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END OF SECTION 00 0110

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prevention of erosion due to construction activities.

B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

C. Restoration of areas eroded due to insufficient preventive measures.

D. Revegetation of disturbed areas.

E. Performance bond.

F. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

A. Section 31 1000 - Site Clearing.

B. Section 31 2200 - Grading.

C. Section 31 2316 - Excavation.

D. Section 31 2323 - Fill.

E. Section 31 3700 - Riprap.

1.03 REFERENCE STANDARDS

A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus; 2014.

B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2017.

C. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2011.

D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.

E. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2012.

F. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2002 (Reapproved 2009).

G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

H. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; 1995.

I. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2009.

J. Texas Commission on Environmental Quality - Storm Water Pollution Prevention Plan (SWPPP) requirements.

K. State, local, County and Municipal SWPPP requirements.

1.04 PERFORMANCE REQUIREMENTS

A. Comply with all requirements for erosion and sedimentation control, as specified for the Texas Pollutant Discharge Elimination System (TPDES), Phases I and II, under requirements for the Construction General Permit (CGP); current edition.

B. Comply with all more stringent requirements of the County and municipal.

C. Comply with all requirements of the SWPPP for erosion and sedimentation control.

D. Best Management Practices Standard: FHWA FLP-94-005.

E. Runoff Calculation Standard for Urban Areas: USDA TR-55.

F. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.

G. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
   1. Contractor will obtain permits and pay for securities required by authority having jurisdiction.
   2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.

H. If required by the Owner, provide a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.

I. Timing: Put preventive measures in place as soon as possible before disturbance of surface cover and before precipitation occurs.

J. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
   1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
   2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 10 years.

K. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
   1. Control movement of sediment and soil from temporary stockpiles of soil.
   2. Prevent development of ruts due to equipment and vehicular traffic.
   3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

L. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
   1. Prevent windblown soil from leaving the project site.
   2. Prevent tracking of mud and sediment onto public roads outside site.
   3. Prevent mud and sediment from flowing onto sidewalks and pavements.
   4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

M. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
   2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

N. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

O. Open Water: Prevent standing water that could become stagnant.

P. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mulch:
   1. Straw or hay.
   2. Wood waste, chips, or bark.
   3. Erosion control matting or netting.

B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

C. Bales: Bound, rectangular straw bales.

D. Bale Stakes:
   1. Steel U- or T-section.
   2. Wood.
   3. Minimum Length: 3 feet.

E. Silt Fence Fabric: Polypropylene, polyethylene, or polyamide woven or nonwoven geotextile fabric resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
   1. Minimum Unit Weight: 4.5 oz/yd.
   2. Minimum Width: 36 inches.
   3. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
   4. Mullen Burst Strength: 190 lb/sq in.
   5. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D4491/D4491M.
   6. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.

7. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
8. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533.
9. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
10. Woven Wire Backing: 2"x4" 12 gauge (min.), welded wire, galvanized.

F. Silt Fence Posts:
1. Steel Y- or T-section, with minimum mass of 1.25 lb per linear foot.
2. Minimum Length: 4 feet.
3. Galvanized or painted surface.
4. Brindle Hardness: Greater than 140.

G. Riprap: See Section 31 3700.

H. Filter Bags: Polypropylene, polyethylene or polyamide woven fabric.
1. Unit Weight: 4 oz/sq yd.
2. Mullen Burst Strength: Greater than 300 psi.
3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D 4355 after 500 hours exposure.
4. Filter Bag Fill: Washed pea gravel to coarse ground (0.31" to 0.75" diameter).

I. Rock Berms
1. Rock: Clean, open graded, 3 to 5 inch diameter; high velocity areas should use 5 to 8 inch diameter.
2. Woven wire; 20 gauge, maximum 1" opening, galvanized, secured with shoat rings.

J. Stabilized Construction Entrance
1. Rock: 4" to 8", washed.
2. Fabric: Geotextile specific for soil filtration; 6 oz/sq yd; Mullen burst rating of 140 lb/sq in, greater than #50 sieve opening size.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.
1. Width: 12 feet, minimum, or full width of driveway, whichever is greater.
2. Length: 50 feet, minimum.
3. Provide at each construction entrance from public right-of-way.
4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences or rock riprap.
1. Provide linear sediment barriers as detailed on drawings with the following parameters:
a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.

b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
c. Along the toe of cut slopes and fill slopes.
d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
e. Across the entrances to culverts that receive runoff from disturbed areas.

D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
1. Bagged gravel inlet protection: As detailed on drawings.

E. Storm Drain Inlet: As detailed on drawings.

F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.

G. Soil Stockpiles: Protect using one of the following measures:
1. Cover with polyethylene film, secured by placing soil on outer edges.
2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 4 inches of straw or hay.

H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.

I. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

A. Traffic-Bearing Aggregate Surface:
1. Excavate minimum of 3 inches.
2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
3. Place and compact at least 6 inches of 1 1/2 to 3 1/2 inch diameter stone.
4. Reference details on the drawings.

B. Silt Fences:
1. Install with top of fabric at nominal height and embedment indicated on drawings.
2. Embed bottom of fabric in a trench on the upslope side of fence, with 6 inches of fabric laid flat on bottom of trench facing upslope; backfill trench and compact.
3. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
4. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
5. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
6. Reference details on the drawings.

C. Straw Bale Rows:
1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
2. Install bales so that bindings are not in contact with the ground.
3. Embed bales at least 4 inches in the ground.
4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.

5. Fill gaps between ends of bales with loose straw wedged tightly.
6. Place soil excavated for trench against bales on the upslope side of the row, compacted.

D. Mulching Over Large Areas:
1. Dry Straw and Hay: Apply 2-1/2 tons per acre; anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.
2. Wood Waste: Apply 6 to 9 tons per acre.
3. Erosion Control Matting: Comply with manufacturer's instructions.

E. Mulching Over Small and Medium Areas:
1. Dry Straw and Hay: Apply 4 to 6 inches depth.
2. Wood Waste: Apply 2 to 3inches depth.
3. Pine Needles: Apply 2 to 3 inches depth.
4. Erosion Control Matting: Comply with manufacturer's instructions.

F. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.
2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
5. Incorporate fertilizer into soil before seeding.
6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

G. Rock Berms
1. Layout the woven wire mesh sheathing perpendicular to the direction of runoff.
2. Rock berm will have a minimum top width of 2 feet with side slopes being 2:1 (h:v) or flatter.
3. Place rock along the sheathing to a height not less than 18".
4. Wrap the wire sheathing around the rock and secure with tie wire so that the ends of the sheathing overlap a minimum of 2 inches.
5. Tie the ends of the berm into the existing upslope grade and bury the berm 3 to 4 inches into existing ground slope.

H. Stabilized Construction Entrance
1. Remove vegetation and grade for positive drainage.
2. Construct entrance a minimum 12 feet wide (or full width of road) by 50 feet long.
3. If slope towards a paved street exceeds 2 percent, construct a ridge 6 to 8 inches high with 3:1 (h:v) side slopes across the foundation 15 feet from the entrance to divert runoff away from street.
4. Place geotextile woven fabric in graded foundation.
5. Place stone over geotextile woven fabric per the drawings.
6. Grade to drain runoff to a sediment trap or basin.

7. Install drain pipe, as needed, to maintain street drainage in right-of-way.

3.05 MAINTENANCE

A. Inspect preventive measures daily, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.

B. Repair deficiencies immediately.

C. Silt Fences:
   1. Promptly replace fabric that deteriorates.
   2. Remove silt deposits that exceed one-third of the height of the fence.
   3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Straw Bale Rows:
   1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
   2. Remove silt deposits that exceed one-half of the height of the bales.
   3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

E. Filter Bags:
   1. Promptly replace bags that have deteriorated or have been damaged.
   2. Remove silt deposits that exceed one-third the height of the bag.
   3. Repair or replace bags that are undercut by runoff or otherwise are damaged, whether by runoff or other causes.

F. Stabilized Construction Entrance
   1. Promptly replace rock that has deteriorated or been damaged.
   2. Remove excess dirt and sediment accumulations as needed.

G. Rock Berms
   1. Promptly repair or replace rock berms that have been undercut by runoff or otherwise damaged.
   2. Remove silt deposits that exceed one-third the height of the rock berm.
   3. Repair any loose wire sheathing.

H. Clean out temporary sediment control structures weekly and relocate soil on site.

I. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Engineer.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION 01 5713

FIELD ENGINEERING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall, at his expense, perform the following:
   1. Engage a licensed Surveyor, approved by the Owner, and acceptable to the Engineer, to locate all surveyor marks, including bench marks in order that the exact lines of the property, building and grades may be determined.
   2. Lay out entire Project prior to start of construction.
   3. Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction. Replace project control points which may be lost or destroyed.
   4. Establish a minimum of two permanent bench marks on the site, referenced to data established by survey control points. Record locations, with horizontal and vertical data, on Project Record Documents.
   5. Establish all construction lines and levels by instrumentation and similar appropriate means.

B. Any discrepancies arising in locating the work in respect to property and building line shall be reported immediately to the Owner and the Engineer.

END OF SECTION 01 7123.10

SUBSURFACE INVESTIGATION

PART 1 - GENERAL

1.01 SUMMARY

A. A Geotechnical Report (available for review in the office of the Engineer) was obtained for use in preparing the design.

B. The Geotechnical Report is not a conclusive indication of the soil conditions other than where the borings were taken.

C. The accuracy of the Geotechnical Report is not guaranteed in any respect by the Owner, and the Owner accepts no responsibility for interpretation of conclusions drawn therefrom.

D. The information contained in the Geotechnical Report is made available in order that the Contractor may have ready access to the same information available to the Owner as of this date.

E. Contractor is invited and encouraged to make his own interpretation and evaluation of the information and by starting work shall be assumed to have fully accepted responsibility for the subsurface conditions that may hereafter be encountered in performing the excavation work.

F. Contractor is to examine the project site and the record of investigation and make, to whatever extent they deem appropriate, his own investigation of existing subsurface conditions to determine the nature, kind and character of materials to be encountered.

G. Extra payment will not be authorized for work which should have been anticipated or could have been anticipated upon careful examination of the site, or upon soil investigation, or upon consideration of factors generally recognized as being inherent in excavation work of the nature indicated by the Contract Documents.

H. The Contractor shall advise Engineer of discovery of any unknown or undetermined items.

I. The Contractor shall make their own investigation into the location and size of existing site utilities whether represented on the drawings or not.

END OF SECTION 02 3000

MAINTENANCE OF CONCRETE

PART 1 GENERAL

1.01 Section Includes

A. Cleaning of existing concrete surfaces.

B. Repair of exposed structural, shrinkage, and settlement cracks.

C. Resurfacing of concrete surfaces having spalled areas and other damage.

D. Repair of deteriorated concrete.

E. Repair of internal concrete reinforcement.

F. Restoration and patching of concrete surfaces.

1.02 Related Requirements

A. Section 03 1000 - Concrete Forming and Accessories.

B. Section 03 2000 - Concrete Reinforcing.

C. Section 03 3000 - Cast-in-Place Concrete.

1.03 Price and Payment Procedures

A. Repair Surface: By the square foot. Includes surface preparation, repair, finishing.

B. Preparation for Resurfacing: By the square foot. Includes surface preparation, cleaning.

1.04 Reference Standards

A. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.

B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.

C. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2009.

D. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2007b (Reapproved 2014).

E. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2014.

F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.

G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016.

H. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

I. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars; 2014.

J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.

K. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear; 2012.

L. ASTM C928/C928M - Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Material for Concrete Repairs; 2013.

M. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.

N. ASTM D3039/D3039M - Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials; 2017.

O. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2010.

P. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics; 2010.

Q. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.

R. ICC-ES AC178 - Acceptance Criteria for Inspection and Verification of Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) or Steel-Reinforced Polymer (SRP) Composite Systems; 2017, with Editorial Revision 2020.

1.05 Administrative Requirements

A. Scheduling: Perform work during a time period allowed by authority having jurisdiction of road right-of-way.

1.06 Submittals

A. Product Data: Indicate product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.

B. Field quality control submittals.

C. Field quality control submittals for CFRP.

D. Manufacturer's Certificate: Certify that specified products meet or exceed specified requirements.

E. Project Record Documents: Accurately record actual locations of structural reinforcement repairs and type of repair.

1.07 Quality Assurance

A. Designer Qualifications: Design reinforcement splices under direct supervision of a Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.

C. Cleaner Qualifications: Company specializing in performing work of the type specified.

D. Installer Qualifications: Company specializing in performing work of the type specified.

E. Perform welding work in accordance with AWS D1.4.

1.08 Delivery, Storage, and Handling

A. Comply with manufacturers' instructions for storage, shelf life limitations, and handling of products.

PART 2 PRODUCTS

2.01 Cleaning Materials

A. Detergent: Non-ionic detergent.

B. Blasting Medium: Sand.

2.02 Cementitious Patching and Repair Materials

A. Cementitious Resurfacing Mortar: One- or two-component, factory-mixed, polymer-modified cementitious mortar designed for continuous thin-coat application.

1. In-place material resistant to freezing conditions.
2. Mixed with water or latex type bonding agent in proportions as recommended by manufacturer.
3. Integral corrosion inhibitor.
4. Recommended Thickness: Feather edge to 1/8 inch.
5. Color: Gray.

B. Cementitious Repair Mortar, Trowel Grade: One- or two-component, factory-mixed, polymer-modified cementitious mortar.
1. In-place material resistant to freezing conditions.
2. Mixed with water or latex type bonding agent in proportions as recommended by manufacturer.
3. Dry Material: Complies with ASTM C928/C928M.
4. Integral corrosion inhibitor.

C. Cementitious Repair Mortar, Form and Pour/Pump Grade: Flowable, one- or two-component, factory-mixed, polymer-modified cementitious mortar; in-place material resistant to freezing conditions.
1. Mixed with water in proportions as recommended by manufacturer.

D. Cementitious Pavement Repair Mortar: Fast hardening, flowable; composed of cement, sand, and additives; capable of setting in cold weather conditions without the aid of chloride- or gypsum-based accelerators; in-place material resistant to freezing conditions.
1. Dry Material: Complies with ASTM C928/C928M.
2. Integral corrosion inhibitor.
3. Time To Open To Traffic: 1 hour, maximum.
4. Time to Top-Coating: 4 hours, maximum.

E. Cementitious Hydraulic Waterstop: Very fast setting, low slump, hand formable, and capable of stopping active water leaks; in-place material resistant to freezing conditions.

F. Mix cementitious mortar and grout in accordance with manufacturer's instructions for purpose intended.

G. Include bonding agent as additive to mix.

2.03 Epoxy Patching and Repair Materials

A. Epoxy Repair Mortar: Epoxy resin mixed with aggregate and other materials in accordance with manufacturer's instructions for purpose intended; comply with pot life and workability limits.

B. Mix epoxy mortars in accordance with manufacturer's instructions for purpose intended.

C. Mix components in clean equipment or containers. Conform to pot life and workability limits.

D. Epoxy Bonding Adhesive: Non-sag, two-component, 100 percent solids; recommended by manufacturer for purpose and conditions under which used.
1. Bond Strength (ASTM C882): 1,500 psi, minimum.
2. Tensile Strength (ASTM D638): 6,600 psi, minimum.
3. Percent Elongation (ASTM D638): 3.3 percent at 7 days at 70 degrees F, maximum.
4. Compressive Strength (ASTM D695): 10,000 psi, minimum.

2.04 Accessories

A. Anchoring Adhesive: Self-leveling or non-sag as applicable.

B. Portland Cement: ASTM C 150, Type I, II, or III; gray or white.

C. Sand: ASTM C33/C33M or ASTM C404; uniformly graded, clean.

D. Water: Clean and potable.

E. Reinforcing Steel: ASTM A615/A615M Grade 40 (40,000 psi) billet-steel deformed bars, unfinished.

F. Reinforcing Steel: Deformed bars, ASTM A996/A996M Grade 40 (280), Type A.
   1. Galvanized in accordance with ASTM A 767/A 767M, Class I or II.

G. Stirrup Steel: ASTM A1064/A1064M.

H. Splicing Sleeves: Per shop drawings.

PART 3 EXECUTION

3.01 Examination

A. Verify that surfaces are ready to receive work.

B. Beginning of installation means acceptance of substrate.

3.02 Cleaning Existing Concrete

A. Provide enclosures, barricades, and other temporary construction as required to protect adjacent work from damage.

B. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
   1. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage.
   2. Clean out cracks and voids using same methods.

C. The following are acceptable cleaning methods, in order from gentlest to less gentle:
   1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, brushes with natural or synthetic bristles.
   2. Increasing the water washing pressure to maximum of 400 psi.
   3. Adding detergent to washing water; with final water rinse to remove residual detergent.
   4. Steam-generated low-pressure hot-water washing.
   5. Abrasive blasting: Use sand.

3.03 Concrete Structural Member Repair

A. See drawings for specific areas to be repaired.

B. Remove broken and soft concrete at least 1/4 inch deep.

C. Mechanically cut away damaged portions of reinforcement.

D. Remove corrosion from steel and clean mechanically.

E. Blast clean remaining exposed reinforcement surfaces.

F. Repair by welding new bar reinforcement to existing reinforcement using sleeve splices.
   1. Perform welding work in accordance with AWS D1.4/D1.4M.
   2. Make welded sleeve splices to achieve strength to exceed strength of new reinforcement.

G. Cover exposed steel reinforcement with epoxy mortar.

H. Work epoxy mortar into broken surface and build up patch to match original.

I. Feather edges of repairs flush to sound surface and trowel surface to match surrounding area.

3.04 Crack Repair Using Epoxy Adhesive Injection

A. Repair exposed cracks.

B. Provide temporary entry ports spaced to accomplish movement of fluids between ports; no deeper than the depth of the crack to be filled or port size diameter no greater than the thickness of the crack. Provide temporary seal at concrete surface to prevent leakage of adhesive.

C. Inject adhesive into ports under pressure using equipment appropriate for particular application.

D. Begin injection at lower entry port and continue until adhesive appears in adjacent entry port. Continue from port to port until entire crack is filled.

E. Remove temporary seal and excess adhesive.

F. Clean surfaces adjacent to repair and blend finish.

3.05 Concrete Surface Repair Using Cementitious Materials

A. Clean concrete surfaces, cracks, and joints of dirt, laitance, corrosion, and other contamination using method(s) specified above and allow to dry.

B. Apply coating of bonding agent to entire concrete surface to be repaired.

C. Fill voids with cementitious mortar flush with surface.

D. Apply repair mortar by steel trowel to a minimum thickness of 1/4 inch over entire surface, terminating at a vertical change in plane on all sides.

E. Trowel finish to match adjacent concrete surfaces.

F. Damp cure for four days.

3.06 Field Quality Control

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. An independent testing agency will perform field inspection and testing.

1. Test concrete for calcium chloride content during the execution of the Work.
2. Field Quality Control for CFRP:
    a. Inspect installation and test for compliance with ICC-ES AC178.
    b. Inspect for voids, bubbles, and delaminations by performing a visual and acoustic tap test of layered surface after 24 hours of initial resin saturant cure.
    c. Test for material properties of CFRP in accordance with ASTM D3039/D3039M.
    d. Nonconforming Work: Repair defective work after minimum cure time for CFRP laminates.

END OF SECTION 03 0100

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 Section Includes

A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.

B. Openings for other work.

C. Form accessories.

D. Form stripping.

1.02 Related Requirements

A. Section 03 2000 - Concrete Reinforcing.

B. Section 03 3000 - Cast-in-Place Concrete.

1.03 Price and Payment Procedures

A. See Section 01 2200 - Unit Prices, for additional unit price requirements.

B. Measurement and payment of forming work will be by the unit price method.

C. Formwork (Vertical Structures): Measure by the square foot. Includes form materials, placement, placing accessories, stripping.

D. Formwork (Horizontal Structures): Measure by the square foot. Includes form materials, placement, placing accessories, stripping.

1.04 Reference Standards

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

C. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

D. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

E. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.

F. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).

G. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.

H. ACI 347R - Guide to Formwork for Concrete; 2014.

I. ASME A17.1 - Safety Code for Elevators and Escalators; 2013.

J. PS 1 - Structural Plywood; 2009.

1.05 Submittals

A. Product Data: Provide data on void form materials and installation requirements.

B. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.

C. Permanent Insulated Foam Panel Formwork Shop Drawings: Include calculations or selections from manufacturer's prescriptive design tables that indicate compliance with applicable building code and manufacturer's requirements.

1. Include test reports for performance criteria specified.

2. Include the design engineer's stamp or seal on each sheet of shop drawings.

D. Design Data: As required by authorities having jurisdiction.

E. Construction Joints: Submit diagram of proposed construction joints not shown on the Drawings prior to or concurrent with reinforcing bar shop drawings.

1.06 Quality Assurance

A. Perform work of this section in accordance with Texas Department of Transportation standards.

B. Maintain one copy of each installation standard on site throughout the duration of concrete work.

1.07 Delivery, Storage, and Handling

A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.

B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.

C. Protect plastic foam products from damage and exposure to sunlight.

PART 2 PRODUCTS

2.01 Formwork - General

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.

C. Chamfer outside corners of beams, joists, columns, and walls.

D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

E. Comply with relevant portions of ACI CODE-318, ACI PRC-347, and ACI SPEC-301.

F. Comply with Texas Department of Transportation standards.

G. Use the following form types:
1. Walls Not Exposed To View: Site fabricated plywood of sufficient thickness capable of sustaining the loads.
2. Walls Exposed To View: Commercial grade, moisture resistant, smooth-faced plywood of sufficient thickness capable of sustaining the loads.
3. Elevated Floor/Roof Slabs: Permanent prefabricated foam panel formwork; formwork to remain.

H. Form Ties:
1. Form ties for exposed concrete surfaces shall be manufactured to allow a positive break back of no less than one inch (1") inside the concrete surface.
2. Ties shall be equipped with a plastic cone of not less than five-eighths inch (5/8") diameter and one inch (1") long which will completely cover the hole and prevent the leakage of any mortar.
3. Form ties for unexposed surfaces shall be bolt rods or patented devices having a minimum tensile strength of three thousand (3,000) pounds when fully assembled.

4. Ties shall be adjustable in length and free of lugs, cones, washers or other features which would leave a hole larger than seven-eighths inch (7/8") in diameter, or depressions back of the exposed surface of the concrete.
5. Ties shall be of such construction that, when the forms are removed, there will be no metal remaining within one inch (1") of the finished surface of the concrete.

2.02 Wood Form Materials

A. Softwood Plywood: PS 1, B-B High Density Concrete Form Overlay, Class I.

B. Plywood: Douglas Fir, Spruce, or Yellow Pine species; solid one side grade; sound undamaged sheets with clean, true edges.

C. Lumber: Yellow Pine species; #2 grade; with grade stamp clearly visible.

2.03 Removable Prefabricated Forms

A. Preformed Steel Forms: Minimum 16 gauge, 0.0598 inch thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Preformed Plastic Forms: Thermoplastic polystyrene, thermoplastic, thermosetting, filled polyurethane elastomer; or polyurethane elastomer form liner, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

D. Pan Type: Steel or glass fiber, of size and profile indicated.

E. Tubular Column Type: Round, Spirally wound laminated fiber, wood, or glass fiber material, surface treated with release agent, non-reusable, of sizes indicated.

F. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set.

2.04 Permanent Prefabricated Foam Panel Formwork

A. Floor/Roof Deck Forms: Pre-engineered expanded polystyrene foam plastic deck and beam/joist forms with factory installed metal channel furring strips flush with face of panel and field installed form stiffener slots.
1. Structural Performance: In accordance with applicable code.
2. Form Cross Section: As indicated on drawings; flat-bottomed solid foam blocks with voids only for stiffeners and beam/joist cross-section; interlocking long edges.

2.05 Formwork Accessories

A. Form Ties: Removable or snap-off type, galvanized metal or plastic, fixed length, cone type, 1 inch back break dimension, free of defects that could leave holes larger than 1 inch in concrete surface.

B. Form Release Agent: Colorless mineral oil that will not stain concrete, absorb moisture, impair natural bonding of concrete finish coatings, or affect color characteristics of concrete finish coatings.

C. Filler Strips for Chamfered Corners: Rigid plastic or wood strip type.

D. Dovetail Anchor Slot: Galvanized steel, at least 22 gauge, 0.0299 inch thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

E. Flashing Reglets: Galvanized steel, at least 22 gauge, 0.0299 inch thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

G. Waterstops: Rubber or polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range.

PART 3 EXECUTION

3.01 Examination

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 Earth Forms

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.03 Erection - Formwork

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI SPEC-301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Install permanent insulated foam panel formwork per manufacturer's recommendations.

D. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

E. Align joints and make watertight. Keep form joints to a minimum.

F. Obtain approval before framing openings in structural members that are not indicated on drawings.

G. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

H. Coordinate this section with other sections of work that require attachment of components to formwork.

I. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Engineer before proceeding.

3.04 Application - Form Release Agent

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.05 Inserts, Embedded Parts, and Openings

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 Form Cleaning

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.07 Formwork Tolerances

A. Construct formwork to maintain tolerances required by ACI SPEC-117, unless otherwise indicated.

B. Construct permanent insulated foam panel formwork to maintain tolerances required by ACI SPEC-301.

C. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.

D. Camber slabs and beams in accordance with ACI SPEC-301.

3.08 Field Quality Control

A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.09 Form Removal

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION 03 1000

CONCRETE REINFORCING

PART 1 GENERAL

1.01 Section Includes

A. Reinforcing steel for cast-in-place concrete.

B. Supports and accessories for steel reinforcement.

1.02 Related Requirements

A. Section 03 1000 - Concrete Forming and Accessories.

B. Section 03 3000 - Cast-in-Place Concrete.

1.03 Price and Payment Procedures

A. Bar Reinforcement: By the ton. Includes reinforcement, placement, and accessories.

B. Welded Wire Reinforcement: By the square foot. Includes welded wire reinforcement, placement, and accessories.

1.04 Reference Standards

A. ACI MNL-66 - ACI Detailing Manual; 2020.

B. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).

C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.

D. ACI SP-66 - ACI Detailing Manual; 2004.

E. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

F. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.

G. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2006 (Reapproved 2011).

H. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.

I. ASTM A497/A497M - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete; 2007.

J. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.

K. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).

L. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement; 2006 (Reapproved 2011).

M. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement; 2014.

N. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2009.

O. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2007b (Reapproved 2014).

P. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2014.

Q. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2014.

R. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.

S. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars; 2001 (Reapproved 2007).

T. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.

U. CRSI (DA4) - Manual of Standard Practice; 2009.

V. CRSI (P1) - Placing Reinforcing Bars; 2011.

1.05 Submittals

A. Shop Drawings: Comply with requirements of ACI MNL-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
   1. Prepare shop drawings under seal of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.

B. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

C. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

1.06 Quality Assurance

A. Perform work of this section in accordance with ACI SPEC-301.
   1. Maintain one copy of each document on project site.

B. Provide Engineer with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.

PART 2 PRODUCTS

2.01 Reinforcement

A. Reinforcing Steel: ASTM A 615/A 615M Grade 40 (280), Unfinished.

B. Reinforcing Steel: ASTM A 706/A 706M, deformed low-alloy steel bars, Unfinished.

C. Reinforcing Steel: Deformed bars, ASTM A996/A996M Grade 40 (280), Type A.
   1. Galvanized in accordance with ASTM A767/A767M, Class I.

D. Reinforcing Steel Mat: ASTM A704/A704M, using ASTM A615/A615M, Grade 40 (40,000 psi) steel bars or rods, unfinished.

E. Stirrup Steel: ASTM A1064/A1064M steel wire, unfinished.

F. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.
   1. Form: Flat Sheets.
   2. WWR Style: 4 x 8-W6 x W10.
   3. Wire Gage: W4xW4 unless otherwise indicated on drawings.

G. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.02 Fabrication

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

B. Welding of reinforcement is permitted only with the specific approval of Engineer. Perform welding in accordance with AWS D1.4/D1.4M.
   1. Galvanized and Epoxy Coated Reinforcement: Clean surfaces, weld and re-protect welded joint in accordance with CRSI (DA4).

C. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.

D. Locate reinforcing splices not indicated on drawings at point of minimum stress.
   1. Review locations of splices with Engineer.

PART 3 EXECUTION

3.01 Placement

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Do not displace or damage vapor barrier.

C. Accommodate placement of formed openings.

D. Maintain concrete cover around reinforcing as follows:
   1. Beams: 2 inch or per Engineer's drawings.
   2. Supported Slabs and Joists: 2 inch or per Engineer's drawings.
   3. Column Ties: 2 inch or per Engineer's drawings.
   4. Walls (exposed to weather or backfill): 2 inch or per Engineer's drawings.
   5. Footings and Concrete Formed Against Earth: 2 inch or per Engineer's drawings.
   6. Slabs on Fill: 2 inch or per Engineer's drawings.

E. Reinforcement shall be accurately placed and securely saddle tied at every other intersection with No. 18 gauge black annealed wire, and shall be rigidly held in place during the placing of the concrete by means of metal chairs or spacers.

F. Bars in concrete walls shall be held in position, and to proper clearance, by means of concrete or metal spacer made especially for the locations where spacers are required.

G. Bars in beams and slabs shall be held to exact location during placing of concrete by spacers, chairs, or other necessary supports.

H. Comply with applicable code for concrete cover over reinforcement.

I. Bond and ground all reinforcement.

3.02 Field Quality Control

A. An independent testing agency will inspect installed reinforcement for conformance to contract documents before concrete placement.

3.03 Schedules

A. Reinforcement For Superstructure Framing Members: Deformed bars, unfinished.

B. Reinforcement For Foundation Wall Framing Members and Slab-on-Grade: Deformed bars and welded wire reinforcement, galvanized finish.

C. Reinforcement For Parking Structure Framing Members: Deformed bars, epoxy coated finish.

END OF SECTION 03 2000

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 Section Includes

A. Concrete formwork.

B. Concrete shear walls, elevator shaft walls, and foundation walls.

C. Miscellaneous concrete elements.

D. Concrete curing.

1.02 Related Requirements

A. Section 03 1000 - Concrete Forming and Accessories.

B. Section 03 2000 - Concrete Reinforcing.

C. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

D. Section 32 1250 - Site Pavement.

1.03 Price and Payment Procedures

A. Cement: By the cubic yard.

1.04 Reference Standards

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).

C. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; 1998 (Reapproved 2004).

D. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

E. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

F. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).

G. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).

H. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.

I. ACI 305R - Hot Weather Concreting; 2010.

J. ACI 306R - Cold Weather Concreting; 2010.

K. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).

L. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.

M. ACI 347R - Guide to Formwork for Concrete; 2014.

N. ACI PRC-304 - Heavyweight Concrete: Measuring, Mixing, Transporting and Placing; 2020.

O. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.

P. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.

Q. ACI PRC-308 - Guide to External Curing of Concrete; 2016.

R. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

S. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.

T. ASTM A497/A497M - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete; 2007.

U. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.

V. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2009.

W. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2007b (Reapproved 2014).

X. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2014.

Y. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016.

Z. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.

AA. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.

AB. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.

AC. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2012.

AD. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

AE. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.

AF. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.

AG. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.

AH. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.

AI. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2014.

AJ. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.

AK. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.

AL. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.

AM. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2014.

AN. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.

AO. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.

AP. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014.

AQ. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2014.

AR. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.

AS. ASTM D994/D994M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type); 2011.

AT. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).

AU. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting; 2015.

AV. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars; 2001 (Reapproved 2007).

AW. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).

AX. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2008).

AY. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.

AZ. ASTM E 1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers [Metric]; 1996 (Reapproved 2008).

BA. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

BB. ASTM E1993/E1993M - Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs; 1998 (Reapproved 2013).

BC. COE CRD-C 48 - Method of Test for Water Permeability of Concrete; 1992.

BD. COE CRD-C 513 - COE Specifications for Rubber Waterstops; 1974.

BE. COE CRD-C 572 - Corps of Engineers Specifications for Polyvinylchloride Waterstop; 1974.

BF. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).

1.05 Submittals

A. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
   1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.

B. Construction Joints: Submit drawing of proposed construction joints for slab on grade, etc. where they are not indicated on the drawings.

C. Laboratory Test Reports and Mix Design: Submit laboratory test reports for concrete materials and mix designs as specified in the Testing Laboratory section of the Specifications.

D. Test Reports: Submit report for each test or series of tests specified.

E. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

F. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

1.06 Quality Assurance

A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
   1. Maintain one copy of each document on site.

B. Follow recommendations of ACI PRC-305 when concreting during hot weather.

C. Follow recommendations of ACI PRC-306 when concreting during cold weather.

PART 2 PRODUCTS

2.01 Formwork

A. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
   2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
   3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
   4. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 Reinforcement Materials

A. Comply with requirements of Section 03 2000.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.

C. Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain type.
   1. Form: Flat sheets or coiled rolls.
   2. Mesh Size: 6"x6", unless otherwise noted on drawings.
   3. Wire Gage: W 4 x W 4, unless otherwise noted on drawings.

D. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 Concrete Materials

A. Cement: ASTM C 150, Type I - Normal portland type. Use one brand of cement throughout project.
   1. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C33/C33M.

1. Acquire all aggregates for entire project from same source for exposed concrete only.

C. Lightweight Aggregate: ASTM C330/C330M.

D. Fly Ash: ASTM C618, Class C or F.

E. Calcined Pozzolan: ASTM C618, Class N.

F. Silica Fume: ASTM C1240, proportioned in accordance with ACI PRC-211.1.

G. Waterproofing Additive: Crystalline waterproofing intended for mixing into concrete to close concrete pores by growth of crystals, with no decrease in concrete strength or chemical resistance.
   1. Permeability of Cured Concrete: No measurable leakage when tested in accordance with COE CRD-C 48 at 350 feet of head; provide test reports.
   2. Potable Water Contact Approval: NSF certification for use on structures holding potable water, based on testing in accordance with NSF 61.

H. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

I. Fiber Reinforcement: Synthetic fiber shown to have long-term resistance to deterioration when exposed to moisture and alkalis; 1/2 inch length.

2.04 Admixtures

A. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride irons are not permitted.

B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

C. Air Entrainment Admixture: ASTM C260/C260M.

D. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.

E. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

F. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.

G. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

H. Accelerating Admixture: ASTM C494/C494M Type C.

I. Retarding Admixture: ASTM C494/C494M Type B.

J. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 Accessory Materials

A. Non-Shrink Cementitious Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.
   2. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch.
   3. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch.

B. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, nonmetallic aggregate, and activator.

2.06 Bonding and Jointing Products

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.

B. Epoxy Bonding System:

C. Waterproofing Admixture Slurry: Slurry coat of Portland cement, sand, and crystalline waterproofing additive, mixed with water in proportions recommended by manufacturer to achieve waterproofing at cold joints in concrete.

D. Waterstops: Rubber, complying with COE CRD-C 513.
   1. Configuration: As indicated on drawings.
   2. Size: As indicated on drawings.

E. Waterstops: PVC, complying with COE CRD-C 572.
   1. Configuration: As indicated on drawings.
   2. Size: As indicated on drawings.

F. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
   1. Size: As indicated on drawings.

G. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.

H. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.
   1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
   2. Height: To suit slab thickness.

2.07 Curing Materials

A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.

C. Curing and Anti-Spalling Compound: Boiled linseed oil compound.
   1. Application: Use on roadway, bridge deck, parking deck, and ramps.

D. Curing and Sealing Compound, Low Gloss: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C1315 Type 1 Class A.
   1. Vehicle: Water-based.
   2. Solids by Mass: 25 percent, minimum.
   3. VOC Content: OTC compliant.

E. Curing and Sealing Compound, High Gloss: Liquid, membrane-forming, clear, nonyellowing acrylic; complying with ASTM C1315 Type 1 Class A.
   1. Vehicle: Solvent-based.
   2. Solids by Mass: 25 percent, minimum.
   3. VOC Content: Ozone Transport Commission (OTC) compliant.

F. Moisture-Retaining Sheet: ASTM C171.
   1. Curing paper, regular.
   2. Polyethylene film, white opaque, minimum nominal thickness of 4 mil, 0.004 inch.
   3. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.

G. Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch thick, clear.

H. Water: Potable, not detrimental to concrete.

2.08 Concrete Mix Design

A. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.
   1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

B. Proportioning Structural Lightweight Concrete: Comply with ACI 211.2 recommendations.
   1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

C. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.
   1. For trial mixtures method, employ independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.

D. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.

E. Normal Weight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 3,000 pounds per square inch or as indicated on drawings.
   2. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
   3. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.
   4. Cement Content: Minimum 5 sacks per cubic yard.
   5. Water-Cement Ratio: Maximum 59 percent by weight.
   6. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
   7. Maximum Slump: 4 inches.
   8. Maximum Aggregate Size: 5/8 inch.

2.09 Mixing

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

B. Transit Mixers: Comply with ASTM C94/C94M.

C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 Examination

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 Preparation

A. Formwork: Comply with requirements of ACI SPEC-301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
   1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
   2. Use latex bonding agent only for non-load-bearing applications.

E. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.

F. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.03 Installing Reinforcement and Other Embedded Items

A. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.

B. Comply with requirements of ACI SPEC-301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

C. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

D. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 Placing Concrete

A. Place concrete in accordance with ACI PRC-304.

B. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

C. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

D. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

E. Finish concert within the tolerances specified below.

3.05 Slab Jointing

A. Locate joints as indicated in the geotechnical report unless otherwise shown on the drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

D. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

E. Extend joint filler from bottom of slab to within 1/4 inch of finished slab surface. Conform to manufacturer's requirements for joint sealer finish.

3.06 Concrete Finishing

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
   1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
   2. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.
   3. Cork Floated Finish: Immediately after form removal, apply grout with trowel or firm rubber float; compress grout with low-speed grinder, and apply final texture with cork float.

D. Concrete Slabs: Finish to requirements of ACI 302.1R.

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.

3.07 Curing and Protection

A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.
   2. High early strength concrete: Not less than four days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

D. Surfaces Not in Contact with Forms:
   1. Final Curing: Begin after initial curing but before surface is dry.
      a. Moisture-Retaining Cover: Seal in place with waterproof tape or adhesive.
      b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.08 Field Quality Control

A. An independent testing agency will perform field quality control tests.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.09 Defective Concrete

A. Test Results: The testing agency shall report test results in writing to Engineer and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.10 Schedule - Concrete Types and Finishes

A. Structural Walls: 3,000 psi 28 day concrete or as indicated on drawings.

END OF SECTION 03 3000

CONTROLLED LOW STRENGTH BACKFILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Contractor shall furnish all labor, materials, equipment and incidentals as shown, specified and required to provide for the proportioning, mixing, transportation and placement of Controlled Low Strength Backfill at the specified locations and dimensions shown on the plans, or as directed by the Engineer.

B. The Controlled Low Strength Backfill shall be composed of portland cement, fly ash, natural fine aggregate and water, proportioned and mixed as herein specified.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 – Grading.

B. Section 31 2316 – Excavation.

C. Section 31 2316.13 – Trenching.

D. Section 31 2316.14 – Trench Excavation Protection.

E. Section 31 2323 - Fill.

1.03 QUALITY CONTROL

A. Testing
   1. Test materials for compliance with technical requirements of the Specifications shall be performed by a testing laboratory.
   2. Testing Services Include:
      a. Test the Contractor's proposed materials in the laboratory and/or field for compliance with the Specifications.
      b. Report test results to the Engineer and the Contractor.

1.04 PRICE AND PAYMENT PROCEDURES

A. Cement: By the cubic yard.

1.05 REFERENCE STANDARDS

A. Comply with applicable provisions and recommendation of the following, except as otherwise shown or specified.
   1. ASTM C 150, Portland Cement.
   2. ASTM C 618, Fly Ash.
   3. ASTM C 494, Water Reducing Admixtures.

1.06 SUBMITTALS

A. Certificates: Submit certificates of compliance with referenced standards.

B. The testing laboratory shall submit copies of the reports directly to the Engineer, with copy to the Contractor.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement: Furnish hydraulic cement that meets the requirements of TxDOT's DMS-4600, "Hydraulic Cement," TxDOT's Hydraulic Cement Quality Monitoring Program (HCQMP), and ASTM C-150 Type I Portland Cement. Sources not on the HCQMP or other sources to be used in combination with an approved source will require approval before use.

B. Fly Ash: Furnish fly ash conforming to TxDOT DMS-4610, "Fly Ash".

C. Chemical Admixtures: Furnish chemical admixtures conforming to TxDOT DMS-4640, "Chemical Admixtures for Concrete."

D. Fine Aggregate: Provide fine aggregate that will stay in suspension in the mortar to the extent required for proper flow and that meets the gradation requirements of Table 1. Test fine aggregate gradation in accordance with TxDOT standard laboratory test procedure Tex-401-A. Plasticity Index (PI) must not exceed 6 when tested in accordance with TxDOT standard laboratory test procedure Tex-l06-A.

TABLE 1 - GRADATION FOR FINE AGGREGATE

SIEVE SIZE	PERCENT BY WEIGHT PASSING SIEVES
3/8 inch	100
No. 8	80-100
No. 16	60-100
No. 30	45-80
No. 50	12-40
No. 100	1.5-25
No. 200	0-5

E. Admixtures
1. The use of any material added to the Controlled Low Strength Backfill shall be reviewed by the Engineer.
2. Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C494, Type A, water-reducing, or Type D, water reducing and retarding. Water reducing admixtures shall be added to the mixer in accordance with manufacturer's printed instructions.

F. Water
1. Water used in mixing shall be as clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product as possible.
2. Water will be tested and shall meet the suggested requirements of AASHTO T26.
3. Water known to be of potable quality may be used without testing.

PART 3 EXECUTIONS

3.01 MIXING AND PROPORTIONING

A. The Contractor or Controlled Low Strength Backfill supplier shall submit for acceptance test data from prior experience if available.

B. The supplier also must provide 5 copies of the recommended mix proportions and trial batch test results prepared by an independent testing laboratory three weeks prior to use.

C. Submitted data should include product performance curves indicating 1, 7 and 28 day unconfined compressive strengths.

D. Proportions must be selected to produce the specified unconfined compressive strength and workability designed below.

E. Proportions shall be selected on the basis of unconfined compressive strength tests of specimens continuously moist cured, for testing at the age or ages specified below.

3.02 PERFORMANCE

A. Strengths: for trench backfill, the Controlled Low Strength Backfill shall have an unconfined compressive strength of 21 psi minimum, no more than 24 hours after watering. The 28 day unconfined compressive strength shall not exceed 500 psi.

B. Workability: The Controlled Low Strength Backfill shall be flowable and shall have an initial slump greater than 9" and a minimum slump of 4-½" after one hour.

C. When a sample of Controlled Low Strength Backfill is poured out on the ground, the aggregate and mortar should stay well mixed with no separation. The Engineer may reject the mix if excessive separation is found.

3.03 PLACING

A. For pipe trench backfill, provide bulkheads at units of fill placement sufficient to confine backfill to area designated in the plans. Bulkheads may be structural or earthen.

B. During placement, station workers in a safe location where they can view inside of pipe to check for leakage. When any leakage into pipe is discovered, stop placement and repair leak before resuming placement.

3.04 TESTING

A. A minimum of three test cylinders per 1000 cubic yards of Controlled Low Strength Backfill shall be drawn and tested for 7 and 28 day unconfined compressive strengths by the independent testing laboratory engaged by the Owner.

3.05 COVERING

A. Controlled Low Strength Backfill placed in pipe trenches may be covered when it adequately supports the weight of construction equipment, no less than 24 hours after completion of placement.

B. Other Controlled Low Strength Backfill should be allowed to cure for a minimum of 72 hours before covering.

END OF SECTION 03 3000.10

PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 Section Includes

A. Circular or box culverts.

B. Structural walls.

C. Grout packing.

D. Connection and supporting devices.

1.02 Price and Payment Procedures

A. Precast Column and Beam Members:
   1. Structural Walls: By the face foot.
   2. Culverts: By the linear foot.
   3. Includes unit member placed and anchored.

1.03 Reference Standards

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

E. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.

F. ASTM A416/A416M - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete; 2012a.

G. ASTM A497/A497M - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete; 2007.

H. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.

I. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

J. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2009.

K. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2007b (Reapproved 2014).

L. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

M. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars; 2001 (Reapproved 2007).

N. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

O. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products; 1999, Fourth Edition.

P. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete; 2010, Seventh Edition.

Q. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete; 1988, Second Edition.

R. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete; 1989, Second Edition.

S. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; 2000.

T. UL (FRD) - Fire Resistance Directory; current edition.

1.04 Submittals

A. Product Data: Indicate standard component configurations, design loads, deflections, cambers, and bearing requirements.

B. Shop Drawings: Indicate layout, unit locations, fabrication details, unit identification marks, reinforcement, integral insulation, insulated panel system connectors, connection details, support items, dimensions, openings, and relationship to adjacent materials. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.
   1. Submit reviewed shop drawings and design data to Engineer.

1.05 Quality Assurance

A. Designer Qualifications: Design precast concrete members under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in the State in which the Project is located.

B. Fabricator Qualifications: Company specializing in manufacturing products specified in this section.

C. Erector Qualifications: Company specializing in erecting products of this section.

D. Welder Qualifications: Qualified in accordance with AWS D1.1 and AWS D1.4.

1.06 Delivery, Storage, and Handling

A. Handle precast members in position consistent with their shape and design. Lift and support only from support points.

B. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

C. Protect members to prevent staining, chipping, or spalling of concrete.

D. Mark each member with date of production and final position in structure.

PART 2 PRODUCTS

2.01 Manufacturers

A. Structural Precast Concrete:
   1. Any manufacturer holding a PCI Group C Plant Certification for the types of products specified; see www.pci.org.

2.02 Precast Units

A. Precast Structural Concrete Units: Comply with PCI MNL-116, PCI MNL-120, PCI MNL-123, PCI MNL-135, ACI CODE-318, and applicable codes.
   1. Design components to withstand dead loads and design loads in the configuration indicated on the drawings.

2. Calculate structural properties of framing members in accordance with ACI CODE-318.
3. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with strength requirements.
4. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.
5. Design system to accommodate construction tolerances, deflection of other structural members and clearances of intended openings.

2.03 Materials

A. Cement: White Portland type, complying with ASTM C150/C150M, Type I.

B. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements and PCI MNL-116.

2.04 Reinforcement

A. Tensioning Steel Tendons: ASTM A 416/A 416M, Grade 250 (1725) or 270 (1860); seven-wire stranded steel cable; full length without splices.

B. Reinforcing Steel: ASTM A 615/A 615M Grade 40 (280).
   1. Plain or deformed billet-steel bars.
   2. Unfinished.

C. Steel Welded Wire Reinforcement: ASTM A 185/A 185M plain type; in flat sheets or coiled rolls.

2.05 Fabrication

A. Comply with fabrication procedures specified in PCI MNL-116.

B. Fabricate and handle epoxy-coated reinforcing bars in accordance with ASTM D3963/D3963M.

C. Maintain plant records and quality control program during production of precast members. Make records available upon request.

D. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

E. Tension reinforcement tendons as required to achieve design load criteria.

F. Provide required openings with a dimension larger than 10 inches and embed accessories provided under other sections of the specifications, at indicated locations.

G. Exposed Ends at Stressing Tendons: Fill recess with non-shrink or epoxy grout, trowel flush.

2.06 Finishes

A. Ensure exposed-to-view finish surfaces of precast concrete members are uniform in color and appearance.

B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

C. Finish members to PCI MNL-116 Commercial grade.

D. Plant Finish: Normal plant finish; surface may contain small surface holes caused by air bubbles, minor chips or spalling at edges or ends, without major discoloration.

E. Exposed-to-View Finish: Normal plant finish with fins and protrusions removed, ground edges and ends, flat face surfaces.

F. Rubbed Finish: Surface holes or bubbles over 1/4 inch filled with matching cementitious paste, fins or protrusions removed and surface ground smooth, surface then rubbed with neat cementitious paste to smooth and even color and texture.

G. Sandblast Finish: Lightly sandblast to achieve partial exposure of aggregate.

2.07 Source Quality Control

A. Test samples in accordance with applicable ASTM standard.

PART 3 EXECUTION

3.01 Examination

A. Verify that site conditions are ready to receive work and field measurements are as indicated on shop drawings.

3.02 Preparation

A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

3.03 Erection

A. Install members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Align and maintain uniform horizontal and vertical joints, as installation progresses.

C. Maintain temporary bracing in place until final support is provided. Protect members from staining.

D. Provide temporary lateral support to prevent bowing, twisting, or warping of members.

E. Adjust differential camber between precast members to tolerance before final attachment.

F. Install bearing pads.

G. Level differential elevation of adjoining horizontal members with grout.

H. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.

I. Secure units in place.

3.04 Tolerances

A. Install members level and plumb within allowable tolerances.

B. Conform to PCI MNL-135 for installation tolerances.

C. When members cannot be adjusted to comply with design or tolerance criteria, cease work and advise Engineer. Execute modifications as directed.

3.05 Protection

A. Protect members from damage caused by field welding or erection operations.

B. Provide non-combustible shields during welding operations.

3.06 Cleaning

A. Clean weld marks, dirt, or blemishes from surface of exposed members.

END OF SECTION 03 4100

MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mortar for masonry.

B. Grout for masonry.

1.02 REFERENCE STANDARDS

A. ACI 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures; American Concrete Institute International; 2008.

B. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2010.

C. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.

D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.

E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.

F. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).

H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.

I. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2011b.

J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.

K. ASTM C476 - Standard Specification for Grout for Masonry; 2010.

L. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.

M. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.

N. ASTM C1019 - Standard Test Method for Sampling and Testing Grout; 2013.

O. ASTM C1072 - Standard Test Method for Measurement of Masonry Flexural Bond Strength; 2013.

P. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry; 1995 (Reapproved 2013).

Q. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2014.

R. ASTM E518/E518M - Standard Test Methods for Flexural Bond Strength of Masonry; 2010.

S. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

T. IMIAWC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.

U. IMIAWC (HW) - Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.

1.03 SUBMITTALS

A. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used.

B. Samples: Submit two samples of mortar, illustrating mortar color and color range.

C. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.

D. Reports: Submit reports on grout indicating compliance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer's Instructions: Submit manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
   1. Maintain one copy of each document on project site.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.06 FIELD CONDITIONS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

A. Mortar Mix Designs: ASTM C270, Property Specification.

2.02 MATERIALS

A. Masonry Cement: ASTM C 91, types as scheduled in this section.
   1. Colored mortar: Premixed cement.

B. Portland Cement: ASTM C 150, Type I - Normal.

C. Packaged Dry Mortar: ASTM C 387/C 387M.

D. Hydrated Lime: ASTM C 207

E. Quicklime: ASTM C5, non-hydraulic type.

F. Mortar Aggregate: ASTM C144.

G. Grout Aggregate: ASTM C404.

H. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): As indicated on drawings.

I. Water: Clean and potable.

J. Accelerating Admixture: Nonchloride type for use in cold weather.

K. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.

L. Bonding Agent: Latex or epoxy type.

2.03 MORTAR MIXES

A. Ready Mixed Mortar: ASTM C 1142.

B. Stain Resistant Pointing Mortar: One part Portland cement, 1/8 part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate equal to 2 percent of Portland cement by weight.

C. Colored Mortar: Proportion selected pigments and other ingredients without exceeding manufacturer's recommended pigment-to-cement ratio.

2.04 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. Add mortar color and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.

D. Do not use anti-freeze compounds to lower the freezing point of mortar.

E. If water is lost by evaporation, re-temper only within two hours of mixing.

2.05 GROUT MIXES

A. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M, or mix in accordance with ASTM C 476.
   1. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
   2. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

B. Engineered Masonry: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M, or mix in accordance with ASTM C 476.
   1. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
   2. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

2.06 GROUT MIXING

A. Mix grout in accordance with ASTM C94/C94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

D. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 EXECUTION

3.01 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

B. Plug clean-out holes for grouted masonry with brick or block masonry units. Brace masonry to resist wet grout pressure.

3.02 INSTALLATION

A. Install mortar and grout to requirements of section(s) in which masonry is specified.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not install grout in lifts greater than 3 inches without consolidating grout by rodding.

D. Do not displace reinforcement while placing grout.

E. Remove excess mortar from grout spaces.

3.03 GROUTING

A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of Contract Documents.

B. Perform grouting by means of high-lift technique, except in locations that mandate use of low-lift grouting technique.
   1. Do not use high-lift grouting where size of cavities mandates use of fine grout.

C. Low-Lift Grouting:
   1. Limit height of pours to 12 inches.
   2. Limit height of masonry to 12 inches above each pour.
   3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
   4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

D. High-Lift Grouting:
   1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
   2. Brick: Limit pours to maximum 16 feet in height and 25 feet horizontally.
   3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
   4. Place grout for spanning elements in single, continuous pour.

3.04 FIELD QUALITY CONTROL

A. Test and evaluate mortar in accordance with ASTM C780 procedures.
   1. Test with same frequency as specified for masonry units.

B. Test and evaluate grout in accordance with ASTM C1019 procedures.
   1. Test with same frequency as specified for masonry units.

C. Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C1314, and for flexural bond strength in accordance with ASTM C1072 or ASTM E518/E518M; perform tests and evaluate results as specified in individual masonry sections.

3.05 SCHEDULES

A. Exterior Cavity Wall: Type S mortar with Type N pointing mortar.

B. Loading Dock Area, No. 100: CMU partitions with Type N mortar.

C. Conference Room 102: Glass Unit Masonry with Type N mortar and Type O pointing mortar.

END OF SECTION 04 0511

SITE CLEARING

PART 1 GENERAL

1.01 Section Includes

A. Clearing and grubbing.

B. Selective removal and trimming.

C. Debris removal.

1.02 Related Requirements

A. Section 01 5713 - Temporary Erosion and Sediment Control.

B. Section 31 1000.10 - Tree Protection.

C. Section 31 2200 - Grading.

D. Section 31 2323 - Fill.

1.03 REFERENCE STANDARDS -- NOT USED

1.04 SUBMITTALS -- NOT USED

A. Clearing Firm Qualification Statement: Documentation of specialized experience.

1.05 Quality Assurance

A. Clearing Firm Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

B. State and local laws and code requirements shall govern the hauling and disposal of trees, shrubs, stumps, roots, rubbish, debris and other matter.

C. Contractor shall not clear site until a permit is obtained from the authorized regulatory agency.

D. Air pollution caused by dust and dirt shall be controlled and comply with governing regulations.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 Examination

A. Remove from site and satisfactorily dispose of all trees, shrubs, stumps, roots, brush, masonry, rubbish, scrap, debris, pavement, curbs, fences and miscellaneous other structures required to permit construction of new work.

B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 Preparation

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain and pay for required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Protect existing structures and other elements that are to remain.

3.03 Clearing and Grubbing

A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, landscape areas, and planting beds.

B. Clear site after relocating vegetation in accordance with ANSI A300 Part 6.

C. Do not remove or damage vegetation beyond limits indicated on drawings.

D. Install substantial, highly visible chain link or orange mesh fences at least 4 feet high to prevent inadvertent damage to vegetation at the removal limits. Reference tree protection detail in drawings.

E. In areas where vegetation must be removed but no construction will occur, remove vegetation with minimum disturbance of the subsoil.

F. Vegetation Removed: Do not burn, bury, landfill, or leave on site, unless indicated on drawings.
   1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
   2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed.
   3. Existing Stumps: Treat as specified for other vegetation removed; completely remove stumps and roots to depth of 6 inches below subgrade.
   4. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.

G. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.

H. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner. Contractor shall warrant damaged vegetation for 18 months.

3.04 Selective Removal and Trimming

A. Selective Removal: Individual tree and shrub identified for removal as indicated on drawings according to 29 CFR 1910.266.

B. Selective Trimming: Individual limbs and branches cut back according to ANSI A300 Part 1 identified for removal as indicated on drawings. Follow recommendations of ANSI Z133 and best local practices for species involved.

3.05 Removed Vegetation Processing

A. Do not burn, bury, landfill, or leave on-site, except as indicated on drawings.

B. Trees: Sell if marketable.

3.06 Debris Removal

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and windblown debris from public and private lands.

END OF SECTION 31 1000

TREE PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Protection of Existing Trees.

1.02 RELATED REQUIREMENTS

A. Section 31 1000 - Site Clearing.

B. Section 31 2200 - Grading.

1.03 PRICE AND PAYMENT PROCEDURES

A. Tree Protection Fence: By the linear foot. Includes chain link or plastic mesh fence, posts, tie wire, and installation.

1.04 REFERENCE STANDARDS

A. ANSI A300-2008 Pruning.

B. Local Municipal Code.

1.05 SUBMITTALS -- NOT USED

1.06 QUALITY ASSURANCE

A. Employ certified arborist or landscape architect to supervise or perform tree protection work as required.

PART 2 PRODUCTS

2.01 MATERIALS

A. Tree Protection Fence: 4 feet high galvanized chain link.
   1. Posts: 1-1/2 inch at 6 feet on center, 2 feet deep.
   2. Tension Wire: Not less than 12 gauge at top and 6 inches above existing grade.

B. Tree Protection Fence: 4 feet high heavy gauge orange plastic mesh with 2" openings.
   1. Posts: "T" posts at 6 feet on center, 2 feet deep.

PART 3 EXECUTION

3.01 TREE PROTECTION FENCE

A. Install at Root Protection Zone of all existing trees to be protected as shown on drawing.

B. Root Protection Zone shall be located 1 foot radius from trunk for every 1 inch diameter of trunk at 4 feet from ground. The diameter of a multi-trunk tree is calculated as the sum of the largest trunk plus half of the sum of additional trunks at 4.5 feet from ground.

C. Fence may be located a minimum of half of the root protection radius if approved by the regulatory authority, Engineer, or Owner.

D. Fence Location Detail: See detail as shown on drawings.

3.02 TREE PROTECTION REQUIREMENTS

A. Install tree protection fence prior to any clearing, excavation, or grading and maintain in good repair for the duration of all construction work unless otherwise directed**.**

B. No construction operations are allowed within the Root Protection Zone.

C. Root Protection Zone shall be sustained in a natural state and shall be free from vehicular or mechanical traffic; no fill, equipment, liquids, or construction debris shall be placed inside the protective barrier.

D. Root Protection Zone shall be covered with 6" of mulch to reduce moisture stress.

E. The proposed finished grade and elevation of land within the Root Protection Zone of any trees to be preserved shall not be raised or lowered more than 3 inches. Welling and retaining methods are allowed outside the Root Protection Zone.

F. Root Protection Zone shall remain pervious, i.e. ground cover or turf at completion of landscape design.

G. No roots may be cut closer than 6 feet from the base of any tree. Roots cut within the Root Protection Zone will only be allowed on one side of the tree. Any roots that need to be cut within the Root Protection Zone will be cut using a saw-type trencher, and all cut roots will be painted.

H. All trees impacted by construction shall be fertilized with an organic tree fertilizer prior to construction and again at the end of construction. The area within the protective fencing shall be mulched with about 6 inches of mulch. Water barrels shall be placed within the Root Protection Zone to irrigate these trees if necessary.

I. No trash or warming fires shall be placed within 50 feet of any tree.

J. No pedestrian traffic shall occur within dripline of any tree.

3.03 DAMAGE TO PROTECTED TREES

A. Trim trees and shrubs when doing so will prevent removal or damage. Trimmed or damaged trees shall be treated or repaired under supervision of a certified arborist or landscape architect.

B. Any damage done to existing tree crowns or root systems shall be repaired immediately under supervision of a certified arborist. All wounds to oaks shall be painted with pruning paint within 20 minutes after damage. Roots exposed during construction operations will be cut cleanly. Cut surfaces shall be painted and topsoil and mulch placed over exposed root area immediately.

C. Branch Pruning Detail: See detail as shown on drawings.

D. Contractor shall compensate owner for damage to existing trees designated to remain in the amount of $200 per caliper inch measured 4 feet from ground. This amount will be deducted from final payment.

END OF SECTION 31 1000.10

GRADING

PART 1 GENERAL

1.01 Section Includes

A. Removal of topsoil.

B. Rough grading the site.

C. Fine grading.

D. Finish grading.

1.02 Related Requirements

A. Section 31 1000 - Site Clearing.

B. Section 31 1000.10 - Tree Protection.

C. Section 31 2316 - Excavation.

D. Section 31 2323 - Fill.

E. Project Geotechnical Report.

1.03 Price and Payment Procedures

A. Topsoil:
   1. Measurement Method: By the cubic yard.
   2. Includes: scarifying substrate surface, placing where required, and compacting.

1.04 Submittals

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.05 Quality Assurance

A. Perform Work in accordance with available geotechnical engineering and landscape specifications.

PART 2 PRODUCTS

2.01 Materials

A. Gravel: Excavated on-site.
   1. Graded according to ASTM D2487 Group Symbol GW, GP, or SP.

B. Topsoil: Topsoil excavated on-site; friable loam, imported borrow; local borrow.
   1. Graded.
   2. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.

C. Other Fill Materials: See Section 31 2323.

PART 3 EXECUTION

3.01 Examination

A. Verify survey bench mark and intended elevations for grading areas are as indicated.

B. Verify the absence of standing or ponding water.

3.02 Preparation

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect above- and below-grade utilities to remain.

D. Notify utility company to remove and relocate utilities.

E. Provide temporary means and methods to remove standing or ponding water from areas prior to grading.

F. Protect site features to remain, including but not limited to bench marks, survey control points, and fences.

G. Protect trees to remain. Reference Section 31 1000.10.

H. Protect features to remain as a portion of final landscaping.

3.03 Rough Grading

A. Excavate and fill subgrade material to elevations indicated on plans.

B. Remove topsoil from areas to be further excavated, without mixing with foreign materials.

C. Do not remove topsoil when wet.

D. Remove subsoil from areas to be further excavated.

E. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

F. When excavating through roots, perform work by hand and cut roots with sharp axe.

G. See Section 31 2323 for filling procedures.

H. Benching Slopes: Horizontally bench slopes greater than 4:1 to key fill material to slope for firm bearing.

I. Replace displaced subgrade in accordance with Section 31 2323.

J. Remove and replace unsuitable materials as specified fill.

3.04 Fine Grading

A. Scrape and spread subgrade material uniformly smooth and without disruptions as indicated on drawings.

3.05 SOIL REMOVAL

A. Stockpile topsoil to be re-used on site; remove remainder from site.

B. Stockpile subsoil to be re-used on site; remove remainder from site.

C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.06 FINISH GRADING

A. Before Finish Grading:
   1. Verify building and trench backfilling have been inspected.
   2. Verify subgrade has been contoured and compacted.

B. Remove debris, roots, branches, stones, in excess of 1-1/2 inch in size. Remove soil contaminated with petroleum products.

C. Where topsoil is to be placed, scarify surface to depth of 3 inches.

D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.

E. Place topsoil in areas indicated on drawings.

F. If not otherwise indicated, place topsoil to the following compacted thicknesses:
   1. Areas to be Seeded with Grass: 4 inches.
   2. Areas to be Sodded: 4 inches.

G. Place topsoil during dry weather.

H. Remove roots, weeds, rocks, and foreign material while spreading.

I. Near plants, buildings, and curbs spread topsoil manually to prevent damage.

J. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

K. Lightly compact placed topsoil.

L. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.07 Tolerances

A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.

B. Top Surface: Plus or minus 1/2 inch.

3.08 REPAIR AND RESTORATION

A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.

B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Engineer as to remedy.

C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.09 FIELD QUALITY CONTROL

A. See Section 31 2323 for compaction density testing.

3.10 Cleaning

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove unused stockpiled subsoil. Grade stockpile area to prevent standing water.

C. Leave site clean and raked, ready to receive work.

END OF SECTION 31 2200

EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating for site grading, paving, structures.

B. Trenching for utilities from 5 feet outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

A. Section 01 5713 - Temporary Erosion and Sediment Control.

B. Section 31 2200 - Grading.

C. Section 31 2323 - Fill.

D. Section 31 2316.13 - Trenching.

E. Section 31 2316.14 - Trench Excavation Protection.

F. Project Geotechnical Report.

1.03 PRICE AND PAYMENT PROCEDURES

A. Excavating Soil Materials:

1. Measurement method: By the cubic yard measured before removal.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the work are as indicated.

B. Verify that existing topography is as shown in the plans. Coordinate with the engineer for any discrepancies prior to start of excavation.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Excavate and backfill, in advance of construction, test pits to determine conditions or location of existing utilities.

C. Locate, identify, and protect utilities that remain and protect from damage.

D. Notify utility company to remove and relocate utilities.

E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, curbs, and existing utilities from excavating equipment and vehicular traffic. Repair damage at no additional charge to Owner, including utility company charges.

F. Protect plants, lawns, rock outcroppings, and other features to remain.

G. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Engineer.

3.03 EXCAVATING

A. Excavate to accommodate construction operations and to lines and grades indicated on the drawings.

B. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

C. Excavate to provide adequate work space and clearance for concrete forms. Do not undercut excavation face for extended footings.

D. Steep slope and trench excavations shall conform with OHSA standards for shoring and safety protection.

E. Do not interfere with 45 degree bearing splay of foundations.

F. Cut utility trenches wide enough to allow inspection of installed utilities. Reference Sections 31 2316.13 and .

G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.

H. Provide temporary means and methods, as required, to remove all water from excavations until directed by Engineer. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.

I. Stockpile excavated material to be re-used in area designated on site.

J. Remove excess excavated material from site. Transport and place in accordance with all applicable regulations. Do not dispose of excess material in any stream or watercourse. Do not dump excess material on public property. Do not dispose of excess material on private property unless authorized by Owner.

K. Structure and Roadway Excavations:
   1. Subgrade shall be firm, dense, and compacted to 95 percent maximum density at a moisture content between optimum and optimum plus or minus 4 percent unless otherwise indicated in the Project Geotechnical Report.
   2. Bottom of excavations for footings and slabs shall be level, clean, dry, and clear of loose material.
   3. Remove unsuitable material and replace with suitable material as required or directed by Testing Laboratory.
   4. Refill over-excavated areas with properly compacted select backfill material.
   5. Extend excavation 5 feet minimum on each side of structure or footing unless otherwise indicated on drawings.
   6. Proof roll exposed design subgrade using a 25 ton pneumatic tire roller, maintaining a minimum tire pressure of 75 psi. Proof rolling operation shall be inspected by Testing Laboratory. Any soft or unconsolidated zones or areas detected by proof rolling operations shall be undercut as directed by the Engineer or the Testing Laboratory. Undercut subgrade shall be scarified to a minimum depth of six inches and compacted to a minimum of 95 percent maximum density at a moisture content between optimum and optimum plus 4 percent unless otherwise indicated in the Project Geotechnical Report. After the undercut subgrade has been scarified and compacted, the undercut shall be backfilled with select backfill to the design subgrade elevation. The final subgrade shall be reviewed by the Engineer or the Testing Laboratory.
   7. The surface of the subgrade for street excavations shall be finished to the lines and grades as established, and be in conformity with the typical sections shown on the plans. Any deviation in excess of one-half inch in cross section, and in a length of sixteen feet, measured longitudinally, shall be corrected by loosening, adding, or removing material, reshaping and compacting by sprinkling and rolling.

3.04 FIELD QUALITY CONTROL

A. Provide for visual inspection of load-bearing excavated surfaces by Engineer before placement of foundations.

3.05 PROTECTION

A. Divert surface flow from rains or water discharges from the excavation.

B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.

D. Protect bottom of excavations and exposed soil against physical disturbance, rain, and freeze.

E. Keep excavations free of standing water and completely free of water during concrete placement.

F. Protect footing excavations; construct concrete footings same day excavation is made wherever possible.

END OF SECTION 31 2316

TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating, backfilling and compacting for utilities outside of any structure to utility main connections or storm drainage outfalls.

1.02 RELATED REQUIREMENTS

A. Project Geotechnical Report.

B. Section 03 3000.10 - Controlled Low Strength Backfill.

C. Section 31 2200 - Grading.

D. Section 31 2316 - Excavation.

E. Section 31 2323 - Fill.

F. Section 31 2316.14 - Trench Excavation Protection.

1.03 PRICE AND PAYMENT PROCEDURES

A. Excavating Soil Materials:
   1. Measurement method: By the cubic yard.
   2. Includes: Excavating to required elevations, loading and placing materials in stockpile or removing from site.
   3. Does Not Include Over-Excavation: Payment will not be made for over-excavated work nor for replacement materials.

B. General Fill:
   1. Measurement Method: By the cubic yard.
   2. Includes: Excavating existing soil, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

C. Structural Fill:
   1. Measurement Method: By the cubic yard.
   2. Includes: Excavating existing soil, stockpiling, scarifying substrate surface, placing where required, and compacting.

D. Granular Fill:
   1. Measurement Method: By the cubic yard.
   2. Includes: Excavating existing material, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

E. Aggregates:
   1. Measurement Method: By the cubic yard.
   2. Includes: Excavating existing material, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

1.04 DEFINITIONS

A. Finish Grade Elevations: Top of paving or proposed contours indicated on drawings.

B. Subgrade Elevations: Bottom of paving section indicated on drawings.

1.05 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.

B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.

C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.

D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.

E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.

F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.

G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.

H. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

I. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.

J. TxDOT TEX-113-E - Laboratory Compaction Characteristics and Moisture-Density Relationship of Base Materials; 2010.

K. TxDOT TEX-114-E - Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade, Embankment Soils, and Backfill Material; 2005.

L. NFPA 24 - Installation of Private Fire Service Mains and their appurtenances.

1.06 SUBMITTALS

A. Samples: sample of each type of fill; submit each material sample in three 5-gallon air-tight containers to testing laboratory.

B. Materials Sources: Submit name of imported materials source.

C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

D. Compaction Density Test Reports.

1.07 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where designated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.
   4. Provide positive drainage away from stockpiled material.
   5. Install erosion control measures around stockpiles as needed.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill: Subsoil excavated on-site or imported borrow.
   1. For imported borrow, gradation less than 15 percent passing No. 200 sieve as determined by ASTM D 1140.

2. For imported borrow, plasticity index less than 20 percent as determined by ASTM D 4318.
3. No organic matter or debris.
4. For subsoil excavated onsite, reference Geotechnical Engineering Report.

B. Structural Fill:
1. Reference Geotechnical Engineering Report.
2. If a Geotechnical Engineering Report is not available then comply with TxDOT Item 247 Type A Grade 2 Base.
3. Graded in accordance with the following limits unless otherwise indicated:
a. 1-3/4 inch sieve: 90-100 percent passing.
b. No. 4 sieve: 25-55 percent passing.
c. No. 40 sieve: 15-40 percent passing.
4. Mixture shall be crushed stone and contain no clay lumps or organic matter.
5. Fraction passing No. 40 sieve shall have a liquid limit less than 40 and a plasticity index less than 12 as determined by ASTM D 4318.

C. Concrete for Fill: As specified in Section 03 3000.10 - Controlled Low Strength Backfill.

D. Granular Fill : Crushed limestone or pea gravel ; free of shale, clay, friable material and debris.
1. Graded in accordance with ASTM C136/C136M, within the following limits:
a. 1/2 inch sieve: 95 percent passing.
b. No. 4 sieve: 5 percent passing.

E. Select Initial Backfill or Bedding Material: Clean, well graded crushed stone or gravels, crushed screenings or sand.
1. Modified Grade 5:
a. 1/2 inch sieve: 100 percent passing.
b. 3/8 inch sieve: 100 to 95 percent passing.
c. No. 4 sieve: 80 to 20 percent passing.
d. No. 10 sieve: less than 25 percent passing.
e. No. 20 sieve: less than 2 percent passing.
2. Plasticity index 12 or less as determined by TxDOT Test Method TEX-106-E.

2.02 ACCESSORIES

A. Geotextile Fabric: Non-biodegradable.

2.03 SOURCE QUALITY CONTROL

A. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

B. If tests indicate materials do not meet specified requirements, change material and retest.

C. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

B. Identify required lines, levels, contours, and datum locations.

3.02 PREPARATION

A. Locate, identify, and protect utilities that remain and protect from damage.

B. Notify utility company to remove and relocate utilities as indicated on plans.

C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Protect other features to remain.

E. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Engineer.

3.03 TRENCHING

A. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

B. Banks of excavations may be cut back on slopes to angle of repose or less until shored. Slope shall not extend lower than 12 inches above top of pipe.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Cut trenches wide enough to allow proper installation, jointing, embedment, and inspection of utilities. See drawing details for minimum trench width.

E. Hand trim excavations. Remove loose matter.

F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

G. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume. See Section 31 2316.26 for removal of larger material.

H. Excavate pipe trenches six inches (6") below the underside of the pipe to provide for the installation of a granular fill pipe foundation material except where otherwise required.

I. Where in earth, trench bottoms for pipe six inches (6") or smaller, may be graded to provide uniform and continuous support (between bell holes or end joints) of the installed pipe.

J. Remove excavated material that is unsuitable for re-use from site.

K. Stockpile excavated material to be re-used in area designated on site. Stockpile material a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins.

L. Remove excess excavated material from site.

M. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

N. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Engineer.

3.04 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with properly compacted structural fill.

B. Backfill over-depths in trench excavation with properly compacted structural fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Provide adequate clearance at bell holes for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

E. Where existing piping constructed by others cross the new pipeline trench excavation, the existing piping or ductbank shall be adequately supported and protected from damage due to construction. All methods for supporting and maintaining these facilities shall be subject to review by the Engineer or the Testing Laboratory. Backfill between utility crossings shall meet the requirements of standard backfill compact. See Section 03 3000.10 for low strength flowable fill option.

F. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation. Prevent surface water from flowing into trenches. Any water accumulating in trenches shall be removed by pumping or other approved methods.

G. If this project is within the Edwards Aquifer Recharge Zone, follow all requirements and recommendations of approved Water Pollution Abatement Plan (WPAP) and Sewer Collection System (SCS), including, plans, reports, and TCEQ approval letters. If, during construction, any recharge features are found, all activities near the feature must be suspended immediately and the Engineer must be notified. No activities near the feature may proceed until TCEQ has approved a plan to address the feature. If any sanitary sewer lines cross geologic fault lines, as indicated in the SCS plans and report, contact the Engineer 48 hours prior to excavating in the vicinity of the fault. The Engineer's geologist is required to assess such faults during excavation.

3.05 BACKFILLING

A. See Section 31 2323 for general backfill requirements.

B. Backfill is divided into three (3) separate zones:
   1. Bedding: The material in trench bottom in direct contact with the bottom of the pipe.
   2. Initial backfill: The backfill zone extending from the surface of the bedding to a point one foot (1') above the top of the pipe.
   3. Secondary backfill: The backfill zone extending from the initial backfill surface to the top of the trench. Placement of materials for each of the zones is described herein.

C. Bedding
   1. When unacceptable materials such as water, silt, muck, trash or debris, or rock boulder or coarse gravel (particle size greater than 1 ¾ inch) exist at the bearing level or for pipes with a nominal inner diameter greater than six inches (6"), use a bedding of granular embedment material.
   2. Unstable materials shall be removed at the direction of the Engineer and replaced to a minimum depth of four inches (4") or one-eighth (1/8) of the outside diameter of the pipe, whichever is greater, with granular embedment material. Extend this material up to the sides of the pipe sufficiently to embed the lower quadrant of the pipe. If stability is not accomplished by using the above procedure, the Engineer may require additional granular embedment.
   3. Spread and grade granular embedment to provide a uniform and continuous bedding zone beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface to withdraw pipe slings or

other lifting tackle. After each pipe has been graded, aligned, and shoved home, deposit and compact sufficient pipe embedment material under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations. Deposit and compact embedment material uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

4. Compact each layer of embedment material by at least two complete coverages of all portions of the surface of each lift using adequate compaction equipment. One coverage is defined as the conditions reached when all portions of the lift fill have been subjected to the direct contact of the compacting surface of the compactor.
5. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

D. Initial Backfill: Initial backfill is defined as backfill having a thickness in its compacted state from the surface of the bedding to a point one foot (1') above the top of the pipe. Initial backfill shall be constructed in accordance with details shown on the plans and these specifications.

1. Select Initial Backfill: Where pipe is to be laid in a rock cut or where rock in boulder ledge or coarse gravel (particle size larger than 1¾ inch) formations exist in the initial backfill zone, or where trench walls or conditions are unstable or where the pipe to be laid is flexible pipe, use granular embedment for initial backfill.
2. For conduits less than twenty-four inches (24") in diameter select initial backfill material shall be placed in two (2) lifts. The first lift shall be spread uniformly and simultaneously on each side and under the shoulders of the pipe to the mid-point or spring line of the pipe. The first lift of select initial backfill shall be inspected and approved prior to placement of the second lift. The second lift of select initial backfill material shall extend from the spring line of the pipe to a depth sufficient to produce a compacted depth of material a minimum of one foot (1') above the top of the pipe. The second lift shall be evenly spread in a similar manner as the first lift.
3. For conduits twenty-four (24") in diameter and larger, select initial backfill material shall be evenly and simultaneously spread alongside, under the shoulders or haunches of the pipe and over the pipe in six-inch (6") lifts to a point sufficient to produce a compacted depth of material a minimum of one foot (1') above the top of the pipe.
4. Natural Initial Backfill: Where the pipe to be laid is rigid pipe and where stable materials and laying conditions exist at the pipe bearing level and initial backfill zone and existing excavated materials are acceptable to the Engineer, such excavated natural materials may be utilized as initial backfill material.
5. For dedicated water lines used for fire protection and trenched in rock, tamped initial backfill and bedding material shall be used for at least 6 inches under and around the pipe and for at least 2 feet above the pipe.

E. Secondary Backfill: Secondary backfill is defined as backfill from one foot (1') above the top of the pipe of the trench. Secondary backfill shall be constructed in accordance with details shown on the plans and these specifications.

1. Secondary backfill shall generally consist of materials removed from the trench and shall be free of trash brush and other debris. No rock or stones having any dimension larger than one half of the trench width, or four inches (4"), whichever is less, shall be used in the secondary backfilling zone. In special cases where excessive width and/or depth of the trench permit, and only with approval of the Engineer, larger rocks up to six inches

(6") in diameter may be incorporated into the backfill provided that the surrounding compactable soil may be properly and adequately compacted.

F. Restore the surface of the backfilled trench, if not disturbed by surrounding construction, to match previous existing conditions.

G. Compaction Density unless otherwise indicated in the project Geotechnical Report:
   1. Compaction to meet the requirements of TxDOT TEX-114-E.
   2. Lift Thickness: 8 inches.
   3. Moisture Content: Between optimum and optimum +4 percent.
   4. Testing laboratory will perform density tests at completion of each lift.
   5. If the tests indicate unsatisfactory compaction, the Contractor shall provide the additional compaction necessary to obtain the specified degree of compaction. All additional compaction work shall be performed by the Contractor at no additional cost to the Owner until the specified compaction is obtained. This work shall include complete removal of unacceptable (as determined by the Testing Laboratory) fill areas and replacement and recompaction until acceptable fill is provided.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

A. Use general fill unless otherwise specified or indicated.

3.07 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.08 CLEANING

A. Leave unused materials in a neat, compact stockpile.

B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION 31 2316.13

TRENCH EXCAVATION PROTECTION

PART I - GENERAL

1.01 SECTION INCLUDES:

A. Trench Excavation Protection required for the construction of all trench excavation protection systems to be utilized in the project and including all additional excavation and backfill necessitated by the protection and backfill necessitated by the protection system.

1.02 MEASUREMENT AND PAYMENT

A. Trench Excavation Protection is to be included in the cost of installation of trenched underground utilities.

1.03 RELATED SECTIONS

A. Trench Excavation Protection shall be accomplished as required by the provisions of Part 1926, Subpart P - Excavations, Trenching, and Shoring of the Occupational Safety and Health Administration Standards and Interpretations.

B. A copy of the Document is available for review at the office of the Engineer. It shall be construed that this document is included in this Project Manual and shall apply to every Section as if written in full therein.

PART 2 - PRODUCTS -- NOT USED

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

A. Trench Excavation Protection shall be accomplished as required by the provisions of, Part 1926, Subpart P - Excavations, Trenching, and Shoring of the Occupational Safety and Health Administration Standards and Interpretations.

END OF SECTION 31 2316.14

FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for building volume below grade, footings, slabs-on-grade, paving, and utilities within the building.

B. Filling holes, pits, and excavations.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading.

B. Section 31 2316 - Excavation.

C. Section 31 2316.13 - Trenching.

D. Project Geotechnical Report.

1.03 PRICE AND PAYMENT PROCEDURES

A. General Fill:
   1. Measurement Method: By the cubic yard.
   2. Includes: Excavating existing soil, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

B. Structural Fill:
   1. Measurement Method: By the cubic yard.
   2. Includes: Excavating existing soil, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

C. Granular Fill:
   1. Measurement Method: By the cubic yard.
   2. Includes: Excavating existing material, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

D. Aggregates:
   1. Measurement Method: By the cubic yard.
   2. Includes: Excavating existing material, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

1.04 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

B. Subgrade Elevations: Indicated on drawings.

1.05 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.

B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.

C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.

D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.

E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.

F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.

G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.

H. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

I. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.

J. TxDOT TEX-113-E, Laboratory Compaction Characteristics and Moisture-Density Relationship of Base Materials, using 5.5 lb rammer and 12-inch drop.

1.06 SUBMITTALS

A. Samples: sample of each type of fill; submit each material sample in three 5-gallon air-tight containers to testing laboratory.

B. Materials Sources: Submit name of imported materials source.

C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.

D. Compaction Density Test Reports.

1.07 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where designated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill: Subsoil excavated onsite, imported borrow.
   1. For imported borrow, gradation less than 15 percent passing No. 200 sieve as determined by ASTM D 1140.
   2. For imported borrow, plasticity index less than 20 percent as determined by ASTM D 4318.
   3. No vegetative matter or debris.
   4. No rocks larger than half of the lift thickness.

B. Structural Fill:
   1. Refer to Geotechnical Engineering Report.
   2. If a Geotechnical Engineering Report is not available then comply with TxDOT Item 247 Type A Grade 2 Base.
   3. Graded in accordance with the following limits unless otherwise indicated:
      a. 1-3/4 inch sieve: 90-100 percent passing.
      b. No. 4 sieve: 25-55 percent passing.
      c. No. 40 sieve: 15-40 percent passing.

4. Mixture shall be crushed stone and contain no clay lumps or organic matter.
5. Fraction passing No. 40 sieve shall have a liquid limit less than 40 and a plasticity index less than 12 as determined by ASTM D 4318.

C. Granular Fill : Crushed limestone or pea gravel ; free of shale, clay, friable material and debris.
1. Graded in accordance with ASTM C136/C136M, within the following limits:
a. 1/2 inch sieve: 95 percent passing.
b. No. 4 sieve: 5 percent passing.

D. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter.
1. Graded in accordance with ASTM C136/C136M; within the following limits:
a. No. 4 sieve: 100 percent passing.
b. No. 200 sieve: 0 to 10 percent passing.

E. Drain Gravel: Washed gravel.
1. Material shall have an LA abrasion number of 35 or less.
2. Graded within the following limits:
a. 2 inch sieve: 100 percent passing.
b. 1-1/2 inch sieve: 90-100 percent passing.
c. 1 inch sieve: 25-55 percent passing.
d. 1/2 inch sieve: 0-10 percent passing.
e. 1/4 inch sieve: 0-5 percent passing.

2.02 SOURCE QUALITY CONTROL

A. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

B. If tests indicate materials do not meet specified requirements, change material and retest.

C. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the Work are as indicated.

B. Verify that existing topography is as shown in the plans. Coordinate with the engineer for any discrepancies prior to start of excavation.

C. Identify required lines, levels, contours, and datum locations.

D. See Section 31 2200 for additional requirements.

E. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

F. Verify structural ability of unsupported walls to support imposed loads by the fill.

G. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

E. Record locations of underground utilities.

F. If required, remove concrete formwork.

G. Remove trash and debris.

3.03 FILLING

A. Fill to contours and elevations indicated using suitable materials.

B. All select backfill, backfill and fill required for structures and trenches and required to provide the finished grades shown and as described herein shall be furnished, placed and compacted by the Contractor.

C. Employ a placement method that does not disturb or damage other work.

D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Slope grade away from building minimum 2 percent, unless noted otherwise. Make gradual grade changes. Blend slope to transition at grade changes.

G. Correct areas that are over-excavated.

H. All material shall be placed in horizontal loose lifts not exceeding eight inches (8") in thickness and shall be mixed and spread in a manner assuring uniform lift thickness after placing. Each lift shall be compacted by not less than two complete coverages of the specified compactor. Select backfill shall be placed to the underside of all concrete slabs or paved areas. The fill material shall extend a minimum of five feet (5') outside the face of each structure and be twelve inches (12") below finished grade. The maximum slope of select backfill to the subgrade shall be one vertical to one and one half horizontal.

I. Backfill around and outside of structures and over select backfill shall be deposited in layers not to exceed eight inches (8") in uncompacted thickness and mechanically compacted, using platform type tampers. Compaction of structural backfill, by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of select backfill and/or backfill by inundation with water will not be permitted. All materials shall be deposited as specified herein and as shown on the drawings.

J. Unless otherwise indicated in the Geotechnical Report, all material shall be placed at a moisture content that falls in the range of laboratory optimum moisture content and laboratory optimum +4%. It shall be compacted to a density of 95 percent (95%) of the maximum laboratory dry density for that material as determined by TxDOT TEX-113-E. The Contractor shall provide equipment capable of adding measured amounts of water to the material to bring it to a condition within the range of the required moisture content. The Contractor shall provide equipment capable of discing, aerating, and mixing the soil to insure reasonable uniformity of moisture content throughout the material and to reduce the moisture content of the material by air drying if necessary. If the subgrade material must be moisture conditioned before compaction, the material shall be sufficiently mixed or worked on the subgrade to insure a uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of the specified limit shall be dried by aeration or stockpiled for drying.

K. No material shall be placed when free water is standing on the surface of the area where the material is to be placed. No compaction of material will be permitted with free water on any portion of the material to be compacted. No material shall be placed or compacted in a frozen condition or on top of frozen material. Any material containing organic materials or other unacceptable material previously described shall be removed and replaced with acceptable material prior to compaction.

L. Each lift of compacted material shall be compacted by the designated number of coverages of all portions of the surface of each lift by a smooth drum vibratory roller for granular material having a static weight not less than 5,500 pounds, a sheepsfoot roller for cohesive material exerting a pressure of 250 psi on the surface of the feet, or equivalent equipment, prior to commencement of the work. One coverage is defined as the condition obtained when all portions of the surface of the backfill material have been subjected to the direct contact of the compactor. The compactor shall be operated at a forward speed not exceeding 40 feet per minute.

M. Compaction shall be performed with equipment suitable for the type of material being placed. The contractor shall select equipment which is capable of providing the minimum density required by these Specifications. The gross weight of compacting equipment shall not exceed 7,000 pounds within a distance of ten feet (10') from the wall of any existing structure or completed structure under this contract. Equipment shall be provided that is capable of compacting in restricted areas next to structures and around piping. The effectiveness of the equipment selected by the Contractor shall be tested at the commencement of compacted material work by construction of a small section of material within the area where material is to be placed. If tests on this section of backfill show that the specified compaction is not obtained, the Contractor shall increase the amount of coverages, decrease the lift thicknesses or obtain a different type of compactor.

N. Particular care shall be taken to compact structure backfill which will be beneath pipes, roads, or other surface construction or structures. In addition, wherever a trench passes through structure backfill, the structure backfill shall be placed and compacted to an elevation twelve inches (12") above the top of the pipe before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

O. The compaction requirements specified are predicated on the use of normal materials and compaction equipment. In order to establish criteria for the placement of a controlled fill so that it will have compressibility and strength characteristics compatible with the proposed structural loadings, a series of laboratory compaction and/or compressive strength tests will be performed on the samples of materials submitted by the Contractor. From the results of the laboratory tests, the final values of the required percent compaction, the allowable compaction moisture content range, and the maximum permissible lift thickness will be established for the fill material and construction equipment proposed.

P. Compaction Density, unless otherwise specified or indicated:
   1. Standard: TxDOT TEX-113-E.
   2. Required Density: 95 percent of the maximum dry density.
   3. Lift Thickness: 8 inches.
   4. Moisture Content: Between optimum and optimum +4 percent.
   5. Testing laboratory will perform density tests at completion of each lift.
   6. If the tests indicate unsatisfactory compaction, the Contractor shall provide the additional compaction necessary to obtain the specified degree of compaction. All

additional compaction work shall be performed by the Contractor at no additional cost to the Owner until the specified compaction is obtained. This work shall include complete removal of unacceptable (as determined by the Testing Laboratory) fill areas and replacement and recompaction until acceptable fill is provided.

7. Pit Run Sand Placement: Pit run sand shall be placed and compacted to the limits shown on the drawings.
8. Drainage Gravel: Drain gravel shall be compacted in maximum 8-inch lifts with a minimum of two passes of a hand operated vibratory plate compactor weighing between 150 and 500 pounds.

Q. Reshape and re-compact fills subjected to vehicular traffic.

R. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 FILL AT SPECIFIC LOCATIONS

3.05 TOLERANCES

A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.

3.06 FIELD QUALITY CONTROL

A. Refer to the Geotechnical Engineer for general requirements for field inspections and testing.

3.07 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. Leave unused materials in a neat, compact stockpile.

C. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

D. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION 31 2323

LIME SOIL STABILIZATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating, treatment, and placement of lime treated subsoil mix.

1.02 RELATED REQUIREMENTS

A. Section 31 2316 - Excavation.

B. Section 31 2323 - Fill.

C. Section 31 2316.13 - Trenching.

1.03 PRICE AND PAYMENT PROCEDURES

A. Measurement Method: Lime: By the ton (2000 lbs) of the type specified.

B. Measurement Method: Lime Treatment: By the square yard of lime/subsoil mix. Includes supplying ingredient materials, scarifying substrate surface, mixing and placing where required, compacting and curing.

1.04 REFERENCE STANDARDS

A. AASHTO M 216 - Standard Specification for Lime for Soil Stabilization; 2005.

B. ASTM C977 - Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization; 2010.

C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.

D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.

E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.

F. NLA Bull 326 - Lime-Treated Soil Construction Manual: Lime Stabilization & Lime Modification; 2004, 11th Edition.

G. Project Geotechnical Report.

1.05 SUBMITTALS

A. Submit mix design and materials mix ratio that will achieve specified requirements.

B. Samples: Submit 10 lb sample of each type of fill in air-tight containers, to testing laboratory.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with NLA Bull 326.

B. Maintain one copy on site.

1.07 FIELD CONDITIONS

A. Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40 degrees F.

PART 2 PRODUCTS

2.01 MIX MATERIALS

A. Subsoil: Existing reused.

B. Type A, Hydrated Lime.

C. Type B, Commercial Lime Slurry.
   1. Lime: TxDOT DMS-6350 "Lime and Lime Slurry."
   2. Mix Design: The Engineer will determine the target lime content and optimum moisture content in accordance with TxDOT Tex-121-E.

D. Type C, Quicklime.

E. The Contractor shall select, prior to construction, the grade to be used and shall notify the Engineer in writing before changing from one grade to another. Lime shall be placed in slurry form only, unless written permission is granted by the Engineer and a safety and containment plan is submitted to the Engineer by the Contractor seven days prior to use. In circumstances where it would be beneficial to utilize lime for "drying" subgrade materials to expedite construction, the Contractor may request approval from the Engineer to use pelletized lime.

2.02 EQUIPMENT

A. Equipment: Capable of excavating subsoil, mixing and placing materials, wetting, consolidation, and compaction of material.

2.03 LIME/SOIL MIX

A. Mix materials in accordance with Texas Department of Transportation Item No. 260, Lime Treatment-Road Mixed.

B. Carefully add water to the mix to achieve a consistent mixture without lumping yet not create a wet plastic consistency.

C. Obtain approval of the mix by geotech engineer before proceeding with placement.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not place fill over frozen, wet or soft subgrade surfaces.

3.02 EXCAVATION

A. Protect adjacent structures from damage by this work.

B. Excavate subsoil to depth and configuration as indicated in the drawings. Minimum depth is 6 inches.

C. Proof roll subgrade to identify soft areas; excavate those areas.

D. Do not excavate within normal 45 degree bearing splay of any foundation.

E. Notify Engineer of unexpected subsurface conditions. Discontinue affected Work in area until notified to resume work.

F. Correct areas over-excavated in accordance with Section 31 2316.

G. Stockpile excavated material in area designated on site; remove excess material not being reused from site.

H. In lieu of using the cutting and pulverizing machine, the Contractor may excavate and windrow the material to expose the secondary grade to the typical sections, lines and grades as shown on the plans or as established by the Engineer.

I. Pulverization: The existing pavement or base material shall be pulverized or scarified so that 100 percent shall pass the 2-1/2 inch sieve.

3.03 SOIL TREATMENT AND BACKFILLING

A. Application: The percentage by weight or pounds per square yard of lime to be added will be as shown on the plans and may be varied by the Engineer if conditions warrant.
   1. Lime shall be spread only on that area where the mixing operations can be completed during the same working day.
   2. Unless otherwise approved by the Engineer, the lime operation shall not be started when the air temperature is below 40 degrees F. Lime shall not be placed when weather conditions in the opinion of the Engineer are unsuitable.

B. Slurry Placing: When Type A Hydrated Lime is specified and slurry placement is to be used, the Type A Hydrated Lime shall be mixed with water to form a slurry with a solids content approved by the Engineer.
   1. Type B Commercial Lime Slurry:
      a. Deliver to the project in slurry form at or above the minimum dry solids content approved by the Engineer.
      b. The distribution of lime at the rate(s) shown on the plans or approved by the Engineer shall be attained by successive passes over a measured section of roadway until the proper lime content has been secured.
   2. Type C Quicklime:
      a. Apply as slurry, the amount of dry quicklime shall be 80 percent of the amount shown on the plans.
      b. The slurry shall contain at least the minimum dry solids content approved by the Engineer.
      c. The residue from the slurrying procedure shall be spread uniformly over the length of the roadway currently being processed unless otherwise approved by the Engineer.
   3. Slurry shall be of such consistency that it can be applied uniformly without difficulty.
   4. When the distributor truck is not equipped with an agitator, the Contractor shall have a standby pump available on the project for agitating the lime and water as required by the Engineer in case of undue delays in dispersing the slurry.

C. Dry Placing: Dry placing is not allowed unless approved by the Engineer in writing.
   1. The lime shall be distributed by an approved spreader at the rate shown on the plans or as directed by the Engineer.
   2. The lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime by the wind.
   3. The material shall be sprinkled as approved by the Inspector.

D. Mixing: The mixing procedure shall be the same for "Slurry Placing" or "Dry Placing" as herein described.
   1. Begin Mixing within 6 hours of lime application. During the interval between application and mixing, hydrated lime that has been exposed to the open air for a period of six (6)

hours or more or to excessive loss due to washing or blowing will not be accepted for payment.

a. Initial Mixing: The material and lime shall be thoroughly mixed. The material and lime shall be brought to the proper moisture content and left to mellow for 1 to 4 days. When pebble grade quicklime is used, allow the mixture to mellow for 2 to 4 days as approved by the Engineer.
   1) If Type C Quicklime, Grade "DS," is approved for use by the Engineer under "Dry Placing," the material and lime shall be mixed as thoroughly as possible at the time of the lime application. Sufficient moisture shall be added during the mixing to hydrate the quicklime.
   2) During the mellowing period, the material shall be kept moist as directed by the Inspector.
   3) When shown on the plans or approved by the Engineer, the pulverization requirement may be waived when the material contains a substantial quantity of aggregate.

2. Final Mixing: After the required mellowing time, the material shall be uniformly mixed by approved methods. If the soil binder-lime mixture contains clods, they shall be reduced in size by the use of approved pulverization methods.
   a. Following mixing, a sample of the material at roadway moisture will be obtained for pulverization testing. All non-slaking aggregates retained on the 3/4 inch sieve will be removed from the sample. The remainder of the material shall meet the following pulverization requirement when tested by TxDOT Test Method Tex-101-E, Part III:
      1) Minimum passing 1-3/4 " sieve 100
      2) Minimum passing 3/4" sieve 85
      3) Minimum passing No. 4 sieve 60

E. Compaction: Prior to compaction, the material shall be aerated or sprinkled as necessary to provide the optimum moisture. Compaction of the mixture shall begin immediately after final mixing and in no case more than 24 hours after final mixing
   1. Compaction shall continue until the entire depth of the mixture is uniformly compacted. Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical sections, lines and grades as shown on the plans or as established by the Engineer.
      a. Ordinary Compaction: Roll with approved compaction equipment, as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing treated material as required, reshaping, and recompacting.
      b. Density Control: Each course shall be sprinkled as required and compacted to the extent necessary to provide not less than 95 percent of the optimum density. Unless otherwise shown on the plans, the Engineer will determine roadway density of completed sections in accordance with TxDOT Test Method Tex-115-E. The Engineer may accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

2. When the material fails to meet the density requirements, or should the material lose the required stability, density or finish before the next course is placed, or the project is accepted, it shall be reworked as specified below.

F. Reworking a Section:
   1. When a section is reworked within 72 hours after completion of compaction, the Contractor shall rework the section to provide the required compaction.
   2. When a section is reworked more than 72 hours after completion of compaction, the Contractor shall add 25 percent of the specified rate of lime.
   3. Reworking shall include loosening, road mixing as approved by the Engineer, compacting, and finishing.
   4. When a section is reworked, a new optimum density will be determined from the reworked material in accordance with TXDOT Test Method Tex-121-E, Part II and shall compact in-place to a minimum of 95 percent of this density.
   5. Do not surface patch.

G. Finishing:
   1. Site mix subsoil, backfill and compact. Blend treated subsoil mix to achieve mix formulation and required stabilization.
   2. Place mix material in continuous layers not exceeding 12 inches depth unless otherwise indicated in drawings. Maintain optimum moisture content of mix materials to attain required stabilization.
   3. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise.
   4. Shape to required line, grade, and cross section.
   5. Make grade changes gradual. Blend slope into level areas.
   6. Immediately after completing compaction, clip, skin, or tight-blade the surface of the lime treated material with a maintainer or subgrade trimmer to a depth of approximately 1/4-inch.
   7. Remove loosened material and dispose of it at an approved location.
   8. Roll the clipped surface immediately with a pneumatic-tire roller until a smooth surface is attained.
   9. Add small increments of water as needed during rolling.
   10. Shape and maintain the course and surface in conformity with the typical sections, lines and grades shown on the plans or as directed.
   11. At end of day, terminate completed Work by forming a straight and vertical construction joint.
   12. Replace damaged fill with new mix to full depth of original mix.
   13. Remove surplus mix materials from site.

3.04 CURING

A. After the final layer or course of the lime treated material has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections.

B. The completed section shall then be finished by rolling with a pneumatic tire or other suitable roller.
   1. The completed section shall be moist cured or prevented from drying by addition of an asphalt material at the rate of 0.05 to 0.20 gallons per square yard.
   2. Curing shall continue for 2 to 5 days before further courses are added or traffic is permitted, unless otherwise approved by the Engineer.

C. The lime treated material may be covered by other courses, the day following finishing, when approved by the Engineer. When the plans provide for the treated material to be covered by other courses of material, the next course shall be applied within 14 calendar days after final compaction is completed, unless otherwise approved by the Engineer.

3.05 TOLERANCES

A. Top Surface of Fill: Plus or minus 0.1 inch from required elevations.

3.06 FIELD QUALITY CONTROL

A. Compression test and analysis of hardened fill material will be performed in accordance with ASTM D 698.

B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

C. Frequency of Tests: As determined by construction materials testing firm.

END OF SECTION 31 3213.19

RIPRAP

PART 1 GENERAL

1.01 Section Includes

A. Riprap rock.

B. Cement sacks.

1.02 Related Requirements

A. Section 31 2323 - Fill.

1.03 Price and Payment Procedures

A. Riprap: By the square yard of riprap area; summing the areas of individual layers, of riprap sacks. Includes supply and placing riprap mix in sacks, moist cured.

1.04 Quality Assurance

A. Perform Work in accordance with Texas Department of Transportation.

B. Maintain one copy of each document on site.

PART 2 PRODUCTS

2.01 GENERAL RIPRAP

A. Riprap: Provide in accordance with State of Texas Highways standards standards.

B. Riprap: Limestone type; broken stone or irregular shaped rock; solid and nonfriable; 4 inch minimum size, 12 inch maximum size, or as indicated on drawings.

C. Aggregate: Granular fill, see Section 31 2323.

D. Bags: Woven jute or geotextile fabric.

E. Binder: Portland cement.

F. Geotextile: Non-biodegradable, woven.

2.02 BAGGED RIPRAP

A. Mix riprap, cement, sand and aggregate dry. Limit quantity of cement to 10 percent of dry mixed materials by volume.

B. Fill bags with dry ingredients to 70 percent capacity and close by sewing or stapling to a straight seam.

PART 3 EXECUTION

3.01 Examination

A. Verify survey benchmarks and intended elevations for work are as indicated on plans.

B. Identify required lines, levels, contours, and datum locations.

C. Verify riprap areas are uncompromised with surface or groundwater.

D. Do not place riprap over frozen, wet or soft subgrade surfaces.

3.02 Preparation

A. Grade riprap areas to indicated elevations, allowing for riprap thickness. Remove organic materials and compact.

3.03 Placement

A. Place geotextile over substrate, lap edges and ends.

B. Place riprap at culvert pipe ends, embankment slopes, or as indicated on drawings.

C. Place bags into position. Knead, ram, or pack filled bags to fit with the contour of adjacent material and other bags previously placed.

D. Place bags in a staggered pattern. Remove foreign matter from bag surfaces.

E. After placement, spray with water to moisten the bagged mix. Maintain moist for 24 hours.

F. Installed Thickness: As indicated on drawings.

G. Place rock into position in an interlocking manner to preclude disturbance or displacement of substrate.

H. Place rock at location and depth indicated on drawings.

3.04 Bedding or Substrate Contact Installation

3.05 Geotextile or Bedding Contact Installation

3.06 SCHEDULES

A. Culvert Pipe Ends: Bagged, placed one layer thick, 6 inch average thickness, concealed with topsoil fill.

B. Sloped Grade At Retaining Wall: Individual riprap units, 6 inch thickness; placed prior to finish topsoil.

END OF SECTION 31 3700

AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aggregate base course.

B. Paving aggregates.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading.

B. Section 31 2323 - Fill.

C. Section 32 1250 - Site Pavement.

D. Project Geotechnical Report.

1.03 PRICE AND PAYMENT PROCEDURES

A. Coarse Aggregate: By the cubic yard. Includes supplying aggregate material, stockpiling, scarifying substrate surface, placing, and compacting.

B. Fine Aggregate: By the cubic yard. Includes supplying aggregate material, stockpiling, scarifying substrate surface, placing where required, and compacting.

1.04 REFERENCE STANDARDS

A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; 1965 (2004).

B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.

C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.

D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.

E. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.

F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.

G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.

H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.

I. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

J. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.

K. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

L. TxDOT TEX-113-E - Laboratory Compaction Characteristics and Moisture-Density Relationship of Base Materials.

1.05 SUBMITTALS

A. Samples: 10 lb sample of each type of aggregate; submit in air-tight containers to testing laboratory.

B. Materials Sources: Submit name of imported materials source.

C. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. Aggregate Storage, General:
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. Limestone, coarse, crushed rock meeting the requirements of 2004 TxDOT Item 247, Type A, Grade 1 or 2.

2.02 SOURCE QUALITY CONTROL

A. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.

B. If tests indicate materials do not meet specified requirements, change material and retest.

C. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

A. Spread aggregate over prepared substrate to a total compacted minimum thickness of 6 inches or as indicated on the drawings.

B. Under Bituminous Concrete Paving:
   1. Place coarse aggregate to a total compacted minimum thickness of 6 inches or as indicated on the drawings.
   2. Compact to 95 percent of maximum dry density as determined by ASTM D 1557 at a moisture content ranging from -2 to +3 percent of the optimum moisture content unless otherwise indicated on the geotechnical report.

C. Under Portland Cement Concrete Paving:

1. Place coarse aggregate to a total compacted minimum thickness of 6 inches or as indicated on the drawings.
2. Compact to 95 percent of maximum dry density as determined by ASTM D 1557 at a moisture content ranging from -2 to +3 percent of the optimum moisture content unless otherwise indicated on the geotechnical report.

D. Roller compact to specified density.

E. Level and contour surfaces to elevations and gradients indicated.

F. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

G. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

H. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

C. Variation From Design Elevation: Within 1/4 inch.

3.05 FIELD QUALITY CONTROL

A. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.

B. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with AASHTO T 180, ASTM D698 ("standard Proctor"), or ASTM D1557 ("modified Proctor").

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Tests: To be determined by the Owner's Construction Materials Testing Contractors.

E. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade, pavers, and paving.

3.06 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION 32 1123

ASPHALT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aggregate base course.

B. Single course bituminous concrete paving.

C. Double course bituminous concrete paving.

D. Surface sealer.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Preparation of site for paving and base.

B. Section 31 2323 - Fill: Compacted subgrade for paving.

C. Section 32 1123 - Aggregate Base Courses:

1.03 QUALITY ASSURANCE

A. Perform Work in accordance with State of Texas Highways standard.

B. Mixing Plant: Complying with State of Texas Highways standard.

C. Obtain materials from same source throughout.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate for Base Course: In accordance with State of Texas Highways standards.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

A. Asphalt Base Course: 3.0 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.

PART 3 EXECUTION

3.01 AGGREGATE BASE COURSE

A. Place and compact aggregate base course.

3.02 PLACING ASPHALT PAVEMENT - SINGLE COURSE

A. Install Work in accordance with State of Texas Highways standards.

B. Place asphalt within 24 hours of applying primer or tack coat.

C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

D. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.03 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

A. Place asphalt binder course within 24 hours of applying primer or tack coat.

B. Place asphalt wearing course within two hours of placing and compacting binder course.

C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

D. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.04 SEAL COAT

A. Apply seal coat to asphalt surface course and asphalt curbs in accordance with AI MS-19.

END OF SECTION 32 1216

SITE PAVEMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope
   1. Contractor shall furnish all labor, materials, equipment and incidentals required to provide hot mix-hot laid bituminous paving, as shown and specified for roadways.
   2. The work includes the following:
      a. Lime Stabilized Subbase
      b. Flexible Base
      c. Cement Stabilized Base
      d. Asphalt Stabilized Base
      e. Surface Treatments
      f. Hot Mix Asphaltic Concrete
      g. Portland Cement Concrete Pavement
      h. Testing As Specified

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading.

B. Section 31 2316 - Excavation.

C. Section 31 2323 – Fill.

D. Section 32 1123 – Aggregate Base Course.

1.03 QUALITY ASSURANCE

A. Testing Services
   1. General: Testing of materials and of compaction requirements for compliance with technical requirements of the Specifications shall be the duty of a testing laboratory as provided for by the specifications for this Project.
   2. Testing Services:
      a. The testing laboratory shall:
         1) Test the Contractor's proposed materials in the laboratory and field for compliance with the Specifications.
         2) Perform field density tests to assure that the specified compaction of surface and base course materials has been obtained.
         3) Report all test results to the Engineer and the Contractor.
         4) Perform concrete testing in accordance with the Project specifications.
   3. Authority and Duties of Testing Laboratory:
      a. Technicians representing the testing laboratory shall inspect the materials in the field and perform compaction tests, and shall report their findings to the Engineer and the Contractor. When the materials furnished or work performed by the Contractor fails to fulfill Specifications requirements, the technician will direct the attention of the Engineer and the Contractor to such failure.
      b. The technician shall not act as foreman or perform other duties for the Contractor. Work will be checked as it progresses, but failure to detect any defective work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Engineer for final acceptance. Technicians are

not authorized to revoke, alter, relax, enlarge, or release any requirements of the Specifications, nor to approve or accept any portion of the Work.

4. Responsibilities and Duties of Contractor:
    a. The use of testing services shall in no way relieves the Contractor of his responsibility to furnish materials and construction in full compliance with the Drawings and Specifications. To facilitate testing services, the Contractor shall:
        1) Secure and deliver to the Testing Laboratory, representative samples of the materials he proposes to use and which are required to be tested.
        2) Furnish such casual labor as is necessary to obtain and handle samples at the project or at other sources of material.
        3) Advise the testing laboratory and Engineer sufficiently in advance of operations (24 hrs. minimum) to allow for completion of quality tests and for the assignment of personnel.

B. Referenced Standards
    1. Comply with the applicable provisions and recommendations of the following, unless otherwise shown or specified.
        a. Texas Department of Transportation 2004, Standard Specification for Construction and Maintenance of Highways, Streets and Bridges.
        b. Standard Specifications for Public Works Construction, City of San Antonio, Texas.
        c. TxDOT TEX-113E - Laboratory Compaction Characteristics and Moisture-Density Relationship of Base Materials; 2010.

1.04 SUBMITTALS

A. Certificates: Submit certificates of compliance with these specifications for the following materials:
    1. Lime.
    2. Flexible Base.
    3. Asphalt Stabilized Base.
    4. Cement.
    5. Curing Seal Coat.
    6. Tack Coat.
    7. Hot Mix Asphaltic Concrete.
    8. Aggregates for Surface Treatments.
    9. Reinforcing Steel.

B. Shop Drawings
    1. Submit the following:
        a. Detailed reinforcing steel layout.
        b. Detailed construction and control joint layout.

C. Laboratory Test Reports
    1. Submit copies of laboratory test reports for optimum lime content for subgrade stabilization, and mix designs for Hot Mix Asphaltic Concrete and Portland Cement Concrete.

D. All paving and base course materials shall be tested and approved prior to delivery to the site. Samples of materials proposed for use as pavement and base course should be submitted by the Contractor to the Testing Laboratory for testing. Samples of materials shall be submitted at least 14 days in advance of its use.

PART 2 PRODUCTS

2.01 MATERIALS

A. The source of materials shall be acceptable to the Engineer. Materials shall conform to the following:
   1. Flexible Base
      a. Base material shall be crushed or uncrushed as necessary to meet the requirements hereinafter specified, and shall consist of durable stone or gravel, crushed and/or screened to the required particle size, with or without other approved fine sized materials. The material shall be from approved sources.
         1) Testing of flexible base material shall be in accordance with the following standard laboratory test procedures:
            (a) Preparation of Soil
            (b) Constants and Sieve Analysis: TxDOT TEX-110-E
            (c) Liquid Limit: TxDOT TEX-104-E
            (d) Plastic Limit: TxDOT TEX-105-E
            (e) Plasticity Index: TxDOT TEX-106-E
            (f) Linear Shrinkage: TxDOT TEX-107-E
            (g) Sieve Analysis: TxDOT TEX-110-E
            (h) Wet Ball Mill: TxDOT TEX-116-E
            (i) Los Angeles Abrasion: ASTM C 131 (Grad. A)
         2) Samples for testing the material shall be taken prior to compaction operations.
         3) The material shall be well graded and when properly tested shall meet the following requirements of Texas Department of Transportation Specifications for Type A Grade 2 Flexible Base:
            (a) Retained on 2½ inch sieve: 0%
            (b) Retained on 1¾ inch sieve: 0-10%
            (c) Retained on No. 4 sieve: 45-75%
            (d) Retained on 40 mesh sieve: 60-85%
         4) The material passing the 40 mesh sieve shall be known as "Soil Binder" and shall meet the following requirements:
            (a) The liquid limit shall not exceed 40.
            (b) The plasticity index shall not exceed 12.
            (c) The linear shrinkage shall not exceed 10.

            (Note: The linear shrinkage shall be calculated from the volumetric shrinkage at the liquid limit.)
         5) The crushed stone or crushed gravel shall have an abrasion of no more than 40 when subjected to the Los Angeles Abrasion Test.
   2. Asphalt Treated Base
      a. This item shall consist of a compacted mixture of mineral aggregate and asphaltic material mixed hot in a mixing plant. The asphalt stabilized base shall be constructed on an approved subgrade, as herein specified and in accordance with details shown on the plans. Unless otherwise specified in this Section, all asphalt stabilized base materials shall conform to TxDOT, Item 292 "Asphalt Treatment (Plant Mixed)".
         1) Mineral Aggregate:

(a) Description: The material shall be crushed or uncrushed and shall be screened as necessary to meet the requirements hereinafter specified and shall consist of durable aggregate particles. Unless otherwise specified on the plans, one or more mineral aggregates may be used to produce the specified mixture.

(b) Grades: The grading of the mineral aggregate shall conform to the limitations as shown below:

GRADE 1:

Sieve	Percent Retained
1-1/2 inches	0%
1 inch	0-10%
3/8 inch	30-55%
No. 4	45-70%
No. 40	70-85%

(c) Tests:

(1) Unless otherwise specified on the plans, the mineral aggregate for Grade 1 shall meet the following physical requirements:
Los Angeles Abrasion: 50 Max.*
Plasticity Index: 10 Max.
Liquid Limit: 40 Max.
Decantation: 5% Max.
Crushed Faces: 60% Max.
Sand equivalent value shall not be less than 40.
*Wet Ball Mill may be used in lieu of Los Angeles Abrasion when shown on the plans. A maximum Wet Ball Mill value of 50 is allowed.

(2) Testing of the mineral aggregates shall be as required and in accordance with the following Texas Department of Transportation Standard Test Methods:
Preparation of Soil
Constants and Sieve Analysis: TEX-110-E
Liquid Limit: TEX-104-E
Plastic Limit: TEX-105-E
Plasticity Index: TEX-106-E
Sieve Analysis: TEX-110-E
Wet Ball Mill: TEX-116-E
Los Angeles Abrasion: TEX-410-A
Sand Equivalent: TEX-203-F
Decantation: TEX-406-A
Crushed Faces: TEX-460-A

(3) Samples for testing the material shall be taken prior to the mixing operations. Where more than one material is used, tests will be on the combined material unless otherwise shown on the plans.

(d) Additives:

(1) Additives to facilitate mixing and/or improve the quality of the asphaltic mixture shall be used when noted on the plans or may be used upon written authorization by the Engineer.

(e) Material Sources:

(1) All materials shall be obtained from sources reviewed by the Engineer.

(2) The mineral aggregate sources shall be opened up in such manner as to immediately expose the vertical faces of all the various strata of acceptable material and, unless otherwise directed by the Engineer, the material shall be secured in successive vertical cuts extending through all the exposed strata in order that a uniformly mixed material will be secured.

(3) Unless otherwise shown on the plans, one or more types of mineral aggregate or binder may be used to produce the specified mixture.

(4) Recycled Materials, including reclaimed asphalt concrete pavement (RAP), are allowed when shown on plans and are to be in accordance with Item 292 of the Texas Department of Transportation Standard Specifications. Stockpile aggregates for each source and type separately. Do not add material to an approved stockpile unless approved by the Engineer.

2) Asphaltic Material:

(a) Asphaltic material shall be of the type determined by the Engineer and shall meet the requirements of Item No. 300, "Asphalt, Oils and Emulsions" of the Texas Department of Transportation Standard Specifications. The grade of asphalt shall be PG 70-22 unless otherwise designated on the plans. When RAP is allowed by plan note, use no more than 30% RAP in TxDOT Type A or B HMA, and use no more than 20% RAP for TxDOT Type C or D unless otherwise shown on the plans.

3) Asphaltic Stabilized Mixture:

(a) Paving Mixture:

(1) The mixture shall consist of a uniform mixture of mineral aggregate and asphaltic material. The mineral aggregate will conform to the gradation requirements specified. The asphaltic material shall form from 4.0 to 9.0 percent of the mixture by weight unless otherwise shown on the plans. The design percent asphalt shall be determined in accordance with Test Method TEX-126-E or Test Method TEX-204F and procedures outlined in the TxDOT Bulletin C-14. The required method of control along with any required strength, laboratory density shall be specified on the plans. The percent asphalt in the mix shall be determined by either Extraction, Test Method TEX-210-F, or Pressure Pycnometer, Test Method TEX-126-E.

(b) Tolerances:

(1) The Engineer will designate the asphalt content to be used in the mixture after design tests have been made with the aggregate to be used in the project. When tested as determined by the Engineer, samples of the mixture shall not vary from the asphalt content

designated by the Engineer by more than 0.5 percent dry weight (based on total mixture).

3. Water
   a. Water shall be free from substances deleterious to the hardening of the treated base and shall be reviewed by the Engineer.
4. Cement for Stabilized Base
   a. Cement shall be Type 1 Portland Cement of a standard brand and shall conform to the requirements of ASTM Designation C-150.
      1) One bag, containing one (1) cubic foot of cement shall be considered as weighing 94 pounds net. One (1) barrel of cement shall be considered as weighing 376 pounds net, and containing four (4) cubic feet.
      2) Contractors, as their option, may use bulk cement, provided the apparatus for handling and spreading the cement is reviewed by the Engineer. Bulk cement shall be weighed on platform scales or standard plant batch weighing equipment reviewed by the Engineer.
      3) Cement delivered in bags shall be plainly marked with the brand name of the manufacturer. All bags shall be in good condition at the time of delivery. Cement salvaged from discharge or used bags shall not be permitted.
5. Asphalt Oils and Emulsions
   a. RC-250 Liquid Asphalt and SS-1/SS-1H Emulsion used as a seal shall meet the requirements set forth in Item 300 "Asphalts, Oils and Emulsions," of the Texas Department of Transportation Standard Specifications.
   b. Where Emulsified Asphalts are used, the amount of emulsified asphalt as a percentage by volume of the total mixture shall be within the limits shown on the plans, or shall be of a percentage as directed by the Engineer.
      1) Prime Coat:
         (a) Unless the type and grade are shown on the plans, utilize an MC-30 or AE-P asphalt cement in accordance with Item 300, "Asphalts, Oils and Emulsions" of the Standard Specifications of the Texas Department of Transportation for prime coat. Emulsified asphalts as a percentage by volume of the total mixture shall be used within the limits shown on the plans or as directed/approved by the Engineer.
      2) Tack Coat:
         (a) The asphaltic material used for Tack Coat shall meet the requirements for "Asphalt Cement", "Cut-Back Asphalt", or "Emulsified Asphalt", in Item No. 300 "Asphalts, Oils and Emulsions," of the Texas Department of Transportation Standard Specifications. The asphaltic material used for Tack Coat shall be that type or grade shown on the plans, or shall be as directed, or approved by the Engineer.
      3) Asphaltic Materials for Surface Treatments:
         (a) The asphaltic material used for surface treatments shall meet the requirements for "Asphaltic Cement" in Item No. 300 "Asphalts, Oils and Emulsions" of the Texas Department of Transportation Standard Specifications. The asphaltic material used shall be AC-10 or equal, or shall be as approved by the Engineer.
6. Aggregates for Surface Treatments

a. Aggregates shall meet all the requirements of Item No. 302, "Aggregates for Surface Treatments" of the Texas Department of Transportation Standard Specifications and subsequent revisions thereto.
b. The percent of wear, as determined by Test Method TEX-410-A for the material shall not exceed 15 percent. The aggregate shall be Grade 3, in accordance with the following gradation requirements when tested by Test Method TEX-200.
    1) Retained on 3/4" sieve: 0%
    2) Retained on 5/8" sieve: 0-2%
    3) Retained on 1/2" sieve: 5-20%
    4) Retained on 3/8" sieve: --
    5) Retained on No. 4 sieve: 90-100%
    6) Retained on No. 10 sieve: 98-100%

7. Hot Mix Asphaltic Concrete
    a. Materials used in Hot Mix Asphaltic Concrete Pavement shall meet the requirements as set forth in Item 340, "Dense-Graded Hot Mix Asphalt (Method)" or Item 341, "Dense-Graded Hot Mix Asphalt (QC/QA)" of the Texas Department of Transportation Standard Specifications.
    b. Paving Mixture used shall be Type D. This mixture shall conform to the requirements of Paragraph 4 of Item 340, "Dense-Graded Hot Mix Asphalt (Method)" of the Texas Department of Transportation Standard Specifications.
        1) Part (1) of Paragraph 4 shall be revised as follows, and no other requirements are waived or changed hereby.
            (a) Density
                (1) Minimum: 94%
                (2) Maximum: 99%
                (3) Optimum: 97%

8. Lime for Stabilized Subgrade
    a. Lime for this item shall conform to the requirements of TxDOT Item No. 260, "Lime-Treatment - Road Mixed" of the TxDOT Standard Specifications (Latest Edition). Acceptable forms of lime shall be:
        1) "Type A, Hydrated Lime"
        2) "Type B, Commercial Lime Slurry"
        3) "Type C, Quicklime"
    b. The Contractor shall select, prior to construction, the grade to be used and shall notify the Engineer in writing before changing from one grade to another. Lime shall be placed in slurry form only, unless written permission is granted by the Engineer and a safety and containment plan is submitted to the Engineer by the Contractor seven days prior to use. In circumstances where it would be beneficial to utilize lime for "drying" subgrade materials to expedite construction, the Contractor may request approval from the Engineer to use pelletized lime.
    c. Materials are too be provided in conformance with the following items and requirements:
        1) Lime: TxDOT DMS-6350 "Lime and Lime Slurry"
        2) Mix Design: The Engineer will determine the target lime content and optimum moisture content in accordance with TxDOT TEX-121-E.
        3) When treating existing materials, limit the amount of asphalt concrete pavement to no more than 50% of the mix.

9. Forms
    a. Formwork shall conform to the provisions of TxDOT Item 360 "Concrete Pavement". Forms shall be constructed of wood or steel, profiled to suit condition.
10. Concrete Pavement
    a. Concrete and concrete materials shall conform to the provisions of the TxDOT Standard Specifications Item 360, "Concrete Pavement", unless otherwise stated in this specification.
        1) Coarse aggregate will conform to the gradation requirements of Aggregate Grade No. 2.
        2) Fine aggregates will conform to the gradation requirements of Aggregate Grade No. 1.
        3) Portland Cement shall be Type I.
    b. Air content shall be 4% ± 1%.
    c. Slump shall range from 2 to 5 inches.
    d. Provide concrete design per Geotechnical Report. If not specified, provide Class P concrete designed to meet a minimum average compressive strength of 4,000 psi at 28-days (75% strength at 7 days). Test in accordance with TxDOT TEX-448-A or TxDOT TEX-418-A.
    e. For concrete curbs that are placed separately from the pavement, refer to specification Section 32 1313.10 (use Class A or P concrete for curbs that are placed separately from the pavement).
11. Steel Expansion Joint Dowels
    a. Dowel bars shall be round smooth steel conforming to ASTM A 36, Grade 60. Coat dowels with an approved de-bonding material.
12. Reinforcing Steel
    a. Reinforcing steel bars shall conform to TxDOT Item 440, "Reinforcing Steel", ASTM A 615 Grade 60, deformed bars. All reinforcing steel shall be new billet steel.

2.02 CUTTING AND REPLACING PAVEMENTS

A. All materials used for cutting and replacing pavements shall conform to the requirements of this section.

PART 3 EXECUTION

3.01 GENERAL

A. The drives and parking areas shall be constructed to the lines, and typical section shown on the drawings.

3.02 SUBGRADE PREPARATION

A. Preparation of the subgrade including compaction shall be completed for the full width of the roadways and parking areas, or as shown on plans.
    1. The subgrade shall be compacted to at least 95 percent (95%) of maximum density between optimum moisture content and optimum moisture content +4% as determined by TxDOT TEX-114-E.

B. No materials shall be placed on subgrades which are muddy or have water thereon.

3.03 CONSTRUCTION OF HOT MIX ASPHALTIC CONCRETE ROADWAYS, AND PARKING AREAS

A. General

1. The roadways, and parking areas shall be constructed to the lines, grades, and typical section shown on the Drawings.
2. Conform to all applicable requirements of the Texas Department of Transportation Standard Specifications.

B. Flexible Base Course
   1. Equipment:
      a. All equipment necessary to properly perform and complete the work shall be on the project prior to beginning the work, shall be subject to the review of the Engineer, and shall be maintained in a satisfactory condition at all times.
         1) Motor graders shall be self-propelled, shall have tandem or four-wheel drive, shall have a blade length of not less than 12 feet, shall have a wheel base length (the distance between front and rear axles) of not less than 16 feet, and shall be tight and in good operating condition and reviewed by the Engineer.
         2) Compaction equipment shall be of sufficient weight and adequately loaded to accomplish the required compaction.
         3) Water distributors shall be equipped with positive and rapidly working cut-off valves, approved spray bars equipped with bituminous nozzles and a power pump that will insure distribution of water in a uniform and controllable rate of application. Spray bars shall be so constructed that the effective length may be quickly and easily altered.
         4) All equipment shall meet these specifications and be reviewed by the Engineer. Equipment may be eliminated or substituted only upon review of the Engineer.
         5) Nothing in this section shall relieve the Contractor of his responsibility for producing finished work of the quality specified.
   2. Construction Methods:
      a. General:
         1) It is the intent of this specification to obtain a complete course, or courses, of Flexible Base of uniform moisture and density, with a closely-knit surface free from laminations, cracks, ridges, or loose material, and to the surface requirements hereinafter specified.
      b. Placing of Flexible Base Material:
         1) The Flexible Base material shall be placed on the approved subgrade in courses not to exceed six inches (6") compacted depth. It shall be the responsibility of the Contractor that the required amount of material be delivered and uniformly spread and shaped. All material shall be moved from the place where it is dumped by cutting into windrows. After the material has been cut into windrows, it shall be sprinkled, spread, shaped, and rolled in proper sequence to prevent segregation, and as necessary for required compaction.
      c. Compaction and Finishing:
         1) Flexible Base shall be compacted to an apparent dry density of not less than 95 percent of the maximum dry density, as determined in accordance with TxDOT Test Method TEX-113-E. Tests for density will be made within 24 hours after compaction operations are completed. If the material fails to meet the density specified, it shall be reworked as necessary to meet the density required. Just prior to the placing of any succeeding course of Flexible Base, surfacing on any previously completed course, the density and moisture of the top three inches

(3") of Flexible Base shall be checked and if tests show the density to be more than 2 percent below the specified minimum, or the moisture content to be more than 3 percent above or below the optimum, the course shall be reworked as necessary to obtain the specified compaction and moisture content.

2) The surface upon completion shall be smooth and in conformity with the typical sections and to the established lines and grades. Any deviation in excess of 1/4 inch in cross-section and in length of 16 feet measured longitudinally, shall be corrected. All irregularities, depressions, or weak spots which develop shall be corrected.

C. Asphalt Stabilized Base Course

1. Equipment:
   a. All equipment for the handling of all materials and mixing and placing of the mixture shall be maintained in good repair and operating condition and subject to review by the Engineer. Any equipment found to be defective and affecting the quality of the mixture will be replaced.
   b. Mixing Plants:
      1) Mixing plants that will not consistently produce a paving mixture meeting all the requirements of this specification will be condemned. Mixing plants may be of the weight-batching type, the continuous mixing type or the dryer-drum type meeting all the requirements of Item 345, "Asphalt Stabilized Base (Plant Mix)" of the Texas Department of Transportation Standard Specifications and subsequent revisions and Special Provisions thereto.
   c. Asphalt Material Heating Equipment:
      1) Asphalt material heating equipment shall conform to Paragraph 345.4 of Item 345, "Asphalt Stabilized Base (Plant Mix)" of the Texas Department of Transportation Standard Specifications and subsequent revisions and Special Provisions thereto.
   d. Spreading and Finishing Machine:
      1) The spreading and finishing machine shall be of a type reviewed by the Engineer and shall be capable of producing a surface that will be smooth and true to the established line, grade and cross-section and acceptable to the Engineer. Unacceptable finish shall be corrected by the addition of mixture placed and finished at the entire expense of the Contractor.
2. Construction Methods:
   a. It shall be the responsibility of the Contractor to produce transport, place and compact the specified mixture in accordance with these specifications and as reviewed by the Engineer.
   b. The asphaltic mixture, when placed with a spreading and finishing machine shall not be placed when the air temperature is below 50°F, and is falling, but it may be placed when the air temperature is above 40°F and is rising. The mixture when placed with a motor grader shall not be placed when the air temperature is below 60°F, and is falling, but may be placed when the air temperature is above 50°F and is rising. The air temperature shall be taken in the shade away from artificial heat. It is further provided that the prime coat, tack coat or asphalt stabilized base shall be placed only when the humidity, general weather conditions and temperature and

moisture conditions of the subbase or subgrade, in the opinion of the Engineer are suitable.

c. If, after being discharged from the mixer and prior to placing, the temperature of the asphaltic mixture is 50°F or more below the temperature reviewed by the Engineer all or any part of the load may be rejected and payment will not be made for the rejected material.

1) Prime Coat:
   (a) If a prime coat is required it shall be applied and paid for as a separate item conforming to the requirements of Texas Department of Transportation Item 300 "Prime Coat", except the air temperature for application shall be as provided above for asphaltic mixture to be laid by a spreading and finishing machine. The tack coat or asphalt stabilized base shall not be applied on a previously primed course until the prime coat has completely cured to the satisfaction of the Engineer.
2) Tack Coat:
   (a) Before the asphaltic mixture is laid, the surface upon which the tack coat is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer. The surface shall be given a uniform application of tack coat using asphaltic materials of this specification. This tack coat shall be applied, as directed by the Engineer, with an approved sprayer at a rate not to exceed 0.10 gallon per square yard of surface. Where the mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform coat of the asphaltic material meeting the requirements for a tack coat. The tack coat shall be rolled with a pneumatic tire roller when directed by the Engineer.
3) Transporting:
   (a) The asphaltic mixture, prepared as specified above shall be hauled to the site in tight vehicles previously cleaned of all foreign material. The dispatching of the vehicles shall be arranged so that all material delivered may be placed, and all rolling shall be completed during daylight hours. The inside of the truck body may be given a light coat of oil, lime slurry or other material satisfactory to the Engineer, if necessary, to prevent mixture from adhering to the body. In cool weather or for long hauls, canvas covers and insulating of truck bodies may be required.
4) Placing:
   (a) Generally, the asphaltic mixture shall be dumped and spread on the approved prepared surface with the specified spreading and finishing machine, in such a manner that when properly compacted, the finished course will be smooth, of uniform density, and will conform with the typical sections shown on the plans and to the lines and grades established by the Engineer. During the application of asphaltic material, care shall be taken to prevent splattering of adjacent pavement, curb and gutter and structures. Any unsightly splattering of surroundings shall be clean and restored to original condition at the sole cost of the Contractor.

(b) The mixture shall be spread and compacted in layers or lifts as specified on the plans or as directed by the Engineer. The sequence of compacting shall be such that undue displacement of the edge of the course does not occur. On deep lifts, the edge of the course may be rolled with a motor grader wheel or similar equipment or supported by blading a roll of earth against the edge of the course prior to compacting the surface.

(c) When the asphaltic mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement or placed in small irregular areas when the use of a finishing machine is not practical, the finishing machine may be eliminated when authorized by the Engineer, provided a satisfactory surface can be obtained by other acceptable methods.

5) Compacting:

(a) As directed by the Engineer the asphalt stabilized base shall be compacted thoroughly and uniformly with the specified rollers. In lieu of the rolling equipment specified, the Contractor may, upon written authorization from the Engineer, operate other compacting equipment that will provide equivalent relative compaction as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction as would be expected of the specified equipment, as determined by the Engineer, its use shall be discontinued. When directed by the Engineer, the initial compaction shall be accomplished with the pneumatic tire roller.

(b) When rolling with the three-wheel, tandem, or vibratory rollers, rolling shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the rear wheel unless otherwise directed by the Engineer. Alternate trips of the roller shall be slightly different in length. When roller with vibratory steel-wheel rollers, the manufacturer's recommendation shall be followed unless directed otherwise by the Engineer. Rolling with pneumatic-tire roller shall be done as directed by the Engineer. Roller shall be continued until no further increase in density can be obtained and all roller marks are eliminated. The motion of the roller shall be slow enough at all times to avoid displacement of the mixture. If any displacement occurs, it shall be corrected at once by the use of a rake, and of fresh mixtures where required. The roller shall not be allowed to stand on any portion of the mixture pavement which has not been fully compacted. To prevent adhesion of the mixture to the roller, the wheels shall be kept thoroughly moistened with water, but an excess of water will not be permitted. All rollers must be in good mechanical condition. Necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease or other foreign matter on the roadway, either when the rollers are in operation or when standing.

(c) Hand Tamping:

(1) The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller, or in such

positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

(d) Surface Finish:

(1) The compacted material shall conform to the typical cross sections, lines and grades as shown on plans and directed by the Engineer and shall have a surface smoothness as specified below and with a reasonably uniform texture acceptable to the Engineer. Unacceptable finished surfaces may be corrected by the placement of additional mixture, all at the expense of the Contractor.

(e) Surface Smoothness:

(1) Test finished surface of each bituminous concrete course for smoothness, using a 10-foot straightedge applied parallel to and at right angles to centerline of paved areas.

(2) Check surfaced areas at intervals as directed by Engineer.

(3) Surfaces will not be acceptable if exceeding the following:
Sub-base Courses: 3/8 inch in 10 feet
Surface Course: ¼ inch in 10 feet
Crowned Surfaces:
Test crowned surfaces with a crown template, centered and at right angle to the crown.
Surfaces will not be acceptable if varying more than ¼" from the template.
Protection of the Work and Opening to Traffic:

(4) The completed asphalt stabilized base course shall be opened to traffic as provided by the plans and as directed by the Engineer. All construction traffic allowed on the base course shall comply with the State laws governing traffic, unless otherwise authorized by the Engineer. When another roadway surface is provided for the traveling public and construction traffic through the project, the Engineer may prohibit traffic on the completed base course.

3. In Place Density:

a. When in-place density is required, it is the intent of this specification that the material be placed and compacted to 96 percent of the maximum molded gyrated density as determined by Test Method TEX-126-E or as specified on the plans. The maximum molded gyrated density shall be determined from material sampled from the mixing plant and molded in accordance with Test Method TEX-126-E. Procedures and methods outlined in Test Method TEX-126-E shall also be used in determining the in-place density unless determined otherwise by the Engineer. The field specimens utilized for the in-place density testing may be either cores or sections of asphalt stabilized base tested according to Test Method TEX-207-F. Other methods of determining in-place density which correlate satisfactorily with those results obtained through use of Test Method TEX-126-E may be used. In-place density tests are intended for control tests. If the in-place density of the mixture produced has a value lower than that specified and, in the opinion of the Engineer is not due to a change in the quality of the material, production may proceed with subsequent changes in the mix and/or construction operations until the in-place density equals or exceeds the specified density. Requirements

specifying air temperature limitations for placing and types of rollers to be furnished are not applicable when in-place density is specified. Regardless of the method of compaction control followed, all rolling shall be completed before the mixture temperature drops below 175°F.

D. Cement Stabilized Base Course
   1. Equipment:
      a. All equipment necessary to properly perform and complete the work shall be on the project prior to beginning the work, shall be subject to the review of the Engineer, and shall be maintained in a satisfactory condition at all times.
      b. The following list of equipment shall be considered the minimum necessary for cement stabilized base work:
         1) A single pass traveling mixing plant may be used if it can be made to meet the exact requirements of this Specification.
         2) In lieu of a traveling mixing plant, the following equipment shall be used for the "Mixed-in-Place" method of processing:
            (a) 1-Motor Grader
            (b) 1-7-foot self-powered, self-propelled, heavy-duty rotary speed mixer.
      c. Motor graders shall be self-propelled, shall have tandem or four-wheel drive, shall have a blade length of not less than 12 feet, shall have a wheel base length (the distance between front and rear axles) of not less than 16 feet, and shall be tight and in good operation condition and reviewed by the Engineer.
      d. Cement shall be distributed by cement spreaders equipped with hoppers of adequate capacity to prevent spillage. The proportioning and distributing devices shall be positive in action and capable of necessary adjustments in quantity of cement spread and width of lane spread. The spreader shall be so designed that its accuracy is not varied by changing conditions of the surface over which it operates. The cement spreader shall distribute cement to an accuracy of five percent (5%) of theoretical quantity per square yard and shall be approved by the Engineer.
      e. Compaction equipment shall be of sufficient weight and adequately loaded to accomplish the required compaction.
      f. Water distributors shall be equipped with positive and rapidly working cut off valves, approved spray bars equipped with bituminous nozzles and a power pump that will insure distribution of water in a uniform and controllable rate of application. Spray bars shall be so constructed that the effective length may be quickly and easily altered.
      g. All equipment shall meet these specifications and be reviewed by the Engineer. Equipment may be eliminated or substituted only upon review by the Engineer.
      h. Nothing in this section shall relieve the Contractor of his responsibility for producing finished work of the quality specified.
   2. Test Section:
      a. If the Contractor has had no previous experience in construction of "Cement Stabilized Base", he shall be required to construct a "Test Section" in accordance with the following:
      b. The first section of each cement treated course shall serve as a test section. Its length (not less than 350 linear feet or more than 500 linear feet) shall be determined by the capability of the equipment to perform the work. In case it is found that the work is not satisfactory with respect to the specification

requirements, the Contractor shall revise his procedures and augment or replace equipment as necessary to assure work completed in accordance with the Specifications. Additional test sections may be required as directed by the Engineer. Test sections not conforming to the requirements of the Specifications shall be reconstructed.

3. Construction Methods:
   a. General:
      1) It is the intent of this specification to obtain a complete course or courses of cement stabilized base of uniform moisture and density, containing a uniform mixture of cement; a closely knit surface free from laminations, cracks, ridges, or loose material and to the surface requirements hereinafter specified. It shall be the responsibility of the Contractor to furnish adequate equipment and regulate his sequence of operation in such a manner as to provide a cement treated course or courses with the proper amount of cement for the depth as shown on the plans and to maintain or reconstruct the course or courses as necessary to conform to the specific requirements specified.
   b. Placing of Base Material:
      1) After approval of the subgrade, base material shall be delivered on the road and placed in windrows of uniform sections, then accurately bladed and shaped to required crown and grade to provide a base of compacted depth required by the plans.
   c. Final Preparation of Section:
      1) On the day immediately preceding processing, water, as required, shall be added and uniformly mixed full depth with the base material. This operation shall precede cement spreading by at least 12 hours. The section shall then be accurately bladed and shaped to required grade and section.
   d. Application of Cement:
      1) The specified quantity of Portland Cement required for the full depth of treatment shall be uniformly spread over the surface. Each pass of the cement spreader shall be positioned by either the curb line or a string line. Cement shall be applied only to such areas as can be completed as herein specified within the daylight hours of the same day. No equipment, except that used in spreading and mixing, will be allowed to pass over the freshly spread cement until it is mixed with the base material.
   e. Mixing and Processing:
      1) Either method (1) or (2) below may be used at the option of the Contractor. Method (3) shall be used only on sections less than 200 linear feet in length.
         (a) Multiple-Pass Traveling Mixing Plant:
            (1) After the cement has been applied, it shall be mixed with the base or subbase material. Mixing shall continue until the cement has been sufficiently blended with the base or subbase material to prevent the formation of cement balls when water is applied. Any mixture that has not been compacted and finished shall not remain undisturbed for more than 30 minutes.
            (2) Immediately after the mixing of base or subbase material and cement is completed, water, as necessary, shall be uniformly applied and incorporated into mixture. Proper care shall be exercised to insure

proper moisture distribution at all times. After the last increment of water has been added, mixing shall continue until a thorough and uniform mix has been obtained.

(b) Single-Pass Traveling Mixing Plant:

(1) After the cement has been applied, it shall be sufficiently mixed with the base or subbase material to prevent the formation of cement balls when water is applied. Unpulverized soil lumps in mixture will not be allowed. Should this condition prevail, the Contractor shall "pre-wet" the raw base or subbase material as necessary to correct this condition. The mixer shall be provided with means for visibly and accurately gauging the water application. The water shall be applied uniformly through a pressure spray bar. After cement is spread, mixing operations shall proceed as follows:

(2) The mixer shall, in one continuous operation, mix the base or subbase material and cement full depth, add the required moisture uniformly, thoroughly moist-mix the material, cement, and water, spread the completed mixture evenly over the machine processed width of the subgrade, and leave it in a loose condition ready for immediate compaction.

(3) The mixture shall not remain undisturbed, after mixing and before compacting, for more than 30 minutes.

(c) Blade Mixing:

(1) On sections of street of 200 linear feet or less and authorization by the Engineer, the requirements for mixing equipment may be waived and the cement mixed with a mortar grader.

(2) Immediately after the cement has been distributed, the material shall be scarified full depth and the cement mixed with the loose base material for the full depth of the treatment by blading into windrows. Mixing shall continue until the cement has been sufficiently blended with the base material to percent formation of cement balls when water is applied.

(3) Immediately after the mixing of base material and cement is complete, water as necessary shall be uniformly applied and incorporated into the mixture. Pressurized equipment and supply provided shall be adequate to insure continuous application of the required amount of water to the section being processed. Proper care shall be exercised to insure proper moisture distribution at all times. After the last increment of water has been added, mixing shall continue until thorough and uniform mix has been obtained.

f. Compaction and Finishing:

1) The material shall be compacted to not less than 95 percent of the maximum dry density as determined by TxDOT TEX-113-E. At the start of compaction, the percentage of moisture in the mixture shall be less than that quantity which will cause the mixture to become unstable during compaction and finishing.

2) The surface upon completion shall be smooth and in conformity with typical sections and to the established lines and grades. Any deviation in excess of ¼

inch in cross section and in a length of 16 feet measured longitudinally shall be corrected. All irregularities, depressions, or weak spots which develop shall be corrected.

3) All sections of cement stabilized base shall be processed full width each day without longitudinal construction joints.

4) The density of the cement stabilized base shall be determined by the Engineer after construction. Any portion which has a density below that specified herein and which has not properly hardened after a suitable time interval shall be removed and replaced to meet this Specification at the expense of the Contractor.

g. Protection and Cover:

1) The completed cement treated base course shall be protected against rapid drying by applying a minimum of 0.20 gallons per square yard of RC-2 Liquid Asphalt, or a minimum of 0.15 gallons per square yard of EA-11M Emulsion. The actual amounts may be varied in the field by the Engineer to insure that a complete and adequate seal is achieved.

2) This curing seal shall be applied as soon as practicable, but not later than eight (8) hours after the completion of final compaction. The surface shall be kept moist until the curing seal is applied. It shall be the responsibility of the Contractor to protect the asphalt membrane from being picked up by traffic by either sanding or dusting the surface.

3) The curing period shall be a minimum of 14 days (24 hours each) with a minimum temperature of 40°F unless waived by the Engineer.

h. Weather Limitations:

1) Cement stabilized base construction shall not begin unless the temperature is at least 40°F in the shade and rising or when the wind velocity exceeds 15 MPH. The Contractor is responsible for the quality of the base under any weather conditions.

i. Traffic:

1) The Contractor shall not be permitted to drive heavy equipment over completed portions, but pneumatic-tired equipment required for hauling cement and water may be permitted after the surface has hardened sufficiently to prevent the equipment from marring the surface, provided protection and cover specified herein are not impaired. The cement stabilized base may be opened to local traffic as soon as the RC-2 has been applied and dusted or sanded as necessary to prevent it from being picked up by traffic. It may be opened to all traffic after 7 days.

j. Maintenance:

1) The Contractor shall be required to maintain at his own expense the entire cement stabilized base within the limits of his contract in good condition satisfactory to the Engineer from the time he first starts work until all work shall have been completed.

2) Maintenance shall include immediate repairs of any defect that may occur after construction, which work shall be done by the Contractor at his own expense and repeated as often as necessary to keep the area continuously intact. Repairs are to be made in a manner to insure restoration of a uniform surface of good quality cement stabilized base. Faulty work shall be replaced

for the full depth of base. Any low area shall be remedied by replacing the material for the full depth of treatment, rather than adding a thin layer of base material to the completed work.

E. Prime Coat
   1. When the area and/or base is satisfactory to receive the prime coat, the surface shall be cleaned by sweeping or other acceptable methods. If necessary, the surface shall be lightly sprinkled with water just prior to application of the asphaltic material. The asphaltic material shall be applied on the clean surface by an acceptable type of self-propelled pressure distributor so operated as to distribute the prime coat at a rate not to exceed 0.20 gallon per square yard of surface, evenly and smoothly, under a pressure necessary for proper distribution. During the application of prime coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures.
   2. Prime Coat shall not be applied when the air temperature is below 60° F and falling, but it may be applied when the air temperature is above 50° F and is rising; the air temperature being taken in the shade away from artificial heat.
   3. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

F. Tack Coat
   1. Before the tack coat is applied, the surface shall be cleaned thoroughly. The asphaltic material shall be applied on the clean surface by an acceptable type of self-propelled pressure distributor so operated as to distribute the tack coat at a rate not to exceed 0.10 gallon per square yard of surface, evenly and smoothly under a pressure necessary for proper distribution. Where the pavement mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform coat of the asphaltic material used for tack coat. The tack coat shall be rolled with a pneumatic tire roller. During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures.

G. Hot Mix Asphaltic Concrete
   1. Construction methods used in laying Hot Mix Asphaltic Concrete Pavement shall meet the requirements as set forth in Item 340 "Hot Mix Asphaltic Concrete Pavement" of the Texas Department of Transportation Standard Specifications, with the following exception:
   2. Application of Hot Mix Asphaltic Concrete Pavement shall not begin unless the air temperature is at least sixty degrees Fahrenheit (60° F) and rising.

H. Surface Treatments
   1. The area to be treated shall be cleaned of dirt, dust, or other deleterious matter by sweeping or other approved methods. If it is found necessary by the Engineer the surface shall be lightly sprinkled just prior to the first application of asphaltic material.
   2. Asphaltic material shall be applied on the clean surface by an acceptable type of self-propelled distributor so operated as to distribute the material at the rate as shown on the plans, evenly and smoothly, under pressure necessary for proper distribution. The Contractor shall provide all necessary facilities for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for

determining the rate of which it is applied, and for securing uniformity at the junction of two distributor loads. The distributor shall have been recently calibrated. Asphaltic materials shall not be applied until immediate covering is assured.

3. Aggregate shall be immediately and uniformly applied and spread by an acceptable self-propelled continuous feed aggregate spreader, unless otherwise authorized by the Engineer. The aggregate shall be applied at a rate as directed by the Engineer.
4. The entire surface shall then be broomed or raked as required and shall be thoroughly rolled as soon as practicable after its application. The cover material shall be rolled for its entire width with a multiple wheel self-propelled pneumatic tired traffic roller with provisions for loading to 8 tons. Rolling shall begin longitudinally at the edges of the mat and progress toward the center, uniformly lapping each preceding track by at least 1/2 the width of the roller and be repeated as often as necessary to thoroughly key the cover material into the bitumen over the entire surface. The roller shall be in first class operating condition.
5. Surface treatment or treatments shall not be applied when the air temperature is below 60°F and is falling, but is may be applied when the air temperature is above 50°F and is rising. Air temperature shall be taken in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.
6. The Contractor shall be responsible for the maintenance of the surface until the work is acceptable to the Engineer.

I. Construction Joints

1. Construction joints shall be made in such a manner as to ensure a neat junction, thorough compaction, and bond throughout.
2. A transverse joint extending over the full width of the strip being laid and at right angles to its centerline shall be constructed at the end of each day's work and at any other times when the operations of placing the hot mixture are suspended for a period of time which will permit the mixture to chill. The forward end of a freshly laid strip shall be thoroughly compacted by rolling before the mixture has become chilled. When work is resumed, the end shall be cut vertically for the full depth of the layer.
3. When new pavement is to join pavement installed by others or previously laid pavement by the Contractor, the in-place pavement shall be neatly and carefully edged to allow for overlapping and feathering of the new surface course material. A tack coat of bituminous prime coat material shall be placed at the interface of new and previously laid material.

J. Traffic Maintenance

1. The pavement shall be opened to traffic when directed by the Engineer. Construction traffic on the pavement shall be held to a minimum and shall be acceptable to the Engineer. Adequate protection methods as reviewed by the Engineer shall be utilized when crossing roadways is required.

K. Field Quality Control

1. Contractor will employ a testing laboratory to perform field quality control. The testing laboratory will make compaction testing of flexible base. The testing laboratory will test the HMAC for Asphalt Extraction, Gradation, Bitumen Content, Stability and laboratory density. Contractor shall furnish all necessary assistance required by the testing laboratory. Contractor shall also furnish all labor, materials and equipment necessary

for sampling. Contractor shall furnish all necessary transportation to the Owner's Testing Laboratory required by the testing.

2. Quality Control Testing During Construction:
    a. The testing laboratory will perform sampling and testing for field quality control during the placement of materials as follows:
        1) HMAC shall be tested as described in these Specifications, at least once for every 500 tons of materials placed or fraction thereof.
        2) Density:
            (a) Compare density of in-place material against laboratory specimen or certificated on same for bituminous concrete mixture.
            (b) Acceptable densities of in-place materials shall conform to applicable State Standard Requirements.
        3) Thickness:
            (a) In-place compacted thickness shall average not less than the thickness specified.
        4) Surface Smoothness:
            (a) Test finished surface of each bituminous concrete course for smoothness, using a 10-foot straight edge applied parallel to and at right angles to centerline of paved areas.
            (b) Check surfaced areas at intervals as directed by Engineer.
            (c) Surfaces will not be acceptable if exceeding the following:
                (1) Base Courses: 3/8 inch in 10 feet.
                (2) Surface Course: 1/4 inch in 10 feet.
                (3) Crowned Surfaces:
                Test crowned surfaces with a crown template, centered and at right angle to the crown.
                Surfaces will not be acceptable if varying more than 1/4" from the template.

3.04 PORTLAND CEMENT CONCRETE PAVING

A. General
    1. Unless otherwise noted in these Specifications, construction methods used to place all Portland Cement Concrete Paving are specified by TxDOT Standard Specifications Item 360, "Concrete Pavement".

B. Inspection
    1. Verify subgrade is ready to support paving and imposed loads.
    2. Verify gradients and elevations of subgrade are correct.

C. Preparation
    1. Moisten subgrade to minimize absorption of water from fresh concrete.
    2. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

D. Forming
    1. Place and secure forms to correct location, dimension, and profile.
    2. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
    3. Place joint fillers vertical in position, in straight lines. Secure to form work during concrete placement.

E. Reinforcement
   1. Reinforcing steel shall be grade 60 and shall be placed as shown on the plans. All concrete shall be continuously reinforced as shown on the plans.

F. Formed Joints
   1. Transverse and longitudinal joints shall be constructed in accordance with the details on the plans and Texas Department of Transportation Specifications.
   2. Joints shall be filled in accordance with the construction drawings.

G. Placing Concrete
   1. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.
   2. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

H. Finishing
   1. All concrete pavement shall be finished in accordance with Texas Department of Transportation Item 360.

I. Curing
   1. The Contractor shall select one of the methods of curing stated in TxDOT Standard Specifications, Item 360, Paragraph 360.11, "Curing".
   2. If the Contractor elects to use Membrane Curing, the curing compound must be reviewed by the Engineer.

J. Field Quality Control
   1. Field inspection and testing will be performed according to the requirements of Division 1 - "General Requirements" of this project manual.
   2. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

K. Protection
   1. Immediately after placement, protect concrete under provisions of Section 03 3000 from premature drying excessive hot or cold temperatures, and mechanical injury.

3.05 PAVEMENT REPLACEMENT

A. Cutting of Pavements
   1. Concrete and Asphaltic Concrete Pavements:
      a. All concrete and asphaltic concrete pavements shall be cut with a concrete saw. The depth of the cut shall be such that upon removal of concrete and/or asphaltic concrete the sides of the cut will be straight and square. Care shall be taken, when cutting concrete pavement, not to cut transverse reinforcing steel.

B. Removal of Bases
   1. Concrete and Cement Stabilized Bases:
      a. Concrete and cement stabilized bases shall be removed by means of hand-held pneumatic pavement breakers with acceptable cutting bits. It is the intent of this specification that the base shall be removed in a manner that will leave the sides of the cut straight and square.
      b. Where reinforcement is encountered in concrete bases, a minimum of one (1) foot shall be cleaned of all old concrete and left in place to tie to new reinforcement in the new concrete base.

2. Flexible Base:
    a. Flexible bases shall be removed by normal trenching operations.

C. Replacement of Bases
1. Concrete Bases:
    a. Concrete bases shall be replaced with Class "A" concrete conforming to the provisions of Item No. 300 "Concrete" of the City of San Antonio Standard Specifications for Public Works Construction. If existing concrete is steel reinforced, the reinforcing steel shall be replaced in accordance with Item No. 301, "Reinforcing Steel". The concrete shall have a slump of not more than three inches (3") and shall be spaded, tamped and finished to the satisfaction of the Engineer. Immediately following finishing operations, the surface shall be cured in accordance with the provisions of Item No. 305, "Membrane Curing". The concrete shall be protected from traffic for seventy-two (72) hours.
2. Cement Stabilized Bases:
    a. Cement stabilized base shall be replaced with cement stabilized base in accordance with Item No. 201, "Cement Stabilized Base" of the City of San Antonio Standard Specifications for Public Work Construction where width of trench permits, or with Class "C" concrete conforming to the requirements of Item No. 300, "Concrete". The concrete shall have a slump of not more than three inches (3") and shall be spaded, tamped, and finished to the satisfaction of the Engineer. The concrete shall be protected from traffic for seventy-two (72) hours prior to replacement of the surfacing.
3. Flexible Base:
    a. Flexible base shall be replaced with 1,000 psi (@ 28 days) concrete. The concrete shall have a slump of no more than three (3) inches and shall be spaded, tamped and finished to the satisfaction of the Inspector. The concrete shall be protected from traffic for seventy-two (72) hours prior to replacement of the surface.
4. Asphalt Treated Base:
    a. Asphalt treated base shall be furnished, placed and compacted in accordance with this Section.

D. Replacement of Pavements
1. Pavements shall be replaced under this item with either hot mix asphaltic concrete pavement, or Portland Cement concrete pavement in the thickness and type shown on the plans.
2. When hot mix asphaltic concrete is shown on the plans as replacement of pavement, it shall be furnished and placed in accordance with TxDOT Item 340, "Hot Mix Asphaltic Concrete Pavement". Flexible bases shall be primed with asphalt or emulsion in accordance with the provision of TxDOT Item 310, "Prime Coat" prior to the placement of hot mix asphaltic concrete. All concrete bases shall receive a tack coat of asphalt or emulsion in accordance with the provisions of TxDOT Item 300, "Tack Coat" prior to replacement of hot mix asphaltic concrete.
3. When the replacement pavement is Portland Cement concrete as indicated on the plans, "Class A" Concrete shall be furnished and placed in accordance with TxDOT Item 360, "Concrete Pavement". The concrete shall be placed, spaded, tamped and finished to the line, grade and texture of the surrounding concrete pavement.
4. Prime Coat and Tack Coat:

a. Prime and Tack coats shall be applied in accordance with the Texas Department of Transportation Standard Specifications Item 340.

5. Surface Course Applications:
   a. The construction of all surface course shall conform to the applicable requirements of Item 340 of the TxDOT Standard Specifications.

3.06 CLEANING AND PROTECTION

A. Cleaning
   1. After completion of paving operations, clean surfaces of excess or spilled bituminous materials and all foreign matter.

B. Protect newly finished pavement until it has become properly hardened by cooling.

END OF SECTION 32 1250

CONCRETE CURBS, GUTTERS AND SIDEWALKS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete sidewalks, stair steps, curbs and gutters.

1.02 RELATED SECTIONS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 31 2323 - Fill.

C. Section 32 1123 - Aggregate Base Courses.

D. Section 32 1250 - Site Pavement.

1.03 PRICE AND PAYMENT PROCEDURES

A. Sidewalks: By the square foot. Includes preparation of substrate, sand bedding, steel reinforcement, concrete sidewalk, jointing, and finishing.

B. Concrete Curbs and Gutters: By the linear foot. Includes trenching, steel reinforcement, concrete curb installation, and cleaning.

C. Stair Steps: By the unit price. Includes preparation of substrate, sand bedding, steel reinforcement, stair steps, jointing, and finishing.

1.04 REFERENCES

A. ASTM D 1190, Concrete Joint Sealer Hot Poured Elastic Type.

B. ASTM D 994-71 (R1977), Preformed Expansion Joint Filler For Concrete (Bituminous Type).

C. ASTM D 1751-73 (R1978) Preformed Expansion Joint Fillers for concrete Paving Structural Construction.

1.05 SUBMITTALS

A. Samples: Submit for review samples, applicable manufacturer's product data, test reports and material certifications.

B. Shop Drawings:
   1. Detailed Reinforcing Steel Layout.
   2. Detailed Construction And Control Joint Layout.

1.06 QUALITY ASSURANCE

A. The testing laboratory shall sample and test concrete in accordance with Section 03 3000 - Cast-In-Place Concrete.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified in this Section, all concrete and concrete materials shall conform to TxDOT, Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter" and Item 531 "Sidewalks".

B. Bituminous Joint Filler: Bituminous type conforming to ASTM D 994 or D 1751 unless otherwise indicated on drawings.
   1. Reinforcing steel shall be ASTM A 615 grade 60, deformed and conform to the provisions of TxDOT Standard Specifications, Item No. 529, "Concrete Curb, Gutter and Combined Curb and Gutter" and Item 531 "Sidewalks".

2. All reinforcing steel to be new billet steel.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

A. Preparation of the subgrade including compaction shall be completed two feet (2') beyond the limits of the work:
   1. Where the subgrade is constructed by excavation of existing grade, the top six inches (6") of the subgrade shall be compacted to at least 95 percent of maximum density as determined by TxDOT TEX-113-E at a moisture content between optimum and optimum +4 percent unless otherwise indicated.
   2. The subgrade shall be brought to the final lines and grades utilizing select backfill.
   3. Pit Run Sand or Granular Embedment:
      a. Pit run sand or granular embedment shall be provided as shown on drawings.
      b. The material shall be as specified in Section 31 2323 and compacted as specified.

3.02 FORM CONSTRUCTION

A. Forms shall be in conformance with TxDOT Standard Specification, Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter" and Item 531 "Sidewalks".

B. Set forms to line and grade. Install forms over full length of curbs, gutters and sidewalks.

3.03 REINFORCEMENT

A. Locate, place, and support reinforcement as specified in TxDOT Standard Specifications, Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter" and Item 531 "Sidewalks", unless otherwise shown on drawings.

3.04 CONCRETE PLACEMENT

A. General: Comply with the requirements of TxDOT Standard Specifications, Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter" and Item 531 "Sidewalks".

B. Machine Formed/Hand Formed:
   1. Automatic curb, gutter and sidewalk machine may be used in lieu of hand formed methods for forming and placing.
   2. Concrete shall have properties as previously specified, except that maximum slump shall be 2-1/2 inches (2 1/2") and air content shall be two percent (2%).
   3. Machine forming shall produce curbs, gutters and sidewalks to the required cross-section, lines, and grades, finish and jointing, as specified for conventionally formed concrete.
   4. Unacceptable work will be removed and replaced at Contractor's expense.

3.05 JOINTS

A. General:
   1. Construct expansion, contraction, and construction joints with faces perpendicular to surface of the curb, gutter and sidewalk.
   2. Construct transverse joints at right angles to the work centerline and as shown.

B. Control Joints:
   1. Provide these joints at ten feet (10') on centers for curbs and gutters and five feet (5') on centers for sidewalks.

C. Construction Joints

1. Place joints at locations where placement operations are stopped for a period of more than 1/2 hour, except where such pours terminate at expansion joints.

D. Expansion Joints
   1. Provide 1/2 inch expansion joint filler where work abuts structures; at returns; and at 50-foot spacing for straight runs.
   2. Where gutter and sidewalk are not poured monolithically, provide expansion joints where each abuts the other.
   3. Place top of expansion joint filler not less than 1/2 inch or more than one inch (1") below concrete surface.
   4. Apply joint sealer on top of expansion joint material flush with concrete surface, and in accordance with manufacturer's instructions.

3.06 CONCRETE FINISHING

A. Smooth the exposed surface by screeding and floating.

B. Work edges of gutter and sidewalks, back top edge of curb, and transverse joints; and round to 1/4-inch radius.

C. Complete surface finishing by drawing a fine-hair broom across surface, perpendicular to line of traffic unless alternative finish is indicated on drawings.

3.07 CURING

A. Protect and cure finished concrete curbs, gutters and sidewalks, complying with applicable requirements of TxDOT Standard Specifications, Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter" and Item 531 "Sidewalks".

3.08 REPAIR AND CLEANING

A. Broken or defective curb, gutters and sidewalks shall be repaired or replaced as directed by the Engineer at the Contractor's expense.

B. Sweep work and wash free of stains, discolorations, dirt or other foreign material.

END OF SECTION 32 1313.10

PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Parking lot markings, including parking bays, crosswalks, arrows, handicapped symbols, curb markings, and fire lanes.

B. Roadway lane markings and crosswalk markings.

1.02 RELATED REQUIREMENTS

A. Section 32 1250 - Site Paving.

1.03 PRICE AND PAYMENT PROCEDURES

A. Parking Lot Striping: By the linear foot. Includes preparation of substrate, painting, clean up.

B. Roadway Lane Marking: By the linear foot. Includes preparation of substrate, painting, clean up.

1.04 REFERENCE STANDARDS

A. FS TT-P-1952 - Paint, Traffic Black, and Airfield Marking, Waterborne; Rev. E, 2007.

B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.

C. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; Current Edition.

1.05 SUBMITTALS -- NOT APPLICABLE

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store paint and materials in manufacturer's containers in a suitable storage facility until use.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MATERIALS

A. Line and Zone Marking Paint: MPI (APL) No. 97 Latex Traffic Marking Paint; color(s) as indicated.
   1. Roadway Markings: As required by authorities having jurisdiction.
   2. Parking Lots: Yellow on concrete pavements or white on bituminous pavements or as indicated on drawings.
   3. Handicapped Symbols: Blue.

B. Paint For Obliterating Existing Markings: FS TT-P-1952; black for bituminous pavements, gray for portland cement pavements.

C. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Obliteration of existing markings using paint is acceptable in lieu of removal; apply the black paint in as many coats as necessary to completely obliterate the existing markings. Thermoplastic markings must be completely removed by scraping, sandblasting, or mechanical abrasion.

D. Clean surfaces thoroughly prior to installation.
   1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
   2. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement, by scraping, wire brushing, sandblasting, mechanical abrasion, or approved chemicals.
   3. Sandblasting: Use equipment of sufficient size and capacity.

E. Where oil or grease are present, scrub affected areas with several applications of an approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.

F. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.

G. Temporary Pavement Markings: When required or directed by Engineer or Owner, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
   1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
   2. At Owner's option, temporary marking tape may used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to Owner.

3.03 INSTALLATION

A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.

B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than or greater than manufacturer's instructions.

C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.

D. Comply with FHWA MUTCD manual (http://mutcd.fhwa.dot.gov) for details not shown.

E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.

F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on drawings true, sharp edges and ends.
   1. Apply paint in one coat only or as indicated on the drawings.
   2. Wet Film Thickness: 0.015 inch, minimum.
   3. Length Tolerance: Plus or minus 1 inch.
   4. Width Tolerance: Plus or minus 1/8 inch.

G. Roadway Traffic Lanes: Use suitable mobile mechanical equipment that provides constant agitation of paint and travels at controlled speeds.
   1. Conduct operations in such a manner that necessary traffic can move without hindrance.
   2. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
   3. If paint does not dry within expected time, discontinue paint operations until cause of slow drying is determined and corrected.
   4. Skip Markings: Synchronize one or more paint "guns" to automatically begin and cut off paint flow; make length of intervals as indicated.
   5. Use hand application by pneumatic spray for application of paint in areas where a mobile paint applicator cannot be used.
   6. Distribute glass beads uniformly on the paint lines within ten seconds without any waste, applied at rate of 6 pounds per gallon of paint; if the marking equipment does not have a glass bead dispenser, use a separate piece of equipment adjusted and synchronized with the paint applicator; remove and replace markings having faulty distribution of beads.

H. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
   1. Mark the International Handicapped Symbol at indicated parking spaces.
   2. Hand application by pneumatic spray is acceptable.

I. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

3.04 DRYING, PROTECTION, AND REPLACEMENT

A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.

B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.

C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.

D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.

E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.

F. Replace removed markings at no additional cost to Owner.

END OF SECTION 32 1723.13

STEEL GUARDRAIL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Steel guardrail and steel or steel posts.

B. Excavating for post bases.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

1.03 PRICE AND PAYMENT PROCEDURES

A. Guardrail:
   1. Basis of Measurement: By the linear foot.
   2. Basis of Payment: Includes rail, accessories, end closures, finished.

B. Intermediate Posts:
   1. Basis of Measurement: By the unit.
   2. Basis of Payment: Includes excavating, sleeving through concrete, posts, backfilling and compacting at posts.

C. Terminal Anchor Posts:
   1. Basis of Measurement: By the unit.
   2. Basis of Payment: Includes excavating, sleeving through concrete, posts, anchors and anchor footings, backfilling and compacting at posts.

1.04 REFERENCE STANDARDS

A. AASHTO M 180 - Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail; 2012.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

E. ASTM A428/A428M - Standard Test Method for Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles; 2010 (Reapproved 2014).

F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

H. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.

I. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.

1.05 SUBMITTALS

A. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, anchorage, and schedule of components.

B. Product Data: Provide data on rail, posts, accessories, hardware and structural capabilities of rail section.

C. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation anchor bolt templates.

PART 2 PRODUCTS

2.01 MATERIALS

A. Guardrail Beam: AASHTO M 180 Class A or B Type II; W profile; rolled steel sections, die punched bolt holes for site assembly and attachment to posts, formed steel curved or tapered terminating sections.

B. Steel Posts: ASTM A501/A501M hot-formed tubing.

C. Wood Posts: Softwood timber, pressure preservative treated to AWPA U1 using water borne preservatives, 7 inch diameter nominal size.

2.02 ACCESSORIES

A. Concrete: ASTM C 94/C 94M, ready-mixed; Normal portland Cement, 2,500 psi strength at 28 days, 3 inch slump; 1/2 inch nominal sized coarse aggregate.

B. Hardware: Steel, bolts, nuts and washers to suit rail profile.

2.03 FINISHES

A. Components: Galvanized in accordance with ASTM A123/A123M.

B. Components: Aluminum coated at 3.6 oz/sq ft, when measured in accordance with ASTM A428/A428M.

C. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install rails and posts and accessories in accordance with manufacturer's instructions.

B. Set top of rail 28 inches above finish grade or as indicated on drawings.

C. Space posts at intervals not exceeding 6 feet, 3 inches.

D. Posts shall not be set in concrete unless otherwise indicted on drawings.

E. Posts to be located as indicated on drawings.

F. Attach rails securely to posts with anchoring hardware.

G. Attach terminal connectors, where required, meeting the material and galvanization requirements within this section.

3.02 TOLERANCES

A. Posts - Maximum Variation From Plumb: 1/2 inch.

B. Rail - Maximum Offset From True Position: 1/2 inch.

C. Rail - Maximum Variation From True Height: 1/2 inch.

D. Components shall not infringe adjacent property lines.

END OF SECTION 32 1731

SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation of subsoil.

B. Placing topsoil.

C. Seeding, mulching and fertilizer.

D. Maintenance.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading.

1.03 PRICE AND PAYMENT PROCEDURES

A. Topsoil:
   1. Basis of Measurement: By the cubic yard.
   2. Basis of Payment: Includes topsoil, placing topsoil.

B. Grassed Areas:
   1. Basis of Measurement: By the square yard.
   2. Basis of Payment: Includes preparation of subsoil, preparation of topsoil, placing topsoil, seeding, watering and maintenance for 90 days or until established.

1.04 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.05 SUBMITTALS

A. Topsoil samples.

B. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

C. Maintenance Contract.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 PRODUCTS

2.01 SEED MIXTURE

A. Seed Mixture: As determined by the Landscape Architect or Owner.

2.02 SOIL MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.

2.03 ACCESSORIES

A. Mulching Material: Hay, oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry.

B. Fertilizer: Recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated by analysis.

C. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

D. Erosion Fabric: Jute matting, open weave.

E. Herbicide.

F. Stakes: Softwood lumber, chisel pointed.

G. String: Inorganic fiber.

H. Edging: Galvanized steel.

2.04 TESTS

A. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

B. Submit minimum 10 oz sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.

C. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this Section.

3.02 PREPARATION

A. Prepare subgrade in accordance with Section 31 2200.

B. Install edging at periphery of seeded areas in straight lines to consistent depth.

3.03 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.04 SEEDING

A. Apply seed per seed providers recommendation.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Planting Season: Dependent upon seed species.

D. Do not sow immediately following rain, when ground is too dry, or during windy periods.

E. Roll seeded area with roller not exceeding 112 lbs.

F. Immediately following seeding , apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

G. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

H. Following germination, immediately re-seed areas without germinated seeds that are larger than 24 by 24 inches.

3.05 HYDROSEEDING

A. Apply seeded slurry per seed providers recommendations.

B. Do not hydroseed area in excess of that which can be mulched on same day.

C. Immediately following seeding, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

D. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

E. Following germination, immediately re-seed areas without germinated seeds that are larger than 24 by 24 inches.

3.06 PROTECTION

A. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

B. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12 inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.

C. Secure outside edges and overlaps at 36 inch intervals with stakes.

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.07 MAINTENANCE

A. Provide maintenance at no extra cost to Owner; Owner will pay for water.

B. Provide a separate maintenance contract for specified maintenance service.

C. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

D. Mow grass at regular intervals to maintain at a maximum height of 3 inches. Do not cut more than 1/3 of grass blade at any one mowing.

E. Neatly trim edges and hand clip where necessary.

F. Immediately remove clippings after mowing and trimming.

G. Water to prevent grass and soil from drying out.

H. Roll surface to remove minor depressions or irregularities.

I. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

J. Immediately reseed areas that show bare spots.

K. Protect seeded areas with warning signs during maintenance period.

END OF SECTION 32 9219

SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation of subsoil.

B. Placing topsoil.

C. Fertilizing.

D. Sod installation.

E. Maintenance.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading.

B. Section 31 2323 - Fill.

1.03 PRICE AND PAYMENT PROCEDURES

A. Topsoil:
   1. Basis of Measurement: By the cubic yard.
   2. Basis of Payment: Includes topsoil, placing topsoil.

B. Sodded Areas:
   1. Basis of Measurement: By the square yard.
   2. Basis of Payment: Includes preparation of subsoil, preparation of topsoil, placing topsoil, sodding, watering and maintenance.

1.04 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

B. Grass: Bermuda, St. Augustine, Buffalo; other acceptable grasses suitable for the region and climate.

1.05 REFERENCE STANDARDS

A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.06 SUBMITTALS

A. Certificate: Certify grass species and location of sod source.

B. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.07 QUALITY ASSURANCE

A. Sod Producer: Company specializing in sod production and harvesting, and certified by the State of Texas.

B. Installer Qualifications: Company approved by the sod producer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver sod on pallets or in rolls. Protect exposed roots from dehydration.

B. Do not deliver more sod than can be laid within 48 hours.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sod: TPI (SPEC), Certified Turfgrass Sod quality; cultivated grass sod; type indicated in plant schedule on Drawings; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft. Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
   1. Thickness: "Thick" sod, minimum 1 inch and maximum 1-3/8 inch topsoil base.
   2. Machine cut sod and load on pallets in accordance with TPI (SPEC) Guidelines.

B. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay, or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.

C. Fertilizer: Recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions unless otherwise indicated:
   1. Nitrogen: 16 percent.
   2. Phosphoric Acid: 8 percent.
   3. Soluble Potash: 8 percent.

D. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

2.02 ACCESSORIES

A. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.

B. Wire Mesh: Interwoven hexagonal plastic mesh of 2 inch size.

C. Edging: Galvanized steel, painted steel.

D. Herbicide.

2.03 SOURCE QUALITY CONTROL

A. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

B. Submit minimum 10 oz sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.

C. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

A. Prepare subgrade in accordance with Section 31 2200.

B. Install edging at periphery of seeded areas in straight lines to consistent depth.

3.03 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to installation of sod.

C. Apply fertilizer no more than 48 hours before laying sod.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.04 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.

B. Lay sod immediately after delivery to site to prevent deterioration.

C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.

D. Where new sod adjoins existing grass areas, align top surfaces.

E. Where sod is placed adjacent to hard surfaces, such as curbs, pavements, etc., place top elevation of sod 1/2 inch below top of hard surface.

F. On slopes 4 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.

G. Prior to placing sod, on slopes exceeding 4 inches per foot or where indicated, place wire mesh over topsoil. Securely anchor in place with wood pegs sunk firmly into the ground.

H. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.

I. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities.

3.05 MAINTENANCE

A. Provide maintenance at no extra cost to Owner; Owner will pay for water.

B. Provide a separate maintenance contract for specified maintenance service.

C. Provide maintenance of sodded areas for one month from Date of Substantial Completion.

D. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

E. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

F. Neatly trim edges and hand clip where necessary.

G. Immediately remove clippings after mowing and trimming.

H. Water to prevent grass and soil from drying out.

I. Roll surface to remove irregularities.

J. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

K. Immediately replace sod to areas that show deterioration or bare spots.

L. Protect sodded areas with warning signs during maintenance period.

END OF SECTION 32 9223

DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Disinfection of site domestic water lines and site fire water lines specified in Section 33 1416.

B. Testing and reporting results.

1.02 RELATED REQUIREMENTS

A. Section 33 1416 - Site Water Utility Distribution Piping.

1.03 PRICE AND PAYMENT PROCEDURES

A. Disinfection: By the linear foot. Includes preparing, disinfecting, testing, and reporting.

1.04 REFERENCE STANDARDS

A. AWWA B300 - Hypochlorites; 2011.

B. AWWA C651 - Disinfecting Water Mains; 2005.

1.05 SUBMITTALS

A. Test Reports: Indicate results comparative to specified requirements.

B. Certificate: From authority having jurisdiction indicating approval of water system.

C. Disinfection report:
   1. Type and form of disinfectant used.
   2. Date and time of disinfectant injection start and time of completion.
   3. Test locations.
   4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
   5. Date and time of flushing start and completion.
   6. Disinfectant residual after flushing in ppm for each outlet tested.

D. Bacteriological report:
   1. Date issued, project name, and testing laboratory name, address, and telephone number.
   2. Time and date of water sample collection.
   3. Name of person collecting samples.
   4. Test locations.
   5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
   6. Coliform bacteria test results for each outlet tested.
   7. Certification that water complies, or fails to comply, with bacterial standards of TCEQ.

1.06 QUALITY ASSURANCE

A. Testing Firm: Company specializing in testing potable water systems, approved by governing authorities of the State in which the Project is located.

B. Submit bacteriologist's signature and authority associated with testing.

PART 2 PRODUCTS

2.01 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300, Hypochlorite.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping system has been cleaned, inspected, and pressure tested.

B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

3.02 DISINFECTION

A. Use method prescribed by the applicable state or local codes, or health authority or water service purveyor having jurisdiction, or in the absence of any of these follow AWWA C651.

B. Provide and attach equipment required to perform the work.

C. Inject treatment disinfectant into piping system.

D. Maintain disinfectant in system for 24 hours.

E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.

F. Replace permanent system devices removed for disinfection.

G. Pressure test system to 200 psi. Repair leaks and re-test.

3.03 FIELD QUALITY CONTROL

A. Test samples in accordance with AWWA C651.

END OF SECTION 33 0110.58

JACKING, BORING OR TUNNELING PIPE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnishing and installation of pipe by the methods of jacking, boring, or tunneling.

1.02 RELATED REQUIREMENTS

A. Section 31 2316 - Excavation.

B. Section 31 2316.14 - Trench Excavation Protection.

C. Section 33 1416 - Site Water Utility Distribution Piping.

1.03 PRICE AND PAYMENT PROCEDURES

A. Jacking, Boring, or Tunneling:
   1. Basis of Measurement: By the linear foot.
   2. Basis of Payment: Includes excavation; casing, liner plate, jacking pipe with accessories; and grout.

1.04 REFERENCES

A. Texas Department of Transportation (TxDOT) 2004 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges.

B. Specification and standards of local authority having jurisdiction.

1.05 SUBMITTALS

A. Product Data: Provide casing, liner plate, jacking pipe plus accessories data.

B. Shop Drawings: Indicate plan layout, spacing of components, grouting procedures, and schedule of components.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: All products covered under this Section shall be produced by a single manufacturer unless otherwise specified.

B. Testing: The Contractor shall coordinate all testing required by this Section with the Engineer prior to commencement.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products in exact accordance with manufacturer's latest published requirements and specifications.

PART 2 PRODUCT

2.01 MATERIALS

A. Pipe:
   1. Types and sizes shown on the plans and shall conform to these specifications.
   2. All shipments of pipe shall be accompanied by a certificate of compliance to these specifications prepared by an independent testing laboratory and signed by a registered professional engineer.

B. Liner Plate: As shown on the project plans.

C. Grout:
   1. Sand cement slurry containing a minimum of seven (7) sacks of Portland Cement per cubic yard of slurry.

2. All slurry shall be plant batched and transit mixed.

PART 3 EXECUTION

3.01 JACKING

A. Jacking Pits
   1. Suitable pits or trenches shall be excavated for the purpose of jacking operations for placing end joints of the pipe.
   2. When trenches are cut in the side of embankment such work shall be securely sheeted and braced.
   3. Backfilled immediately upon completion of jacking operations.

B. Jacking Operations
   1. Jacking operations shall in no way interfere with the operation of railroads, streets, highways or other facilities.
   2. Barricades and lights shall be furnished as directed by the Engineer to safeguard traffic and pedestrians.

C. The pipe to be jacked shall be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade.

D. Excavation
   1. Embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the opening thus provided.
   2. The excavation for the underside of the pipe, for at least one-third (1/3) of the circumference of the pipe, shall conform to the contour and grade of the pipe.
   3. A clearance of not more than two inches (2") may be provided for the upper half of the pipe.

E. The distance that the excavation shall extend beyond the end of the pipe shall depend on the character of the material, but it shall not exceed two feet (2') in any case.

F. Generally, pipe shall be jacked from downstream end.

G. Permissible lateral or vertical variation in the final position of the pipe from line and grade will be as shown on the plans or as determined by the Engineer.

H. Any pipe damaged in jacking operations shall be removed and replaced at the Contractor's expense.

3.02 BORING

A. Boring Pits: Excavation for pits and installation of shoring shall be as outlined under "Jacking Pits".

B. Boring Operations:
   1. A pilot hole shall be used.
   2. The pilot hole shall be bored the entire length of the crossing and shall be used as a guide for the larger hole to be bored.
   3. Water or drilling fluids may be used to lubricate cuttings.

C. Variation in line and grade shall apply as specified under "Jacking".

3.03 TUNNELING

A. Tunneling may be used when the size of the proposed pipe or the use of a monolithic system would make the use of tunneling more satisfactory than "Jacking" or "Boring".

B. The excavation for pits and the installation of shoring shall be as specified under "Jacking".

C. The lining of the tunnel shall be of the material shown on the plans.

D. Access holes for grouting shall be spaced a maximum of ten feet (10').

3.04 PIPE JOINTS

A. Shall conform to local specification and standards having jurisdiction for work being performed, or as shown on the project plans or shop drawings.

B. Steel Joints
   1. Shall be mill or fabricated steel pipe conforming to AWWA M-11.
   2. Shall be welded in accordance with procedures established by the AWS.

3.05 GROUTING OF BORES OR TUNNELS

A. Space between pipe and liner, pipe and limits of excavation, and liner and limits of excavation shall be pressure grouted, unless otherwise specified on the plans.

3.06 CLEANING

A. Properly dispose of all excess material, all debris, trash, containers, residue, remains and scraps which result from the work of this Section.

END OF SECTION 33 0230

SITE CONCRETE ENCASEMENT, CRADLES, SADDLES AND COLLARS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. All work required to install and complete all concrete encasements, cradles, saddles and collars.

1.02 RELATED REQUIREMENTS

A. Section 31 2316 - Excavation.

B. Section 31 2316.13 - Trenching.

C. Section 33 0561 - Concrete Manholes

D. Section 33 3113 - Site Sanitary Sewerage Gravity Piping.

1.03 PRICE AND PAYMENT PROCEDURES

A. Encasement, Cradles, Saddles, and Collars: By the cubic yard. Includes formwork, concrete, placement accessories, consolidating and curing.

1.04 REFERENCES

A. Texas Department of Transportation Standard Specification, Item 420 – Concrete for Structures.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer’s data on manufactured products showing compliance with specified requirements.

B. Manufacturer’s Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.

1.06 QUALITY ASSURANCE

A. The testing laboratory shall sample and test concrete in accordance with geotechnical report unless otherwise indicated.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete: Shall conform to Class B in accordance with Item 420, "Concrete for Structures", TxDOT Standard Specifications.

B. Reinforcement: If required, shall be Grade 60, deformed bars, new billet steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Concrete Encasement
   1. The trench shall be excavated and fine graded to a depth conforming with details and sections shown on the plans.
   2. The pipe shall be securely tied down to prevent flotation and supported by precast concrete blocks of the same strength as the concrete for encasement.
   3. Encasement shall then be placed to a depth and width conforming with details and sections shown on the plans.

B. Concrete Cradles

1. The trench shall be prepared and the pipe supported in the same manner as described in this Section.
2. Concrete cradles shall be constructed in accordance with details and sections shown on the plans.

C. Concrete Saddles
1. Pipe to receive concrete saddle shall be backfilled in accordance with Section 31 2316.13 – Trenching to the spring line.
2. Concrete placed to a depth and width conforming with details and sections shown on the plans.

D. Concrete Collars
1. Concrete collars shall be constructed in accordance with details and sections shown on the plans.

3.02 CLEANING

A. Properly dispose of all debris, trash containers, residue, remnants and scraps which result from the work of this Section.

END OF SECTION 33 0273

CONCRETE MANHOLES

PART 1 GENERAL

1.01 Section Includes

A. Monolithic concrete manholes with masonry transition to lid frame, covers, anchorage, and accessories.

B. Modular precast concrete manhole sections with tongue-and-groove joints, covers, anchorage, and accessories.

1.02 Related Requirements

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 04 0511 - Masonry Mortaring and Grouting.

1.03 Price and Payment Procedures

A. Manhole: By the unit. Includes excavating, concrete base pad, concrete manhole sections, FRP manhole sections, brick masonry manhole construction, brick masonry transition to cover frame, cover frame and cover, to indicated depth, forming and sealing pipe inlets and outlets.

1.04 Reference Standards

A. AASHTO HB - Standard Specifications for Highway Bridges; Seventeenth Edition.

B. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2012).

C. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2020.

D. ASTM C923/C923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2020.

E. ASTM D3753 - Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells; 2012.

F. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.

G. Local Municipal Specifications.

H. Local Public Service Provider Specifications.

1.05 Submittals

A. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.

B. Product Data: Provide manhole covers, component construction, features, configuration, and dimensions.

1.06 Quality Assurance

A. Manufacturer: Company specializing in manufacturing products specified in this section.

1.07 Field Conditions

A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 Concrete Manholes

A. Weight Rating: H 10 according to AASHTO HB.

2.02 MANHOLES

A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C478/C478M, with resilient connectors complying with ASTM C923/C923M.

B. Manhole Sections: ASTM D 3753, glass-fiber reinforced polyester (only if indicated on drawings) .

C. Concrete: As specified in Section 03 3000.

D. Concrete Reinforcement: As specified in Section 03 3000, Class A.

2.03 Accessories

A. Lid and Frame: ASTM A 48/A 48M, Class 30B Cast iron construction, machined flat bearing surface, removable boltable lid, closed lid design; heavy duty suitable for H-20 loading .

B. Throat Rings: Reinforced concrete rings, maximum thickness of 2 inches, minimum width 5 inches, and internal diameter not less than 30 inches.

C. Inside Epoxy Coating: Raven 805 Series High Build Epoxy Liner (125 mils thickness) or Spray Wall Polyurethane System (150 mils thickness) or approved equivalent.

D. Manhole Insert: Rainstopper as manufactured by Southwestern Packing and Seals, or approved equivalent.

E. Water tight manhole rings and covers shall be Trane-TEX A77 "O" ring or approved equivalent.

2.04 CONFIGURATION

A. Shaft Construction: Concentric with concentric cone top section; lipped male/female dry joints; sleeved to receive pipe sections.

B. Shape: Cylindrical.

C. Clear Inside Dimensions: 48 inches diameter.

D. Design Depth: As indicated on drawings.

E. Clear Lid Opening: 30 inches diameter.

F. Pipe Entry: Provide openings as indicated on drawings.

PART 3 EXECUTION

3.01 Examination

A. Verify items provided by other sections of work are properly sized and located.

B. Verify that built-in items are in proper location, and ready for roughing into Work.

C. Verify excavation for manholes is correct.

3.02 Preparation

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 Installation

A. Establish elevations and pipe inverts for inlets and outlets as indicated in drawings.

3.04 MANHOLES

A. Place concrete base pad, trowel top surface level.

B. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.

C. Form and place manhole cylinder plumb and level, to correct dimensions and elevations.

D. Cut and fit for pipe.

E. The minimum angle of flow for a connecting sewer to the direction of flow by a collection system is 90 degrees.

F. Inverts shall conform accurately to the size and elevation of the adjoining pipes. Side inverts shall be curved and main inverts, where direction changes, shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipelines.

G. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.

H. Set cover frames and covers level without tipping, to correct elevations.

I. A minimum of 2 and a maximum of 4 throat rings shall be used to adjust the manhole top.

J. Coordinate with other sections of work to provide correct size, shape, and location.

K. Install manhole inserts in each vented sanitary sewer manhole in accordance with manufacturer's recommendations.

L. Vacuum test manholes for water tightness.

M. All new sanitary sewer manholes shall be watertight and coated with an approved sewer structural coating.

1. Epoxy coating: With specified thickness application.
    a. Raven 405 Series High Build Epoxy Liner: Required thickness 125 mils.
    b. Spray Wall Polyurethane System: Required thickness 150 mils.

END OF SECTION 33 0561

SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water pipe for site conveyance lines.

B. Pipe valves.

C. Fire hydrants.

D. Valves, Fire Hydrants, Backflow Preventer, and Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 31 2316 - Excavation.

C. Section 31 2316.13 - Trenching.

D. Section 31 2323 - Fill.

E. Section 33 0110.58 - Disinfection of Water Utility Piping Systems: Disinfection of site service utility water piping.

1.03 PRICE AND PAYMENT PROCEDURES

A. Pipe and Fittings: By the linear foot. Includes excavation, pipe and fittings, bedding, thrust blocks, restraint joints, connection to building service piping, and to municipal utility water source.

B. Valves: By the unit. Includes valve, fittings and accessories.

C. Hydrant: By the unit. Includes excavation, gravel sump, hydrant, valve, connection, and accessories.

D. Fittings: By the ton. Includes installation and accessories.

1.04 REFERENCE STANDARDS

A. Standards and specifications of local authority having jurisdiction over private potable water systems.

B. Standards and specifications of local authority having jurisdiction over public potable water systems.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.

E. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.

F. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.

G. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2013.

H. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).

I. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 1998 (Reapproved 2011).

J. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.

K. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.

L. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2012.

M. AWWA C502 - Dry-Barrel Fire Hydrants; 2014.

N. AWWA C504 - Rubber-Seated Butterfly Valves 3 In. (75 mm) Through 72 In. (1,800 mm); 2010.

O. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS; 2011.

P. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2009.

Q. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances; 2010.

R. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution; 2007.

S. UL 246 - Hydrants for Fire-Protection Service; Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations and provide to the Engineer. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

D. Provide Owner with two valve keys for each type of valve.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with water service purveyor requirements.

B. Perform Work in accordance with requirements of local authority having jurisdiction of private water systems.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

1.08 REGULATORY REQUIREMENTS

A. Conform to applicable code for materials and installation of the Work of this section.

PART 2 PRODUCTS

2.01 WATER PIPE

A. Ductile Iron Pipe: AWWA C151/A21.51:
   1. Fittings: Ductile iron, standard thickness.
   2. Joints: AWWA C111/A21.11, Styrene butadiene rubber (SBR) or vulcanized SBR gasket with rods.
   3. Jackets: AWWA C105/A21.5 polyethylene jacket.

B. Copper Tubing: ASTM B88, Type K, Annealed:
   1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
   2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.

C. PVC Pipe: ASTM D1785, Schedule 40.
   1. Fittings: ASTM D2466, PVC.
   2. Joints: ASTM D2855, solvent weld.

D. PVC Pipe greater than 4 inches in diameter: AWWA C900 Class 150:
   1. Fittings: AWWA C110, gray iron and ductile iron.
   2. Joints: ASTM D3139 compression gasket ring.

E. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Water Service" (14-gauge insulated) in large letters.

2.02 VALVES

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. All mechanical joint valves shall be supplied with glands, bolts, and gaskets. Bolts for mechanical joints shall be high strength low allow steel meeting requirements of the latest revision of AWWA Standard C111.

C. All valves shall open right (clockwise) unless otherwise specified.

D. Valve ends shall be either flanged, mechanical joint, hub-end, push-on joint ("Ring-Tite"), or any combination thereof.

E. Valves shall have a minimum 10 YEAR LIMITED WARRANTY from the manufacturer on material and workmanship.

F. Gate Valves Up To 3 Inches:
   1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, post indicator, valve key, and extension box.

G. Gate Valves 3 Inches and Over:
   1. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged ends, control rod, post indicator, valve key, and extension box.
   2. Coatings: All coatings in contact with potable water shall be approved for potable water immersion service per ANSI/NSF Standard 61.

H. Butterfly Valves From 24 Inches to 48 Inches:
   1. AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, ten position lever handle.

2.03 VALVE BOXES

A. Each valve box assembly shall be of cast-iron and shall consist of a base, top section, and lid as required by local authority.

B. All valve boxes shall be of a single size with a nominal diameter of 6 inches.

C. The valve box lid shall be so designed so that it will remain firmly seated in place when subjected to vehicular traffic.

D. The valve box assembly shall be coated with a bituminous coating of either coal tar or asphalt basic applied to all inside and outside surfaces.

2.04 HYDRANTS

A. Hydrants: AWWA C502, UL 246, dry barrel type or as required by water service purveyor or local authority having jurisdiction of private water systems.
   1. Inside dimension: 7 inches minimum, with minimum 5 inches diameter valve seat opening.
   2. 6 inch bell or mechanical joint inlet connection with accessories, gland bolts, and gaskets.
   3. Open: Right

B. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.

C. Hose and Streamer Connection: Match sizes with water service purveyor, two hose nozzles with a 2-1/2 inch nominal inside diameter, one pumper nozzle with a 4 inch nominal inside diameter. Nozzle threads to conform with ASA B-26 National Standard Fire Hose Coupling Screw Thread.

D. Hydrants shall have at least one untapped drain opening. When the main valve is in fully opened position leakage through the drain opening shall be cause for rejection.

E. All gaskets shall be of rubber composition, copper asbestos, lead or impregnated fiber composition.

F. All fire hydrants having mechanical joint inlets shall be supplied with glands, bolts, and gaskets. Bolts shall be high strength low alloy steel meeting requirements of AWWA Specification C111.

G. Hydrant shall have non-rising stems.

H. Hydrants shall be equipped with a breakable coupling on the barrel section and the stem. These couplings shall be at least two inches above the finished grade line. The breakable coupling shall be so designed that in case of traffic collision, the barrel safety flange and steam safety collar will break before any other part of the hydrant. The coupling shall be designed to afford the hydrant to rotate 360°.

I. Valve stems shall have a diameter of 1-1/4 inch for hydrants up to and including a 5'-0" bury. Hydrants with a bury of greater than 5-'0" shall have a stem diameter of not less than 1-3/8 inch.

J. Hydrant shall have a limited warranty from the manufacturer against defects in materials or workmanship for a period of ten (10) years from date of manufacture. Original Manufacturer repair and replacement parts must be used to maintain valid warranty.

K. Finish: Primer and two coats of enamel in color required by utility company.

2.05 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 31 2316.13.

B. Cover: As specified in Section 31 2316.13.

2.06 REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER

A. Two check valve assemblies, relief valve assembly, two shutoff valves, and four test codes.

B. Check Valve and Relief Valve Assemblies: Single cast body with replaceable seats, capable of being serviced independent of each other.

C. Relief Valve Assembly: Between check valves, supply pressure via a sensing package integral to main body.

D. Shutoff Valves: Each end of assembly, resilient seated.

E. Four Test Codes: Supply side of supply shutoff valve, relief valve cover (sensing supply pressure), after first check valve (sensing zone pressure), and after second check valve (sensing demand pressure).

F. Meet requirements of USC-FCCHR, ASSE 1013, AWWA, UL (2-1/2"-10" models), and FM (2 -1/2"-10" models).

G. Product: Must comply with water service purveyor specifications.

2.07 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type specified in Section 03 3000.

B. Permanent and Temporary Blowoff Assemblies: As shown on plans.
   1. Permanent Blowoff Assembly: 2-inch galvanized iron pipe, ball valve, fittings, 6-inch valve box assembly, and concrete collar around valve box where subjected to vehicular traffic.
   2. Temporary Blowoff Assembly: 2-inch galvanized iron pipe, ball valve, and fittings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building service connection and water service purveyor main size, location, and invert are as indicated.

3.02 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

A. See Section 31 2316.13 for additional requirements.

B. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories.

C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION - PIPE

A. Maintain separation of water main from sewer piping in accordance with Texas Commission on Environmental Quality (TCEQ) requirements. Minimum 9 ft separation when in parallel with sewer piping.

B. Group piping in the same trench as other site piping work whenever practical.

C. Establish elevations of buried piping to ensure not less than four (4) feet of cover.

D. Install ductile iron piping and fittings to AWWA C600.

E. Route pipe in straight line.

F. Install pipe to allow for expansion and contraction without stressing pipe or joints.

G. Install access fittings to permit disinfection of water system performed under Section 33 0110.58.

H. Slope water pipe and position drains at low points.

I. Install trace wire taped to pipe, coordinate with Section 31 2316.13.

3.05 Installation - Valves, Hydrants, Backflow Preventers

A. Set valves on solid bearing. Concrete pad required for valves 12 inches and larger.

B. Center and plumb valve box over valve. Set box cover flush with finished grade.

C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway, no less than 18 inches nor more than 7 feet from face of curb.

D. Set hydrants to grade, with nozzles at least 20 inches above ground.

E. Provide a drainage pit 36 inches square by 24 inches deep filled with 2 inches washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.

F. Paint hydrants in accordance with water service purveyor standards and specifications or for private hydrants with standards and specifications of local authority.

3.06 SERVICE CONNECTIONS

A. Provide water service to utility company requirements .

3.07 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Flush mains to remove all dust, debris, or foreign matter.

C. Pressure test water piping to 235 pounds per square inch.

D. Pressure test duration shall be a minimum of 4 hours.

E. Leakage allowance shall be no greater than listing in table at end of this section.

F. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

HYDROSTATIC TEST LEAKAGE ALLOWANCES (MAXIMUM) @ 200 PSI

ALLOWABLE LEAKAGE IN GALLONS PER HOUR (GPH)*

NOMINAL DIAMETER & TYPE PIPE	100 LF	200 LF	300 LF	400 LF	500 LF	600 LF	700 LF	800 LF	900 LF	1000 LF
6" DI**	0.13	0.25	0.38	0.51	0.64	0.6	0.89	1.02	1.14	1.27
8" DI**	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.7
12" DI**	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.04	2.3	2.55
16" DI**	0.34	0.68	1.02	1.36	1.7	2.04	2.38	2.72	3.06	3.4
20" DI**	0.43	0.85	1.28	1.7	2.13	2.55	2.98	3.4	3.83	4.25
20" CSC	0.08	0.16	0.24	0.32	0.4	0.47	0.55	0.63	0.71	0.79
24" DI**	0.51	1.02	1.53	2.04	2.55	3.06	3.57	4.08	3.59	5.1
24" CSC	0.1	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95
30" DI**	0.64	1.27	1.91	2.55	3.19	3.82	4.46	5.1	5.73	6.37
30" CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18
36" DI**	0.76	1.53	2.29	3.06	3.82	4.58	5.35	6.11	6.88	7.64
36" CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42
42" DI**	0.89	1.78	2.68	3.57	4.46	5.35	6.24	7.14	8.03	8.92
42" CSC	0.17	0.33	0.5	0.66	0.83	1	1.16	1.33	1.49	1.66
48" DI**	1.02	2.04	3.06	4.08	5.1	6.11	7.13	8.15	9.17	10.19
48" CSC	0.19	0.38	0.7	0.76	0.95	1.13	1.32	1.51	1.7	1.89
54" CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.1
60" CSC	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.3

***PVC pipe shall be tested to DI pressures. GPH for CSC pipe are manufacturer's maximum.**

****DI pipe includes mechanical and push-on joints.**

END OF SECTION 33 1416

SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewerage drainage piping, fittings, and accessories.

B. Connection of building sanitary drainage system to public sanitary sewers.

C. Cleanout access.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete for cleanout base pad construction.

B. Section 31 2316 - Excavation: Excavating of trenches.

C. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.

D. Section 33 0561 - Concrete Manholes.

1.03 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.04 REFERENCE STANDARDS

A. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2015.

B. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe; 2009 (Reapproved 2014).

C. ASTM C12 - Standard Practice for Installing Vitrified Clay Pipe Lines; 2014.

D. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2015.

E. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric); 2015.

F. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2015.

G. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric); 2014.

H. ASTM C425 - Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings; 2004 (Reapproved 2013).

I. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2012.

J. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric); 2011.

K. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2014.

L. ASTM C700 - Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated; 2013.

M. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.

N. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2014.

O. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping; 2001 (Reapproved 2014).

P. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.

Q. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2015.

R. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Material; 2012.

S. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2012.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of the sanitary sewer with the local authority having jurisdiction for permits and inspections with regard to size, location and installation of service utilities.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers, and local inspection authorities.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

A. Product Data: Provide data indicating pipe and pipe accessories.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Field Quality Control Submittals: Document results of field quality control testing.

D. Project Record Documents:
   1. Record location of pipe runs, connections, manholes, and invert elevations.
   2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

A. Provide products that comply with applicable code(s).

B. Plastic Pipe: ASTM D 3034, SDR 26, Type PSM, Poly(Vinyl Chloride) (PVC) material, inside nominal diameter as shown on drawings, bell and spigot style joint end with the exception that solvent cement joints shall not be used.

C. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.02 PIPE ACCESSORIES

A. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Sewer Service " in large letters, if required.

2.03 BEDDING AND COVER MATERIALS

A. Pipe Bedding Material: As specified in Section 31 2316.13.

B. Pipe Cover Material: As specified in Section 31 2316.13.

PART 3 EXECUTION

3.01 GENERAL

A. Perform work in accordance with applicable code(s) of local or state jurisdictional authority.

3.02 TRENCHING

A. See Section 31 2316.13 for additional requirements.

B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.03 INSTALLATION - PIPE

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.

C. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Connect to building sanitary sewer outlet and public sanitary sewer system.

E. Install cleanouts a minimum of every 100 linear feet unless otherwise indicated on drawings. See drawings for cleanout detail.

F. Install trace wire 6 inches above top of pipe, if required. Coordinate with Section 31 2316.13.

3.04 WATER MAIN CROSSINGS

A. Requirements of Texas Commission on Environmental Quality, 30 TAC § 217.5 shall be met.

3.05 INSTALLATION - CLEANOUTS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Establish elevations and pipe inverts for inlets and outlets as indicated.

C. Mount cap and frame to match slope of finished grade. Secure to top of pipe at elevation indicated.

3.06 FIELD QUALITY CONTROL

A. Perform field inspection and testing.

B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

C. Pressure Test: Pressure test in accordance with sewer service purveyor standards or local authority having jurisdiction of private sanitary sewer systems.

D. Deflection Test: Deflection test in accordance with sewer service purveyor or local authority having jurisdiction of private sanitary sewer systems.

E. Obtain inspections from sewer service purveyor or local authority having jurisdiction. Do not bury pipe until inspection is approved.

3.07 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 33 3113

STORMWATER GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stormwater drainage piping.

B. Stormwater pipe accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 31 2316 - Excavation.

C. Section 31 2316.13 - Trenching.

D. Section 31 2316.14 - Trench Excavation Protection.

E. Section 31 2323 - Fill.

F. Section 33 0561 - Concrete Manholes.

1.03 PRICE AND PAYMENT PROCEDURES

A. Pipe and Fittings:
   1. Basis of Measurement: By the linear foot.
   2. Basis of Payment: Includes hand trimming excavation, bedding and backfilling, pipe and fittings, connection to building service piping and to municipal system.

B. Catch Basins and Cleanouts:
   1. Basis of Measurement: By the unit.

1.04 REFERENCE STANDARDS

A. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2015.

B. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2015.

C. ASTM D 667 - Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.

D. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2012.

E. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2014.

F. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.

G. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2014.

H. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.

I. ASTM F 2648 - Standard Specification for 2 to 60-inch Annular Corrugated Profile Wall Polyethylene Pipe and Fittings.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of storm drains with local authority having jurisdiction for permits and inspections with regard to size, material, location and installation of service utilities.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers and local inspection authorities.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

A. Product Data: Provide data indicating pipe and pipe accessories .

B. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

C. Manufacturer's Certificate: Certify that materials meet or exceed specified requirements.

D. Project Record Documents:
   1. Record location of pipe runs, connections, and invert elevations.
   2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 STORM SEWER PIPE MATERIALS

A. Cast Iron Soil Pipe: ASTM A 74, Extra Heavy grade, hub and spigot end.

B. Concrete Pipe Joint Devices: ASTM C443 (ASTM C443M) rubber compression gasket joint.

C. Concrete Pipe: Reinforced, ASTM C 76 (ASTM C 76M), Class II with Wall type A; mesh reinforcement; bell and spigot end joints.

D. Reinforced Concrete Pipe Joint Device: ASTM C443 (ASTM C443M) rubber compression gasket joint.

E. Plastic Pipe: ASTM D 2751, SDR 35, Acrylonitrile-Butadiene-Styrene (ABS) material; bell and spigot style solvent sealed joint end.

F. Plastic Pipe: ASTM D 2729, Poly(Vinyl Chloride) (PVC) material; bell and spigot style solvent sealed joint end.

G. Plastic Pipe: ASTM D 3034, Type PSM, Poly(Vinyl Chloride) (PVC) material; bell and spigot style solvent sealed joint end.

H. Plastic Pipe: ASTM D 1785, Schedule 40, Poly(Vinyl Chloride) (PVC) material; bell and spigot style solvent sealed joint end.

I. Corrugated Steel Pipe: AASHTO M 36M Type I; helical lock seam; coated inside and out with 0.050 inch thick bituminous coating.

J. Coupling Bands: Galvanized steel, 0.052 inches thick x 10 inches (250 mm) wide; connected with two neoprene "O" ring gaskets and two galvanized steel bolts.

K. ADS N-12 WT 1B Pipe: ASTM F 2648; 4 inches to 60 inches High Density Polyethylene; bell and spigot ends with a gasket seal.

2.02 PIPE ACCESSORIES

A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

B. Filter Fabric: Non-biodegradable, woven.

2.03 CATCH BASIN, TRENCH DRAIN, CLEANOUT, AND AREA DRAIN COMPONENTS

A. Lids and Drain Covers: Cast iron.
   1. Catch Basin:
      a. H-20 loaded.
      b. Nominal Lid and Frame Size: As shown on drawings.
   2. Cleanout:
      a. Lid Design: As shown on drawings.
      b. H-20 loaded.
      c. Nominal Lid and Frame Size: As shown on drawings.
   3. Area Drain:
      a. Lid Design: As shown on drawings.
      b. H-20 loaded.
      c. Nominal Lid and Frame Size: As shown on drawings.

B. Trench Drain System: Trench drain system assembled from factory fabricated, concrete castings in standard lengths; with or without built in slope; with integral joints and optional grating support rails; includes grating.
   1. Grating Material and Style: Slotted cast iron.
   2. Trench Width: As shown on the drawings.
   3. Trench Section Length: As shown on the drawings.

2.04 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 31 2316.13.

B. Cover: As specified in Section 31 2316.13.

PART 3 EXECUTION

3.01 TRENCHING

A. See Section 31 2316.13 for additional requirements.

B. Hand trim excavation for accurate placement of pipe to elevations indicated.

C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.02 INSTALLATION

A. Verify that trench cut or excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
   1. Plastic Pipe: Also comply with ASTM D2321.

C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Connect to building storm drainage system, foundation drainage system, and utility/municipal system.

E. Make connections through walls through sleeved openings, where provided.

3.03 INSTALLATION - CATCH BASINS, TRENCH DRAINS AND CLEANOUTS

A. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe end sections.

3.04 FIELD QUALITY CONTROL

A. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

3.05 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 33 4211