECTION

SECTION 02610 – PIPE, VALVES, AND FITTING MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes materials for all piping, valves, and fittings required for project. Contractor furnishes all materials, equipment, tools labor, superintendence, and incidentals required for complete construction of work as shown on Drawings and specified herein. All pipe and fittings used for this Project are to be new.

B. Related Requirements:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 02600 – Schedule of Pipe.

1.2 SUBMITTALS

A. Submit for pipe supplier and provide documentation proposed pipe meets requirements set forth in Section 02600 - Schedule of Pipe.

1.3 CERTIFICATION

A. Certifications properly executed by manufacturer furnished to Engineer showing compliance with required specifications. All pipe and fittings must conform to ANSI/NSF Standard 61 and certified by ANSI-accredited organization.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Contractor to supply all pipe required for project. For design purposes, all water pipe sizes shown on drawings and designed for a 150-psi rated working pressure plus additional 100-psi surge pressure. Pipe also designed for earth loads based upon in-situ unit weight of 125 pounds per cubic foot and depths of cover as indicated on drawings.

2.2 PVC PRESSURE PIPE

A. PVC pressure pipe to be unplasticized PVC plastic water pipe with integral bell and spigot joints. Pipe 12 inches in diameter and smaller meet requirements of AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, Pressure Class 150. Make provisions for expansion and contraction at each joint with an elastomeric ring. Bell consists of integral wall section with locked-in, solid, cross section elastomeric ring, meeting ASTM F477 requirements. Design bell section at least as hydrostatically strong as pipe to meet AWWA C900.

B. Pipe to withstand minimum 535-psi quick burst pressure when tested per ASTM D1599. Pipe shall withstand, with no visible evidence of shattering or splitting, when subjected to drop impact test, an impact of 100 feet per pound per ASTM D2444.

C. Minimum length of restrained joints as shown on drawings.

2.3 DUCTILE IRON PIPE

A. Ductile iron pipe and fittings to be American made and conform to AWWA C151 requirements. Pipe sizes shown on drawings and pressure class indicated in Section 02600 - Schedule of Pipe, except where thicker pipe required by AWWA C151 for design condition.

B. Joints: Push-on joints used to connect pipe sections, except where flanged, mechanical, or restrained joints indicated on Drawings or specifications. Push-on joints conform to AWWA C111 requirements. Mechanical and flanged joints conform to AWWA C153 requirements and rated for 150-psi working pressure plus 100-psi additional surge pressure.

C. Interior Coating: Inside ductile iron pipe has cement-mortar lining per ANSI/AWWA C104 requirements.

D. Exterior Coating: All ductile iron pipe installed in pipe trenches wrapped with encasement of polyethylene per AWWA C105. Minimum film thickness for low-density polyethylene is 8 mils, and minimum film thickness for HDPE is 4 mils.

E. Restrained joint pipe and fittings conform to AWWA C111 and C153 requirements, respectively. Restrained push-on joint pipe and fittings deflected after assembly. Deflection not to exceed 75 percent manufacturer recommendation. Restrained joint pipe and fittings to be American Cast Iron Pipe., Flex-Ring Joint, Lok-Ring Joint; U.S. Pipe TR Flex, or equal. Any joint employing field-welded retainers, is <u>unacceptable</u>. Restrain full pipeline length.

F. Delivery, Storage, and Handling:
   1. Block piping material for shipment, prevent damage to castings and linings.
   2. Carefully handle piping material during loading, unloading, and installation. Do not reopen piping material from cars or trucks. Lower piping material by mechanical means. Do not drop or pound pipe to fit grade.
   3. Repair damaged cement mortar lining to match quality, thickness, and bonding original lining per AWWA C 104. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.
   4. Protect gaskets and polyethylene encasement from long-term exposure to sunlight.
   5. Store fittings and other accessories so they do not accumulate and hold rainwater, dirt, and debris.

G. Quality Assurance - Qualifications of Manufacturers: Use manufacturer with minimum five years' experience supplying type of product to water industry.

2.4 PIPE FITTINGS

A. PVC Fittings
   1. Fittings for AWWA C900 pipe to be ductile or cast iron per requirements of ANSI/AWWA C153, and suitable for use with specified PVC pipe used. For other classes and schedules of PVC pipe, fittings shall have same or greater respective class/schedule as pipe used. Fittings shall have elastomeric rings for sealing.
   2. Restrained Joints for PVC Pipe incorporate series of mechanical serrations (not "as-cast") inside diameter to provide positive restraint, exact fit, 360-degree contact, and support of pipe wall. Restraint devices to be ductile iron, ASTM A536, Grade 65-45-12. Connecting bolts to be high-strength, low-alloy material per ANSI/AWWA C111/A21.11.
   3. All restraint devices for PVC pipe have working pressure rating equivalent to full-rated pressure of PVC pipe installed, with minimum 2:1 safety factor in any

nominal pipe size. In addition, they meet/exceed requirements of UNI-B-13-94. Restraint devices for integral bell and spigot pipe joints to be Ford Uni-Flange Series 1350 or approved equal. Restraint devices for mechanic joints to be Romac Grip Ring Pipe Restrainer or approved equal.

B. Ductile Iron Fittings

1. Fittings for ductile iron pipe to be cast or ductile iron, end-grooved, restrained joint, flanged, or combination as shown or required, and conform to AWWA C153. In general, flange fittings used on all exposed piping. All other fittings to be restrained mechanical joints. Mechanical joint restraint to be Romac Grip Ring Pipe Restrainer or approved equal. End grooved fittings only used where shown on drawings. All fittings or restrained joints designed for 150-psi working pressure and additional 100-psi surge pressure. Use same restrained joints on fittings as straight pipe.
2. Interior of ductile iron fittings has cement-mortar lining per requirements of ANSI/AWWA C104. Exterior coating for DIP specified.
3. All ductile iron fittings cast from same quality of metal used in casting ductile iron pipe and subjected to same test requirements. Mark and weigh as required for ductile iron pipe.
4. All flanged fittings to be faced and drilled per standard drilling for ANSI B16.1 Class 125 ductile iron fittings. Bolts to be length and diameter required by ANSI Class 125 flanges. Bolts and nuts to be best quality mild steel provided with hexagonal heads, except where other types of bolts specified. Use ring gaskets in all flanged joints with rubber-composition sheet packing, Rainbow, Durable Barlock, or equal.

2.5 VALVES

A. All valves to be type shown or specified on Drawings and specified. All valves are complete with appurtenances required for operation. All valves for buried service operation.

B. Gate valves: All larger than 2 inches to be resilient wedge iron body, bronze-mounted throughout, complying with AWWA C509, designed for 200-psi working pressure and 75-psi surge pressure, and manufactured by Pratt, Clow, Kennedy, M&H, American Darling, or Mueller. Valves to be restrained mechanical joint where shown on drawings. All valves open by turning counterclockwise and have, unless otherwise specified, non-rising stems. Valves installed in pipe trench provided with 2-inch operating nut.

2.6 VALVE BOXES

A. All valves installed underground 16-inch diameter and less, provided with valve box accurately set over operating nut. Valve boxes to be cast iron, complete with cover, and extension-type with screw-or-slide-type adjustment, flared base suitable for valve where installed. Boxes like Clow-National No. F-24.50 and house locking lid.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 02636 – HIGH-DENSITY POLYETHYLENE (HDPE) PROFILE WALL PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes high-density polyethylene (HDPE) pipe for gravity sewers and drains, including fittings.
B. Related Requirements:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 02730 – Pipe Installation.

1.2 REFERENCES

A. ASTM D618 - Conditioning Plastics and Electrical Insulating Materials for Testing.
B. ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials.
C. ASTM D2657 - Standard Practice for Heat -Joining Polyolefin Pipe and Fittings.
D. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
E. ASTM D3350 - Polyethylene Plastic Pipe and Fittings Materials.
F. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
G. ASTM F894 - Polyethylene Plastic (PE) Large-diameter Profile Wall Sewer and Drain Pipe.
H. ASTM F667 –Large Diameter Corrugated Polyethylene Tubing and Fitting.
I. ASTM F810 –Smoothwall Polyethylene (PE) Pipe for Use in Drainage and Waste Disposal Systems.
J. AASHTO M 294 –Corrugated Polyethylene Pipe, 12 - 36 inch Diameter, except for more stringent crack control requirements listed.

1.3 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.
B. Submit product data and shop drawings with the following information:
   1. Design dimensions and details for pipe and fittings indicating alignment, grade, and laying dimensions.
   2. Fabrication details, details of fittings and flanges, details of specials, and proposed welding procedures.
   3. Show station numbers for pipe and fittings corresponding to Drawings.
   4. Properties and strength of pipe and pipe design analysis.
   5. Instruction on storage, handling, transporting, and installation.
   6. Standard Catalog Sheet.

1.4 QUALITY CONTROL

A. Provide manufacturer’s certificate of conformance to Specifications.
B. Provide manufacturer’s certificate that pipe survives an average of 24 (minimum 17) hours at 15 percent of yield stress without cracking in Drexel Test (ASTM D5397) for annularly corrugated HDPE.
C. Provide manufacturer’s certificate that pipe survives an average of 400 (300 minimum) hours at 15 percent of yield stress without cracking in Drexel Test (ASTM D5397) for wrapped HDPE.

PART 2 - PRODUCTS

2.1 APPROVED AND PRE-APPROVED PRODUCTS

A. Provide HDPE pipe as follows:

Wall Construction	Specification Designation	Diameter range
Profile Wall	AASHTO M294*	6 inches
*with more stringent crack control this Specification		

B. Furnish profile-wall gravity sewer pipe with bell-and-spigot end construction per ASTM D3212. Accomplish joining with an elastomeric gasket per manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so when assembled, elastomeric gasket, contained in a machined groove on pipe spigot, is compressed radially in pipe bell to form a positive seal. Also have joint designed to avoid displacing gasket when installed per manufacturer's recommendations.

C. All HDPE pipe and joints shall withstand an intermittent internal hydrostatic pressure of 10 psi without structural failure. Drips from joint at 10 psi are permissible. Jets of water from joint considered same as structural failure.

2.2 MATERIALS

A. Pipe and Fittings: High-density, high-molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D1248. Material meeting requirements of cell classification per ASTM D3350, also suitable for making pipe products under Specifications.

B. Other Pipe Materials: Materials other than those specified herein, may be used as part of profile construction, (e.g., as core tube to support shape of profile during processing), provided these materials are compatible with base polyethylene material, completely encapsulated in finished product, and in no way compromise performance of pipe products in intended use. Examples of suitable material include polyethylene and polypropylene. Quality control specified in Article 1.4 apply.

C. Pipe shall contain no recycled compound except that generated in manufacturer’s own plant from resin of same raw material. Pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect wall integrity.

D. Gaskets: Use gaskets meeting ASTM F477 requirements. Use gasket molded into circular form or extruded to proper section then spliced into circular form. When no contaminant identified, use gaskets of a properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or a blend.

E. Lubricant: Use for assembly of gasketed joints with no detrimental effect on gasket or pipe, per manufacturer's recommendations.

2.3 WORKMANSHIP

A. Furnish pipe and fittings homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.

2.4 INSPECTIONS

A. Engineer reserves the right to inspect pipes or witness pipe manufacturing. Such inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and Specifications.
B. Manufacturer's Notification: Should Engineer witness manufacture of specific pipes, manufacturer shall provide Engineer with adequate advance notice of when/where production of specific pipes will take place. Engineer shall tell manufacturer of intent to inspect production. Manufacturer shall inform Engineer of dates planned for production.
C. Failure to Inspect: Should Engineer elect NOT to inspect manufacturing, testing, or finished pipes, it in no way implies approval of products or tests.

2.5 TEST METHODS

A. Conditioning samples before and during tests are subject to Owner approval. When tests are required, condition specimens per Procedure A in ASTM D618 at 73.4 ±3.6 degrees F and 50 ±5 percent relative humidity for not less than 40 hours before test. Conduct tests under same conditions of temperature and humidity, unless otherwise specified.
B. Flattening. Flatten three pipe specimens prepared per Article 2.5A, in a suitable press until internal diameter is reduced to 40 percent of original inside diameter of pipe. Rate of loading shall be uniform and at 2 inches per minute. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles.
C. Joint Tightness. Test for joint tightness per ASTM D3212, except replace shear load transfer bars and supports with 6-inch-wide support blocks that can be flat or contoured to conform to pipe's outer contour.
D. Purpose of Tests. Flattening and joint-tightness tests are not intended to be routine quality control tests, but rather qualify pipe to a specified level of performance.

2.6 MARKING

A. Mark each standard and random length of pipe in Specification compliance with:
   1. Pipe size;
   2. Pipe class;
   3. Production code;
   4. Material designation.

2.7 PACKAGING, HANDLING, AND SHIPPING

A. Pack, handle, and ship per manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conform to requirements of Section 02730 – Pipe Installation.
B. Install pipe per Drawings.

3.2 TESTING

A. Refer to Section 02730 – Pipe Installation, Article 2.11 – Testing Pipe Lines.

END OF SECTION

SECTION 02730 - PIPE INSTALLATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Install per pipe requirements.
   2. Inspect pipe, fittings, and accessories upon delivery and during work progress. Engineer will reject any material found defective and Contractor shall remove defective material from site of work.
   3. Contractor responsible for all material he furnishes and shall replace, at his own expense, all material found defective in manufacture or damaged after delivery.
   4. Unless otherwise authorized, Contractor will unload all pipe, fittings, and other accessories at point of delivery, haul to, and distribute at site of work. In loading and unloading, lift materials by hoists with slings, slid, or roll on skidways to avoid shock or damage to materials. DO NOT drop materials. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground.

B. Related Requirements:
   1. Division 01 Specification Sections apply to Work of this Section.

PART 2 - MATERIALS

2.1 PIPE BEDDING

A. Pipe bedding and classes of bedding as indicated on Plans and specified.

B. Use Class A bedding, as shown on Drawings, for installing all piping. Class A bedding material is granular and consists of soil that conforms to these physical characteristics:

SIEVE SIZE (SQUARE OPENINGS)	PERCENT PASSING BY WEIGHT
3/4 inch	100
1/2 inch	90-100
3/8 inch	40 - 70
No. 4	0 - 15
No. 80	0 - 5

C. Granular bedding material is non-plastic per ASTM D4318. Material to be free from roots, grass, other vegetable matter, clay lumps, or other deleterious materials. Use native site soil from cuts for granular pipe bedding, if it meets requirements. Unless shown otherwise on Drawings, place bedding material from 6 inches below to 12 inches above pipe in 8-inch lifts and compacted to 90 percent ASTM D1557 with appropriate compaction equipment. No water flooding allowed. No backfill material larger than 3/4-inch allowed from bottom of trench to 12 inches above pipe.

D. If native material excavated from trench is unsuitable as pipe bedding material, or required compaction is unattainable for spoil bedding material, Contractor shall, at his expense, import select material mixed with or in place of, spoil material. Select material to meet requirements for Class A.

2.2 PIPE INSTALLATION IN TRENCH

A. After trench is excavated and pipe bed properly fine graded, lay pipe per manufacturer recommendations and Specifications. Immediately inspect each length of pipe for defects before laying. Contractor to replace any defective pipe damaged by mishandling or other cause with satisfactory pipe, at his expense.

B. Lay pipe true-to-line and uniform grade with no sharp changes in grade. All pipe rests on bottom of trench or upon prepared bedding throughout length of pipe and bell holes provided, where required, to assure this. Lay all pipe true to lines and depths shown on Plans. Take up and re-lay any pipe not in true alignment or showing any undue settlement after laying, at Contractor expense.

C. Clean inside pipes before joining and maintain free of water, soil, and other foreign matter. Always close all openings to pipe by suitable means except as actual progress of work requires pipe be open.

D. Work shall be watertight at all joints and any leaks or defects immediately repaired. Take up any pipe disturbed for any cause after laid in final position, clean joint, and properly re-lay pipe.

2.3 FIELD QUALITY CONTROL

A. Field Quality Control: Take field densities every 300 LF of pipe installation, per ASTM D6938, at springline, top of pipe, and every lift thereafter to ground surface.

B. Obtain one moisture density curve for each type of material used per ASTM D1557, one sieve analysis, and one plasticity index for each type of material used per ASTM C136 and D4318.

2.4 WATER AND SEWER UTILITY RELOCATIONS

A. Existing water and sewer lines shall always remain in service during construction, unless otherwise noted on Plans. Shore existing utilities exposed during construction or otherwise support so no damage occurs to exposed lines. If leaks develop in any existing, exposed, water or sewer lines, Contractor to repair immediately at no additional expense to Owner. Contractor shall not interrupt service, function, or disturb support of any utility without written authority from utility owner. Where protection required to ensure support of utilities, Contractor places and provides necessary protection and all cost associated with such included in unit price bid for various pipe line items, unless specific bid item stated.

B. Contractor relocates any required existing lines per Specifications.

C. All temporary/permanent relocation and alteration of utilities Contractor requests for convenience, is Contractor responsibility, he makes all arrangements, and bears all associated costs. Contractor responsible for bypassing any existing sewer mains required for installation of pipeline.

2.5 SUBMITTAL OF BYPASS PLANS

A. Submit bypass plan for any utilities to Engineer for review and approval 21 calendar days before planned bypass. Submittal includes time bypass is planned, how accomplished, materials to use, Contractor support personnel and equipment used for bypass, Contractor contact during bypass, time required for bypass, time of day bypass conducted, interruption time (if any), bypass close-down procedures, testing bypass, and disinfection procedures for water lines if applicable.

2.6 SUBMITTAL OF TIE-IN PLANS

A. Submit plans for tie-ins of new facilities to existing facilities or other new facilities to Engineer for review and approval seven calendar days before planned work. Plans include when work is performed, methods and materials used, any interruption of service time required, and testing and disinfection procedures to follow, where applicable.

2.7 SEWER AND POTABLE WATER SEPARATION

A. When installed parallel to existing potable water lines, separate sewer lines from potable water lines by at least 10 feet. Where separation distance not achieved, observe the following separation requirements:
   1. When installed parallel to existing potable water line, sewer piping located lower than potable water line with at least 2 feet between outside diameters vertically, and at least 4 feet between outside diameters horizontally.
   2. When crossing existing potable water line, achieve separation of 24 inches between outside diameters of potable and sewer lines. Center one length of sewer pipe on potable water line.

2.8 OTHER UTILITIES

A. Utility facilities, (phone, cable, electric power, gas, etc.), indicated as nearly as possible on Drawings. Contractor responsible, however, to determine locations, or any other facilities at job site, and arrange with respective utility owners any necessary relocation of conflicting facilities. Contractor contacts all utility owners so respective utilities can be located before any excavation. Contractor is responsible to coordinate all locating efforts with utility owners and reflect efforts in construction schedule.

B. Water and Natural Gas Relocation and/or Bypass: Coordinate all water and/or natural gas line relocation or bypass work with owner of line relocated or bypassed per requirements of contract specifications. Design of relocated lines and by-pass lines subject to specific conditions of each location, and approval by Engineer and owner of respective line.

2.9 MARKING TAPE

A. Mark any new or relocated sewer, potable water, natural gas, buried phone, reuse water line, or other utility, by installing appropriate marking tape in trench. Marking tape consists of minimum 4.0-mil inert polyethylene plastic. Tape imprinted continuously over entire length in permanent black ink to identify type of line. Tape to be 6 inches wide and colored High-Visibility Safety Yellow for gas lines, **Red** for electric lines, Blue for water lines, **Brown** for sewer force main lines, **Purple** for reuse water lines, and Green for gravity sewer lines.

B. Mark water line by concurrently installing appropriate marking tape in trench for detection purposes. Marking tape as manufactured by Pro-Line Safety Products, non-detectable marking tape, or equal. Install in trench as recommended by manufacturer and shown on Drawings.

2.10 TRACER WIRE

A. Install tracer wire along top of all distribution pipelines and fire hydrant extensions with test stations as shown on drawing details. Tape tracer wire to top of pipe every 10 feet.

Install tracer wire in one continuous, un-spliced piece between test stations. Perform continuity tests in Engineer's presence to verify wire continuity.

B. Tracer wire to be #12 AWG, HMW-PE insulation, 45 mils, blue, solid copper conductor, Paigespec, Kris-Tech Wire Co., Coleman Cable, or approved equal.

2.11 TESTING PIPE LINES

A. Water Lines: Contractor to clean sterilize, and pressure-test all water lines on completed sections of lines per procedures.

B. Water for Testing: Contractor provides potable water (tank truck, etc.) where necessary to produce specified test pressure. Contractor keeps pipe interior clean during storing, handling, and laying operations to reduce need for flushing to absolute minimum. Tightly cover all open ends when unattended to prevent small animals and dirt from entering pipeline after in place.

C. Hydrostatic Pressure Testing: Following filling line, subject system to leakage test. Contractor furnishes meter, pressure gauges, pump, small piping and hose connections, and all labor necessary for conducting test. Test all lines in Engineer's presence and as follows:

1. After section of pipeline is filled, pump water into section and raise pressure to 150 psi. Maintain test pressure at least two hours.
2. Deliver water required to maintain pressure into pipe through water meter. Total leakage is amount of water registered on meter at end of two-hour test period. Test pressure shall not vary ±5 psi for duration of test. If it does, repeat test until criteria is met. Should leakage exceed allowable amount as specified, Contractor shall repair as required until actual leakage, as determined by succeeding tests, is not greater than allowable as determined by formula:

(PVC)

$$L = \frac{S\,D\sqrt{P}}{148{,}000}$$

(DIP)

$$L = \frac{N\,D\sqrt{P}}{7{,}400}$$

in which:

L = Allowable Leakage in gallons/hour.
S = Length of pipe in feet.
D = Inside diameter of pipe in inches.
P = Test pressure, in pounds per square inch, gage.
N = Number of joints in length of pipe tested.

D. Disinfection: Before acceptance for operation, sterilize each unit of completed water system as specified or prescribed by AWWA Standard C651-05. Thoroughly flush unit to sterilize with water until all entrained dirt and mud removed and before introducing chlorinating material. Chlorinating material to be liquid chlorine per AWWA B301 or hypochlorite conforming to AWWA B300. Chlorinating material provides dosage of not less than 50 parts per million and introduced into waterline in approved manner. Retain treated water in pipe long enough to destroy all non-spore-forming bacteria. Except where shorter period approved, retention time shall be at least 24 hours and produce not less than 10 ppm of chlorine at extreme end of line at end of retention period. Open and close all valves on lines sterilized several times during contact period. After sterilization, drain or flush water mains and before placing into service, sample for bacteriological analysis per Department of Health Standards. Contractor provide means for draining and disposing water, at Contractor expense. Do not inconvenience public when disposing water.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 02741 - HOT-MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hot-mix asphalt paving patching.
   2. Asphalt surface treatments.
   3. Pavement-marking paint.
   4. Cold milling existing hot-mix asphalt pavement.
   5. Construction detours.
   6. Asphalt stabilized base.

B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 02201 – Excavation, Grading, and Subgrade Preparation.
   3. Section 02764 - Pavement Joint Sealants.

1.2 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D8 for definitions of terms.

B. TxDOT: Texas Department of Transportation - Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 2004.

1.3 REFERENCES

A. AASHTO M248 - Standard Specification for Ready-Mixed White and Yellow Traffic Paints.

B. AASHTO T102 - Spot Test of Asphaltic Materials.

C. AASHTO T245 - Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.

D. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.

E. AI MS-22 - Construction of Hot Mix Asphalt Pavements.

F. ASTM C117 - Materials Finer than 75-Micrometer (No. 200) Sieve in Mineral Aggregates by Washing.

G. ASTM C127 - Specific Gravity and Absorption of Coarse Aggregate.

H. ASTM C128 - Specific Gravity and Absorption of Fine Aggregate.

I. ASTM C131 - Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

J. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates.

K. ASTM C188 - Density of Hydraulic Cement.

L. ASTM C29/C29M - Unit Weight and Voids in Aggregate.

M. ASTM C88 - Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

N. ASTM D1073 - Fine Aggregate for Bituminous Paving Mixtures.

O. ASTM D1075 - Effect of Water on Cohesion of Compacted Bituminous Mixtures.

P. ASTM D1188 - Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens.

Q. ASTM D1559 - Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.

R. ASTM D2027 - Standard Specification for Cutback Asphalt (Medium-Curing Type).

S. ASTM D2041 - Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
T. ASTM D2172 - Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.
U. ASTM D242 - Mineral Filler for Bituminous Paving Mixtures.
V. ASTM D2726 - Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
W. ASTM D2950 - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.
X. ASTM D3381 - Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
Y. ASTM D3405 - Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements.
Z. ASTM D3549 - Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
AA. ASTM D546 - Sieve Analysis of Mineral Filler for Road and Paving Materials.
BB. ASTM D692 - Coarse Aggregate for Bituminous Paving Mixtures.
CC. ASTM D70 - Specific Gravity of Semi-Solid Bituminous Materials.
DD. ASTM D75 - Sampling Aggregates.
EE. ASTM D854 - Specific Gravity of Soils.
FF. ASTM D946 - Penetration-Graded Asphalt Cement for Use in Pavement Construction.
GG. ASTM D979 - Sampling Bituminous Paving Mixtures.
HH. ASTM D995 - Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
II. TEX-126-E - Molding, Testing and Evaluating Bituminous Black Base Materials.
JJ. TEX-204-F - Design of Bituminous Mixtures.
KK. TEX-224-F - Determining Flakiness Index.
LL. TxDOT Item 300 - Asphalt, Oils and Emulsions.
MM. TxDOT Item 301 - Asphalt Antistripping Agents.
NN. TxDOT Item 320 - Equipment for Asphalt Concrete Pavement.
OO. TxDOT Item 340 - Specification for Dense-Graded Hot-Mix Asphalt (Method).
PP. TxDOT Item 662 - Work Zone Pavement Markings.
QQ. TxDOT Item 666 - Reflectorized Pavement Markings.
RR. TxDOT Item 672 - Raised Pavement Markers.

1.4 SUBMITTALS

A. Product Data for each type of product indicated. Include technical data and tested physical and performance properties.
B. Job-Mix Designs: Submit job-mix design for approval before preparing and placing bituminous mixture. Design mix using procedures contained throughout this section with materials as specified. Formulas indicate physical properties of mixes as shown by tests made by commercial laboratory approved by Engineer, using materials identical to those provided. Submit formulas with material samples. Job-mix formula for each mixture in effect until modified in writing by Contractor and approved by Engineer. Provide new job-mix formula for each source change. Job mix is for this specific project. Job mixes developed for other projects, although similar requirements, subject to review and approved/denied by Engineer.
C. Qualification Data: Submit qualifications for product manufacturers.
D. Material Test Reports
   1. Specific gravity test of asphalt;
   2. Coarse aggregate tests;
   3. Weight of slag test;
   4. Percent of crushed pieces in gravel;

5. Fine aggregate tests;
6. Specific gravity of mineral filler;
7. Bituminous mixture tests;
8. Aggregates tests;
9. Bituminous mix tests; and
10. Pavement courses.

E. Product Submittals: Pavement marking materials.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified per ASTM D3666 for testing indicated, as documented per ASTM E548.

B. Mock-Up Test Section: Before full production of binder and wearing course, prepare quantity of bituminous mixture per job-mix formula. Construct test section, 200 feet long by not less than 10 feet wide and same compacted depth specified for constructing course the test section represents. Place test section within required project/plan limits as specified, but Contractor required to remove and replace based on required testing samples or as Engineer approves. Underlying grade or pavement structure upon test section to construct, shall be same as remainder of course represented by test section. Equipment used in constructing test section to be same type and weight used on remainder of course represented by test section. Test no less than two samples of mixture produced at plant for gradation, asphalt cement content, stability, flow, air voids, voids in mineral aggregate, and weight. Obtain no less than three cores from test strip for density and thickness tests. Check test section for smoothness and finish surface texture. If test section proves unsatisfactory, make necessary adjustments to mix design, plant operation, transportation, laydown, and/or rolling procedures. Construct and evaluate additional test sections, as required, per specified requirements. When test sections do not conform to specified requirements, remove and replace bituminous pavement. Marginal quality test section placed in area of little or no traffic, may be left in place. If second test section does not meet specified requirements, remove both sections at Contractor expense. Do not begin full production without Engineer approval.

C. Required Data. Job-mix formula shall show:
1. Source and proportions, percent by weight, of each ingredient of mixture;
2. Correct gradation, percentages passing each size sieve listed in specifications for mixture to use, aggregate and mineral filler from each separate source, and each different size to use in mixture and composite mixture;
3. Amount of material passing No. 200 sieve determined by dry sieving;
4. Number of blows of hammer compaction per side of molded specimen;
5. Temperature viscosity relationship of asphalt cement;
6. Stability, flow, percent voids in mineral aggregate, percent air voids, unit weight;
7. Asphalt absorption by aggregate;
8. Effective asphalt content as percent by weight of total mix;
9. Temperature of mixture immediately upon completion of mixing;
10. Asphalt viscosity grade and/or penetration range; and
11. Curves for asphalt stabilized base and hot-mix asphalt paving courses.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspect delivered materials to site for damage and store with minimum handling. Store aggregates to prevent segregation, contamination, or intermixing different aggregate sizes. Unless otherwise approved, do not store mixture long enough to affect quality of mixture,

nor in any case longer than 12 hours. If temperature of any HMAC, measured while passing through lay-down machine, is ±25 degrees F from mixing temperature, reject load.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet, excessively damp, or the following conditions not met:
   1. Prime and Tack Coats: Minimum surface temperature of 60 degrees F.
   2. Asphalt Base Course: Minimum surface temperature of 40 degrees F and rising at time of placement.
   3. Asphalt Surface Course: Minimum surface temperature of 60 degrees F at time of placement.

1.8 MIXING PLANT

A. Provide mixing plant able to meet Project needs.
B. Plant shall never hinder Project progress.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate General: Use materials and gradations that previously performed satisfactorily.
   1. Coarse Aggregate to conform to ASTM D692.
      a. Coarse aggregate is material retained on No. 4 sieve and consists of clean, tough, durable fragments of crushed stone or crushed gravel of uniform quality. Mixing or combining crushed gravel and stone not permitted. Coarse aggregate crushed to extent to produce minimum 55percent crushed faces when tested per ASTM D692. Course aggregate crushed to produce minimum 85 percent crushed faces for Types C and D HMAC.
      b. Coarse aggregate has maximum 20 percent loss when subjected to five cycles of Magnesium Sulfate Soundness Test ASTM C88. Amount of organic matter, clays, loams, or particles coated, or other undesirable materials, shall not exceed 2 percent. When subjected to Los Angeles Abrasion test, coarse aggregate shall not have loss greater than 40 percent by weight.
      c. Coarse aggregate enhanced by adding recycled asphaltic pavement (RAP). Material to be clean without foreign materials producing crushed aggregate per specifications.
   2. Fine Aggregate conforms to ASTM D1073.
      a. Fine aggregate is part of material passing No. 10 sieve with uniform quality throughout. Maximum 15 percent of total virgin aggregate may be field sand or other crushed fine aggregate. Screenings to be same or similar material as specified for course aggregate.
      b. Sand is composed of durable stone particles free from injurious foreign matter. Screenings are same or similar material as for coarse aggregate.
   3. Mineral Filler conforms to ASTM D242 and consists of thoroughly dry stone dust, Portland cement, or other Engineer-approved material dust. Mineral filler to be free of foreign and other injurious matter and meet the following gradation:
      a. Percent by Weight Retained on No. 30 Sieve: 95-100.
      b. Percent by Weight Retained on No. 80 Sieve: 75 minimum.
      c. Percent by Weight Retained on No. 200 Sieve: 55 minimum.

B. Asphalt
   1. Grade 64-22 or better, AASHTO Performance Graded Binder Specification (MP1).
   2. Contractor notifies Engineer of source of asphaltic material for approval before production of asphaltic mixture.
   3. Optimum asphalt content determined by Test Method Tex 204-F.
   4. Asphalt content will be ±0.3 percent of design during production. When asphalt content falls outside parameters, immediate action required.
   5. If asphalt content falls to 0.5 percent, immediately cease production until Contractor provides sufficient evidence of problem corrected.

C. Prime Coat: Prime surface using application of 0.20 to 0.30 gallons per square yard of MC asphalt conforming to ASTM D2027 – MC 30.

D. Tack Coat: Asphaltic material for tack coat to meet requirements for slow-rate cure SS-1 emulsified asphalt, medium-rate cure MS-1 emulsified asphalt, or PG grade asphalt as used in HMAC Surface Course. All vertical joints to be tack coated.

E. Joint Sealant: ASTM D3405 or AASHTO M 301, hot-applied, single-component, polymer-modified bituminous sealant.

F. Emulsified Asphalt Sealer: All ASB surface courses sprayed with emulsified asphalt sealer consisting of 15/85 mixture of MS-2, or 20/80 SS-1, liquid anionic asphalt and distilled water. Apply emulsified asphalt sealer after HMAC surface cools to below 70 degrees F, at a rate of 0.10 to 0.12 gallons per square yard of surface.

G. Mix Design
   1. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction, designed per procedures in AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types, providing mixes with a history of satisfactory performance in geographical area where Project located.
   2. Base Course/Temporary Pavement
      a. Hot-Mix Base is a compacted mixture of graded gravel aggregate and asphalt cement mixed hot in mixing plant per TxDOT Standard Specifications, 2004, Item 340 Dense-Graded Hot-Mix Asphalt (Method), Type B (fine base), using Texas gyratory compaction method (TX206-F).
      b. Contractor provides current mix design using approved materials indicating gradation and optimum asphalt content. Aggregate mixture conforms to the following master gradation:

Sieve Size	1”	7/8”	5/8”	3/8”	#4	#10	#40	#80	#200
Percent Retained by Weight	0	95-100	75-95	60-80	40-60	27-40	10-25	3-13	1-6

      c. Material passing #40 sieve is known as soil binder and meets these requirements:
         1) Liquid Limit shall not exceed 45.
         2) Plasticity Index shall not exceed 15.
         3) Linear Shrinkage shall not exceed 5.
      d. Mineral aggregate shall not contain more than 0.5 percent moisture before entering pugmill to mixing with asphalt.
      e. ASB mixture is a uniform mixture of mineral aggregate and asphaltic material. Mineral aggregate conforms to gradation requirements specified. Percent asphaltic material determined per Test Method Tex.-204-F, with target density of 96.5 percent lab-molded density. Asphalt content tolerances will be ±0.3 percent. Outside these parameters, immediately take corrective action. Over 0.5 percent requires immediate cease of production. No more than 20 percent RAP allowed in ASB designs. Percent asphaltic material determined per Test Method Tex.-236F. Asphalt for mixture to meet requirements of TxDOT - Asphalt, Oils, and Emulsions, and performance

graded (PG) 64-22 or better. Engineer must approve grade of asphalt and source before use. Contractor submits mix design prepared by a qualified lab for Engineer approval. Engineer will approve asphalt content to use in mixture after design tests made with aggregate to use. Asphalt content of production mixture during production shall not vary from design more than 0.2 percent dry weight based on total mixture.

3. Surface Course
   a. Hot-mix asphalt concrete surface consists of minimum 1.5-inch-thick compacted mixture of coarse aggregate, fine aggregate, mineral filler, and asphalt cement mixed hot in mixing plant per specifications. Unless otherwise specified, materials and construction conform to TxDOT Item 340 – Dense-Graded Hot-Mix Asphalt Method.
   b. Mix designs per TX204-F with 96 percent lab-molded density using Texas gyratory compaction method, with target VMA (voids in mineral aggregate) determined per type of HMAC utilized. Resubmit designs annually or when material properties change.
   c. Contractor plant and equipment subject to Engineer approval, appropriate, and suitable condition to produce HMAC surface consistently in compliance with specifications. Obtain Engineer approval of source and character of materials before use. Combined mineral aggregate, after final processing by mixing plant and before addition of asphalt and mineral filler, has sand equivalent value of not less than 45 when tested per Test Method Tex 203-F. Flat and elongated slivers of stone for any aggregate shall not exceed 25 percent when tested per Test Method Tex 224-F.
   d. Condition asphaltic mixtures with aggregates which exhibit stripping characteristics with Engineer-approved lime or liquid antistripping agent. Antistripping agents meet requirements of TxDOT Asphalt Anti-Stripping Agents, added at manufacturer-recommended dosage and temperature range.
   e. Contractor provides current HMAC mix design using approved materials, indicating gradation and optimum asphalt content, as determined by Test Method Tex 204-F.
      1) If approved by Engineer, Contractor may furnish alternate mix design based on specific proposed materials. Otherwise, aggregate mixture shall conform to the following master gradation:

Type C (Course-Graded Surface Course, streets greater than 36 feet wide)	
Percent passing 7/8”	100
Percent passing ¾”	95-100
Percent passing 3/8”	70-85
Percent passing No. 4	43-63
Percent passing No. 8	32-44
Percent passing No. 30	14-28
Percent passing No. 50	7-21
Percent passing No. 200	2-7
VMA	Design min. 12%

Type D (Fine-Graded Surface Course, streets 36 feet wide or less)	
Percent passing 1/2”	98-100
Percent passing 3/8”	85-100
Percent passing No. 4	50-70
Percent passing No. 8	35-46
Percent passing No. 30	15-29
Percent passing No. 50	7-20
Percent passing No. 200	2-7
VMA	Design min. 14%

2) Lab-molded density is ±1.0 percent of design before corrective action required. ±1.5 percent requires immediate cease in production operations with removal and replacement of HMAC laid at that location. Production will cease until Contractor sufficiently proves corrective actions.
3) Asphalt content is ±0.3 percent before corrective action required. ±0.5 percent requires immediate cease in production in operations with removal and replacement of HMAC laid at that location. Production will cease until Contractor sufficiently proves corrective actions.
4) Material passing No. 40 sieve known as soil binder and meets the following requirements:
   (a) Liquid Limit shall not exceed 45.
   (b) Plasticity Index shall not exceed 15.
   (c) Linear Shrinkage shall not exceed 5.
5) Mineral aggregate shall not contain more than 0.5 percent moisture before entering pugmill for mixing asphalt. HMAC mixture is a uniform mixture of mineral aggregate and asphalt materials.
6) If approved by Engineer, Contractor may provide alternate mix design based on proposed materials. Contractor materials and mix design shall meet all performance criteria addressed in specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify subgrade is dry and in suitable condition to support paving and imposed loads.
B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas unstable or require further compaction.
C. Proceed with paving only after unsatisfactory conditions are corrected.
D. Surface to be clean and free of loose dirt, rock, or any other foreign matter.

3.2 PRIME COAT

A. Application: Immediately following surface preparation, apply prime coat by bituminous distributor. Apply bituminous material at 25 to 75 pounds per square inch pressure range within temperature limits specified, and at not less than 0.20 nor more than 0.30 gallons of bituminous material per square yard. Apply bituminous material so uniform distribution obtained over entire surface to treat with slight puddling on surface.

B. Curing: Following application of bituminous material, allow surface to cure without disturbing for not less than 48 hours, or longer as necessary, to attain penetration into foundation course and evaporation of volatiles from bituminous material. Furnish and spread enough sand to effectively blot up and cure excess bituminous material. Maintain primed surface until succeeding layer of pavement placed by protecting surface against damage and repairing and re-priming deficient areas.
C. Temperature: Maintain application temperature 68 - 149 degrees F.
D. Protection: Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades to prevent traffic over freshly-treated surfaces.

3.3 TACK COAT

A. Application: Apply tack coat when surface to treat is dry. Immediately following preparation of surface for treatment, apply bituminous material by bituminous distributor, within limits of temperature specified at not less than 0.05 nor more than 0.15 gallon of diluted emulsion per square yard. Apply bituminous material so uniform distribution obtained over entire surface to treat. Treat lightly-coated areas and spots missed by distributor with bituminous material. Following application of bituminous material, allow surface to cure without disturbing for time necessary to permit setting tack coat. Apply bituminous tack coat only as far in advance of placing overlying layer as required for that day's operation. Maintain and protect treated surface from damage until succeeding course of pavement placed.
B. Temperature: Maintain application temperature 122 – 185 degrees F.
C. Material Test: Perform spot test for asphalt per AASHTO T102 on each shipment.
D. Traffic Controls: Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so traffic will not travel over freshly-treated surfaces.

3.4 ASPHALT STABILIZED BASE COURSE (ASB)

A. Do not place ASB when air temperature, as reported by National Weather Service, is below 45 degrees F and falling.
B. Place ASB at 255 - 285 degrees F during June, July, and August. During other months, place ASB at 275 - 325 degrees F.
C. Any ASB material above, or below specified temperature range may be rejected. No payment made for any rejected material.
D. Place and compact ASB in 3-inch lifts, unless Engineer directs otherwise. Place material so when properly compacted, finished course is smooth, uniform density, and in conformance with required cross-sections and grades.
E. Compact ASB thoroughly and uniformly with approved rollers to a density of 90.1 to 97.3 percent in place air voids with lab-molded target of 96.5 ±1 percent. All results calculated using maximum theoretical rice gravity. Lab mold per asphalt manufacturer’s recommended temperature. Rolling patterns set by using thin lift nuclear gauge to ensure maximum compaction. Remove and compact all roller marks completed before ASB mixture cools below 185 degrees F.

3.5 JOINTS

A. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to all joints.

2. Offset longitudinal joints, in successive courses, minimum 6 inches.
3. Offset transverse joints, in successive courses, minimum 24 inches.
4. Construct transverse joints as described in AI MS-22 - Construction of Hot-Mix Asphalt Pavements.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to density within 2 percent of specified course density.

3.6 COMPACTION

A. Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers. Complete compaction before mix temperature cools to 185 degrees F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin immediately after breakdown rolling while hot-mix asphalt still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course is uniformly compacted to 95 – 98 percent of Marshall density with 2 – 5 percent air voids.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt still warm.

E. Edge Shaping: While surface is compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt still hot. Compact thoroughly.

F. Repairs: Remove paved areas, defective or contaminated with foreign materials, and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it cools and hardens.

H. Erect barricades to protect paving from traffic until mixture cools enough not to be marked.

3.7 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce thickness indicated within these tolerances:
   1. Base Course: ±1/2 inch.
   2. Surface Course: +1/4 inch (no minus).

B. Surface Smoothness: Compact each course to produce surface smoothness within following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
   1. Base Course: 1/4 inch.
   2. Surface Course: 1/8 inch.
   3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Contractor performs field tests, inspections, and prepares test reports. Testing agency conducts and interpret tests and states in each report if tested work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor expense, performed to determine compliance of replaced or additional work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses determined per ASTM D3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement per ASTM D979 or AASHTO T168.

1. Reference maximum theoretical density determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared per ASTM D2041, and compacted per job-mix specifications.

2. In-place density of compacted pavement determined by testing core samples per ASTM D1188 or D2726. One core sample taken for every 2,000 square yards or less of installed pavement.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate noncompliance with specified requirements.

G. Owner may take confirmation tests at Owner expense. Contractor to cooperate with Owner's testing agency. Failing tests taken at Owner direction, charged to Contractor. Failing test charges include pro-rata technician charges, actual failing test charge, pro-rata mileage charge, and other pro-rated charges.

3.9 DISPOSAL

A. Dispose of excess materials per requirements of Section 01700 – Execution Requirements. Do not allow excavated materials to accumulate onsite.

END OF SECTION

SECTION 02751 - PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes concrete pavement, curb and gutter, driveways (alleys), and sidewalks, and applies to Contractor installation of transfer station concrete pavement driveways.

B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 02201 – Excavation, Grading, and Subgrade Preparation.
   3. Section 02221 – Excavating, Backfilling, and Compacting for Utilities.
   4. Section 02741 – Hot-Mix Asphalt Paving.
   5. Section 02764 – Pavement Joint Sealants.
   6. Section 03300 – Cast-in-Place Concrete.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and/or silica fume.

B. TxDOT: Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 2004.

C. DMS: TxDOT Department of Material Specifications.

1.3 SUBMITTALS

A. Submit product data per Section 01330 – Submittal Procedures.

B. Product Data: For each type of manufactured material and product indicated.

C. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Design indicates target unit weight of mix. Do not allow mix design to be more than 30 days old without Engineer approval.

D. Design mix submittals include:
   1. Fine aggregate gradation.
   2. Course aggregate gradation.
   3. Loss from five-cycle magnesium sulfate or sodium sulfate test on all aggregate.
   4. Cement content.
   5. Fly ash content.
   6. Water content.
   7. All admixtures.
   8. Maximum slump.
   9. Percent air entrainment.
   10. Seven-day flexural strength.
   11. Seven-day compressive strength.
   12. 28-day compressive strength.

E. Material Test Reports: Qualified testing agency indicates and interprets test results for compliance of the following with requirements indicated, based on flexural and comprehensive testing current materials:
   1. Cementitious materials and aggregates.
   2. Steel reinforcement and reinforcement accessories.

3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or adhesive.
8. Joint fillers.

F. Paving and Quality Control Plan. Submit paving and quality control plan for approval before beginning pavement construction operations. Include details of all operations in the concrete paving process, including longitudinal construction joint layout, sequencing, curing, lighting, early opening, leave-outs, sawing, inspection, testing, construction methods, other details and description of all equipment. List certified testing personnel. Submit revisions to paving and quality control plan for approval.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Experienced installer who completed pavement work similar in material, design, and extent to that indicated for this Project and work resulted in construction with record of successful in-service performance.

B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
1. Manufacturer must be certified per National Ready Mix Concrete Association's Plant Certification Program.
2. Inspection report signed and sealed by licensed professional engineer showing concrete measuring, mixing, and delivery equipment meets all requirements of ASTM C94. New certification (or signed and sealed report) required every time plant move. Provide Engineer copy of certification (or signed and sealed inspection report).
3. When equipment or facilities fail to meet specification requirements, remove from service until corrected.

C. Testing Agency Qualifications: Independent and acceptable to authorities having jurisdiction.

D. Source Limitations: Obtain each type or class of cementitious material of same brand from same manufacturer's plant and each aggregate from one source. For changes in material, brand, source, or chemical admixtures, reevaluate mix as new mix design.

E. ACI Publications: Comply with ACI 301 - Specification for Structural Concrete, unless modified by Contract Documents requirements. Refer to Section 03300 – Cast-In-Place Concrete, for additional codes and standards.

F. Concrete Testing Service: Engage qualified independent testing agency to perform material evaluation tests and design concrete mixes.

1.5 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities and emergency services.

PART 2 - PRODUCTS

2.1 FORMS

A. Pavement Forms: Provide metal side forms of sufficient cross section, strength, and rigidity to support paving equipment. Resist impact and vibration of operation without

visible springing or settlement. Use forms free from kinks, bonds, or warps that affect ride quality or alignment.

1. Use flexible or curved forms for curves of 100-foot radius or less.
2. Forms should be no less than 10 feet in length.

2.2 PLACING, CONSOLIDATING, AND FINISHING EQUIPMENT

A. Provide approved self-propelled paving equipment to uniformly distribute concrete with minimal segregation, providing smooth machine-finished consolidated concrete pavement conforming to plan line and grade. Provide approved, automatic-grade control system on slip-forming equipment. Provide approved mechanically-operated finishing floats able to produce uniformly-smooth pavement surface. Provide equipment to provide fine, light water fog mist.

B. Provide mechanically-operated vibratory equipment to adequately consolidate concrete. Provide immersion vibrators on paving equipment at sufficiently close intervals to provide uniform vibration and consolidation of concrete over entire width and depth of pavement per manufacturer recommendations. Provide immersion vibrator units to operate at 8,000-cycle-per-minute frequency in air. Provide enough hand-operated immersion vibrators for timely and proper consolidation of concrete along forms, at joints, and in areas not covered by other vibratory equipment. Use surface vibrators to supplement equipment-mounted immersion vibrators. Provide tachometers to verify proper operation of all vibrators.

C. For small or irregular areas or when approved, paving equipment described in this Section not required.

2.3 REINFORCING STEEL INSERTING EQUIPMENT

A. Do not use inserting equipment in place of two-piece tie bars or drilled and epoxy bars.

2.4 TEXTURING EQUIPMENT

A. Carpet Drag. Provide mounted on work bridge or moveable support system. Provide single piece of carpet of sufficient transverse length to span full width of pavement placed, adjustable so sufficient longitudinal length of carpet is in contact with concrete placed to produce desired texture. Obtain approval to vary length and width of carpet to accommodate specific applications. Use an artificial grass-type carpet with molded polyethylene pile face and blade length of 5/8 - 1 inch, minimum 70-ounce weight per square yard, and strong, durable, rot-resistant backing material bonded to facing.

B. Tining Equipment. Provide self-propelled transverse metal tine device equipped with 4- to 6-inch steel tines with cross-section approximately 1/32 inch thick x 1/12 inch wide, spaced at 1 inch, center-to-center. Only use hand-operated tining equipment to produce equivalent texture on small or irregularly-shaped areas or when permitted in emergencies due to equipment breakdown.

2.5 CURING EQUIPMENT

A. Provide self-propelled machine to apply membrane-curing compound using mechanically-pressurized spraying equipment with atomizing nozzles. Provide equipment and controls that maintain required uniform rate of application over entire paving area. Provide curing equipment independent of all other equipment when production rates are so first application of membrane curing compound not accomplished immediately after texturing and after free moisture disappears. Only use hand-operated pressurized spraying

equipment with atomizing nozzles on small or irregular areas or when permitted in emergencies due to equipment breakdown.

2.6 SAWING EQUIPMENT

A. Provide power-driven concrete saws for joints shown on plans. Provide standby power-driven concrete saws during concrete-sawing operations. Provide adequate illumination for nighttime sawing.

2.7 GRINDING EQUIPMENT

A. When required, provide self-propelled power-grinding equipment specifically designed to smooth and texture concrete pavement using circular diamond blades. Provide equipment with automatic grade control able to grind at least 3 feet width longitudinally in each pass without damaging concrete.

2.8 TESTING EQUIPMENT

A. Provide testing equipment regardless of job-control testing responsibilities per TxDOT Item 421 - Hydraulic Cement Concrete, unless otherwise shown in plans or specified.

2.9 CORING EQUIPMENT

A. When required, provide coring equipment to extract cores per requirements of Tex-424-A.

2.10 MISCELLANEOUS EQUIPMENT

A. Furnish 10- and 15-foot, steel or magnesium, long-handled, standard straightedges. Furnish enough work bridges, long enough to span pavement, to finish and inspect operations. Furnish date stencils to impress pavement placement dates into fresh concrete, with numerals approximately 2 inches high x 1 inch wide x 1/4 inch deep.

2.11 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A185, fabricated from as-drawn steel wire into flat sheets, shall be 6 x 6 inches, 10-gauge, welded wire fabric, or as shown on plans.
B. Reinforcement Bars: ASTM A615/A615M, Grade 60, deformed.
C. Joint Dowel Bars: Plain steel bars, ASTM A615/A615M, Grade 60. Cut bars true to length with ends square and free of burrs.
D. Tie Bars: ASTM A615/A615M, Grade 60, deformed.
E. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and permit removal without damage to concrete or hook bolt.
F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded-wire fabric, and dowels in place. Manufacture bar supports per CRSI Manual of Standard Practice, from steel wire, plastic, precast concrete, or fiber-reinforced concrete of greater compressive strength than concrete, and:
    1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
    2. Space reinforcing supports at 5 feet, 0 inches maximum in any direction.
    3. Place vertical reinforcement supports drilled into sub-base material to prevent horizontal movement of reinforcing steel.

2.12 CONCRETE MATERIALS

A. Use same brand and type of cementitious material from same manufacturer throughout the Project.

B. Portland Cement: ASTM C150, Types I, II, or III; or ASTM G176 IA, IIA, or IIIA for air entrained. Substitute fly ash up to 30 percent by absolute volume of cement. Portland cement concrete should have minimum seven-day, 3,500-psi compressive strength or minimum 28-day, 4,400-psi compressive strength. Concrete material should comply with TXDOT Standard Specifications 2004, Item 360.

C. Aggregate: ASTM C33, uniformly graded, from single source, as:

1. Class: 4M.
2. Maximum Aggregate Size: 1-1/2 inches nominal.
3. Coarse aggregate for Class C or D concrete to be crushed limestone (Brownwood type or equivalent).
4. Aggregate graded from fine to coarse and conform to ASTM C136. Gradation for aggregate shall meet the following requirements by weight:

Table 1 – AGGREGATE GRADATIONS

FINE AGGREGATE		COARSE AGGREGATE	
Sieve	**Percent Passing**	**Sieve**	**Percent Passing**
3/8 inch	100	2 inch	100
No. 4	95-100	1-1/2 inch	95-100
No. 8	80-100		
No. 16	50-85	3/4 inch	35-70
No. 30	25-60	3/8 inch	10-30
No. 50[A]	5-30	No. 4	0-5
No. 100	0-10		
No. 200[B]	0-3		

[A] Range is 6-35 when sand equivalent volume is greater than 85.
[B] 0-6 for manufactured sand.

a. Maximum amounts of organic impurities conform to ASTM C40 and C87. Maximum amounts of impurities finer than #200 sieve conform to ASTM C117. Maximum amounts of soft particles conform to ASTM C123. Maximum amounts of friable particles conform to ASTM C142.
b. Fine aggregate has sand equivalent of at least 80 per Tex-203-F. Provide fine aggregate with fineness modules between 2.3 and 3.1 per ASTM C33.

5. Protect stockpiles from dusty conditions by drift fences or other methods approved by Engineer. Stockpiling methods used shall not allow aggregate to roll down slope as added to existing stockpiles. Stockpiles to be built-in layers of uniform thickness. Equipment not permitted to operate over same lift repeatedly.
6. Coarse aggregate has maximum 18-percent loss when subjected to five cycles of magnesium sulfate soundness test or maximum 12-percent loss when subjected to five cycles of sodium sulfate soundness test (ASTM C88).
7. Percentage of wear to be no more than 40 when tested per ASTM C131 or C535.
8. Aggregates delivered to mixer consist of crushed stone, crushed gravel, or natural sand. Crushing results in product where coarse aggregate has at least 95 percent by weight of particles with one or more fractured faces and 75 percent by weight of particles with two or more fractured faces. Aggregate is composed of sound, tough, durable particles and meets requirements for deleterious substances in ASTM C33. Aggregate in any size group shall not contain more than 8 percent by weight of flat

or elongated pieces. Flat or elongated particle has ratio between maximum and minimum dimensions of circumscribing rectangular prism exceeding 3 to 1.

D. Water: ASTM C94.

2.13 ADMIXTURES

A. Admixtures certified by manufacturer to contain no more than 0.1 percent water-soluble chloride ions by mass of cement and compatible with other admixtures.
B. Air-Entraining Admixture: ASTM C260. Certified by manufacturer compatible with other required admixtures.
C. Water-Reducing Admixture: ASTM C494, Type A.
D. High-Range, Water-Reducing Admixture: ASTM C494, Types F or G.
E. Water-Reducing and Accelerating Admixture: ASTM C494, Type E.
F. Water-Reducing and Retarding Admixture: ASTM C494, Type D.

2.14 FIBER REINFORCEMENT

A. Use fiber reinforcement in place of wire mesh if approved by Engineer and Owner.
B. Fiber reinforcement is 100 percent virgin polypropylene, collated, fibrillated fibers, to use as concrete reinforcement, containing no reprocessed olefin materials, per ASTM C1116, Type III.
C. Specific gravity: 0.91
D. Tensile Strength: 70,000 - 100,000 psi.
E. Length: 2 inches.

2.15 CURING COMPOUND

A. Liquid-type membrane-forming curing compound with white pigment complying with ASTM C309, Type 2, Class A. Moisture loss not more than 1.0 pounds per square yard when applied at 200 square feet per gallon.

2.16 EPOXY

A. Provide Type III epoxy per DMS-6100 - Epoxies and Adhesives, to install all drilled-in reinforcing steel.

2.17 EVAPORATION RETARDANT

A. Provide evaporation retardant conforming to DMS-4650 - Hydraulic Cement Concrete Curing Materials and Evaporation Retardants.

2.18 JOINT SEALANTS AND FILLERS

A. Provide Classes 5 or 8 joint-sealant materials and fillers unless otherwise shown on plans or approved and other sealant materials of size, shape, and type shown on plans per DMS-6310, Joint Sealants and Fillers.

2.19 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Texture Surface for Ramps
   1. Meet requirements of Texas Accessibility Standards.
   2. Concrete paver units to meet all requirements of ASTM C936, C33, and laid in two-by-two-unit basket-weave pattern.
   3. Color as selected by Owner. Contrast color with the adjacent surfaces.
   4. Durabak with Safti-Traxx Detacable Warning System by Cote-L Distribution Company, or approved equal.
   5. Owner modifies texture surface requirements for ramps any time to comply with Texas Accessibility Standards. No additional compensation made for modification.
C. Bonding Agent: Polyvinyl acetate or acrylic base.
D. Sand Cushion: Clean, manufactured, or natural sand with plasticity index of 8 or less.

2.20 CONCRETE MIXES

A. Prepare design mixes, proportioned per ACI 301, for each type and strength of normal-weight concrete determined by laboratory trial mixes or field experience.
B. Use qualified independent testing agency to prepare and report proposed mix designs for trial batch method. Do not use Owner's field quality-control testing agency as independent testing agency.
C. The following classes of concrete shall be used:
   1. Class A - Curb and gutter, sidewalks, driveways curb ramps.
   2. Class B - Alley paving.
   3. Class C - Concrete street paving, fillets, alley returns, valley gutters.
   4. Class D - N/A.
   5. Class E – Fast-setting concrete pavement like Fast-Track Concrete Pavement or other special design.
D. Proportion mixes provide concrete with water-cementitious materials ratio as shown in Article 2.20.E.2.
E. Mix Design
   1. At least 15 days before beginning any concrete pavement construction, Contractor submits the following for Engineer approval:
      a. Test certificates from approved commercial testing laboratory on all proposed aggregate. Certificates indicate material source, gradation, and loss from five-cycle magnesium sulfate soundness test (not to exceed 18 percent) or loss from five cycles of sodium sulfate soundness test (not to exceed 12 percent).
      b. Mix design based on water-cement ratio.
      c. Results of flexural and compression tests per ASTM C39 and/or flexural tests per ASTM C78, made by approved commercial testing laboratory. Tests made on six cylinders/beams at curing times appropriate to class of concrete.
   2. Engineer approves/rejects mix design and materials based on submittals. Approval subject to additional testing during construction. Mix designs for various classes of concrete conform to:

Table 2 – MIX DESIGN DETAILS

Class	Maximum Water/ Cement Ratio	Maximum Slump (Inches)
A	0.60	4
B	0.60	3
C (slip formed)	0.45	3
C (formed)	0.45	6
E	0.45	As specified by concrete batch plant

F. Strength Requirements. Test at least three sets of design strength specimens with two specimens per set. Various classes of concrete to conform to these strengths in psi as determined by average of two test cylinders and beams:

Table 3 – TEST CYLINDERS AND BEAMS AVERAGES

Class	3-Day	COMPRESSIVE		FLEXURAL	
		7-Day	28-Day	7-Day	28-Day
A		2,100	3,000	425	
B	2,500	3,000		280	
C		3,500	4,400	570	680
D					
E	2,600 (24-hour)	Unless otherwise specified		400 (24-hour)	

G. Properties
1. Air Entrainment: 4-percent ASTM C260. If air content more than 1 percentage points below or above required air, reject load of concrete.
2. Synthetic Fiber: Use manufacturer-recommended rate, but not less than 1.0 pound per cubic yard (where applicable).
3. Fly ash: Not more than 30 percent by absolute volume of cement.

2.21 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with ASTM C94 and C1116 requirements when synthetic fibers involved. When air temperature is 85 - 90 degrees F, reduce mixing and delivery time from 90 to 75 minutes. When air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes. Mixing and delivery time starts at time of batching.

B. Project-Site Mixing: Comply with requirements and measure, batch, and mix concrete materials and concrete per ASTM C94. Mix concrete materials appropriately and as approved by Engineer.
1. For 1-cubic-yard or smaller capacity mixers, continue mixing at least 90 seconds, but not more than five minutes after ingredients in mixer, before any part of batch is released.
2. For mixers of capacity larger than 1 cubic yard, increase mixing time by 15 seconds for each additional 1 cubic yard.
3. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water added. Batch ticket also indicates batching operation variances per ACI 304R.
   a. Cement/supplementary cementitious material within ±1 percent of desired weight.
   b. Aggregates measured within ±2 percent of desired weight (±1 percent when cumulative weight taken).
   c. Allowable water adjusted for free moisture in aggregates.
   d. Admixtures discharged separately within volumetric tolerance of ±3 percent using method that not allowing concentrated admixtures to contact each other.
4. When using non-agitating equipment for transporting concrete, provide equipment with smooth, mortar-tight metal containers equipped with gates to prevent accidental discharge of concrete.

PART 3 - EXECUTION

3.1 PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions are corrected and subgrade ready to receive pavement.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 PLACING AND REMOVING FORMS

A. Use clean and oiled forms. Secure forms on base or firm subgrade accurately graded and provides stable support without deflection and movement by form riding equipment. Pin every form at least at middle and near each end. Tightly join and key form sections together to prevent relative displacement.

B. Set side forms far enough in advance of concrete placement to permit inspection. Check conformity of form grade, alignment, and stability immediately before placing concrete, and make all necessary corrections. Use straightedge or other approved method to test top of forms to ensure ride quality requirements for completed pavement is met. Stop paving operations if forms settle or deflect more than 1/8 inch under finishing operations. Reset forms to line and grade and refinish concrete surface to correct grade.

C. Avoid damage to edge of pavement when removing forms. Repair damage resulting from form removal and honeycombed areas with mortar mix within 24 hours after form removal unless otherwise approved. Clean joint face and repair honeycombed or damaged areas within 24 hours after bulkhead for transverse construction joint is removed unless otherwise approved. When forms removed before 72 hours after concrete placement, promptly apply membrane curing compound to edge of concrete pavement.

D. Forms not same depth as pavement but within 2 inches of depth, permitted if subbase is trenched or full width and length of form base supported with firm material to produce required pavement thickness. Promptly repair form trench after use. Use flexible or curved wood or metal forms for curves of 100-foot radius or less.

3.3 STEEL REINFORCEMENT

A. Comply with CRSI Manual of Standard Practice, for fabricating reinforcement and with recommendations in CRSI Placing Reinforcing Bars, for placing/supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. 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.

3.4 JOINTS

A. Reinforcing Steel and Joint Assemblies: Accurately place and secure in position all reinforcing steel as shown on plans. Place dowels at mid-depth of pavement slab, parallel to surface. Place dowels for transverse contraction joints parallel to pavement edge. Tolerances for location and alignment of dowels shown on plans. Stagger longitudinal reinforcement splices to avoid more than a third of splices within a 2-foot longitudinal

length of each lane of pavement. Use multiple-piece tie bars or drill and epoxy-grout tie bars at longitudinal construction joints. Verify tie bars drilled and epoxied into concrete at longitudinal construction joints, develop pullout resistance equal to minimum 3/4 yield strength of steel after seven days. Test 15 bars using ASTM E488, except alternate approved equipment used. All 15 tested bars must meet required pullout strength. If any test result does not meet required minimum pullout strength, perform corrective measures to provide equivalent pullout resistance. Repair damage from testing. Acceptable corrective measures include but are not limited to installation of additional or longer tie bars.

B. Construct isolation, contraction, construction joints, and tool edgings true-to-line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

C. Construction Joints: Set at side and end terminations of pavement and where pavement operations stop more than half an hour, unless pavement terminates at isolation joints.
   1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
   2. Provide tie bars at sides of pavement strips where indicated.
   3. Use bonding agent where fresh concrete placed against hardened or partially-hardened concrete surfaces.

D. Isolation Joints: Form of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
   1. Extend joint fillers full width and depth of joint.
   2. Terminate joint filler less than 1/2 or more than 1 inch below finished surface if joint sealant indicated.
   3. Place top of joint filler flush with finished concrete surface if joint sealant not indicated.
   4. Furnish joint fillers in one-piece lengths. Where more than one length required, lace or clip joint-filler sections together.
   5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete is placed on both sides of joint.

E. Curb and Gutter
   1. Place 3/4-inch, premolded expansion joints at tangent point of each return at intersections and intervals not more than 40 feet between intersections.
   2. Locate construction joints of at least 3/4-inch depth at 10-foot intervals.

F. Sidewalk
   1. Place 3/4-inch expansion joint material where new construction abuts existing structure, sidewalk, etc.
   2. Place expansion joints at 36-foot spacing (max).
   3. Place weakened plane joints at 5-foot spacing (max); 1/4 inch wide x 3/4 inch deep.

G. Driveways and Pavements
   1. Install dowel bars and support assemblies at joints. Dowel bar spacing and size as directed by Engineer. Lubricate or asphalt-coat half of dowel length to prevent concrete bonding to one side of joint.
   2. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
      a. Radius: 1/4 inch.
      b. Bottom Width: 3/8 inch.

c. Top Width: 3/4 inch.
d. Depth: 1 5/8 inch.

3.5 CONCRETE DELIVERY

A. Clean delivery equipment as necessary to prevent accumulation of old concrete before loading fresh concrete. Use agitated delivery equipment for concrete designed for slump more than 5 inches. Segregated concrete subject to rejection. Place agitated concrete within 60 minutes after batching. Place non-agitated concrete within 45 minutes after batching. In hot weather or under conditions causing quick-setting concrete, Engineer may reduce times. Time limitations extended if Contractor demonstrates concrete is properly placed, consolidated, and finished without using additional water.

3.6 CONCRETE PLACEMENT

A. For all roadway lane pavement, construct pavement with approved slip-form paving machine designed to spread, consolidate, screed, and float-finish freshly-placed concrete in one complete pass of machine so dense and homogeneous pavement achieved with minimum hand finishing. Paver-finisher to be heavy-duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements.

B. Individual placement areas of less than 500 square yards, or irregular areas where inaccessible to slip-form paving equipment, place cement concrete pavement with approved placement and finishing equipment utilizing stationary side forms. Only utilize hand screeding and float finishing on small irregular areas as allowed by Engineer.

C. Concrete Placement: Do not allow pavement edge to deviate from established paving line by more than 1/2 inch at any point. Place concrete as near as possible to final location, minimize segregation and rehandling. Where hand spreading necessary, distribute concrete using shovels. Do not use rakes or vibrators to distribute concrete.
   1. Pavement: Consolidate all concrete by approved mechanical vibrators operated front of paving equipment. Use immersion-type vibrators to simultaneously consolidate full width of placement when machine finishing. Keep vibrators from dislodging reinforcement. Use hand-operated vibrators to consolidate concrete in areas inaccessible to machine-mounted vibrators. Do not operate machine-mounted vibrators while paving equipment is stationary. Vibrator operations subject to review.

D. Curbs and Gutters: When automatic machine placement used for curb and gutter placement, submit revised mix design and laboratory test results meeting/exceeding requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

E. When adjoining pavement lanes placed in separate pours, do not operate equipment on concrete until pavement attains 85 percent of 28-day compressive strength.

F. Cold-Weather Placement: Comply with ACI 306.1. Protect concrete work from physical damage or reduced strength caused by frost, freezing actions, or low temperatures.
   1. When air temperature falls to, or is expected to fall below, 40 degrees F, uniformly heat water and aggregates before mixing to obtain concrete mixture temperature not less than 50 nor more than 80 degrees F at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

G. Hot-Weather Placement: Place concrete per recommendations in ACI 305R and as follows when hot-weather conditions exist:
   1. Cool ingredients below 90 degrees F before mixing to maintain concrete temperature at placement. Used chilled mixing water or chopped ice to control temperature, if water equivalent of ice is calculated to total amount of mixing water. Contractor may use liquid nitrogen to cool concrete.
   2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

H. Date Imprinting: Imprint dates in fresh concrete indicating date of concrete placement. Make impressions approximately 1 foot from outside longitudinal construction joint or edge of pavement and approximately 1 foot from transverse construction joint beginning placement day. Orient impressions to be read from outside shoulder in direction of final traffic. Impress date in DD-MM-YY format. Imprinting Contractor name or logo in similar size characters to date is allowed.

3.7 CONCRETE FINISHING

A. Finish all concrete pavement with approved self-propelled equipment. Use power-driven spreaders, vibrators, strike-off, and screed, or approved alternate equipment. Use transverse finishing equipment to compact and strike off concrete to required section and grade without surface voids. Use float equipment for final finishing. Use concrete with consistency to allow completing all finishing operations without adding water to surface. Use minimal amount of water fog mist necessary to maintain a moist surface. Reduce fogging if float or straightedge operations result in excess slurry.
   1. Finished Surface: As soon as concrete hardens sufficiently, test pavement surface in transverse direction with 16-foot straightedge or another specified device. Surface smoothness deviations shall not exceed 1/4 inch from 16-foot straightedge at any location, including placement along and spanning any pavement joint or edge.
      a. Mark areas in slab showing high spots more than 1/4 inch but not exceeding 1/2 inch in 16 feet and immediately ground down with approved grinding machine to elevation falling within tolerance of 1/4 inch or less. Where departure from correct cross section exceeds 1/2 inch, Engineer will direct Contractor to remove and replace pavement at Contractor expense.
      b. In addition to 16-foot straight edge, Contractor furnishes an approved profilograph and competent operator to measure longitudinal pavement surface deviations. Operate profilograph under Engineer supervision and per manufacturer's instructions. Operate profilograph at speed no greater than normal walk. Original profilograms for appropriate locations interpreted per ASTM E1274, furnished to Engineer. Record profilograms on a scale of 1 inch = 25 feet longitudinally and 1 inch = to 1 inch or full scale vertically. Maintain records showing all smoothness measurements.
         1) Test and evaluate surface pavements of continuous placement of 50 feet or more as described. Make two passes in each paving lane greater than 20 feet in width; each pass at 6 feet from and parallel with centerline of paving lane. Consider the average of two passes as profilograph result for paving lane. For paving lanes less than 20 feet in width, one pass along centerline required. Run tests next working day following concrete placement. Completely label each trace to show paving lane, wheel pass, and stationing.

2) Contractor furnishes paving equipment and employs methods to produce riding surface for each section of pavement with average profile index meeting requirements of Article 3.11.5. Consider a typical subsection width of paving lane and 1/10 mile long. Determine profile index per ASTM E1274 using 0.2-inch blanking band. Within each 1/10th mile subsection, Contractor removes all areas represented by high points with deviation more than 0.4 inch in 25 feet or less using approved grinding device or device with multiple diamond blades. Do not use bush hammer or other impact devices. After removing all individual deviations more than 0.4 inch, perform additional corrective work if necessary to achieve required ride quality. Complete all corrective work before determining pavement thickness.

3) On pavement subsections where corrections necessary, perform second profilograph runs to verify corrections produced an average profile index of 15 inches per mile or less. If initial average profile index was less than 15, only reprofile areas representing greater than 0.4-inch deviation for correction verification.

4) When average profile index does not exceed 7.0 inches per mile, make payment for section at contract unit price for completed pavement. When average profile index exceeds 7.1 inches per mile but not 15 inches per mile, Contractor may elect to accept contract unit price adjustment in lieu of reducing profile index.

5) Straight edge individual sections shorter than 50 feet and last 15 feet of any section Contractor not responsible for adjoining section, with 16-foot straightedge or other specified device. Surface smoothness deviations to meet acceptable criteria as shown.

6) For a 250-foot or less section, include profilogram for that section in evaluating previous section. For independently-placed section of 50 to 250-feet in length, make a profilogram and pay adjustment factors for short sections of Article 3.11.5 apply.

7) Perform any corrective work required before joint sealing and grooving.

8) All cost necessary to provide profilograph and related to furnishing appropriate profilograms as required, are incidental to concrete pavement construction and no direct compensation made therefore.

2. Maintenance of Surface Moisture: Prevent surface drying of pavement before applying curing system by fog application of evaporation retardant on pavement surface. Apply evaporation retardant at manufacturer-recommended rate. Reapply evaporation retardant as needed to maintain a moist concrete surface until curing system applied. Do not use evaporation retardant finishing aid. Failure to take acceptable precautions to prevent surface drying of pavement, is cause for shutdown of pavement operations.

3. Surface Texturing: Perform surface texturing using combination of carpet drag and metal tining. Complete final texturing before concrete attains initial set. Draw carpet drag longitudinally along pavement surface with carpet contact surface area adjusted to provide satisfactory coarsely-textured surface. A metal-tine texture finish required unless otherwise shown on plans. Provide metal-tine finish immediately after concrete surface set enough for consistent tining. Operate metal-tine device to obtain grooves spaced at 1 inch, approximately 3/16-inch deep, with minimum1/8-inch depth and approximately 1/12-inch wide. Do not overlap previously-tined area. Use manual methods to achieve similar results on ramps and other irregular sections of

pavements. Repair damage to edge of slab and joints immediately after texturing. Do not tine overlay pavement. Metal-tine texture finish required unless otherwise shown on plans.

a. Burlap Finish: For sidewalks, drag seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide uniform, gritty texture.

b. Medium-to-Fine-Textured Broom Finish: For curb and gutter, draw soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide uniform, fine-line texture.

c. Medium-to-Coarse-Textured Broom Finish: For fillets, driveways, and alleys, provide coarse finish by striating float-finished concrete surface 1/16 to 1/8-inch deep with stiff-bristled broom, perpendicular to line of traffic.

d. Tined Finish: For concrete pavement, perform surface texturing using combination carpet drag and metal tining. Complete final texturing before concrete attains initial set. Draw carpet drag longitudinally along pavement surface with carpet contact surface area adjusted to provide satisfactory coarsely-textured surface.

4. Small or Irregular Placements. Where machine placements and finishing concrete pavement not practical, use hand equipment and procedures to produce consolidated and finished pavement section to line and grade.

5. Emergency Procedures. Use hand-operated equipment to apply texture, evaporation retardant, and cure in event of equipment breakdown.

3.8 CONCRETE PROTECTION AND CURING

A. Curing: Keep concrete pavement surface from drying by water fogging until curing material applied. If forms removed during day of placement, apply curing compound to exposed areas. When placing concrete pavement, place curing compound on backside of curb. Maintain and promptly repair damage to curing materials on exposed surfaces of concrete pavement continuously at least three curing days unless specified otherwise. Curing day is a 24-hour period when temperature taken in shade away from artificial heat is above 50 degrees F at least 19 hours or surface temperature of concrete is maintained above 40 degrees F for 24 hours. Curing begins when concrete curing system applied. Stop concrete paving if curing compound not applied promptly and maintained adequately.

B. Protect freshly-placed concrete from excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing. Submit for approval proposed measures to protect concrete from anticipated freezing weather the first 72 hours after placement. Repair or replace all concrete damaged by freezing.

C. Evaporation Retarder: Apply to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq ft x h before and during finishing operations. Apply per manufacturer-written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete, but not before free water disappears from concrete surface.

E. Curing Methods: Cure concrete by one or a combination of these:

1. Moisture Curing: Keep surfaces continuously moist not less than seven days with:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated, kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing using cover material and waterproof tape.
3. Curing Compound: After texturing and immediately after free surface moisture disappears, spray concrete surface uniformly with two coats membrane-curing compound at not more than 180-square-foot-per-gallon individual application rate. Apply first coat within 10 minutes after completing texturing operations. Apply second coat within 30 minutes after completing texturing operations.
   a. Before and during application, maintain curing compounds in uniformly-agitated condition, free of settlement. Do not thin or dilute curing compound.
   b. Where coating shows discontinuities or other defects or rain falls on newly-coated surface before film dries enough to resist damage, apply additional compound at same rate of coverage to correct damage. Ensure curing compound coats sides of tining grooves.
4. Curing Class E Concrete: For all Class HES concrete pavement, provide membrane curing per Section 360.4.I.1 - Membrane Curing, followed promptly by moisture curing until opening strength achieved but not less than 24 hours.

3.9 SAWING JOINTS

A. Saw joints to depth shown on plans as soon as sawing accomplished without damage to pavement regardless of time of day or weather conditions. Once sawing commences, continue until completed, completed within 12 hours of placement. Use chalk line, string line, sawing template, or other approved method to provide true-joint alignment. Provide enough saws to match paving production rate to ensure sawing completion at earliest possible time to avoid uncontrolled cracking. Reduce paving production if necessary to ensure timely sawing of joints. Promptly restore membrane cure damaged within first 72 hours of curing.

3.10 PROTECTION OF PAVEMENT AND OPENING TO TRAFFIC

A. Testing for early opening is Contractor responsibility regardless of job-control testing unless otherwise directed or shown in plans. Testing result interpretation for opening to traffic is subject to Engineer approval.
   1. Protect Pavement: Erect and maintain barricades and other standard and approved devices to exclude all vehicles and equipment from newly-placed pavement for periods specified. Before opening to traffic, protect pavement from crossing damage using approved methods. Where detour not readily available or economically feasible, occasional crossing of roadway with overweight equipment permitted for relocating equipment only but not to haul material. When occasional crossing of overweight equipment permitted, temporary matting or other approved methods may be required. Maintain adequate supply of sheeting or other material to cover and protect fresh concrete surface from weather damage. Apply as needed to protect pavement surface from weather.
   2. Open Pavement to All Traffic: Pavement seven days old may be opened to all traffic. Before opening to traffic, clean pavement, place stable material against pavement edges, seal joints, and perform all other traffic-safety-related work.
   3. Open Pavement to Construction Equipment: Unless otherwise shown on plans, open concrete pavement early to concrete paving equipment and related delivery

equipment after concrete is at least 48 hours old and opening strength demonstrated per Article 3.10.A.4 - Early Opening to All Traffic, before curing complete. Keep delivery equipment at least 2 feet from edge of concrete pavement. Keep tracks of paving equipment at least 1 foot from pavement edge. Protect textured surfaces from paving equipment. Restore damaged membrane curing as soon as possible. Repair pavement damaged by paving or delivery equipment before opening to all traffic.

4. Early Opening to All Traffic: Open concrete pavement after curing complete and concrete attains 450-psi flexural strength or 2,800-psi compressive strength, except pavement using Class HES concrete may be opened after 24 hours if specified strength achieved. For strength testing, test concrete specimens cured under same conditions as portion of pavement involved.
5. Emergency Opening to Traffic: Under emergency conditions, when pavement is at least 72 hours old, open pavement to traffic when directed in writing. Remove all obstructing materials, place stable material against pavement edges, and perform other work involved in providing traffic safety as required for emergency opening.

3.11 PAVEMENT THICKNESS

A. Engineer checks thickness per Tex-423-A unless other methods shown on plans. Engineer performs one thickness test consisting of one reading at approximate center of each lane every 500 feet or fraction thereof. Core where directed per Tex-424-A to verify deficiencies more than 0.2 inch from plan thickness and determine limits of deficiencies of more than 0.75 inch from plan thickness. Fill core holes using concrete mixture and method approved by Engineer.

1. Thickness Deficiencies Greater than 0.2 inch: When any depth test measured per Tex-423-A is deficient by more than 0.2 inch from plan thickness, take one 4-inch diameter core at location to verify measurement. If core deficient more than 0.2 but not more than 0.75 inch from plan thickness, take two additional cores from unit (per Article 3.11.A.3 - Pavement Units for Payment Adjustment) at least 150-foot intervals, Engineer-selected locations, and determine unit thickness for payment purposes by averaging length of three cores. In calculating average thickness of this unit of pavement, measurements more than specified thickness more than 0.2 inch, considered as specified thickness, plus 0.2 inch.
2. Thickness Deficiencies Greater than 0.75 inches: If core deficient by more than 0.75, take additional cores at 10-foot intervals in each direction parallel to centerline to determine boundary of deficient area. Engineer evaluates any area of pavement deficient in thickness by more than 0.75 but no more than 1 inch. As directed, remove and replace deficient areas without additional compensation or retain deficient areas without compensation. Remove and replace any area of pavement deficient in thickness by more than 1 inch without additional compensation.
3. Pavement Units for Payment Adjustment: Limits for applying payment adjustment for deficient pavement thickness from 0.20 to no more than 0.75 inch, are 500 feet of pavement in each lane. Lane width as shown on typical sections and pavement design standards.
    a. For greater than 0.75-inch deficient thickness, limits for applying zero payment or requiring removal, defined by coring or equivalent nondestructive means as Engineer determines. Remaining portion of unit determined less than 0.75-inch deficient, subject to payment adjustment based on average core thickness at each end of 10-foot interval investigation as Engineer determines.

b. Measure shoulders for thickness unless otherwise shown on plans. Shoulders 6 feet wide or wider, considered lanes. Shoulders less than 6 feet wide, considered part of adjacent lane.

c. Limits for applying payment adjustment for deficient pavement thickness for ramps, widenings, acceleration/deceleration lanes, and other miscellaneous areas, are 500 feet in length. Ares less than 500 feet in length individually evaluated for payment adjustment based on plan area.

4. Deficient Thickness Adjustment: Where average thickness of pavement deficient in thickness more than 0.2 but no more than 0.75 inch, payment made using adjustment factor (Table 4) applied to bid price for deficient area for each unit as defined under Article 3.11.A.3 - Pavement Units for Payment Adjustment.

Table 4 - DEFICIENT THICKNESS PRICE ADJUSTMENT FACTOR

Deficiency in Thickness Determined by Cores (in.)	Proportional Part of Contract Price Allowed (adjustment factor)
Not deficient	1.00
Over 0.00 through 0.20	1.00
Over 0.20 through 0.30	0.80
Over 0.30 through 0.40	0.72
Over 0.40 through 0.50	0.68
Over 0.50 through 0.75	0.57

5. Basis of Adjusted Payment for Smoothness. Price adjustment for pavement smoothness will apply to total area of concrete within a section of pavement and applied per this equation and schedule:

a. (square yard in section) x (original unit price per square yard) x PFm = reduction in payment for area within section

Table 5 – BASIS OF ADJUSTMENT FOR SMOOTHNESS

Average Profile Index (inches per mile) Pavement Strength Rating			Contract Unit Price Adjustment (PFm)
Over 30,000 lb.	30,000 lb. or less	Short Sections	
0-7	0-10	0-15	0.00
7.1-9	10.1-11	15.1-16	0.02
9.1-11	11.1-12	16.1-17	0.04
11.1-13	12.1-13	17.1-18	0.06
13.1-14	13.1-14	18.1-20	0.08
14.1-15	14.1-15	20.1-22	0.10
15.1 and up	15.1 and up	22.1 and up	Corrective work required

3.12 PAVEMENT MARKINGS

A. Permanent pavement markings shall be reflectorized multipolymer applied per manufacturer recommendations including surface preparation.

B. Materials and installation for surface markings to be per TxDOT Specifications.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Contractor to sample materials, perform tests, and submit test reports during concrete placement. Contractor personnel performing testing must be ACI-certified or qualified by recognized equivalent written and performance testing program for tests performed. Sampling and testing for quality control include those specified herein.

B. Job-Control Testing: Unless otherwise shown on plans, perform all fresh and hardened concrete job-control testing at specified frequency. Using commercial laboratory is

acceptable. Maintain all testing equipment calibrated per pertinent test methods. Make strength-testing equipment available to Engineer for verification testing. Provide Engineer opportunity to witness all tests. Engineer may require retest if not given opportunity to witness. Daily furnish copy of all tests results to Engineer. Engineer directs random job-control sampling and testing. Immediately investigate and take corrective action as approved if any Contractor test results, including tests performed for verification purposes, do not meet specification requirements. When job-control testing by Contractor waived by plans, Engineer performs testing; however, this does not waive Contractor responsibility for providing materials and work per this Item.

C. Job-Control Strength: Unless otherwise shown on the plans or permitted by Engineer, use seven-day job-control strength testing per ASTM C78. When job-control concrete strength test value is more than 10 percent below required job-control strength, or three consecutive job-control strength values fall below required job-control strength, investigate strength test procedures, quality of materials, concrete production operations, and other possible problem areas to determine cause. Take necessary action to correct problem, including redesigning concrete mix, if needed. Owner may suspend concrete paving if Contractor unable to identify, document, and timely correct cause of low strength test values. If any job-control strength is more than 15 percent below required job-control strength, Engineer evaluates structural adequacy of pavements. When directed, remove and replace pavements found structurally inadequate, at no additional cost.

D. Testing Services performed per the following requirements:

1. Sampling Fresh Concrete: Obtain representative samples of fresh concrete per ASTM C172, except modified for slump to comply with ASTM C94.

   Flexural and Compressive-Strength Tests: ASTM C78 and C39; one set for each day's pour of each concrete class exceeding 5 but less than 25 cubic yards, plus one set for each additional 50 cubic yard. Test one specimen at seven days and two specimens at 28 days. Retain one specimen in reserve for later testing if required.

   a. Provide Engineer opportunity to witness all tests. Engineer may require retest if not given opportunity to witness. Daily furnish Engineer copy of all test results. Check first few concrete loads for slump, air, and temperature on start-up production days to check for concrete conformance and consistency. Sample and prepare strength test specimens (two specimens per test) on first day of production and each 2,000 square yards, or fraction, of concrete pavement. Prepare at least one set of strength-test specimens for each production day. Perform slump, air, and temperature tests each time strength specimens made. Monitor concrete temperature to ensure concrete consistently within temperature requirements. Engineer directs random job-control sampling and testing. Immediately investigate and take corrective action as approved if any Contractor test result, including tests performed for verification purposes, do not meet specification requirements.

   b. When frequency of testing provides fewer than five strength tests for given class of concrete, conduct testing from at least five randomly-selected batches or from each batch if fewer than five used.

2. Slump: ASTM C143; one test at point of placement for each strength test, but no less than one test for each day's pour of each type of concrete. Additional tests required when concrete consistency changes.

3. Air Content: ASTM C231, pressure method; one test for each strength test, but no less than one test for each day's pour of each type of air-entrained concrete.

4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 degrees F and below and 80 degrees F and above, and one test for each set of strength specimens.

5. Test Specimens: ASTM C31/C31M; one set of two standard beams and one set of four standard cylinders for each flexural and compressive-strength test, unless otherwise indicated. Flexural strength test specimens cured under same conditions as portion of pavement involved. Mold cylinders and store for laboratory-cured test specimens unless field-cured test specimens required.

E. Report test results in writing to Engineer and Contractor within 24 hours of testing. Reports of strength tests contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design strengths at required time, concrete mix proportions and materials, breaking strengths, and type of break for both seven- and 28-day tests.

F. Nondestructive Testing: Engineer may permit impact hammer, sonoscope, or other nondestructive device but do not use as sole basis for approval or rejection.

G. Additional Tests: Contractor makes additional tests of concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements not met, as Engineer directs. Contractor conducts tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or other methods as directed.

H. Contractor pays for failing tests.

I. Questionable Concrete is where any of the following test evaluations occur:

1. Individual test strength below specified strength; or
2. Samples of concrete for acceptance test cylinders or acceptance test beams not representative of concrete-in-place in pavement; or
3. Insufficient or inadequate concrete curing; or
4. Insufficient number of acceptance test cylinders or acceptance test beams for day's concreting made for testing.
5. In-place core densities, on average, are less than 97 percent of original mix design density, or any one core is below 96 percent of original mix design density,
6. Except where core tests impair strength of structure, core test as Owner directs, made at no cost to Owner to resolve Questionable Concrete. If core tests fail to demonstrate test strength required by contract documents or structural analysis does not confirm adequacy of structure, Owner may, at his discretion, reject work or require load tests or additional construction. Should structural analysis confirm adequacy of pavement, Owner may, at his discretion, accept concrete with credit for full value of concrete delivered to site per General Conditions.
7. Contractor pays all costs incurred in providing additional testing or analysis to resolve acceptability of Questionable Concrete.
8. Core Tests
   a. Take three representative cores from each member or area of concrete for each test considered questionable. Location of cores as Owner directs to least impair strength of pavement. Replace damaged cores.
   b. Obtain and test cores per ASTM C42 except if concrete in structure is dry under service conditions, air dry cores (60 to 80 degrees F, and relative humidity less than 60 percent) for seven days before test and tested dry. If concrete in structure more than superficially wet under service conditions, immerse cores in water at least 48 hours and test wet.

3.14 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.

B. Drill test cores where Engineer directs when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement at least 14 days after placement. When construction traffic permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material from construction traffic. Sweep concrete pavement not more than two days before date scheduled for opening section to public traffic.

END OF SECTION

SECTION 02764 - PAVEMENT JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes expansion and contraction joints within Portland cement concrete pavement and joints between Portland cement concrete and asphalt pavement.

B. Related Sections
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 02741 – Hot-Mix Asphalt Paving.
   3. Section 02751 – Portland Cement Concrete Pavement.

1.2 REFERENCES

A. ASTM C1193 – Use of Joint Sealants.

B. ASTM D5249 – Backer Material for Use with Cold-and-Hot-Applied Joint Sealants in Portland Cement Concrete and Asphalt Joints.

C. ASTM D1751 – Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

D. ASTM D3405 – Joint Sealants, Hot Applied, for Concrete and Asphalt Pavements.

E. ASTM D3406 – Joint Sealant, Hot Applied, Elastomeric Type, for Portland Cement Concrete Pavements.

F. ASTM C920 – Elastomeric Joint Sealants.

G. DMS – TxDOT Departmental Material Specification.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching appearance of exposed surfaces adjacent to joint sealants.

C. Product Certificates: Signed by manufacturers of joint sealants certifying products furnished comply with requirements and suitable for use indicated.

D. Compatibility and Adhesion Test Reports: From joint sealant manufacturer indicating:
   1. Materials forming joint substrates and joint-sealant backer materials tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Product Test Reports: From qualified testing agency indicating joint sealants comply with requirements, based on comprehensive testing of current product formulations.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and work resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Product Testing: Obtain test results per Article 1.3.E from qualified testing agency, based on testing current sealant formulations within 36-month period.

1. Testing Agency Qualifications: Qualified independent testing agency per ASTM C1021 to conduct testing indicated, per ASTM E548.
2. Test joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

D. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturer, for testing indicated, samples of materials to contact or affect joint sealants. Use manufacturer-standard test methods to determine if priming and other specific joint preparation techniques required to obtain rapid, optimum, adhesion of joint sealants to joint substrates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
B. Store and handle materials to comply with manufacturer-written instructions to prevent deterioration or damage from moisture, high/low temperatures, contaminants, etc.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. When blowing-dust conditions exist.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants able to interfere with adhesion removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials compatible with one another and joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
B. Bituminous premolded expansion joint shall conform to ASTM D1751.
C. Joint sealant shall be per DMS-6300.
1. Provide Class 3, 4, or 5 for joints between Portland cement concrete and asphalt concrete.
2. Provide Class 5 or 8 for joints in Portland cement concrete pavement.

D. Mix material per manufacturer recommendations.

2.2 JOINT-SEALANT BACKER MATERIALS

A. Provide non-staining joint-sealant backer materials, compatible with joint substrates, sealants, primers, and other joint fillers, and approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rod for Cold- and Hot-Applied Sealants: ASTM D5249, Type 1, diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.
C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D5249; Type 2; thickness and width required to control sealant depths, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
D. Round-Backer Rods for Cold-Applied Sealants: ASTM D5249, Type 3; diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

2.3 PRIMERS

A. Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. With Installer present, examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
B. Proceed with installation only after unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Surface Cleaning Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer-written instructions.
B. Joint Priming: Prime joint substrates where indicated or recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer-written instructions. Confine primers to areas of joint-sealant bond. Do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALL JOINT SEALANTS

A. Comply with joint-sealant manufacturer-written installation instructions applicable to products and applications indicated, unless more stringent requirements apply.
B. Sealant Installation Standard: Comply with ASTM C1193 recommendations for joint sealants as applicable to materials, applications, and conditions indicated.
C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
    1. Do not leave gaps between ends of backer materials.
    2. Do not stretch, twist, puncture, or tear backer materials.
    3. Remove absorbent backer materials that are wet before sealant application and replace with dry materials.
D. Install sealants by proven techniques to comply with these and when backings are installed:
    1. Place sealants for direct contact and fully-wet joint substrates.
    2. Completely fill recesses provided for each joint configuration.
    3. Produce uniform, cross-sectional shapes and depths relative to joint widths to allow optimum sealant movement capability.

E. Tooling Non-Sag Sealants: Immediately after sealant application and before skinning or curing, tool sealants per requirements specified to form smooth, uniform beads of configuration indicated, eliminate air pockets, and ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealants from surfaces adjacent to joint.
   2. Use tooling agents approved in writing by joint-sealant manufacturer that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer-written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth at locations indicated.

3.4 CLEANING

A. Clean excess sealants or sealant smears adjacent to joints as Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and products joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 02832 – CONCRETE SEGMENTAL RETAINING-WALL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes single- and multiple-depth segmental retaining walls with soil reinforcement.
B. Related Requirements:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 02301 – Earthwork for Structural Purposes, for excavation for segmental retaining walls.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Samples: For each color and texture of concrete unit specified.
C. Delegated-Design Submittal: For segmental retaining walls.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction test reports.
B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage qualified professional engineer, per Section 01400 - Quality Control, to design segmental retaining walls.
B. Compliance Review: Qualified professional engineer responsible for segmental retaining wall design shall review and approve submittals and source and field quality-control reports for compliance of materials and construction with design.
C. Structural Performance: Engineering design based on these loads per NCMA Design Manual for Segmental Retaining Walls:
   1. Horizontal Peak Ground Acceleration (A) for Project: 0.0729g.
      a. 5g = 1516g (0.2 second response).
      b. 5g = .0492g (1 second response).

2.2 SEGMENTAL RETAINING WALL UNITS

A. Concrete Units: ASTM C1372, Normal Weight, except maximum water absorption shall not exceed 7 percent by weight and units shall not differ in height more than ±1/16 inch from specified dimension.
   1. Provide units that comply with requirements in ASTM C1372 for freeze-thaw durability.

2. Provide units that interlock with courses above and below by means of integral lugs, lips, or tongues and grooves, pins, and clips.

B. Color: As selected by Engineer from manufacturer's full range.

C. Shape and Texture: Provide units of basic shape and dimensions as Engineer selects with machine-split textured exposed faces.

2.3 INSTALLATION MATERIALS

A. Pins and Clips: Product supplied by segmental retaining wall unit manufacturer for use with units provided, made from non-degrading polymer reinforced with glass fibers.

B. Cap Adhesive: Product supplied or recommended by segmental retaining wall unit manufacturer for adhering cap units to units below.

C. Leveling Base: Comply with segmental retaining wall manufacturer requirements for base material and drainage course.

D. Drainage Fill: Comply with segmental retaining wall manufacturer requirements for subdrainage course.

E. Soil Fill: Comply with requirements in Section 02301 – Earthwork for Structural Purposes, for satisfactory soils.

F. Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation 50+ percent.

1. Apparent Opening Size: No. 70 to 100 sieve, maximum; ASTM D4751.
2. Minimum Grab Tensile Strength: 110 pound; ASTM D4632.

G. Subdrainage Pipe and Filter Fabric: Comply with segmental retaining wall manufacturer requirements.

H. Soil Reinforcement: Product specifically manufactured for use as soil reinforcement

PART 3 - EXECUTION

3.1 RETAINING WALL INSTALLATION

A. Place units according to NCMA, *Segmental Retaining Wall Installation Guide*, and segmental retaining wall unit manufacturer-written instructions.

1. Lay units in running bond.
2. Form corners and ends by using special units.

B. Leveling Base: Place and compact base material to thickness indicated and with not less than 95 percent maximum dry unit weight per ASTM D698.

C. First Course: Place first course of segmental retaining wall units for full length of wall. Place units in firm contact with each other, properly aligned, and level. Tamp units into leveling base as necessary to bring tops of units into level plane.

D. Subsequent Courses: Remove excess fill and debris from tops of units in course below. Place units in firm contact, properly aligned, and directly on course below.

E. Cap Units: Place cap units and secure with cap adhesive.

3.2 FILL PLACEMENT

A. Comply with requirements in Section 02301 – Earthwork for Structural Purposes, NCMA *Segmental Retaining Wall Installation Guide*, and segmental retaining wall unit manufacturer-written instructions.

B. Fill voids between and within units with drainage fill. Place fill as each course is laid.

C. Place, spread, and compact drainage fill and soil fill in uniform lifts for full width and length of embankment as wall is laid. Place and compact fills without disturbing alignment

of units. Where both sides of wall are indicated to be filled, place fills on both sides at same time. Begin at wall, place, and spread fills toward embankment.

1. Use only hand-operated compaction equipment within 48 inches of wall, or half of height above bottom of wall, whichever is greater.
2. Compact reinforced-soil fill to not less than 95-percent maximum dry unit weight according to ASTM D698. Where only hand-operated compaction equipment allowed, compact fills to not less than 90-percent maximum dry unit weight according to ASTM D698.
3. Compact nonreinforced-soil fill to comply with Section 02301 – Earthwork for Structural Purposes.

D. Place drainage geotextile against back of wall, and place layer of drainage fill at least 12 inches wide behind drainage geotextile to within 12 inches of finished grade. Place another layer of drainage geotextile between drainage fill and soil fill.

E. If drainage geotextile is needed to keep fines in lace layer of drainage fill at least 12 inches wide behind wall to within 12 inches of finished grade. Place layer of drainage geotextile between drainage fill and soil fill.

F. Wrap subdrainage pipe with filter fabric and place in drainage fill as indicated, sloped not less than 0.5 percent to drain.

G. Place impervious fill over top edge of drainage fill layer.

H. Place soil reinforcement in horizontal joints of retaining wall where indicated per soil-reinforcement manufacturer-written instructions. Embed reinforcement minimum 8 inches into retaining wall and stretch tight over compacted backfill. Anchor soil reinforcement before placing fill.

1. Place additional soil reinforcement at corners and curved walls to provide continuous reinforcement.
2. Place geosynthetics with seams, if any, oriented perpendicular to segmental retaining walls.
3. Do not dump fill material directly from trucks onto geosynthetics.
4. Place at least 6 inches of fill over reinforcement before compacting with tracked vehicles or 4 inches before compacting with rubber-tired vehicles.
5. Do not turn vehicles on fill until first layer of fill is compacted and second layer is placed over each soil-reinforcement layer.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner engages qualified testing agency to perform tests and inspections.

B. Comply with requirements in Section 02301 – Earthwork for Structural Purposes, for field quality control. In each alternate compacted backfill layer, perform at least one field in-place compaction test for each 150 feet.

END OF SECTION

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
B. Related Requirements:
   1. Division 01 Specification Sections apply to Work of this Section.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume. Materials subject to compliance with requirements.
B. W/C Ratio: Ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.
      e. Special concrete finish subcontractor.
   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod, and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Design Mixtures: For each concrete mixture, submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Do not add water to concrete once truck leaves batch plant.
C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement, include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
D. Construction Joint Layout: Indicate proposed construction joints required to construct structure. Location of construction joints subject to Engineer approval.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data for installer, manufacturer, and testing agency.
B. Material Certificates for each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories.
   5. Waterstops.
   6. Curing compounds.
   7. Floor and slab treatments.
   8. Bonding agents.
   9. Adhesives.
   10. Semi-rigid joint filler.
   11. Joint-filler strips.
   12. Repair materials.
C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
D. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Qualified and employs Project personnel qualified as ACI-certified Flatwork Technician/Finisher with ACI-certified Concrete Flatwork Technician supervisor.
B. Manufacturer Qualifications: Firm experienced in manufacturing ready-mixed concrete products that complies with ASTM C94/C94M requirements for production facilities and equipment. Manufacturer certified per NRMCA - Certification of Ready-Mixed Concrete Production Facilities.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
B. Waterstops: Store under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength caused by frost, freezing actions, or low temperatures. Comply with ACI 306.1 and:
   1. When average temperature expected to fall below 40 degrees F three successive days, maintain delivered concrete mixture temperature within temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
B. Hot-Weather Placement. Comply with ACI 301 and:
   1. Maintain concrete temperature below 90 degrees F at placement time. Use chilled mixing water or chopped ice to control temperature, if water equivalent of ice is

calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 and ACI 117 unless modified by requirements in Contract Documents:

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, per DOC PS 1, and:
      a. High-density overlay, Class 1 or better.
      b. Medium-density overlay, Class 1 or better; mill-release, agent-treated, and edge-sealed.
      c. Structural 1, B-B or better; mill-oiled and edge-sealed.
      d. B-B (Concrete Form), Class 1 or better; mill-oiled and edge-sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Rectangular Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 x 3/4 inch, minimum.

E. Form-Release Agent: Commercially formulated form-release agent to not bond with, stain, or adversely affect concrete surfaces nor impair subsequent treatments of concrete surfaces. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal-form ties designed to resist lateral pressure of fresh concrete on forms and prevent spalling concrete on removal.
   1. Furnish ties so when removed, leaves holes no larger than 1 inch diameter in concrete surface.
   2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Deformed-Steel Wire: ASTM A1064/A1864M.

C. Deformed-Steel Welded-Wire Reinforcement: ASTM A1065/A1064M flat sheet.

D. Reinforcing Bars to Weld: ASTM A706.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire or plastic, and for concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material, aggregate, and admixtures from single source from single manufacturer.

B. Cementitious Materials:
   1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
   2. Fly Ash: ASTM C618, Class F or C.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from single source with documented service record data at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
   1. Maximum Coarse-Aggregate Size: 1 inch.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer compatible with other admixtures and not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
   2. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

F. Water: ASTM C94/C94M and potable.

2.6 LIQUID FLOOR TREATMENTS

A. Penetrating-Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; penetrates, hardens, and densifies concrete surfaces.
   1. Products are subject to compliance with requirements. Provide one of the following:
      a. ChemMasters; Chemsil Plus.
      b. ChemTec International; Chem Tec One.
      c. Dayton Superior; Sure Hard Densifier J17.
      d. L&M Construction Chemicals Inc.; Seal hard.
      e. Meadows, W. T. Inc.; LIQUI-HARD.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete. Products are subject to compliance with requirements. Provide one of the following:
   1. BASF Construction Chemicals - Building Systems; Confilm.
   2. ChemMasters; SprayFilm.
   3. Dayton Superior; AquaFilm J74.

4. L&M Construction Chemicals Inc.; E-CON.
5. Meadows, W. R. Inc.; EVAPRE.
6. Sika Corporation; SikaFilm.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A. Products are subject to compliance with requirements. Provide one of the following:
1. BASF Construction Chemicals - Building Systems; KURE 1315.
2. ChemMasters Inc.; Polyseal WB.
3. Dayton Superior Corporation; Cure & Seal 1315 J22WB.
4. L&M Construction Chemicals Inc.; Lumiseal WB Plus.
5. Meadows, W. R. Inc.; VOCOMP-30.
6. Metalcrete Industries; Metcure 30.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with Type A shore durometer hardness of 80.

C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion, or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, able to humid cure and bond to damp surfaces, of class suitable for application temperature, ad grade to suit requirements, and Types IV and V, load bearing, for bonding hardened or freshly-mixed concrete to hardened concrete.

2.9 REPAIR MATERIALS

A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product applied in thicknesses from 1/4 inch and filled in over scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C150/C150M, Portland cement, hydraulic, or blended hydraulic cement as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 - 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5,000 psi at 28 days when tested per ASTM C109/C109M.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned based on laboratory trial mixture or field test data, or both, per ACI 301. Use qualified, independent testing agency to prepare and report proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as 25 percent fly ash.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use per manufacturer-written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing admixture in pumped concrete and concrete with W/C ratio below 0.50.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: 4,500 psi at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 5 inches for concrete with verified slump of 2 - 4 inches before adding high-range water-reducing admixture or plasticizing admixture, ±1 inch.

B. Foundation Walls, Pilasters: Normal-weight concrete.

1. Minimum Compressive Strength: 4,500 psi at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 5 inches for concrete with verified slump of 2 - 4 inches before adding high-range water-reducing admixture or plasticizing admixture, ±1 inch.

C. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: 4,500 psi at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Minimum Cementitious Materials Content: Minimum cementitious material per Table 4.2.2.1 in ACI-301 relative to the maximum aggregate size.
4. Slump Limit: 4 inches, ±1 inch.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

D. Miscellaneous Concrete Items (see Article 3.10 – Miscellaneous Concrete Item Installation):

1. Minimum Compressive Strength: 4,000 psi at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit 4 inches for concrete with verified slump of 2 – 4 inches before adding high-range, water-reducing or plasticizing admixture, ±1 inch.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement per CRSI - Manual of Standard Practice.

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete per ASTM C94/C94M. When air temperature is 85 – 90 degrees F, reduce mixing and delivery time from 90 to 75 minutes. When air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Footings may be cast against earth forms if soil alongside of trenches and/or excavations is stable and not slough off into excavation during placing operations. If soil not sufficiently stable, forms must be utilized.

B. Design, erect, shore, brace, and maintain formwork, per ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads applied, until structure supports such loads.

C. Construct formwork so concrete members and structures are size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

D. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as:
   1. Class A, 1/8 inch for smooth-formed finished surfaces.
   2. Class B, 1/4 inch for rough-formed finished surfaces.

E. Construct forms tight enough to prevent loss of concrete mortar.

F. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush- or wrecking-plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, etc., for easy removal.
   2. Do not use rust-stained steel form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork inaccessible. Close openings with panels tightly fitted to forms and securely brace to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in Work. Determine sizes and locations from trades providing items.

K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

M. Coat contact surfaces of forms with form-release agent, per manufacturer-written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to embed. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 REMOVING AND REUSING FORMS

A. Remove formwork for sides of beams, walls, columns, and similar parts of Work not supporting weight of concrete after cumulatively curing not less than 50 degrees F,

24 hours after placing concrete. Concrete must be hard enough to not be damaged by form-removal operations, and curing and protection operations need maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements to support weight of concrete in place until concrete achieves at least 70 percent of 28-day design compressive strength.
2. Remove forms only if shores arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to reuse in Work. Split, frayed, delaminated, or otherwise damaged form-facing material not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI - Manual of Standard Practice, for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials reducing bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

A. Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete not impaired, where indicated or as Engineer approves.

1. Place joints perpendicular to main reinforcement. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated.
3. Space vertical joints in walls. See structural notes.
4. Use epoxy-bonding adhesive at locations where fresh concrete placed against hardened or partially-hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for depth equal to at least one-fourth of concrete thickness. For sawed joints, form contraction joints with early entry dry cut saws. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, (column pedestals, foundation walls, grade beams, etc.), as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Install joint-filler strips in lengths if practicable. Where more than one length required, lace or clip sections together.

E. Lubricate one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify installation of formwork, reinforcement, and embedded items is complete and required inspections completed.

B. Do not add water to concrete during delivery, at Project site, or during placement.

C. Do not add water at Project site. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of thickness so no new concrete placed on concrete hardened enough to cause seams or planes of weakness. If section not placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment per ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly-spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete beginning to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form uniform and open-textured surface plane, before excess bleedwater appears on surface. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged orderly and symmetrical with minimum seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities. Apply to concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with texture-matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce profile amplitude of 1/4 inch in one direction. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighten until surface left with uniform, smooth, granular texture. Apply float finish to surfaces to receive trowel finish.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects to telegraph through applied coatings or floor coverings. Apply trowel finish to surfaces exposed to view or to cover with resilient flooring, carpet, ceramic, or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

E. Trowel and Fine-Broom Finish: Apply first trowel finish to surfaces where ceramic or quarry tile to be installed by thickset or thinset method. While concrete still plastic, slightly scarify surface with fine broom. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply to exterior concrete platforms, steps, ramps, and elsewhere as indicated. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete still green and steel-troweling surfaces to hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:
   1. Coordinate sizes and locations of concrete bases with actual equipment provided.
   2. Construct concrete bases 4 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
   3. Minimum Compressive Strength: 4,000 psi at 28 days.
   4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of concrete base.
   5. For supported equipment, install epoxy-coated anchor bolts to extend through concrete base and anchor into structural concrete substrate.
   6. Before pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to embed.

7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 CONCRETE PROTECTING AND CURING

A. Protect freshly-placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft./hr. before and during finishing operations. Apply per manufacturer-written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete per ACI 308.1, by one or combination of these methods, as indicated in structural notes:

1. Moisture Curing: Keep surfaces continuously moist not less than seven days with:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with moisture-retaining cover or curing compound manufacturer certifies does not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller per manufacturer-written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. After curing period elapses, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.11 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment per manufacturer-written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete less than 28 days old.
3. Apply liquid until surface is saturated, scrubbing into surface until gel forms. Rewet and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply second coat in similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller per manufacturer-written instructions.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler per manufacturer-written instructions. Defer joint filling until concrete ages at least one month. Do not fill joints until construction traffic permanently ceases.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints. Leave contact faces of joints clean and dry.

C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch when approved by Engineer. Remove and replace concrete not repaired and patched to Engineer approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins, and other surface, stains, and other discolorations not removed by cleaning.
1. Immediately after form removal and review by Engineer, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent dries. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so when dry, patching mortar matches surrounding color. Patch inconspicuous test area to verify mixture and color match before patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness. Use sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, pop outs, honeycombs, rock pockets, crazing and cracks more than 0.01 inch wide, penetrate to reinforcement, or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete cures at least 14 days, correct high areas by grinding.
3. Correct localized low areas 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.

4. Correct other low areas scheduled to receive floor coverings with repair underlayment. Prepare, mix, and apply repair underlayment and primer per manufacturer-written instructions to produce smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with repair topping. Cut out low areas to ensure minimum 1/4-inch repair topping depth to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer per manufacturer's written instructions to produce smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement 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 and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure same as adjacent concrete.
7. Repair cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent dries. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for 72 hours.

E. Repair f concrete using epoxy adhesive and patching mortar subject to Engineer approval,.

F. Repair materials and installation not specified may be used, subject to Engineer approval.

3.14 FIELD QUALITY CONTROL

A. Special Inspections: Owner engages special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:
1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.

C. Concrete Tests: Test composite samples of fresh concrete obtained per ASTM C172 for:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cubic yards, but less than 25 cubic yards, plus one set for each additional 50 cubic yard or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100-cubic-yard or fraction thereof of each concrete mixture placed each day. When testing frequency provides fewer than five compressive-strength tests for each concrete mixture, test from at least five randomly-selected batches or each batch if fewer than five used.
3. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency changes.
4. Air Content: ASTM C231/C231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 degrees F and below or 80 and above, and one test for each composite sample.

6. Compression Test Specimens: ASTM C31/C31M. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39/C39M; test one set of two lab-cured specimens at seven days and one set of two specimens at 28 days.
   a. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
   b. Compressive-strength test is average compressive strength from set of two specimens obtained from same composite sample and tested at age indicated.
8. When field-cured cylinder strength is less than 85 percent companion lab-cured cylinders, Contractor evaluates operations and provides corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture is satisfactory if every average of any three-consecutive compressive-strength tests equals/exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Report test results in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both seven- and 28-day tests.
11. Nondestructive Testing: Engineer may permit impact hammer, sonoscope, or other nondestructive device but not used as sole basis for approval/rejection of concrete.
12. Additional Tests: Testing/inspecting agency may additionally test concrete when test results indicate slump, air entrainment, compressive strengths, or other requirements not met, as Engineer directs. Testing/inspecting agency may test to determine adequacy of concrete by cored cylinders per ASTM C42/C42M or other methods as Engineer directs.
13. Perform additional testing and inspecting, at Contractor expense, to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in Work that test reports and inspections indicate do not comply with Contract Documents.

D. Measure floor and slab surface so gap at any point between concrete surface and unlevelled, freestanding 10-foot long straightedge, resting on two high spots and placed anywhere on the surface, do not exceed 3/16 inch.

3.15 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 08331 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes overhead coiling service doors.
B. Related Sections:
1. Division 01 Specification Sections apply to Work of this Section.
2. Section 16000 – Electrical General Provisions.
3. Section 16130 - Boxes: Conduit from electric circuit to door operator and from door operator to control station.

1.2 REFERENCES

A. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
B. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
C. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
E. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
F. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.
G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
H. NEMA MG 1 - Motors and Generators.
I. NFRC 102 - Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.

1.3 DESIGN/PERFORMANCE REQUIREMENTS

A. Overhead coiling service doors:
1. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf (958 Pa) without damage to door or assembly components.
2. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.
B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.
C. Products Requiring Electrical Connection: Listed and classified by UL, Inc., acceptable to authority having jurisdiction as suitable for purpose specified.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300 – Administrative Requirements.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.
3. Details of construction and fabrication.
4. Installation instructions.

C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

F. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing Work of this section with minimum five years' experience in fabricating and installing security closures.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum three years' experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

C. Store materials in a dry, warm, ventilated, weathertight location.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 COORDINATION

A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.9 WARRANTY

A. Door and Operator System: Manufacturer's limited warranty, except counterbalance spring and finish, free from defects in materials and workmanship three years or 20,000 cycles, whichever occurs first.

B. Door: Manufacturer's limited warranty two years for all parts and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, available manufacturers offering products incorporated into Work include, but not limited to:
   1. ACME Rolling Doors.
   2. Amarr Overhead Doors, Inc.
   3. Lawrence Roll-up Doors, Inc.
   4. Overhead Door Corporation.
   5. Raynor

B. Requests for substitutions considered upon request.

2.2 OVERHEAD COILING SERVICE DOORS

A. Industrial Doors: Overhead Door Corporation Model 610 Service Doors.
   1. Curtain: Interlocking roll-formed slats as specified. Endlocks attached to each end of alternate slats to prevent lateral movement. Curved profile type C-187 fabricated of 18-gauge galvanized steel.
   2. Finish: Galvanized Steel. Slats and hood galvanized per ASTM A653 and receive rust-inhibitive, roll-coating process, including 0.2-mil-thick baked-on prime paint, and 0.6-mil-thick baked-on polyester topcoat.
      a. Polyester Top Coat: Color as selected by Architect.
      b. Powder Coat: PowderGuard weathered-finish industrial textured powder coat provides thicker, more scratch-resistant coat. Apply to entire door system including slats, guides, bottom bar, and head plate.
      c. Non-galvanized exposed ferrous surfaces receive one coat rust-inhibitive primer.
   3. Bottom Bar: Two primed steel angles for doors over 15 feet 4 inches wide.
   4. Guides: Three structural steel angles with PowderGuard zinc finish for guides, bottom bar, and head plate.
   5. Brackets: Hot-rolled steel to support counterbalance, curtain, and hood.
   6. Counterbalance: Helical torsion spring type housed in steel tube or pipe barrel, supporting curtain with deflection limited to 0.03-inch-per-foot span. Counterbalance adjustable by adjusting tension wheel. Hood is 24-gauge galvanized steel with intermediate supports as required.
   7. Manual Operation: Chain hoist for doors over 96 square feet.
   8. Electric Motor Operation: Provide UL-listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Selected model: RHX.
      a. Sensing Edge Protection: Electric-sensing edge.
      b. Operator Controls:
         1) Push-button operated control stations with open, close, and stop buttons.
         2) Controls surface mounted.
      c. Motor Voltage: 115/230 single phase, 60 Hz.
   9. Windload Design: Standard windload is 20 PSF.
   10. Locking: Interior slide bolt lock for electric operation with interlock switch.
   11. Wall Mounting Condition: Face-of-wall mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify opening sizes, tolerances, and conditions are acceptable.
B. Examine conditions of substrates, supports, and other conditions where work to be performed.
C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly before installation.
B. Prepare surfaces using manufacturer-recommended methods for achieving best result for substrate under project conditions.

3.3 INSTALLATION

A. Install per manufacturer instructions.
B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
C. Securely- and rigidly-brace components suspended from structure. Secure guides to structural members only.
D. Fit and align assembly including hardware level and plumb to provide smooth operation.
E. Coordinate installation of electrical service with Section 16000 – Electrical General Provisions. Complete wiring from disconnect to unit components.
F. Install perimeter trim and closures.
G. Instruct Owner’s personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING

A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
B. Remove labels and visible markings.
C. Touch-up, repair, or replace damaged products before Substantial Completion.

3.6 PROTECTION

A. Protect installed products until completion of project.

END OF SECTION

SECTION 13121 – PRE-ENGINEERED BUILDINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal building system:
   1. Structural steel framing system.
   2. Metal roof system.
   3. Metal wall system.

B. Related Requirements:
   1. Division 01 Specification Sections apply to Work of this Section.

1.2 REFERENCE STANDARDS

A. AISC 360 - Specification for Structural Steel Buildings.
B. AISC 341 – Seismic Provisions for Structural Steel Buildings (when appropriate).
C. AISC Design Guide 3 – Serviceability for Steel Buildings
D. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.
E. AWS D1.1 / D1.1M – Structural Welding Code – Steel.
F. AWS D1.3 / D1.3M – Structural Welding Code – Sheet Steel.
G. AISE 13 – Specifications for Design and Construction of Mill Buildings.
H. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
I. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
J. ASTM A792/A792M – Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
K. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
L. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
M. ASTM D522 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
N. ASTM D523 – Standard Test Method for Specular Gloss.
O. ASTM D968 – Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
P. ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
Q. ASTM D2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
R. ASTM D2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
S. ASTM D2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
T. ASTM D3361 – Standard Practice for Unfiltered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
U. ASTM D4214 – Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
V. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

W. ASTM E96 / E96M – Standard Test Methods for Water Vapor Transmission of Materials.
X. ASTM E1592 – Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
Y. ASTM G87 – Standard Practice for Conducting Moist SO2 Tests.
Z. FMRC Standard 4471 – Approval Standard for Class 1 Roofs for Hail Damage Resistance, Combustibility, and Wind Uplift Resistance.
AA. MBMA Metal Building Systems Manual.
BB. MBMA Seismic Design Guide for Metal Building Systems.
CC. SSPC-Paint 15 - Primer for Use Over Hand Cleaned Steel performs to SSPC-Paint 15 standards.
DD. SSPC-SP2 – Hand Tool Cleaning.
EE. UL 580 – Standard for Tests for Uplift Resistance of Roof Assemblies.
FF. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.

1.3 PREINSTALLATION MEETINGS

A. Convene preinstallation meeting two weeks before start of installation of metal building system.
B. Require attendance of parties directly affecting work of this section, including Contractor, Architect, Engineer, installer, and metal building system manufacturer's representative.
C. Review materials, installation, protection, and coordination with other work.

1.4 SUBMITTALS

A. Comply with Section 01330 – Submittal Procedures.
B. Product Data: Submit metal building system manufacturer's product information, specifications, and installation instructions for building components and accessories.
C. Erection Drawings: Submit metal building system manufacturer's erection drawings, including plans, elevations, sections, and details, indicating roof framing, transverse cross-sections, covering and trim details, and accessory installation details to clearly indicate proper assembly of building components.
D. Certification: Submit written *Certificate of Design and Manufacturing Conformance* prepared and signed by a Professional Engineer, registered to practice in Texas, verifying metal building system design and metal roof system design (including panels, clips, and support system components) meet indicated loading requirements and codes of authorities having jurisdiction.
   1. Certification shall reference specific dead loads, live loads, snow loads, wind loads/speeds, tributary area load reductions (if applicable), concentrated loads, collateral loads, seismic loads, end-use categories, governing code bodies including year, and load applications.
   2. Submit certification one week before bid date on metal building system manufacturer's letterhead.
E. Submit certification verifying metal roof system is tested and approved by UL as Class 90.
F. Dealer Certification: Submit certification one week before bid date that metal building/roof system supplier is a manufacturer's authorized and franchised dealer of system furnished. Certification shall state date when authorization was granted.
G. Installer Certification: Submit certification one week before bid date that metal building/roof system installer regularly engaged in installation of building systems of same or equal construction to system specified.
H. Warranty Documentation: Submit manufacturer's standard warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer regularly engaged, for past 10 years, in manufacture of metal building systems of similar type to that specified.
   2. Accredited based on IAS Accreditation Criteria AC472 and IBC Chapter 17 requirements.

B. Installer's Qualifications:
   1. Installer regularly engaged, for past five years, in installation of metal building systems of similar type to that specified.
   2. Employ persons trained for installation of metal building systems.

C. Certificate of design and manufacturing conformance:
   1. Metal building system manufacturer shall submit written certification prepared and signed by a Professional Engineer, registered to practice in Texas, verifying building/metal roof system designs (including panels, clips, and support system components) meet indicated loading requirements and codes of authorities having jurisdiction.
   2. Certification shall reference specific dead loads, live loads, snow loads, wind loads/speeds, tributary area load reductions (if applicable), concentrated loads, collateral loads, seismic loads, end-use categories, governing code bodies including year, and load applications.
   3. Certificate shall be on metal building system manufacturer's letterhead.
   4. Refer to Article 1.4 - Submittals.

D. Material Testing:
   1. In addition to material certifications of structural steel, metal building system manufacturer shall provide, upon request at time of order, evidence of compliance with specifications through testing.
   2. Quality assurance testing shall include testing structural bolts, nuts, screw fasteners, mastics, and metal coatings (primers, metallic-coated and painted-coil products).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling Requirements:
   1. Store and handle materials per manufacturer's instructions.
   2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
   3. Do not store materials directly on ground.
   4. Store materials on flat, level surface, raised above ground, with adequate support to prevent sagging.
   5. Protect materials and finish during storage, handling, and installation to prevent damage.

1.7 WARRANTY

A. Metal building system manufacturer shall provide a written weathertightness warranty for a maximum 25 years against leaks in standing seam roof panels, arising out of or caused by ordinary wear and tear under normal weather and atmospheric conditions.
   1. Warranty shall be signed by manufacturer of metal roof AND metal roof systems.

2. Maximum liability of warranty shall be no less than $0.70 per square foot roof area.

B. Metal building system manufacturer shall provide a written 25-year warranty against perforation of metal roof panels due to corrosion under normal weather and atmospheric conditions. Warranty shall be signed by metal roof system manufacturer.

C. Metal building system manufacturer shall provide a 25-year paint film written warranty against cracking, peeling, chalking, and fading exterior coating on painted roof and wall panels.
   1. Warranty shall be signed by metal building system or roof system manufacturer and state coating contains 70-percent *Kynar 500* or *Hylar 5000* resin.
   2. Metal building system manufacturer shall warrant coating shall not peel, crack, or chip for 25 years.
   3. For 25 years, chalking shall not exceed ASTM D4214, #8 rating nor fade more than five color difference units per ASTM D2244.

D. Metal Building System Manufacturer's Certification: Metal building system manufacturer shall submit a signed written Certification one week before bid date, stating metal roof system manufacturer or approved representative will provide warranties, inspection, and report service specified herein. Submit warranty terms with bid.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Metal Building System Manufacturer: Subject to compliance with requirements, provide metal building system by Butler Manufacturing, (PO Box 419917, Kansas City, Missouri 64141; 816.968.3000; www.butlermfg.com), or approved equal, by:
   1. American Buildings Company;
   2. CECO Building Systems;
   3. Kirby Building Systems;
   4. Mueller Inc.; or
   5. Whirlwind Steel Buildings.

2.2 BUILDING DESCRIPTION

A. Building Dimensions: As indicated on Drawings.
   1. Horizontal Dimensions: Measure to inside face of wall sheets.
   2. Eave Height: Measure from top of finished floor to intersection of insides of roof and sidewall sheets.
   3. Clear Height Between Finished Floor and Bottom of Roof Beams: Indicated on Drawings.

B. Primary Structural Members:
   1. Primary Framing System: Metal building manufacturer framing system, as specified herein.
   2. Frames: Welded-up plate section columns and roof beams, complete with necessary splice plates for bolted field assembly as specified herein.
   3. Bolts for Field Assembling Primary Steel: High-strength bolts as indicated on erection drawings of metal building system manufacturer.
   4. Beam and Post Endwall Frames: Endwall corner posts, roof beams, and posts as required by design criteria.
   5. Exterior Columns: Welded-up H-sections or cold-formed C-sections.
   6. Interior Columns: H-sections or tube columns.

7. Connecting Primary Structural Members: ASTM A325 bolts thru factory-punched holes.
8. Primary Structural Members: Paint with metal building system manufacturer's standard primer with surface preparation as specified herein.

C. Secondary Structural Members:
1. Secondary Framing System: Metal building manufacturer framing system, as specified herein.
2. C/Z Purlins and Girts: Acrylic-coated G30 galvanized finish.

D. Metal Roof System: Metal building manufacturer metal roof system, as specified herein.

E. Metal Wall System: Metal building manufacturer metal wall system as specified herein.

F. Where metal panels required to paint, use coating system as specified herein.

2.3 DESIGN REQUIREMENTS

A. Governing Design Code. Structural design for building structural system provided by metal building system manufacturer for the following design criteria:
1. Governing Building Code: IBC.
2. Year/Version: 2015.
3. Occupancy Category: Risk Category II (General Use).

B. Roof Live Load:
1. Loads produced during the life by moveable objects.
2. Wind, snow, seismic, or dead loads are NOT live loads.
3. Applied based on Tributary Area as stated in code.

C. Roof Snow Load:
1. Roof snow load used for designing structure shall not be reduced and shall be the product of the following criteria:
a. Snow Load Coefficient (Ce): 0.90.
b. Thermal Factor (C_t): 1.20.
c. Snow Importance Factor (I): 1.0.
d. Ground Snow Load (Pg): 5.0 psf.
e. Roof Snow Load (Pf): 3.78 psf.
2. Design snow load shall include effects of minimum flat roof load limits, rain on snow, drifting snow, and unbalanced snow load as defined in governing building code specified.

D. Wind Load:
1. Wind load used to design structure shall be product of the following criteria:
a. Wind Exposure Category: C.
b. Wind Topographic Factor (K_{zt}): 1.0.
c. Wind Directionality Factor (K_d): 0.85.
d. Wind Velocity (V), miles per hour: 105.
2. Wind pressure coefficients and design pressures shall be applied per governing code.

E. Seismic Load:
1. Seismic load used for designing structure based on the following criteria:
a. Spectral response acceleration for short periods (S_s): 15.16 percent g.
b. Spectral response acceleration for 1-sec. period (S_1): 4.92 percent g.
c. Site Class: D.
d. Seismic Importance Factor (I): 1.0.
2. Apply seismic loads per governing code.

F. Dead Load shall consist of weight of building system construction (roof, framing, covering members, etc.).

G. Collateral Load:
   1. Apply collateral load in pounds per square foot to entire structure to account for weight of additional permanent materials other than building system, (sprinklers, mechanical systems, electrical systems, hung partitions, ceilings, etc.).
      a. Minimum Collateral Load: 3 psf for miscellaneous suspended loads.
   2. Allowance does not include weight of hung equipment weighing 50+ pounds.
   3. Indicate equipment loads of 50+ pounds on Drawings and strengthen structure as required.
   4. Architect provides metal building system manufacturer with magnitude and approximate location of concentrated loads more than 50 pounds before starting design of building.

H. Auxiliary loads include dynamic loads, (cranes, material handling systems, etc), and defined in Contract Documents.

I. Load combinations used to design primary and secondary structural members shall be per governing code.

2.4 DEFLECTIONS

A. Structural Members:
   1. Maximum deflection of main framing members shall not exceed 1/180 of respective spans.
   2. Maximum deflection due to snow load in roof panels and purlins shall not exceed 1/180 of respective spans.
   3. Maximum deflection due to wind load in wall panels and girts shall not exceed 1/90 of respective spans.

B. Lateral deflections, or drift, at structure roof level in relation to floor or slab-on-grade, caused by deflection of horizontal force resisting elements, shall not exceed H/60.

C. Calculate deflections using only bare frame method.
   1. Reductions based on engineering judgment using assumed composite stiffness of building envelope, not allowed.
   2. Drift per AISC Serviceability Design Considerations for Low-Rise Buildings.
   3. Using composite stiffness for deflection calculations permitted only when actual calculations for stiffness included with design for project.
   4. When maximum deflections specified, include calculations in design data.

2.5 STRUCTURAL STEEL FRAMING SYSTEM

A. General:
   1. Design Structural System: Clear span rigid frame with tapered or straight columns and roof beams, with gable roof.
   2. Actual Building Length:
      a. Structural line to structural line.
      b. Same as nominal (i.e., number of bays times length of bays).
      c. Structural Line: Defined as inside face of wall sheets.
   3. Actual Building Width:
      a. Structural line to structural line.
      b. Nominal building width.
   4. Roof Slope: 1/2 inch in 12 inches.
   5. Components and Parts of Structural System:
      a. Indicated on Drawings or Specifications.
      b. Clearly marked.

c. Erection Drawings: Supply for identification and assembly of parts.
d. Drawings: Carry stamp of registered professional engineer.

6. Foundations:
   a. Foundations, Including Anchor Bolt Embedment Length: Properly designed by qualified engineer, retained by other than metal building system manufacturer, per specific soil conditions for building site.
   b. Reactions for Proper Design of Foundations: Supplied by metal building system manufacturer.
   c. Anchor Bolts:
      1) Diameter: Indicated on anchor bolt layout drawings furnished by metal building system manufacturer.
      2) Supplied by Contractor, not metal building system manufacturer.
      3) On Moment-Resisting Column Bases: Nuts above and below base plates.

B. Structural Steel Design:
   1. Structural Mill Sections or Welded-up Plate Sections: Design per AISC Specification for Structural Steel Buildings.
   2. Cold-Formed Steel Structural Members: Design per AISI North American Specification for Design of Cold-Formed Steel Structural Members.
   3. Structural System: Design per specified building code (Refer to Design Loads and Building Codes).

C. Primary Framing:
   1. Rigid Frames:
      a. Frames: Welded-up plate section columns and roof beams, complete with necessary splice plates for bolted field assembly.
         1) Base, Cap, Compression Splice, and Stiffener Plates: Factory welded into place and connection holes factory fabricated.
         2) Columns and Roof Beams: Fabricated complete with holes in webs and flanges for attachment of secondary structural members and bracing, except for fieldwork noted on erection drawings furnished by metal building system manufacturer.
      b. Bolts for Field Assembly of Frame Members: ASTM A325 high-strength bolts indicated on erection drawings furnished by metal building system manufacturer.
   2. Endwall Structural Members: Welded-up plate sections designed per AISC Specification for Structural Steel Buildings.
      a. Endwall corner posts, roof beams, and posts as required by design criteria.
         1) Splice Plates and Base Clips: Shop fabricated complete with bolt connection holes.
         2) Base, Cap, Compression Splice, and Stiffener Plates: Factory welded into place and connection holes shop fabricated.
         3) Beams and Posts: Factory fabricated complete with holes for attachment of secondary structural members, except for field work noted on erection drawings furnished by metal building system manufacturer.
      b. Intermediate Frames: Substituted for end-wall roof beams, when specified. Factory fabricate necessary endwall posts and holes for connection to intermediate frame used in endwall.

D. Secondary Structural Members:
   1. Purlins:
      a. Size and Shape:
         1) Z-shaped, precision-roll-formed, acrylic-coated G30 galvanized steel in different gauges to meet specified loading conditions.
         2) 7-, 8 1/2-, 10-, or 11 1/2-inch-deep Z-sections.
      b. Outer Flange of Purlins: Factory-punched holes for panel connections.
      c. Attach purlins to main frames and endwalls with 1/2-inch-diameter bolts.
      d. Brace purlins at intervals indicated on erection drawings furnished by metal building system manufacturer.
      e. Concentrated Loads: Hung at purlin panel points.
   2. Eave Struts: Factory punched 7-, 8 1/2-, 10-, or 11 1/2-inch-deep C-sections, precision-roll-formed, acrylic-coated G30 galvanized steel in different gauges to meet specified loading conditions.
   3. Girts:
      a. Z- or C-shaped, precision-roll-formed, acrylic-coated G30 galvanized steel in different gauges to meet specified loading conditions.
      b. 7-, 8 1/2-, 10-, or 11 1/2-inch-deep Z- or C-sections.
      c. Outer Flange of Girts: Factory-punched holes for panel connections.
   4. Bracing:
      a. Locate bracing indicated on Drawings.
      b. Diagonal Bracing:
         1) Hot-rolled rods of sizes indicated on Drawings.
         2) Attach to columns and roof beams indicated on Drawings.
      c. Optional fixed-base wind posts or pinned-base portal frames may be substituted for wall rod bracing on buildings, as required.
      d. Flange Braces and Purlin Braces: Cold formed and installed as indicated on Drawings.
E. Welding:
   1. Procedures, Operator Qualifications, and Quality Standards: AWS D1.1 - Structural Welding Code – Steel, and AWS D1.3 - Structural Welding Code – Sheet Steel.
   2. Identify and negotiate welding inspection, other than visual inspection as defined by AWS D1.1, paragraph 6.9, before bidding.
   3. Certification of Welder Qualification: Supply when requested.
F. Painting Structural Steel Framing System:
   1. General:
      a. Structural Steel: Prime paint as temporary protection against ordinary atmospheric conditions.
      b. Perform subsequent finish painting in field, if required, per manufacturer recommendations.
      c. Before painting, clean steel of loose rust, mill scale, dirt, and other foreign materials.
      d. Steel Fabricator: Not required to sand blast, flame clean, or pickle steel before painting, unless otherwise specified.
   2. Primary Frames:
      a. Clean steel per SSPC-SP2.
      b. Factory cover steel with one coat gray water-reducible alkyd primer paint formulated to equal or exceed performance requirements SSPC-Paint 15.
      c. Minimum Coating Thickness: 1.0 mil.

3. Secondary Structural Members – Roll-Formed:
   a. Hot-dipped zinc coating, ASTM A 653, G30; followed by one coat clear acrylic finish.
   b. Acrylic-Coated G30 Galvanized Steel: Equal or exceed performance requirements of SSPC Paint-15.

2.6 METAL ROOF SYSTEM

A. Metal Roof System Basis of Design: Butler Manufacturing *Butlerib®II* roof system, or equal.

B. Roof System Design:
   1. Design roof panels per AISI North American Specification for Design of Cold-Formed Steel Structural Members.
   2. Design roof panels to support 200-pound load distributed evenly over 2-foot-square area centered between purlins, without exceeding panel deflection-to-span ratio of 1/180 in two-span condition.
   3. Design roof paneling system for a minimum roof slope of 1/2 inch in 12 inches.
   4. Design roof paneling system to support design live, snow, and wind loads.

C. Roof System Performance Testing:
   1. UL Wind Uplift Classification Rating, UL 580: Class 90.
   2. Structural Performance Under Uniform Static Air Pressure Difference: Test roof system per ASTM E1592.
   3. FM Global (Factory Mutual): Roof system tested per FMRC Standard 4471 and approved as a Class 1 Panel Roof.

D. Roof Panels:
   1. General:
      a. Factory roll-formed to provide width coverage of 3 feet.
      b. Four major corrugations spaced 12 inches on center.
      c. Each Major Corrugation: 1 1/2 inches high, 2 7/8 inches wide, tapering 1 9/32 inches wide at top, with no intermediate minor corrugations.
      d. In Panel Flat: Two additional minor corrugations, 1 inch wide, 1/8 inch high, spaced 4 inches on center, between major corrugations.
   2. Roof Panel Side Laps:
      a. Overlap one major corrugation.
      b. One Outboard Corrugation: Formed as overlapping corrugation.
      c. Other Outboard Corrugations: Formed as underneath corrugation.
         1) Full corrugation to provide bearing support to side lap.
         2) Formed with continuous-length sealant groove.
   3. Roof Panel End Laps:
      a. 6 inches.
      b. Supply maximum possible panel lengths, up to 38 feet, 9 inches, to minimize panel end laps.
      c. Factory punch roof panel end laps (top panel with round hole and bottom panel with slotted hole) to provide expansion, contraction, and panel alignment.
      d. Design end laps to occur over and fasten to secondary structural members.
   4. Ridge Panels:
      a. One-piece, factory formed to match roof slope.
      b. Ridge Panel Cross Section: Match roof panels.
      c. Ridge Panel Splices: Occur over first purlin on either side of building center.
   5. Eave Panels: Extend beyond building structural line.

6. Factory punch roof panels at panel ends to match factory-punched or field-drilled holes in structural members to ensure proper alignment.
   a. Upper End of Eave and Splice Panels: 3/4-inch-long slots to provide for panel expansion and contraction.
7. Panel Material and Finish:
   a. 26-gauge painted Galvalume aluminum-zinc alloy (approximately 55 percent aluminum, 45 percent zinc), ASTM A792.
   b. Paint with exterior colors of *Butler-Cote™* finish system, full-strength, 70-percent *Kynar 500* or *Hylar 5000* fluoropolymer (PVDF) coating.
   c. PVDF Coating Warranty: Metal building system manufacturer shall warrant coating 25 years for:
      1) Not to peel, crack, or chip.
      2) Chalking: Not to exceed ASTM D4214, #8 rating.
      3) Fading: Not more than five color-difference units, ASTM D2244.

E. Provision for Expansion and Contraction:
1. Optional Factory-Punched Roof Panels: 5/16- x 3/4-inch-slotted holes at upper end and 5/16-inch-diameter holes at lower end.
2. Slotted Holes: Permit thermal movement of panels without detrimental effect on roof panels.

F. Fasteners:
1. Fastener Locations and Quantities: Indicated on erection drawings furnished by metal building system manufacturer.
2. Panel-to-Structural Connections: Type 410 stainless steel *Scrubolt™* fasteners, 3/8-inch hex head, with 3/4-inch OD aluminum-backed EPDM washers.
3. Panel-to-Panel Connections: #14-14 by 7/8-inch galvanized steel 3/8-inch hex-head mini-point self-drilling screws, with 5/8-inch OD metal-backed EPDM washers.

G. Accessories:
1. Ventilators, skylights, eave and gable trim, gutters, jacks, curbs, etc. Standard with metal building system manufacturer, unless otherwise noted/furnished as specified.
2. Metal Coating on Gutters, Downspouts, Gable Trim, and Eave Trim: *Butler-Cote™* finish system, full-strength, 70-percent *Kynar 500* or *Hylar 5000* fluoropolymer (PVDF) coating.
3. Location of Standard Accessories: Indicated on erection drawings furnished by metal building system manufacturer.

2.7 METAL WALL SYSTEM

A. Exterior Metal Wall System Basis of Design: Butler Manufacturing *Butlerib® II* wall system, or equal.
B. Wall System Design: Design wall panels per AISI North American Specification for Design of Cold-Formed Steel Structural Members.
C. Wall Panels:
1. Roll-formed panels, 3 feet wide with four major corrugations, 1 1/2 inches high, 12 inches on center, with two minor corrugations between each major corrugation entire length of panel.
2. One piece from base to building eave.
3. Upper End of Panels: Fabricate with mitered cut to match corrugations of *Butlerib® II* roof panels of 1/2 - 12 inches and square cut for all other roof panels and slopes.
4. Factory punch or field drill wall panels at panel ends and match factory-punched or field-drilled holes in structural members for proper alignment.

5. Panel Material and Finish:
    a. 26-gauge painted Galvalume aluminum-zinc alloy (approximately 55-percent aluminum, 45-percent zinc), ASTM A792.
    b. Paint with exterior colors of *Butler-Cote™* finish system, full-strength, 70-percent *Kynar 500* or *Hylar 5000* fluoropolymer (PVDF) coating.
    c. PVDF Coating Warranty: Metal building system manufacturer shall warrant coating 25 years for:
        1) No peeling, cracking, or chipping.
        2) Chalking: Not to exceed ASTM D4214, #8 rating.
        3) Fading: Not more than five color-difference units, ASTM D2244.

D. Fasteners:
1. Wall Panel-to-Structural Connections: Torx-head *Scrubolt™* fasteners.
2. Wall Panel-to-Panel Connections: Torx-head self-drilling screws.
3. Fastener Locations: Indicated on erection drawings furnished by metal building system manufacturer.
4. Exposed Fasteners: Factory painted to match wall color.

E. Accessories:
1. Accessories (doors, windows, louvers, etc.): Standard with metal building system manufacturer, unless otherwise noted and furnished as specified.
2. Location of Standard Accessories: Indicated on erection drawings furnished by metal building system manufacturer.

2.8 METAL COATING SYSTEM

A. Metal Coating System Basis of Design: Butler Manufacturing *Butler-Cote™* finish system factory-applied, exterior metal coating system, or equal.

B. Substrate Preparation for G90 Hot-Dipped Galvanized Steel or AZ50 Galvalume: Factory-controlled chemical-conversion treatment.

C. Coating
1. Material: Full-strength, 70-percent *Kynar 500* or *Hylar 5000* fluoropolymer (PVDF) color coating.
2. After steel preparation, coat exterior exposed surface with primer and PVDF.
    a. Nominal Total Dry Film Thickness: 1.0 mil.
3. Interior Exposed Surfaces: Coat with polyester color coat.
4. Apply coatings to entire material dimensions of steel sheets before forming panels.

D. Physical Characteristics of Exterior Coating:
1. Resistance to failure through cracking, checking, peeling, and loss of adhesion.
2. Measure by the following laboratory weather-simulating tests to obtain test results justifying metal building system manufacturer's 25-year warranty:
    a. Humidity resistance at 100 degrees F and 100-percent relative humidity, ASTM D2247.
    b. Salt-spray resistance at 5-percent salt fog, ASTM B117.
    c. Reverse impact resistance, ASTM D2794.
    d. Resistance to accelerated weathering, Atlas Model XW-R Dew Cycle Weather-O-Meter, ASTM D3361.
    e. Resistance to dry heat.
    f. Abrasion resistance, ASTM D968.
    g. Chemical/acid/pollution resistance, ASTM D1308 and G87.
    h. Maintain gloss of finish evenly over entire surface, ASTM D523

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area to receive metal building system.
B. Notify Architect of conditions that would adversely affect installation or subsequent use.
C. Do not begin installation until unacceptable conditions are corrected.

3.2 ERECTION – STRUCTURAL STEEL FRAMING SYSTEM

A. Erect structural steel framing system per Drawings and metal building system manufacturer's erection drawings.
B. Field Modifications:
   1. Require approval of metal building system manufacturer.
   2. Responsibility of building erector.
   3. Field Modifications to Truss Purlins: Not allowed, unless indicated on erection drawings furnished by metal building system manufacturer.
C. Fixed Column Bases: Grout flush with floor line after structural steel erection is complete.

3.3 INSTALLATION – METAL ROOF SYSTEM

A. Install roof system per metal building system manufacturer's instructions at locations indicated on Drawings.
B. Install roof system weathertight.
C. Factory cut-to-length roof panels per erection drawings furnished by metal building system manufacturer.
D. Position and align roof panels to hold 3-foot module throughout building length. Position and align optional factory-punched roof panels by matching factory-punched holes in panels with factory-punched holes in roof structural members.
E. Install side laps with minimum one full corrugation.
F. End Laps:
   1. Minimum 6 inches.
   2. Fasten together over and to structural members.
G. Panel Side and End Laps: Seal with *Panlastic* sealant to prevent capillary moisture entry.

3.4 INSTALLATION – METAL WALL SYSTEM

A. Install wall system per metal building system manufacturer's instructions where indicated on Drawings.
B. Install wall system weathertight.
C. Verify structural system is plumb before attaching wall panels.
D. Align and attach wall panels per erection drawings furnished by metal building system manufacturer.
E. Install side laps with minimum one full corrugation.
F. Seal wall panels at base with metal trim.
G. Exterior Trim. Apply same finish as exterior color of wall panels, except:
   1. Gutters, Downspouts, Eave Trim, Gable Trim, Door-Side Flashings, and Header Flashings: Paint with exterior colors of *Butler-Cote*™ finish system, full-strength, 70-percent *Kynar 500* or *Hylar 5000* fluoropolymer (PVDF) coating in standard color of metal building system manufacturer.
H. Flashings, Trim, Closures, and Similar Items: Install as indicated on erection drawings furnished by metal building system manufacturer.

3.5 PROTECTION

A. Protect installed metal building system to ensure that, except for normal weathering, metal building system will be without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 16000 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Sections:
1. Division 01 Specification Sections apply to Work of this Section.
2. Requirements of the General Conditions, Special Conditions, and General Requirements of these specifications are applicable and part of every section in Division 16 - Electrical. Contractor shall furnish all labor, material, service, equipment, appliances, and shall perform all operations regarding installation and testing of electrical work per Contract Drawings and Specifications. Any material found defective will be rejected by Engineer, and Contractor shall remove such defective material from site of work.
3. Contractor is responsible for all such material furnished by him and he shall replace, at his own expense, all such materials found defective in manufacture or damaged after delivery.

1.2 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

A. Regulatory Agencies: Installation, materials, equipment, and workmanship shall conform to applicable provisions of:
1. National Electrical Code (NEC).
2. National Electrical Safety Code (NESC).
3. Terms and conditions of electrical utility and other authorities having lawful jurisdiction pertaining to work required.

1.3 MODIFICATIONS

A. All modifications required by these applicable codes, rules, regulations, and authorities shall be made by Contractor without additional charge to Owner.
B. UL: All materials, appliances, equipment or devices shall conform to UL applicable standards. Label of, or listing by UL required.
C. Standards: Where referenced in Specifications or Drawings, publications and standards of these organizations shall apply:
1. American Society of Testing and Materials (ASTM).
2. Institute of Electrical and Electronic Engineers (IEEE).
3. Insulated Power Cable Engineers Association (IPCEA).
4. National Electrical Manufacturers Association (NEMA).
5. National Fire Protection Association (NFPA).
6. American National Standards Institute (ANSI).
7. Illuminating Engineering Society of North America (IESNA).
D. If Contractor observes any conflict or variation in Plans and/or Specifications, he shall notify Engineer in writing no later than 10 days before date of bid opening. Failure to clarify such variations will result in Electrical Contractor bearing all costs arising from electrical work done contrary to Specifications or Drawings.
E. Electrical Contractor shall coordinate all conduit runs, control wiring, and electrical connections to equipment items furnished by Mechanical Contractor, General Contractor, Instrumentation Contractor, Owner, and other contractors under Specifications.

1.4 SUBMITTALS

A. Materials List: Within 15 days after Award of Contract, Contractor shall submit to Engineer a list of all equipment to be furnished. Where substitutions are proposed, complete data must be furnished showing performance, quality, and dimensions. Written approval of Engineer must be obtained before purchasing any substitute equipment.

B. Shop Drawings: As per Section 01330 – Submittal Procedures, submit for approval all Shop Drawings after material list is approved, and before ordering. Show complete outlines, dimensions, electrical services, control diagrams, electrical characteristics of a special nature or critical to the installation, and pertinent data required for installation. All descriptive data, technical data, and Shop Drawings shall bear signed certification that they have been carefully examined and found correct with respect to dimension, space available, non-interference with other trades, and equipment complies with all specification requirements. Where catalog data are submitted, proposed items shall be clearly "flagged," or otherwise identified, so no confusion exists. In addition to specific references or requests, submit Shop Drawings motor starters, switches, control devices, control systems, and sensing equipment.

C. Substitutions: Submit proposed substitutions of electrical equipment, control devices, and other equipment with other submittal data. This request shall be accompanied by complete descriptions of substitutes offered, including catalog cuts. Entire burden of proof of equality shall be placed on Contractor and Engineer decision shall be final.

D. Test Data: Provide one copy of all data obtained during tests required in Specifications. Data shall be organized, typed, and indicate each test result. This shall be submitted for Engineer Review within three days of performing required tests.

PART 2 - PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

A. Electrical requirements for equipment specified or indicated on Drawings are based on information available at time of design. If equipment furnished for installation has electrical requirements other than indicated on electrical drawings, Contractor shall make any required changes to wire and conduit size, controls, over current protection and installation, as required to accommodate equipment supplied, without additional charge to Owner. Complete responsibility and costs for such adjustments shall be assigned to this Specification where equipment is furnished.

2.2 MATERIALS

A. All similar materials and equipment shall be the product of the same manufacturer unless specified otherwise. Where no specific material, apparatus, or appliance is mentioned, any first-class product, with Engineer approval, may be used. Materials and equipment shall be standard products of manufacturers regularly engaged in production of such material and shall be manufacturer's current and standard design. Equipment affected by altitude shall perform satisfactorily for function intended at altitude of project site.

PART 3 - EXECUTION

3.1 GENERAL

A. Fabrication, erection, and installation of complete electrical system shall be done per accepted good practice by qualified personnel experienced in such work and orderly proceed so not to impede project progress. Electrical Contractor shall check all areas and surfaces where electrical equipment material is to be installed, removed, or relocated, and report any unsatisfactory conditions before starting work. Commencement of work signifies Contractor acceptance of existing conditions. In acceptance or rejection of the finished installation, no allowance will be made for lack of skill on the part of workmen.

3.2 TEMPORARY POWER AND LIGHTING

A. Furnish and install temporary electrical facilities, if required, for construction and safety operations. No part of the permanent electrical systems or existing electrical system may be used for temporary service unless approved by Engineer. Provide separate electrical metering for temporary power.

3.3 PERFORMANCE TESTS

A. Thoroughly test all control circuits, fixtures, services, and all circuits for proper operating condition and freedom from grounds and short circuits before requesting acceptance. All equipment, appliances, and devices shall be operated under load conditions. After completing interior wiring system installation and when Engineer may direct, conduct operating tests for approval. When requested, test all wire, cable, devices, and equipment after installation to assure all material possesses original characteristics as required by governing codes and standards listed in specifications.

B. Perform such tests as required by specifications or as requested to prove acceptability. Furnish all instruments and labor for testing.

3.4 RECORD DRAWINGS

A. During work progress, maintain a clean, full set of project plans to use in recording accurate red-lined changes to system installation. Upon completion of installation, submit full set of red-lined drawings with all record data to Engineer.

3.5 OPERATING INSTRUCTIONS AND MANUALS

A. Without additional charge to Owner, furnish complete instruction to Owner in care, adjustment, and operation of all parts of electrical equipment and systems. Upon completion of work, prepare and deliver to Owner, four complete sets of Operating and Maintenance manuals for the systems and major equipment installed. Include catalog data, shop drawings, wiring diagrams, performance curves and rating data, spare parts lists, and manufacturer operating maintenance data. A copy of testing data collected during field tests shall also be included in manuals.

B. Noted requirements are in addition to specific instructions and manuals specified for individual systems or equipment.

3.6 DRAWINGS

A. General: Electrical drawings show general arrangement of all conduit, equipment, etc. and shall be followed as closely as actual building construction and work of other trades will permit.

Structural drawings shall be considered part of the work insofar these drawings furnish Contractor with information relating to building design and construction. Because of the small scale of electrical drawings, indicating all offsets, fittings, and accessories required is not possible. Contractor shall investigate structural and finish conditions affecting work and arrange his work accordingly, providing such fittings, elbows, pull boxes, and accessories as may be required to meet such conditions.

B. Field Measurements: Contractor shall verify dimensions governing electrical work at facility. No extra compensation shall be claimed or allowed because differences between actual dimensions and those indicated on Drawings.

C. Coordination Drawings: In locations where several trades' work must be sequenced and positioned with precision to fit into available space, prepare coordination drawings (shop drawings) showing actual physical dimensions (at accurate scale) required for installation, if Engineer deems necessary. Prepare and submit these coordination drawings, if required, before purchase-fabrication-installation of any elements involved in coordination.

3.7 LOCATION OF EQUIPMENT AND OUTLETS

A. Approximate locations of cabinets, conduits, controllers, power outlets, etc., are indicated on Drawings, although not intended to give complete and detailed information. Determine exact location after thoroughly examining general building plans and by actual measurements during construction, subject to Engineer approval.

3.8 EXISTING ELECTRICAL

A. Existing electrical system information has been obtained from the most up-to-date source and documents, but accuracy is not guaranteed. Contractor shall familiarize himself with existing conditions before preparing bid.

B. Only existing electrical affected by this Contract is shown on Drawings. Existing electrical not shown in Drawings is to remain in place and in operation. All existing electrical damaged during construction shall be repaired or replaced.

C. Contractor is responsible for damage to existing walls or ceilings from electrical construction. Repairing of damage to existing building shall be done by proper trades involved.

3.9 ELECTRIC UTILITY SERVICE

A. Texas-New Mexico Power is the local electric utility company providing service to existing facility. Design and installation of overhead and underground facilities will be done by Texas-New Mexico Power.

B. Contractor shall be familiar and comply with requirements of latest version of Service Requirements book from each service provider. Any equipment in the Service Requirements book stated to be provided or installed by Customer, Contractor shall provide and install.

C. Contractor shall coordinate with service provider to establish exact location and spacing requirements of the service pole.

END OF SECTION

SECTION 16111 - CONDUIT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal and nonmetal conduit.
   2. Liquidtight flexible metal conduit.
   3. Fittings and conduit bodies.

B. Scope:
   1. Inspect conduit, fittings, conduit bodies, and accessories upon delivery and during work progress. Any material found defective will be rejected by Engineer, and Contractor shall remove such defective material from site of work.
   2. Contractor responsible for all materials furnished by him and shall replace, at his own expense, all materials found defective in manufacture or damaged after delivery.

C. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 16130 - Boxes.
   3. Section 16190 – Supporting Devices.

1.2 REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
B. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated.
C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable assemblies.
D. ANSI/NFPA 70 - National Electrical Code.
E. NECA - Standard of Installation.
F. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally-Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
G. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
H. NEMA VE1 – Metal Cable Tray Systems
I. NEMA VE2 – Cable Tray Installation Guidelines

1.3 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01400 – Quality Control. Accurately record actual routing of all conduits.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. Furnish products listed and classified by UL as suitable for purpose specified and shown.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle Products to site under provisions of General Conditions. Accept conduit onsite and inspect for damage. Protect conduit from corrosion and entrance

of debris by storing above grade and providing appropriate covering. Protect PVC conduit from sunlight.

1.6 PROJECT CONDITIONS

A. Verify field measurements are as shown on Drawings. Verify routing and termination locations of conduit before rough-in. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

A. Conduit Minimum Size: 3/4 inch unless otherwise specified.
B. Rigid Metallic Conduit (RMC): Hot-Dipped Galvanized Rigid Steel, ANSI C80.1.
   1. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.
C. Liquidtight Flexible Metal Conduit: Interlocked steel construction with PVC jacket. Use flexible conduit only for connection to devices and structures subject to vibration. Maximum length of flexible conduit shall be 3 feet.
D. Electrical Metallic Tubing (EMT): ANSI C80.3; galvanized tubing.
   1. Fittings and Conduit Bodies: ANSI/NEMA FB1; steel or malleable iron, compression type.
E. PVC-Coated RMC: 40 mil gray PVC exterior coating over galvanized rigid conduit, clear urethane coating over hot galvanized threads, UL listed with PVC as primary corrosion protection for steal conduit with an underlying zinc coating as a supplemental corrosion protection coating.
   1. Fittings and Conduit Bodies:
      a. By same manufacturer as conduit.
      b. UL Listed Standard 514B, material and coatings to match conduit.
      c. Urethane coating shall be uniformly and consistently applied to interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness.
      d. Conduit or fittings having areas with thin or no coating, shall be unacceptable.
F. Rigid Nonmetallic Conduit (RNC): NEMA TC-2; Schedule 40 or 80 PVC.
   1. PVC Fittings and Conduit Bodies: NEMA TC.

2.2 UNDERGROUND INSTALLATIONS

A. At 18 inches below grade and lower utilize Rigid Nonmetallic Conduit (RNC). If underground conduit run not encased in concrete, place 4 inches of sand below and above conduit, and install a 2-inch red detectable ribbon 6 inches above top of conduit for entire length of underground run.
B. Any conduit located less than 18 inches below grade shall be PVC-coated RMC, or RNC encased in concrete.
C. When transferring from below grade to above grade, use PVC-coated RMC Ells.

2.3 ABOVEGROUND INSTALLATIONS

A. Wet and Damp Locations: Use RMC.
B. Dry Locations: Use electrical metallic tubing, zinc-coated, where conduit will be concealed. Use RMC where conduit will be exposed.

C. Corrosive/Hazardous Environments: Use PVC-coated RMC at all locations where explosive gasses may be present.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install conduit per NECA Standard of Installation. Install nonmetallic conduit per manufacturer instructions. Arrange supports to prevent misalignment during wiring installation. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and splint hangers. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits. Fasten conduit supports to building structure and concrete surfaces with galvanized hardware. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

B. Arrange conduit to maintain headroom and present neat appearance. Route exposed conduit parallel and perpendicular to walls. Maintain adequate clearance between conduit and piping. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F. Remove all sharp edges from ends after cutting. Do not use “pipe” cutters for cutting conduit. Bring conduit to shoulder of fittings; fasten securely.

C. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full, even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

D. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Conduit bends shall be made so as not to alter the cross-sectional area of the conduit.

E. Use suitable caps to protect installed conduit against entrance of dirt and moisture. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control and expansion joints. Provide suitable pull string in each empty conduit except sleeves and nipples.

F. All conduits identified on a conduit schedule shall be tagged at each end with metal tags engraved or stamped to identify conduit per identification on “schedule.”

3.2 PAYMENT

A. Payment will be made for all work covered in this section at Contract unit price per unit or included in the lump sum price per job for items, as shown on Proposal. Either payment shall be complete compensation for the complete performance of work per Drawings and specification provisions.

END OF SECTION

SECTION 16123 - WIRE AND CABLE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Power wire and cable.
2. Underground feeder and branch circuit cable.
3. Service entrance and control cable.
4. Wiring connectors and connections.

B. Related Sections:
1. Division 01 Specification Sections apply to Work of this Section.
2. Section 16111 - Conduit.
3. Section 16130 - Boxes.

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Submit under provisions of General Conditions.
B. Product Data: Provide for each cable assembly type.
C. Test Reports: Indicate procedures and values obtained.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.
B. Furnish UL-listed and -classified products as suitable for purpose specified and shown.

1.5 PROJECT CONDITIONS

A. Verify field measurements are as shown on Drawings.
B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wires and cables as required meeting Project Conditions.
C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.6 COORDINATION

A. Coordinate work with other trades.
B. Determine required separation between cable and other work.
C. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Power Wire and Cable: Cable as manufactured by Carol Cable, Triangle PWC, Inc., Capital Wire & Cable Corp. or equal.
B. Control Cable: Belden or equal

2.2 POWER WIRE AND CABLE

A. Description: Single or multi-conductor insulated wire.
B. Conductor: Copper.
C. Insulation Voltage Rating: 600 volts.
D. Insulation: ANSI/NFPA 70; Type THHN/THWN, 90 degrees C insulation for service entrance, feeders, and branch circuits.

2.3 CONTROL CABLE

A. Analog I/O wiring shall be 16 AWG, twisted pair shielded, Belden 8719 or equal.
B. Discrete I/O wiring shall be 16AWG, 600V, stranded copper, THWN. Use multi-conductor cable when possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify mechanical work likely to damage wire has been completed.

3.2 INSTALLATION

A. Install products per manufacturer instructions.
B. Use copper conductor not smaller than 12 AWG for power and lighting circuits.
C. Use copper conductor not smaller than 16 AWG for control circuits.
D. Pull all conductors into raceway at same time.
E. Use suitable wire-pulling lubricant for building wire 8 AWG and larger or runs longer than 50 feet.
F. Use suitable cable fittings and connectors.
G. Neatly train and lace wiring inside boxes, equipment, and panelboards.
H. Clean conductor surfaces before installing lugs and connectors.
I. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
J. Use split bolt connectors for copper conductor splices and taps, 8 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
K. Use solderless pressure connectors with insulating covers or spring wire connectors for copper conductor splices and taps, 10 AWG and smaller.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Identify each conductor with destination terminal block.

3.4 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of General Conditions.
B. Inspect wire for physical damage and proper connection.
C. Measure tightness of bolted connections.
D. Utilize accurate torque wrench to tighten bolts and nuts on MCC.
E. Verify continuity of each branch circuit conductor.
F. Verify that all non-grounded conductors have an open circuit to ground.

3.5 PAYMENT

A. Payment will be made for all work covered in this section at Contract unit price per unit or included in the lump sum price per job for items, as shown on Proposal. Such payment shall be complete compensation for complete performance of work per Drawings and specification provisions.

END OF SECTION

SECTION 16130 - BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall, ceiling outlet, pull, and junction boxes.
B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 16140 - Wiring Devices: Wall plates in finished areas.

1.2 REFERENCES

A. NECA Standard of Installation.
B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
D. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
E. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR CLOSEOUT

A. Section 01700 – Execution Requirements: Submittals for Project closeout.
B. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.
B. Provide UL-listed and -classified products as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
B. Equipment Supporting Boxes: Rated for weight of equipment supported; include .5-inch male fixture studs where required.
C. Cast Boxes: NEMA FB 1, Type FD, cast ferroalloy. Provide gasketed cover by box manufacturer.
D. Wall Plates for Finished Areas: As specified in Section 16140 – Wiring Devices.

2.2 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
B. Surface-Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface-mounted junction box:
   1. Material: Galvanized cast iron.
   2. Cover: Furnish with flange, neoprene gasket, and stainless steel cover screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify locations of outlets in all locations areas before rough-in.

3.2 INSTALLATION

A. Install boxes per NECA Standard of Installation.
B. Install in locations as shown on Drawings and required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.
C. Set wall-mounted boxes at elevations to accommodate mounting heights specified for outlet device.
D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose.
E. Orient boxes to accommodate wiring devices oriented as specified in Section 16140 – Wiring Devices.
F. Maintain headroom and present neat mechanical appearance.
G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
I. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
J. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
K. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
L. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices. All such devices shall be mounted at the same elevation.
M. Use flush-mounting outlet box in finished areas.
N. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
O. Do not install flush-mounting box back-to-back in walls; provide minimum 6-inch separation. Provide minimum 24-inch separation in acoustic-rated walls.
P. Secure flush-mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
Q. Use stamped steel bridges to fasten flush-mounting outlet box between studs. In lieu of bridges, provide boxes with brackets that limited box travel by contacting adjacent wall.
R. Install flush-mounting box without damaging wall insulation or reducing effectiveness.
S. Use adjustable steel channel fasteners for hung ceiling outlet box.
T. Do not fasten boxes to ceiling support wires.
U. Support boxes independently of conduit.
V. Use gang box where more than one device is mounted together. Do not use sectional box.
W. Use gang box with plaster ring for single device outlets.
X. Use cast outlet box in exterior locations exposed to weather and wet locations. Non-metallic boxes shall not be used.
Y. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Coordinate installation of outlet box for equipment connected.

3.4 ADJUSTING

A. Section 01700 - Execution Requirements: Adjusting installed work.
B. Adjust flush-mounting outlets to make front flush with finished wall material.
C. Install knockout closures in unused box openings.

3.5 CLEANING

A. Section 01700 - Execution Requirements: Cleaning installed work.
B. Clean interior of boxes to remove dust, debris, and other material.
C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall switches, receptacles, device plates, and covers.
B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 16130 - Boxes.

1.2 REFERENCES

A. NECA Standard of Installation.
B. NEMA WD 1 - General Requirements for Wiring Devices.
C. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
D. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW

A. Section 01330 – Submittal Procedures: Procedures for submittals.
B. Product Data: Provide manufacturer catalog information showing dimensions, colors, and configurations.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified with minimum three years' documented experience.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.
B. Provide UL-listed and -classified products as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers:
   1. General Electric 5951-2G.
   2. Hubbell 1221-I.
   3. P&S Model 20-AC-1-I.
   4. Approved equal.
B. Description: NEMA WD 1, 20-amp, heavy-duty, AC only general-use snap switch.
C. Body and Handle: Nylon ivory handle.
D. Utilize equivalent series of manufacturer numbers for three- and four-way and two-pole applications.

2.2 RECEPTACLES

A. Manufacturers:
   1. Hubbell.
   2. Leviton.
   3. Cooper/Eaton.
B. Description: NEMA WD 1, Heavy-duty, receptacles with triple wipe contacts and grounding contacts integral with the backstop (no rivets).
C. Device Body: Ivory plastic.
D. Configuration: NEMA WD 6, type as specified and indicated.
E. Convenience Receptacle: Type 5-20.
F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements. Hubbell 5352-I or equivalent.

2.3 WALL PLATES

A. Weatherproof Cover Plate: Gasketed cast metal with gasketed device cover on exterior devices.
B. Surface-Mounted Plates: Galvanized steel plates

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01039 - Coordination and Meetings: Verify existing conditions before beginning work.
B. Verify outlet boxes are installed at proper height.
C. Verify wall openings are neatly cut and will be completely covered by wall plates.
D. Verify branch circuit wiring installation is completed, tested, and ready to connect to wiring devices.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install per NECA - Standard of Installation."
B. Install devices plumb and level.
C. Install switches with OFF position down.
D. Install receptacles with grounding pole on top.
E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
F. Connect wiring devices by wrapping conductor around screw terminal.
G. Use jumbo size plates for outlets installed in masonry walls.
H. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

3.4 FIELD QUALITY CONTROL

A. Section 01400 - Quality Control: Field inspection, testing, adjusting, and balancing.
B. Inspect each wiring device for defects.
C. Operate each wall switch with circuit energized and verify proper operation.

D. Verify each receptacle device is energized.
E. Test each receptacle device for proper polarity.
F. Test each GFCI receptacle device for proper operation.

3.5 ADJUSTING

A. Section 01700 - Execution Requirements: Adjusting installed work.
B. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

A. Section 01700 - Execution Requirements: Cleaning installed work.
B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 16170 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding electrodes, equipment grounding conductors, and bonding.
B. Related Sections:
1. Division 01 Specification Sections apply to Work of this Section.

1.2 REFERENCES

A. Section 01400 - Quality Control: Requirements for references and standards.
B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
C. NFPA 70 - National Electrical Code.

1.3 GROUNDING SYSTEM DESCRIPTION

A. Metal underground water pipe.
B. Metal frame of the building.
C. Rod electrode.

1.4 PERFORMANCE REQUIREMENTS

A. Maximum Grounding System Resistance: 10 ohms.

1.5 SUBMITTALS FOR REVIEW

A. Section 01330 – Submittal Procedures: Procedures for submittals.
B. Product Data: Provide for grounding electrodes and connections.

1.6 SUBMITTALS FOR CLOSEOUT

A. Section 01700 - Execution Requirements: Procedures for submittals.
B. Project Record Documents: Record actual locations of components and grounding electrodes.
C. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing specified Products with minimum three years' documented experience, and with service facilities within 100 miles of Project.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by UL as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

A. Material: Copper.
B. Diameter: 3/4 inch.
C. Length: 10 feet.

2.2 MECHANICAL CONNECTORS

A. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS

A. Manufacturers: Cadweld.

2.4 WIRE

A. Material: Stranded copper.
B. Grounding Electrode Conductor: Minimum size to meet NFPA 70 requirements or as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01039 - Coordination and Meetings: Verify existing conditions before beginning work.
B. Verify final backfill and compaction is complete before driving rod electrodes.

3.2 INSTALLATION

A. Section 01400 - Quality Control: Manufacturer's instructions.
B. Install rod electrodes. Install additional rod electrodes as required to achieve a minimum resistance to ground of 10 ohms.
C. Provide bonding to meet Regulatory Requirements.
D. Bond together metal siding not attached to grounded structure; bond to ground.
E. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
F. Provide bonding of reinforcing steel in concrete foundation, building steel, steel water pipes, and any supplemental electrodes (rods) per NEC and Drawings.

3.3 FIELD QUALITY CONTROL

A. Section 01400 - Quality Assurance: Field inspection, testing, adjusting.
B. Inspect and test per NETA ATS, except Section 4.
C. Perform inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION

SECTION 16190 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes conduit, equipment supports, anchors, and fasteners.
B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.

1.2 REFERENCES

A. NECA - National Electrical Contractors Association.
B. ANSI/NFPA 70 - National Electrical Code.

1.3 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide adequate corrosion resistance.
B. Provide materials, sizes, and types of anchors, fasteners, and supports to carry loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
C. Anchors and Fasteners:
   1. Concrete Structural Elements: Use expansion anchors, powder-actuated anchors, and preset inserts.
   2. Steel Structural Elements: Use beam clamps, spring steel clips, and steel ramset fasteners.
   3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.
   4. Sheet Metal: Use sheet metal screws.
   5. Wood Elements: Use wood screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products per manufacturer instructions.
B. Provide anchors, fasteners, and supports per NECA Standard of Installation.
C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
D. Obtain permission from Engineer before drilling or cutting structural members.
E. Fabricate supports from structural steel as indicated on drawings. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use lock washers under all nuts.
F. Install surface-mounted cabinets and panelboards with minimum four anchors.

G. In wet and damp locations, use steel channel supports to stand cabinets and panelboards 1 inch off wall.
H. Install conduit supports a maximum spacing specified in NEC.
I. Items mounted on hollow metal walls provided with full blocking or heavy gauge strapping that spans entire width between structural members.

END OF SECTION

SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes nameplates and labels, wire and cable markers.
B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND LABELS

A. Engraved three-layer laminated plastic, white letters on black background.
B. Letter Size:
   1. Use 1/4-inch letters for identifying individual equipment and loads.
   2. Use 1/4-inch letters for identifying grouped equipment and loads.
   3. Use 3/8-inch letters for identifying Main Disconnect equipment.
C. Locations:
   1. Each electrical distribution and control equipment enclosure.
   2. Field disconnects, start stop stations, control panels, transformers.

2.2 BOX MARKERS

A. All junction boxes in accessible location to have box cover labeled to indicate which circuit and panel served from.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

A. Install nameplate and label parallel to equipment lines.
B. Secure nameplate to equipment front using screws or rivets.
C. Identify underground conduits with underground warning tape. Install one tape per trench 3 inches below finished grade. Identify all conduit at exposed locations into all boxes, cabinets, etc.
D. Identify all conductors at every termination indicating endpoints of termination and tag identification as required.

E. Color-coding for phase identification:

120/208 volts	Phase	277/480 volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

F. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by colored electrical tape. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made.

END OF SECTION

SECTION 16441 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fuses and fusible and non-fusible switches.
B. Related Sections:
1. Division 01 Specification Sections apply to Work of this Section.

1.2 REFERENCES

A. NEMA KS 1 - Enclosed Switches.
B. NFPA 70 - National Electrical Code.
C. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.
D. UL 198E - Class R Fuses.

1.3 SUBMITTALS

A. Submit under provisions of Section 01330 – Submittal Procedures.
B. Product Data: Provide switch ratings and enclosure dimensions.

1.4 QUALITY ASSURANCE

A. Perform Work per NECA Standard of Installation.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years' documented experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.
B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Square D.
B. General Electric.
C. Siemens.

2.2 ENCLOSED SWITCHES

A. Fusible or non-fusible as indicated.
B. Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
C. Fuse Clips: Designed to accommodate NEMA FU1, class R fuses.

D. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R or 4.
E. Current rating of switch to be equal to or greater than that of the circuit it is interrupting.

2.3 FUSES

A. Manufacturers:
   1. Bussman.
   2. Littlefuse.
   3. Gould Shawmut.
B. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
C. Voltage: Provide fuses with suitable voltage ratings for phase-to-phase voltages.
D. Service Entrance: Class L, Bussman Low-peak or equivalent.
E. General Purpose Loads: Class RK1, Bussman Low-peak or equivalent.
F. Motor Loads: Class RK5, Bussman Fusetron or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install per NECA Standard of Installation.
B. Install fuses in all fusible disconnects.
C. Apply adhesive tag inside door of all disconnects indicating NEMA class fuse and size installed.
D. Provide a disconnect switch for all equipment where indicated or required by NEC. Coordinate with other disciplines to determine where disconnects are furnished with equipment.

END OF SECTION

SECTION 16470 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards.
B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 16190 - Supporting Devices.

1.2 REFERENCES

A. NECA Standard of Installation.
B. NEMA AB 1 - Molded Case Circuit Breakers.
C. NEMA PB 1 - Panelboards.
D. NEMA PB 1.1 - Instructions for Safe Installation, Operation, and Maintenance of Panelboards.
E. Rated 600 Volts or Less.
F. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Submit under provisions of Section 01330 – Submittal Procedures.
B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.4 MANUFACTURER INSTALLATION INSTRUCTIONS

A. Indicate application conditions and limitations of use stipulated by Product testing agency.
B. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of General Conditions. Record actual locations of Products; indicate actual branch circuit arrangement.

1.6 OPERATION AND MAINTENANCE DATA:

A. Submit under provisions of General Conditions.
B. Maintenance Data: Include spare parts data listing; and recommended maintenance procedures and intervals.

1.7 QUALITY ASSURANCE

A. Perform Work per NECA Standard of installation.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing of products specified in this section with minimum five years' experience.

1.9 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70. Furnish UL-listed and -classified products as suitable for purpose specified and indicated.

1.10 GENERAL CONDITIONS

A. Provide two of each panelboard key if required.

1.11 FIELD QUALITY CONTROL

A. Field inspection and test for grounds on each circuit after installation is completed. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Independently-mounted panelboards manufactured by:
   1. Siemens.
   2. Square D.
   3. Or equal.

2.2 DISTRIBUTION PANELBOARDS

A. Panelboards 208/120 VAC, three-phase, four-wire, 60 Hertz.
   1. Service Conditions.
      a. Temperature: 105 degrees F.
      b. Altitude: 4,000 feet.
   2. Bus: Copper.
      a. Provide copper ground bus in each panelboard.
      b. Minimum integrated short circuit rating: 20,000 amperes RMS symmetrical at 208 VAC.
      c. Molded-Case Circuit Breakers: NEMA AB1, bolt-on type. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breaker accessory trip units and auxiliary switches as indicated.
      d. Provide nameplate and locate near top of front trim on exterior surface listing panel type. Ratings as required by UL.
      e. Enclosure: NEMA 4.
      f. Enclosure provided with provisions for locking cover of panel closed with a padlock.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards plumb and per NEMA PB 1.1. Provide supports per Drawings and Section 16190 – Supporting Devices:
   1. Height: 6 feet maximum to top of panelboard.
   2. Provide filler plates for unused spaces in panelboards.
   3. Provide typed circuit directory for each branch circuit panelboard.
   4. Revise directory to reflect circuiting changes required to balance phase loads.
   5. Label spare slots in erasable pencil on directory.
   6. Provide black-on-white engraved plastic nameplates.

END OF SECTION

SECTION 16670 - SURGE PROTECTIVE DEVICE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Surge Protective Device (SPD) used in this section and all Drawings.
B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 16123 - Wire and Cable.
   3. Section 16170 - Grounding and Bonding.

1.2 REFERENCES

A. Specified system designed, manufactured, tested, and installed per:
   1. ANSI/IEEE C62.11.
   2. C62.41.
   3. C62.45.
   4. CSA.
   5. FIP PUB 94.
   6. NEMA.
   7. NFPA 20.
   8. NFPA 70.
   9. NFPA 75.
   10. NFPA 780.
   11. UL 1449 3rd. Ed., UL 1283: MIL-STD-220A.

1.3 SYSTEM DESCRIPTION

A. Includes electrical and mechanical requirements for a high-energy transient voltage surge suppression system. Specified system shall provide effective high energy surge current diversion, sine wave tracking for electrical line noise filtering and be suitable for application in ANSI/IEEE C62.41 Category A, B, and C environments, as tested by ANSI/IEEE C62.11, C62.45, and MIL-STD-220A.
B. System connected parallel with protected system; no series connected elements used which limit load current or kVA capability.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 01330 – Submittal Procedures.
B. Provide dimensions and materials of each component. Include isolation switch data.
C. Documentation of specified system's UL 1449 Listing and clamping voltage ratings of all protection modes included as required product data submittal information.
D. Documentation of the specified system's UL 1283 Complimentary Listing included as required product data submittal information.
E. Independent fuse coordination tests from nationally-recognized, independent testing laboratory.

1.5 PROJECT CLOSEOUT SUBMITTALS

A. Manufacturer shall furnish an installation manual with installation, start up, trouble-shooting guide and operating instructions for the specified system.
B. Electrical and mechanical drawings provided by manufacturer showing unit dimensions, weights, component and connection locations, mounting provisions, connection details, and wiring diagram.
C. Record actual location of SPD.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture of SPD equipment with minimum five years' experience.

1.7 REGULATORY REQUIREMENTS

A. UL listed under UL 1449 (Rev 09/2009) Standard for SPD; surge ratings permanently affixed to SPD.
B. Complimentary listed to UL 1283 Standard for EMI/RFI Facility Filters.

1.8 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.
B. Verify all connections a properly bonded.

1.9 WARRANTY

A. Manufacturer to provide full, five-year warranty from date of shipment against any failure when installed per manufacturer-written instructions, UL listing requirements, and any applicable national or local electrical codes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Erico Critec.
B. MVC.
C. Square D.
D. Approved equal.
E. All manufacturers shall submit independent test data from nationally-recognized testing laboratory for current protection, protection modes, and compliance with UL 1449 ratings.

2.2 ENVIRONMENTAL REQUIREMENTS

A. Storage temperature range: -67 to +187 degrees F.
B. Operating temperature range: -40 to +122 degrees F.
C. Reliable operation in environment with 0 to 95 percent non-condensing relative humidity.
D. SPD shall not generate any appreciable audible noise.
E. Unit shall not generate any appreciable magnetic fields but be suitable for use directly inside computer rooms.

2.3 ELECTRICAL REQUIREMENTS

A. Nominal system operating voltage, phase, connection type, and number of wired match that required on Plans.
B. Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of nominal system operating voltage to ensure ability of system to withstand temporary RMS overvoltage (swell) conditions.
C. Operating frequency range of system to be at least 47 to 63 Hertz.
D. All protection modes (including neutral-to-ground) of SPD, are internally fused at component level with fuses I x I x T capability to allow suppressor's maximum rated transient current to pass through suppressor without fuse operation. If rated I x I x T characteristic of fusing is exceeded, fusing able to open in less than one millisecond and clear high and low impedance fault conditions. Fusing can interrupt up to 100-kA symmetrical fault current with 600 VAC applied. Monitor overcurrent protection circuit and provide indication of suppression failure/operability. Conductor level fuses or circuit breakers internal or external to SPD, not acceptable. Contractor to furnish submittal documentation on proper fuse coordination of actual fault tests from nationally recognized testing laboratory for product approval.
E. SPD unit supplied with factory-installed disconnect and overcurrent protection eliminating external fusing requirement.

2.4 PROTECTION MODES

A. Protection Modes:
   1. Line-to-neutral (L-N).
   2. Neutral-to-ground (N-G).
   3. Line-to-ground (L-G).
   4. Line-to-line (L-L).
B. SPD surge current capacity: 100 kA per phase.
C. SPD system provides a joule rating meeting/exceeding ANSI/IEEE C62.41 Category C requirements delivery capability.
D. Typical response time of all suppression components: Less than one nanosecond.

2.5 SURGE SUPPRESSION COMPONENTS

A. TVSS unit shall display combined total number of transient voltage surges detected from L-N, L-G, N-G, and L-L since counter was last reset.
B. Provide dry contacts to monitor ON/OFF and alarm status.
C. Alarm silence, reset, and test functions.
D. Indication of full or partial loss of protection.
E. Individually-fused suppression modules.
F. AC Tracking Filter: EMI/RFI filtering up to –50dB from 100 kHz to 100 MHz.
G. Unit to include isolation switch, module status indicator lights, form C summary alarm contact.

PART 3 - EXECUTION

3.1 INSTALLATION

A. SPD installed as a Type 2 device.
B. Contractor follows SPD manufacturer-recommended installation practices and complies with all applicable codes.
C. Manufacturer shall furnish an installation manual with installation, start up, trouble-shooting guide, and operating instructions for specified system.
D. Manufacturer provides electrical and mechanical drawings to show unit dimensions, weights, component and connection locations, mounting provisions, connection details, and wiring diagram.
E. No sharp bend allowed in wiring from SPD unit to ground.
F. Install SPD so wiring between SPD and Point of Connection is kept to a minimum.

END OF SECTION

SECTION 16990 - ELECTRICAL SYSTEM TESTING AND START-UP

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes testing procedures and methods required before acceptance of electrical systems by Owner. Electrical system start-up procedures.

B. Related Sections:
   1. Division 01 Specification Sections apply to Work of this Section.
   2. Section 16000 - Electrical General Provisions
   3. Section 16441 - Enclosed Switches

1.2 REFERENCES

A. National Electrical Code – NEC.
B. National Electrical Manufacturer's Association – NEMA.
C. American Society for Testing and Materials – ASTM.
D. Institute of Electrical and Electronic Engineers – IEEE.
E. American National Standards Institute – ANSI.
F. ANSI C2 - National Electrical Safety Code.
G. ANSI Z244-1 - American National Standard for Protection.
H. Manufacturer instruction manuals applicable to each apparatus.

1.3 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01400 – Quality Control. Calibration of all equipment utilized in electrical system tests must be documented and verified. Accuracy of test instruments to be directly traceable to the National Bureau of Standards. Analog field instruments to be calibrated within 6 months of use and digital field instruments, within 12 months of use. Leased instruments to be calibrated within 12 months of use where lessor guarantees accuracy.

B. Accurately record field data obtained during tests in a manner acceptable to Owner. Provide three copies of tests summary to Owner in a form acceptable to Owner.

C. Contractor provides a copy of all test reports included in Operating and Maintenance Manuals to Owner at project closeout.

PART 2 - TEST REQUIREMENTS

2.1 CABLE TESTS

A. Visually inspect cables for physical damage and proper connection per single line diagram. Verify all cables are permanently numbered. Check cable color-coding with applicable Engineer specifications and the NEC standards.

B. After installation and before rated voltage is applied to any power cable #8 AWG or larger, make a DC insulation check for each cable with megohmmeter. Applied potential shall be 1,000 Volts DC for one minute. Minimum acceptable resultant value shall be 100 megohms. Individually test each conductor with all other conductors and shields grounded at both ends. Properly corona suppress terminations by guard ring, field reduction sphere, or other suitable method. If any power cable fails, replace entire length of cable.

2.2 GROUNDING SYSTEMS

A. Inspect ground system for compliance with Plans and Specifications. Perform three-point fall-of-potential test per IEEE Standard No. 81, Section 9.04 on main grounding electrode. Resistance to ground shall be no greater than 5 ohms. Contractor installs additional electrodes as required to lower resistance to 5 ohms, if greater, at no additional expense to Owner.

B. Contractor performs a three-point fall-of-potential test at each location indicated by Engineer at completion of Project.

2.3 FIELD DEVICE TESTS

A. Visually inspect field devices for physical damage and proper installation. Calibrate devices per manufacturer recommendations. Verify proper operation of all field devices before start-up.

PART 3 - EXECUTION

3.1 GENERAL

A. Purpose of start-up procedures is to assure equipment and systems utilized are ready for operation and use by City of Pecos.

B. Contractor performs start-up with Engineer and City of Pecos representative (if desired) present.

C. Contractor responsible for recording results and providing a report to Engineer.

3.2 PROCEDURE

A. Operate field devices and other equipment utilized as required for efficient system operation. Contractor demonstrates field devices work as specified. Upon effectively demonstrating satisfactory operation of all electrical systems, Contractor energizes all equipment not adversely affected for seven days. Owner replaces any controls or other equipment found defective shall be replaced before acceptance by Owner.

B. Contractor provides Engineer "Certification of Proper Operation" upon start-up completion.

END OF SECTION

APPENDIX A

GEOTECHNICAL STUDY

GEOTECHNICAL STUDY
PECOS TRANSFER STATION
PECOS, REEVES COUNTY, TEXAS

Amec Foster Wheeler PROJECT NO. 1737192035

Submitted To:
Parkhill, Smith & Cooper, Inc.
501 West San Antonio Avenue
El Paso, Texas 79901

Submitted By:
Amec Foster Wheeler Environment & Infrastructure
125 Montoya Road
El Paso, Texas 79932

October 4, 2017

October 4, 2017
Amec Foster Wheeler Project No. 1737192035

Parkhill, Smith & Cooper, Inc.
501 West San Antonio
El Paso, Texas 79901

Attn.: Mr. Nicholas Ybarra, P. E.

Re: Geotechnical Study
Pecos Transfer Station
Tx-17
Pecos, Reeves County, Texas

Dear Mr. Ybarra:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) submits this Geotechnical Report for the above referenced project. The report includes the results of test drilling and laboratory analyses and presents recommendations for recommendations for foundation and pavement design.

Should any questions arise concerning this report, we would be pleased to discuss them with you.

Respectfully submitted,

Amec Foster Wheeler
Environment & Infrastructure, Inc.
Texas Registered Engineering Firm F-0012
Texas Registered Geoscience Firm 50184

Mark J. Breitnauer, P.E.
Senior Engineer

STATE OF TEXAS
Mark J. Breitnauer
83085
LICENSED
PROFESSIONAL ENGINEER
10-4-2017

Reviewed by:

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Senior Engineer

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Amec Foster Wheeler Project No. 1737192035

1.0 INTRODUCTION

This report is submitted pursuant to a geotechnical study completed by Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) for a proposed The objective of this study was to evaluate the physical properties of the soils underlying the site and to provide recommendations for foundation design and related earthwork.

2.0 PROPOSED CONSTRUCTION

Details of the project were provided to Amec Foster Wheeler by Mr. Nicholas Ybarra, P.E. with Parkhill, Smith & Cooper, Inc.

It is our understanding that the project will consist of the construction of a new transfer station in Pecos, Texas. We understand that a portion of the site will be built-up with about 12 feet of fill. As a result, recommendations for the earthen embankment, slope stability and foundations are needed for the project. Foundation loads for the facility are not known, but anticipated to be moderate. Additional improvements will consist of asphalt or concrete paved parking and driving areas. Although no traffic information is available at this time, it is anticipated that traffic will consist of service vehicles, trash vehicle and heavy truck traffic.

Should final design details vary significantly from those outlined above, this firm should be notified for review and possible modification of recommendations.

3.0 SOIL STUDY

3.1 SUBSURFACE EXPLORATION

Two (2) exploratory boring was advanced at the project site to a depth of 25 feet below existing grades. The test boring was completed using a Mobile B-47 truck-mounted drill rig equipped with 3¼ inch I.D. hollow stem augers. Standard penetration testing was completed at selected intervals in the boring. During the field study, the soils encountered were examined, visually classified and logged. Results of the field study are presented in ***Appendix A***, which includes a brief description of drilling and sampling equipment and procedures, site plan showing the boring locations and logs of the test borings.

The boring logs and related information included in this report are indicators of subsurface conditions only at the specific locations and times noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ from conditions that were encountered at the locations sampled.

3.2 LABORATORY ANALYSIS

To aid in soil classification and evaluate the engineering properties of the soil, selected soil samples were tested for moisture content, particle size distribution and Atterberg Limits. Laboratory tests were performed in general accordance with test standards ASTM D2216, ASTM D6913 and ASTM D4318. The results of the moisture testing are shown on the boring logs presented in ***Appendix A***. Particle distribution test and Atterberg Limits results are presented in ***Appendix B***.

The soils encountered during the field study were classified in general accordance with the Unified Soil Classification System. The soil classification symbols appear on the boring logs and are briefly described in ***Appendix A***.

4.0 SITE CONDITIONS & GEOTECHNICAL PROFILE

4.1 SITE CONDITIONS

At the time of our field study, the site is relatively flat and used as a staging area for the landfill operation.

4.2 GEOTECHNICAL PROFILE

Our field exploration program consisted of performing two (2) 25 foot SPT borings within the project area. The borings were conducted in accordance with methodology consistent with ASTM International Standard D1586, *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*. The location of the borings are graphically depicted on the Site Plan; they were located by digital measuring wheel from existing site features and should be considered accurate only to the extent implied by the limitation of the depiction.

The general subsurface conditions encountered during the field exploration conducted September 1, 2017, are shown on the soil boring logs which is included hereafter. The lines of stratification shown on the log are based upon examination of the recovered soil samples and interpretation of the field boring log and represent the approximate boundaries between the soil types; the actual transitions may be gradual.

As the exploratory borings indicate, the soils encountered at the project site consist of gypsiferious silty clays extending to the depth explored (26.5 feet). Standard penetration tests indicate a relative consistency of firm to hard. Test boring B-2 had soft soils from the ground surface to a depth of about 1.5 feet. Laboratory testing indicates that the clay soils has liquid limits ranging from 22 to 34 with corresponding plasticity indices ranging from 5 to 14.

The soil classification symbols used in this report are derived from ASTM D2487, *Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)* and D2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).*
The descriptions for relative density and firmness are based on grain size and standard penetration tests as detailed in "Terminology Used to Describe the Relative Density, Consistency or Firmness of Soil" in ***Appendix A*** of this report.

4.3 SOIL MOISTURE AND GROUNDWATER CONDITIONS

At the time of our field study, no groundwater was observed at the test boring locations within the depths explored. Moisture contents of the soil were damp, varying from 5.0 to 14.5.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 RETAINING WALL FOUNDATION AND EMBANKMENT

Based on the results of our field and laboratory study, the soils underlying the project site will provide reliable support for the planned retaining wall structure and associated embankment following some soil improvements. Shallow continuous type footings bearing at uniform depths below finished grade, in conjunction with the recommended site preparation and moisture protection of the supporting soil are recommended for support of the retaining wall structure. It should be noted that a degree of risk is involved with the use of shallow foundations. Should a broken water line or other source of moisture occur, some movement of foundations and slabs is possible.

The recommended site preparation consists of excavating the native soils to a depth of 3 feet below the base of all foundation elements and embankment area. The excavations should extend a minimum lateral distance of 24 inches from the edge of all footings. The base of the excavation should then be scarified to a depth of 8 inches, moisture conditioned to plus or minus 3 percent of the optimum moisture content and compacted. Structural fill should then be placed in compacted lifts to final grade. Based on the results of our study, the existing soils are suitable for reuse as structural backfill.

In order to provide additional stability for the embankment area, it is recommended a minimum of two layers of geogrid, such as a Tensar TriAx-Tx160 or equivalent product, be placed on the structural backfill a minimum of one (1) foot above bottom of excavation. The second geogrid layer should be place approximately two (2) feet above bottom of excavation.

As described previously, soils at the site contain gypsum, which are known to be susceptible to dissolution from infiltrating water and large voids can occur from continued flow of water into the native soils. Concentrations of water into the native soils should be aggressively controlled to minimize potential risks associated with voids from dissolution. Typical sources of water that have resulted in voids in the area have included plumbing leaks, downspouts, and ponded water from

poor drainage. As a result, it is recommended that the grading design for the project make provisions for the rapid drainage of the work areas and haul road with no ponding on site. In addition, the site layout should consider having a haul road that is generally straight and, if required, constructed with a long turning radius to reduce potential for surface damage from wheel action due to turning on asphalt.

A net allowable bearing pressure of 2,500 pounds per square foot is recommended for the design of continuous type footings bearing on structural fill. This bearing pressure applies to full dead plus realistic live loads. The minimum depth of the footing should be 2 feet below the lowest adjacent finished grade. The minimum recommended width of continuous type footing is 2 feet.

It is estimated that vertical movements of footings and the embankment designed as recommended above will not exceed 1 inch for moisture contents of the native soil encountered during test drilling or compaction moisture contents introduced during construction. Differential movements are expected to be less than 75 percent of the total movement. Significant moisture increases above these values could result in additional movements. As a result, recommendations presented in Section 5.3 concerning site drainage and moisture protection are considered critical for the satisfactory performance of the proposed structures.

The pressure exerted on retaining walls will depend on their degree of restraint. Rigid, restrained walls with horizontal backfill meeting structural fill requirements presented below, should be designed using an "at rest" equivalent fluid pressure of 115 pounds per cubic foot (pcf). Walls allowed to rotate around their bases at a distance of 0.001 times their height or more, at the top, should be designed using an "active" equivalent fluid pressure of 100 pcf. The passive soil resistance against the edges of footings, stem walls, etc. with properly compacted backfill, should be considered as being equal to forces exerted by a fluid of 260 pounds per cubic foot unit weight. A coefficient of friction (f) of 0.40 may be used in calculations for sliding purposes between the base of the footing and soil.

The equivalent fluid pressures do not include any lateral component due to either hydrostatic or surcharge loads. The retaining walls at this site should be designed with a drainage system to prevent the buildup of hydrostatic forces behind the wall. If a drain system is not provided, then an additional 62.4 pcf must be added to the lateral forces acting on the wall. Special care should be taken not to over compact the backfill material to reduce the potential for the buildup of residual compaction pressures against the retaining walls.

The equivalent fluid pressures provided above do not include a factor of safety, however, we recommend that a minimum factor of safety of 1.5 be used for the design of retaining walls against overturning and sliding. Surcharge loads, such as vehicular wheel loads, to the area adjacent to the retaining wall can add additional horizontal components of lateral earth pressures to this wall. The magnitude of these components will depend on the loads and locations of these loads relative to the retaining wall.

Soils encountered at the project site are considered to have a moderate erosion potential. As a result, it is recommended that side slopes for embankments and other areas on the project should not exceed 3:1 horizontal to vertical. Steeper slope conditions should be protected against erosion with rock or concrete rip rap, vegetation, geosynthetic materials or other approved methods. Protection of the slope face, especially at any spill-way, inlet structure or at natural drainage features, should also be provided.

5.2 PAVEMENT RECOMMENDATIONS

5.2.1 FLEXIBLE PAVMENT

The proposed embankment soils should consist of an A-6 classification in accordance with the American Association for State Highway and Transportation Officials (AASHTO) Standard M-145, and are considered fair to poor for use as subgrade support.

Drive Lanes will be subjected to usage by heavier vehicles are recommended to be constructed with a “Heavy Duty” Flexible Section.

The recommended subgrade preparation should consist of scarifying the native soils to a depth of 12 inches. The scarified soil should then be brought to within plus or minus 3 percent of optimum moisture content and compacted. The pavement areas should then be brought to final subgrade elevation with properly compacted structural fill as determined by drainage considerations and pavement thickness. Structural fill should be non-expansive and meet specifications as outlined in ***Appendix C*** of this geotechnical report.

Following the proper treatment of the subgrade, a flexible pavement section consisting of 3 inches of asphaltic concrete overlying 12 inches of crushed aggregate base course should be constructed for truck traffic.

Asphaltic concrete materials quality and construction requirements should conform to Division III of the current Texas Department of Highways and Public Transportation Standard Specification for Construction of Highways, Streets, and Bridges. Mineral aggregate should comply with Type B, Item 341. A job mix formula should be established using the Marshall method of mix design which has a minimum stability of 1600 pounds as determined in accordance with ASTM D1559. The bituminous material and aggregate proposed for use in construction by the contractor should be used in the mix design.

Aggregate base course should conform to the requirements of Type A, Grade 1 or 2 of Item 247 of the Texas Department of Highways and Public Transportation Standard Specifications for Construction of Highways, Streets, and Bridges.

Adequate drainage is critical to satisfactory performance of pavement areas. In order to minimize rainwater infiltration through the pavement surface, and thereby minimize the potential for water

infiltration into the subgrade, all cracks and joints in the pavement should be sealed on a routine basis after construction.

5.2.2 RIGID PAVEMENT

For paved areas on the slope of the embankment and at the tipping floor, a rigid pavement section is recommended in lieu of a flexible pavement. Recommendations provided above for subgrade preparation, dependent on the level of risk accepted, should be followed prior to the construction of the rigid pavement section.

The concrete to be used in construction was assumed to have an elastic modulus of 3.8×10^6 psi and a mean modulus of rupture of 650 psi. This would generally correspond to a 28-day cylinder strength of 4,400 psi as determined in accordance with ASTM C39. A working stress of 60,000 psi (corresponding to Grade 60) was assumed for the reinforcing steel.

All materials and methodologies used in construction should conform with guidelines presented in "Item 360-Concrete Pavement" section of the current edition of the Texas Department for Construction of Highways, Streets and Bridges. Based on the above design parameters and guidelines provided by AASHTO (1993), a 7-inch concrete pavement overlying 6 inches of aggregate base course is recommended. It is recommended the concrete slab is constructed to allow rapid drainage of surface runoff away from the soil directly underlying the pavement section.

In order to minimize rainwater infiltration through the pavement surface, and thereby minimize the potential for water infiltration into the subgrade, all cracks and joints in the pavement should be sealed on a routine basis after construction.

5.3 SITE DRAINAGE AND MOISTURE PROTECTION

Positive site drainage should be provided during construction and carefully maintained for the life of the construction, staging, haul roads and target areas. The ground surface should be sloped to provide rapid, positive drainage of surface water to natural water courses or other designated areas away from work areas. Long-term ponding of water should never be allowed within target preparation, haul roads and testing areas.

5.4 CONSTRUCTION OBSERVATION AND TESTING

Recommendations presented in previous sections of this report are predicated on the fact that there will be continuous observation and testing by the geotechnical engineer during earthwork operations. Verification of recommended excavations, moisture increases and required degree of compaction should be performed in accordance with "Guide Specifications for Earthwork," ***Appendix C***.

The recommendations presented in this report are based upon a limited number of subsurface samples obtained from two sampling locations. The samples may not fully indicate the nature

and extent of the variations that actually exist beyond the sampling location. For that reason, among others, Amec Foster Wheeler recommends that Amec Foster Wheeler be retained to observe earthwork construction. It should be noted if variations or other latent conditions become evident during earthwork construction, it will be necessary for Amec Foster Wheeler to review these conditions and modify its recommendations.

APPENDIX A

TEST DRILLING EQUIPMENT & PROCEDURES

SAMPLING PROCEDURES - Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D-1586 procedures. In most cases, 2" O.D.samplers are used to obtain the standard penetration resistance. Undisturbed samples of firmer soil are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140 pound, 30-inch free fall drop hammer required to advance the samplers in 6-inch increments. However, in stratified soil, driving resistance is sometimes recorded in 2 or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per foot on the logs. Undisturbed sampling of softer soil is sometimes performed with thin walled Shelby tubes (ASTM D-1587). Where samples of rock are required, they are obtained in NX diamond core drilling (ASTM D-2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings.

CONTINUOUS PENETRATION TESTS - Continuous penetration tests are performed by driving a 2" O.D. blunt nosed penetrometer adjacent to or in the bottom of borings. The penetrometer is attached to 1-inch O.D. drill rods to provide clearance to minimize side friction so that penetration values are recorded as the number of blows of a 140 pound, 30-inch free fall drop hammer required to advance the penetrometer in one foot increments or less.

BORING RECORDS - Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares boring logs. Soil is visually classified in accordance with the Unified Soil Classification System (ASTM D-2487), with appropriate group symbols being shown on the logs.

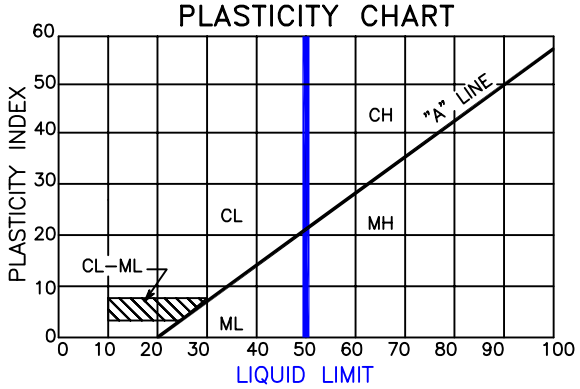
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified by the Unified Soil Classification System on the boring logs presented in this report. Grain–size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System", Corp of Engineers, US Army Technical Memorandum No. 3–357 (Revised April 1960) or ASTM Designation: D2487–93T.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE–GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel–sand mixtures, or sand–gravel–cobble mixtures.
					GP	Poorly graded gravels, gravel–sand mixtures or sand–gravel–cobble mixtures
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line or hatched zone on plasticity chart		GM	Silty gravels, gravel–sand–silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel–sand–clay mixtures
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 seive)			SW	Well graded sands, gravelly sands
					SP	Poorly graded sands, gravelly sands
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line or hatched zone on plasticity chart		SM	Silty sands, sand–silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand–clay mixtures
FINE–GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS Limits plot below "A" line or hatched zone on plasticity chart	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50%)			ML	Inorganic silts, clayey silts with slight plasticity
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50%)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
	CLAYS Limits plot above "A" line & hatched zone on plasticity chart	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50%)			CL	Inorganic clays of low to medium plasticity; gravelly clays, sandy clays, silty clays, lean clays
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50%)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity

NOTE: **Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.**

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
COBBLES	Above 3 inches
GRAVEL	3 inches to No. 4 sieve
Coarse Gravel	3 inches to 3/4 inch
Fine Gravel	3/4 inch to No. 4 sieve
SAND	No. 4 sieve to No. 200
Coarse	No. 4 sieve to No. 10
Medium	No. 10 sieve to No. 40
Fine	No 40 sieve to No. 200
FINES (SILT or CLAY)	Below No. 200 sieve

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY CONSISTENCY, OR FIRMNESS OF SOIL

The terminology used on the boring logs to describe the relative density, consistency or firmness of soil relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blow per foot is obtained by ASTM D-1586 procedure using 2" O.D., 1-inch I.D. samplers.

RELATIVE DENSITY: Terms for description of relative density of cohesionless, uncemented sand and sand-gravel mixtures.

N	RELATIVE DENSITY
0-4	Very Loose
5-10	Loose
11-30	Medium Dense
31-50	Dense
50+	Very Dense

COMPONENT %

Description	Percent (%)
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45
Mostly	50 - 100

RELATIVE CONSISTENCY: Terms for the description of clay which is saturated or near saturation.

N	RELATIVE CONSISTENCY	REMARKS
0-2	Very Soft	Easily penetrated several inches with fist.
2-4	Soft	Easily penetrated several inches with thumb.
4-8	Firm	Can be penetrated several inches with thumb moderate effort.
8-15	Stiff	Readily indented with thumb but penetrated only with great effort.
15-30	Very Stiff	Readily indented with thumbnail.
>30	Hard	Indented only with difficulty by thumbnail.

RELATIVE FIRMNESS: Terms for the descriptions of partially saturated and/or cemented soil which commonly occurs in the Southwest including clay, cemented granular materials, silt and silty and clayey granular soil:

N	RELATIVE DENSITY
0-4	Very Soft
5-8	Soft
9-15	Moderately Firm
16-30	Firm
31-50	Very Firm
50+	Hard

SOIL MOISTURE CLASSIFICATION

MOISTURE CONDITION	FIELD IDENTIFICATION	ESTIMATED RANGE OF MOISTURE	
		Group A (%)	Group B (%)
Dry	Absence of moisture, dusty. Dry to the touch.	0-4	0-8
Damp	Grains appear slightly darkened, but no visible water. Silt/clay may clump. Sand will not bulk. Soils are below plastic limits.	4-8	8-16
Moist	Grains appear darkened, but no visible water. Silt/clay will clump. Sand will bulk. Soils are often at or near plastic limits.	8-16	16-30
Wet	Visible water on larger grain surfaces. Sand and cohesionless silt exhibit dilatancy. Cohesive silt/clay can be readily remolded. "Wet" indicates that the soil is much wetter than the optimum moisture content and above the plastic limit (APL).	>16	>30
Water Bearing	A water-producing formation.	N/A	N/A

Group A - Coarse Grained Soils, nonplastic to plasticity index <7.
Includes: SM, SP-SM, SP, SW, GM, GP, and GW.

Group B - Fine Grained Soils to clayey sands & gravels with a plasticity index >7.
Includes: GC, SC, ML, MH, CL, and CH.

Approximate Boring Location **B-1**

Note: Drawing not to scale

North

FIGURE 1
Site Plan
City of Pecos – Proposed Transfer Station
TX-17
Pecos, Reeves County, Texas
Amec Foster Wheeler Project No. 1737192035

Drawn By: mjb	Date: 9/11/2017
Checked By:	Drawing No.: 17137192035

amec foster wheeler
Environment & Infrastructure, Inc.
125 Montoya Road
El Paso, TX 79932
Telephone: 915-585-2472

PROJECT Pecos Transfer Station
TX-17
Pecos, Reeves County, Texas

JOB NO. 1737192035 **DATE** 9/1/17

LOCATION See Site Location Plan

RIG TYPE CME 75
BORING TYPE 3¼" I.D. Hollow Stem Auger
SURFACE ELEV.
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	7-15-30	45						CL	Very Firm PP>4.5 tsf	Lean Clay with Sand - Brown CLAY, medium plastic fines, little sand, dry. Gypsum cystals visible in sample.
			X	S	9-16-14	30	5.0	64	34	29	5	CL-ML	Firm PP=3.0 tsf	Sandy Silty Clay - Brown silty CLAY, low plastic fines, some sand, dry. Gypsum crystals observed in sample.
5			X	S	24-53-50/3"							CL	Hard PP=3.75 tsf	Lean Clay with Sand - Brown CLAY, medium plastic fines, little sand, dry. Gypsum cystals visible in sample.
			X	S	23-15-19	34	8.3	78	27	19	8	CL	Very Firm PP>4.5 tsf	Lean Clay with Sand - Brown CLAY, low plastic fines, little sand, dry. Gypsum cystals visible in sample.
10			X	S	16-25-35	60						CL-ML	Hard PP=4.0 tsf	Silty Clay with Sand - Brown silty CLAY, low plastic fines, little sand, damp. Gypsum crystals observed in sample.
												CL		Lean Clay with Sand - Brown CLAY, medium plastic fines, little sand, dry. Gypsum cystals visible in sample.
15			X	S	5-8-18	26							Firm PP=4.25 tsf	
												CL-ML		Sandy Silty Clay - Brown silty CLAY, low plastic fines, some sand, damp.
20			X	S	18-14-31	45	14.5	73	24	18	6		Very Firm PP=2.75 tsf γ_m=125.0 pcf	
25			X	S	11-19-34	53							Hard	
														Auger terminated at 25 feet. Sampler terminated at 26.5 feet. NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot γ_m - Moist Unit Weight pcf - pounds per cubic foot
30														

GROUNDWATER

DEPTH(ft)	HOUR	DATE
NE		9/1/2017

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
SH - 3" Shelby sample
NR - No Recovery

LOG OF TEST BORING NO. B-1

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PROJECT Pecos Transfer Station
TX-17
Pecos, Reeves County, Texas

JOB NO. 1737192035 **DATE** 9/1/17

LOCATION See Site Location Plan

RIG TYPE CME 75
BORING TYPE 3¼" I.D. Hollow Stem Auger
SURFACE ELEV.
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	4-4-4	8	7.7	72	27	13	14	CL	Soft PP=4.0 tsf	Lean Clay with Sand - Brown CLAY, medium plastic fines, little sand, dry. Gypsum cystals visible in sample.
			X	S	4-20-39	59							Hard	
5			X	S	10-16-34	50						CL	Hard PP>4.5 tsf	Sandy Silty Clay - Brown silty CLAY, medium plastic fines, some sand, dry. Gypsum crystals observed in sample.
			X	S	22-29-29	58							Hard PP>4.5 tsf	
10			X	S	11-21-23	44	9.8	69	27	19	8	CL	Very Firm PP>4.5 tsf γ_m=127.0 pcf	Sandy Lean Clay - Brown CLAY, low plastic fines, some sand, dry. Gypsum cystals visible in sample.
												CL		Lean Clay with Sand - Brown CLAY, medium plastic fines, little sand, dry. Gypsum cystals visible in sample.
15			X	S	12-22-22	44							Very Firm PP>4.5 tsf	
												CL-ML		Sandy Silty Clay - Brown silty CLAY, low plastic fines, some sand, damp.
20			X	S	17-14-17	31							Very Firm PP=4.5 tsf	
25			X	S	11-18-21	39	12.1	54	22	17	5		Very Firm PP=3.0 tsf	
														Auger terminated at 25 feet. Sampler terminated at 26.5 feet. NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot γ_m - Moist Unit Weight pcf - pounds per cubic foot
30														

GROUNDWATER

DEPTH(ft)	HOUR	DATE
NE		9/1/2017

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
SH - 3" Shelby sample
NR - No Recovery

LOG OF TEST BORING NO. B-2

APPENDIX B

TABULATION OF TEST RESULTS

DATE: September 2017

Amec Foster Wheeler Project No.: 1537192035

PROJECT: Pecos Transfer Station

Tx-17

Pecos, Reeves County, Texas

BORING NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PL	PI	SIEVE ANALYSIS - ACCUM. % PASSING												MOISTURE %
							No.200	No.100	No.40	No.10	No.4	⅜"	½"	¾"	1"	1¼"	1½"	3"	
B-1	See Site Plan	2½' - 4'	CL-ML	34	29	5	64	75	83	92	95	96	100						5.0
B-1	See Site Plan	7½' - 9'	CL	27	19	8	78	89	95	99	100								8.3
B-1	See Site Plan	20' - 21½'	CL-ML	24	18	6	73	90	97	100	100								14.5
B-2	See Site Plan	0' - 1½'	CL	27	13	14	72	86	99	100	100	100							7.7
B-2	See Site Plan	10' - 11½'	CL	27	19	8	69	80	88	97	100								9.8
B-2	See Site Plan	25' – 26½'.	CL-ML	22	17	5	54	88	99	100	100								12.1

APPENDIX C

GUIDE SPECIFICATIONS FOR EARTHWORK

1. SCOPE

Includes all clearing and grubbing, removal of obstructions, general excavating, grading and filling and any related items necessary to complete the grading for the entire project in accordance with these specifications.

2. SUBSURFACE SOIL DATA

Subsurface soil studies have been made and the results are available for examination by the contractor. The contractor is expected to examine the site and determine for himself the character of materials to be encountered.

No additional allowance will be made for rock removal, site clearing and grading, filling, compaction, disposal or removal of any unclassified materials.

3. CLEARING AND GRUBBING

A. **General:** Clearing and grubbing will be required for all areas shown on the plans to be excavated or on which fill is to be constructed.

B. **Clearing:** Clearing shall consist of removal and disposal of vegetation and other deleterious material.

C. **Grubbing:** Stumps, matted roots and roots larger than 2 inches in diameter shall be removed from within 6 inches of the surface of areas on which fills are to be constructed except in roadways. Materials as described above within 18 inches of finished subgrade in either cut or fill sections shall be removed. Areas disturbed by grubbing will be filled as specified hereinafter for STRUCTURAL FILL.

4. EARTH EXCAVATION

A. Earth excavation shall consist of the excavation and removal of suitable soil for use as embankment as well as the satisfactory disposal of all vegetation, debris and deleterious materials encountered within the area to be graded and/or in a borrow area.

B. Excavated areas shall be continuously maintained such that the surface shall be smooth and have sufficient slope to allow water to drain from the surface.

5. STRUCTURAL FILL

A. General: Structural fill shall consist of a controlled fill constructed in areas indicated on the grading plans.

B. Materials:

(1) Physical Characteristics: Select fill shall consist of material consist non-active, inorganic sandy lean clay having a plasticity index (PI) between 5 and 10 and a liquid limit not to exceed 35. Based on the results of this study, most of the native lean clay soils encountered at the project site are anticipated to meet requirements for select fill. In addition, select fill should be free of vegetation, debris and deleterious materials.

(2) Site Soil: Site soil from cuts may be used for fill, provided they meet the requirements in paragraph 5.B.(1). The results of this soil study indicate the soils encountered at the site will meet the requirements for structural fill.

(3) Borrow: When the quantity of suitable material required for embankments is not available within the limits of the jobsite, the contractor shall provide sufficient materials to construct the embankments to the lines, elevations and cross sections as shown on the drawings from borrow areas. The contractor shall obtain from owners of said borrow areas the right to excavate material, shall pay all royalties and other charges involved, and shall pay all expenses in developing the source including the cost of right-of-way required for hauling the material.

C. Construction:

(1) Embankment: The retaining wall footing and embankment excavation shall be inspected by a representative of the geotechnical engineer prior to fill placement to verify clearing and grubbing.

Prior to the placement of any fill, the site preparation shall consist of the excavation of the native soils to a depth of 3-feet below the embankment and bottom of footings. Excavations shall remove any encountered vegetation, +3-inch material, man-made material, debris, or any other material other than the native soils. The over excavation shall extend a minimum lateral distance of 24 inches beyond the edge of all footings. The bottom of the excavation shall then be scarified to a depth of 8 inches, brought to within plus or minus 3 percent of optimum moisture content and compacted. Structural fill shall then be placed in compacted lifts to final grade.

During construction, the project area shall be shaped to provide drainage of surface water in order to avoid the ponding of water. Surface water shall be pumped immediately from the construction area after each rain and a firm subgrade maintained. In addition, the

moisture content and density within the completed subgrade must be maintained until construction is complete.

(2) Pavement Subgrade Treatment: The project area shall be inspected by a representative of the geotechnical engineer prior to fill placement to verify clearing and grubbing.

The recommended site preparation consists of scarifying the native soils to a depth of 12 inches. The scarified soils shall then be brought to within plus or minus 3 percent of the optimum moisture content and compacted. Structural fill shall then be placed, as required, in compacted lifts to final grade.

During construction, the project area shall be shaped to provide drainage of surface water in order to avoid the ponding of water. Surface water shall be pumped immediately from the construction area after each rain and a firm subgrade maintained.

Earthwork operations shall be monitored for the presence of any subsurface structures that may be related to the former septic tank system. If encountered, the structures or other deleterious materials shall be completely removed and replaced with compacted structural fill.

(3) Compaction: All fill shall be spread in layers not exceeding 8 inches, watered as necessary, and compacted. Moisture content at the time of compaction shall be within plus or minus 3 percent of the optimum moisture content. Compaction of the fill shall be accomplished by mechanical means only to obtain a density of not less than 95 percent of maximum dry density for the building pad, paved areas, and other structural areas. Embankments outside the building pads shall be compacted to 90 percent of maximum dry density. Optimum moisture content and maximum dry density for each soil type used shall be determined in accordance with ASTM D1557. Where vibratory compaction equipment is used, it shall be the contractor's responsibility to insure that the vibrations do not damage nearby buildings or other adjacent property.

(4) Weather Limitations: Controlled fill shall not be constructed when the atmospheric temperature is below 35 degrees F. When the temperature falls below 35 degrees, it shall be the responsibility of the contractor to protect all areas of completed surface against any detrimental effects of ground freezing by methods approved by the geotechnical engineer. Any areas that are damaged by freezing shall be reconditioned, reshaped and compacted by the contractor in conformance with the requirements of this specification without additional cost to the owner.

D. Slope Protection & Drainage: The edges of the controlled fill embankments shall be graded to the contours shown on the drawings and compacted to the density required in

paragraph 5.C.(3). Slopes steeper than 1 vertical to 3 horizontal shall be protected from erosion.

6. INSPECTION & TESTS

A. Field Inspection & Testing: The owner shall employ the services of a registered, licensed geotechnical engineer for consultation during all controlled earthwork operations. The geotechnical engineer shall provide continuous on-site observation and testing services during controlled earthwork activities. The contractor shall notify the engineer at least two working days in advance of any field operations of the controlled earthwork, or of any resumption of operations after stoppages. Tests of fill materials and embankments will be made at the following suggested minimum rates:

(1) One field density test in the embankment area for each 5,000 square feet of original ground surface prior to placing fill.

(2) One field density test in the embankment area for each 5,000 square feet of fill placed or each layer of fill for each work area, whichever is the greater number of tests.

(3) One moisture-density curve for each type of material used, as indicated by sieve analysis and plasticity index.

B. Report of Field Density Tests: The geotechnical engineer shall submit, daily, the results of field density tests required by these specifications.

C. Costs of Tests & Inspection: The costs of tests, inspection and engineering, as specified in this section of the specifications, shall be borne by the owner.