PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
   2. Sleeve-seal systems.
   5. Silicone sealants.

B. Related Requirements:
   1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.02 MEASUREMENT AND PAYMENT

A. Payment for Sleeves and Sleeve Seals for Communications Pathways and Cabling is on a Lump Sum basis.

PART 2 - PRODUCTS

2.01 SLEEVES

A. Wall Sleeves:
   2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube
closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:
   2. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
      b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

D. It is the Contractor’s responsibility to confirm that all products/vendors meet the “BUY AMERICA” requirement and the Contractor must provide documentation in accordance with Specification 01 33 00 – Submittal Procedures.

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Advance Products & Systems, Inc.
      b. CALPICO, Inc.
      c. Metraflex Company (The).
      d. Pipeline Seal and Insulator, Inc.
      e. Proco Products, Inc.
   2. Sealing Elements: EPDM or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Stainless steel.
   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
1. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by the following:

a. Presealed Systems.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.


C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

   a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

   b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Preparing subgrades for walks.

2. Excavating and backfilling for buildings and structures.

3. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for 31 20 00 EARTH MOVING. Include price for all EARTH MOVING in Bid Form line item 03 30 00 CAST-IN-PLACE CONCRETE. The price shall include all work and material required for EARTH MOVING as described in the plans and specifications.

1.03 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.

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

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

1. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
D. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

E. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

F. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.04 PREINSTALLATION MEETINGS

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

1. Require representatives of each entity directly concerned with earthwork to attend, including the following:

   a. Contractor's superintendent.

   b. Representatives of the Owner, Architect, Structural Engineer, and Civil Engineer.

   c. Owner's geotechnical consultant.

2. Earthwork subcontractorReview methods and procedures related to earthmoving, including, but not limited to, the following:

   a. Review geotechnical report and recommendations that has been prepared for this site.

   b. Personnel and equipment needed to make progress and avoid delays.

   c. Coordination of Work with utility locator service.

   d. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.

   e. Extent of trenching by hand or with air spade.

   f. Field quality control.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Warning tapes.
B. Samples for Verification: For the following products, in sizes indicated below:

   1. Warning Tape: 12 inches long; of each color.

1.06 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For each on-site soil material proposed for fill and backfill as follows:

   1. Classification according to ASTM D 2487.
   2. Laboratory compaction curve according to ASTM D 698.

1.07 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
   3. Provide barriers to direct vehicle and pedestrian traffic around construction site. Cover open excavation at the end of each work day.

B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

   1. Clearly mark, on the ground, the location of existing utilities with wire and flag markers that are color coded by type of utility.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures are in place.

PART 2 - P R O D U C T S

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, a combination of these groups, or other soils acceptable to the Owner’s geotechnical consultant; free of rock or gravel larger
than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soils not acceptable to the Owner's geotechnical consultant.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Sand: ASTM C 33/C 33M; fine aggregate.

2.02 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:


2. Yellow: Gas, oil, steam, and dangerous materials.

3. Orange: Telephone and other communications.

4. Blue: Water systems.

5. Green: Sewer systems.
PART 3 - EXECUTION

3.01 PREPARATION

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

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

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

3.02 DEWATERING

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

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.03 EXPLOSIVES

A. Explosives: Do not use explosives.

3.04 EXCAVATION, GENERAL

A. Obtain a copy of the geotechnical report that has been prepared for this site. Comply with the geotechnical report’s recommendations. If recommendations in the report conflict with the Specifications, notify the Contracting Officer for clarification.

B. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
3.05 EXCAVATION FOR STRUCTURES

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

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.07 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

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

1. Clearance: As indicated.

C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.08 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.09 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for Record Documents.

3. Testing and inspecting underground utilities.

4. Removing concrete formwork.

5. Removing trash and debris.

6. Removing temporary shoring, bracing, and sheeting.

7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.
3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 “Cast-in-Place Concrete.”

D. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Division 03 “Cast-in-Place Concrete.”

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. At the locations where utility trenches go under on grade building, disrupt aggregate bedding joint with two feet of compacted impervious “fat” clay.

G. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
   
   a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.

H. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

I. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under walks and pavements, use satisfactory soil material.
   2. Under building slabs, use engineered fill.
   3. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

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

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
   2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Walks: Plus or minus 1 inch.

2. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 FIELD QUALITY CONTROL

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

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.

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

3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION
PART 1  G E N E R A L

1.01 SECTION INCLUDES

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

A.02 MEASUREMENT AND PAYMENT

A. No additional payment will be made for Work under this section. Include price with applicable utility construction.

B. No additional payment will be made for over excavated trench bottom, in the following situations:

   1. No payment will be paid if Owner’s Representative does not direct Contractor to over excavate trench bottom.

   2. No over excavation will be measured or paid when unsuitable conditions result from dewatering system not in conformance with Section 01 57 25 – Control of Ground Water and Surface Water.

C. No additional payment will be made for performing Critical Location exploratory excavation. Include cost in unit price for installed underground piping, sewer, conduit, or duct work.

D. Unit Price Line Item – Extra Unit Price Table

   1. If Owner’s Representative directs Contractor to over excavate trench bottom, Contractor will be paid by unit price bid per linear foot under bid item “6-Inch Over-excavation of Trench Bottom”.

1.03 DEFINITIONS

A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on Drawings, or foundation backfill material placed and compacted in over–excavations.

B. Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.
C. **Haunching:** Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.

D. **Initial Backfill:** Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.

E. **Pipe Embedment:** Portion of trench backfill that consists of bedding, haunching, and initial backfill.

F. **Trench Zone:** Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.

G. **Unsuitable Material:** Unsuitable soil materials are the following:
   1. Materials that are classified as ML, CL–ML, MH, PT, OH, and OL according to ASTM D 2487.
   2. Materials that cannot be compacted to required density due to either gradation, plasticity, or moisture content.
   3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
   4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

H. **Suitable Material:** Suitable soil materials are those meeting specification requirements. Materials mixed with lime, fly ash, or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, unless otherwise indicated.

I. **Backfill:** Suitable material meeting specified quality requirements, placed, and compacted under controlled conditions.

J. **Ground Water Control Systems:** Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Section 01 57 25 – Control of Ground Water and Surface Water.

K. **Surface Water Control:** Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.
L. **Excavation Drainage:** Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D 2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.

M. **Trench Conditions** are defined with regard to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.

1. **Dry Stable Trench:** Stable and substantially dry trench conditions exist in pipe embedment zone as result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.

2. **Stable Trench with Seepage:** Stable trench in which ground water seepage is controlled by excavation drainage.
   
   a. **Stable Trench with Seepage in Clayey Soils:** Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
   
   b. **Stable Wet Trench in Sandy Soils:** Excavation drainage is provided in embedment zone in combination with ground water control in predominately sandy or silty soils.

3. **Unstable Trench:** Unstable trench conditions exist in pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving, or loss of density.

N. **Sub-trench:** Sub-trench is special case of benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by Contractor.

O. **Trench Dam:** Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along trench.

P. **Over-Excavation and Backfill:** Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.
Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.

R. Trench Safety Systems include both protective systems and shoring systems as defined in Section 31 50 01 – Trench Safety Systems.

S. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by cave-in, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.

T. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements.

U. Special Shoring: Shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on Drawings.

V. Vacuum Excavation: An excavation technique performed by an experienced subcontractor in which water or air jets are used to slough off and vacuum away soil.

1.04 REFERENCES


1.05 SCHEDULING

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

1.06 SUBMITTALS

A. Conform to requirements of Section 01 33 00 – Submittal Procedures.

B. Submit proposed vacuum excavation method and qualifications of proposed subcontractor for approval by Owner’s Representative.

C. Submit planned typical method of excavation, backfill placement, and compaction including:

   1. Trench widths.

   2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.

   3. Procedures for assuring compaction against undisturbed soil when premanufactured trench safety systems are proposed.

D. Submit backfill material sources and product quality information in accordance with requirements of Section 31 23 32 – Utility Backfill Materials.

E. Submit trench excavation safety program in accordance with requirements of Section 31 50 01 – Trench Safety System. Include designs for special shoring meeting requirements defined in Paragraph 1.08, Special Shoring Design Requirements contained herein.

F. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.
G. Submit 11 inch by 17 inch copy of Drawing with plotted utility or obstruction location titled “Potential Obstruction Report” to Owner’s Representative.

1.07 TESTS

A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the Owner in accordance with requirements of Section 01 45 29 – Testing Laboratory Services and as specified in this Section.

B. Perform backfill material source qualification testing in accordance with requirements of Section 31 23 32 – Utility Backfill Materials.

1.08 SPECIAL SHORING DESIGN REQUIREMENTS

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

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.

B. Use only hand-operated tamping equipment until minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.

C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.

D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting requirements as specified in Paragraph 1.08, Special Shoring Design Requirements.

2.02 MATERIAL CLASSIFICATIONS

A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Section 31 23 32 - Utility Backfill Materials and
Section 02321 - Cement Stabilized Sand the City of Houston Standard Specifications.

B. Concrete Backfill: Conform to requirements for Class B concrete as specified in Section 03315 – Concrete for Utility Construction of the City of Houston Standard Specifications.

C. Geotextile (Filter Fabric): Conform to requirements of Section 02621 – Geotextile of the City of Houston Standard Specifications.

D. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.

PART 3 EXECUTION

3.01 STANDARD PRACTICE

A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.

B. Install rigid pipe to conform to standard practice described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.

C. Classification of material will be determined by the Owner’s Representative, based on documentation from the Contractor.

3.02 PREPARATION

A. Establish traffic control to conform with requirements of Section 01 14 16 – Safety and Security.

B. Maintain barricades and warning lights for streets and intersections affected by Work, and are considered hazardous to traffic movements.

C. Perform work to conform with applicable safety standards and regulations. Employ trench safety system as specified in Section 31 50 01 – Trench Safety Systems.

D. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from Owner’s Representative and agency for any repairs or relocations, either temporary or permanent.

E. Remove existing pavements and structures, including sidewalks and driveways, to conform with requirements of Section 02 41 14 – Removing Existing Pavements and Structures, as applicable.
F. Install and operate necessary dewatering and surface water control measures to conform with Section 01 57 25 – Control of Ground Water and Surface Water. Provide stable trench to allow installation in accordance with Specifications.

G. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Section 01 57 25 – Field Surveying.

H. Limit concrete removal, pavement removal, and dewatering to less than five pipe laying days in advance of pipe laying.

3.03 CRITICAL LOCATION INVESTIGATION

A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. Unless otherwise approved by Owner’s Representative, at Critical Locations shown on Drawings, perform vacuum excavation to field verify horizontal and vertical locations of such lines within zone of 2 feet vertically and 4 feet horizontally of proposed work.

1. Verify location of existing utilities prior to manufacturing pipe and prior to beginning installation of auger pit or tunnel shaft. Use extreme caution and care when uncovering utilities designated by Critical Locate.

2. Notify Owner’s Representative in writing immediately upon identification of obstruction. In event of failure to identify obstruction in minimum of 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time Owner’s Representative is notified of obstruction.

C. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Owner’s Representative with 48 hours notice prior to field excavation or related work.

D. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot on 12 inch by 18 inch copy of Drawings. For large diameter water lines, submit to Owner’s Representative for approval, horizontal and vertical alignment dimensions for connections to existing lines, tied into project baseline, signed, and sealed by R.P.L.S.

3.04 PROTECTION
A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.

D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to Owner.

3.05 EXCAVATION

A. Except as otherwise specified or shown on Drawings, install underground utilities in open cut trenches with vertical sides.

B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.

C. Determine trench excavation widths using following schedule as related to pipe outside diameter (O.D.).

<table>
<thead>
<tr>
<th>Nominal Pipe Size, O.D.</th>
<th>Minimum Trench Width, O.D. +</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 18</td>
<td>18</td>
</tr>
<tr>
<td>18 to 30</td>
<td>24</td>
</tr>
<tr>
<td>Over 30</td>
<td>36</td>
</tr>
</tbody>
</table>

Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

D. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment, and backfill, and other materials.

E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Owner’s Representative and obtain instructions before proceeding.
F. Shoring of Trench Walls.
   1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.
   2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports sufficiently tight to prevent washing trench wall soil out from behind trench wall support.
   3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by Owner's Representative. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and trench wall in vicinity of pipe zone.
   4. Employ special methods for maintaining integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
   5. If sheeting or other shoring is used below top of pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into embedment zone shall be equivalent of 1-inch-thick steel plate. As sheeting is removed, fill in voids left with grouting material.

G. Use of Trench Shields. When trench shield (trench box) is used as worker safety device, the following requirements apply:
   1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to trench sidewalls.
   2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Recompact after shield is moved is soil is disturbed.
   3. When required, place, spread, and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
   4. Maintain trench shield in position to allow sampling and testing to be performed in safe manner.
   5. Conform to applicable Government regulations.
H. Voids under paving area outside shield caused by Contractor’s work will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports.

I. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.

J. Coordinate excavation within 15 feet of pipeline with company’s representative. Support pipeline with methods agreed to by pipeline company’s representative. Use small, rubber-tired excavator, such as backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within 1 foot of pipeline company’s line. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by pipeline company’s representative.

K. When, during excavation to uncover pipeline company’s pipelines, screwed collar or an oxyacetylene weld is exposed, immediately notify Owner’s Representative. Provide supports for collar or welds. Discuss with pipeline company’s representative and determine methods of supporting collar or weld during excavation and later backfilling operations. When collar is exposed, request pipeline company to provide welder in a timely manner to weld ends of collar prior to backfilling of excavation.

3.06 HANDLING EXCAVATED MATERIALS

A. Use only excavated materials which are suitable as defined in this Section and conforming with Section 31 23 32 – Utility Backfill Materials. Place material suitable for backfilling in stockpiles at distance from trench to prevent slides or cave-ins.

B. When required, provide additional backfill material conforming to requirements of Section 31 23 32 – Utility Backfill Materials.

C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect excess stockpiles for use on site. Maintain site conditions in accordance with Section 01 51 00 – Temporary Facilities. Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

3.07 TRENCH FOUNDATION
A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.

B. When wet soil is encountered on trench bottom and dewatering system is not required, overexcavate an additional 6 inches with approval by Owner’s Representative. Place nonwoven geotextile fabric and then compact 12 inches of crushed stone in one lift on top of fabric. Compact crushed stone with four passes of vibratory-type compaction equipment.

C. Perform over excavation, when directed by Owner’s Representative, in accordance with Paragraph 3.07B above.

1. Even though Contractor has not determined material to be unsuitable, or

2. If unstable trench bottom is encountered and an adequate ground water control system is installed and operating according to Section 01 57 25 – Control of Ground Water and Surface Water.

D. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.08 PIPE EMBEDMENT, PLACEMENT, AND COMPACTION

A. Remove loose, sloughing, caving, or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.

B. Place embedment including bedding, haunching, and initial backfill as shown on Drawings.

C. For pipe installation, manually spread embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement and compaction directly against undisturbed soils in trench sidewalls, or against sheeting which is to remain in place.

D. Do not place trench shields or shoring within height of embedment zone unless means to maintain density of compacted embedment material are used. If moveable supports are used in embedment zone, lift supports incrementally to allow placement and compaction of material against undisturbed soil.

E. Place geotextile to prevent particle migration from in-situ soil into open–graded (Class I) embedment materials or drainage layers.
F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.

G. Place haunching material manually around pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside pipe with sand bags or other suitable means.

H. Place electrical conduit, if used, directly on foundation without bedding.

I. Shovel in-place and compact embedment material using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping is not allowed.

J. For water lines construction embedment, use bank run sand, concrete sand, gem sand, pea gravel, or crushed limestone as specified in Section 31 23 32 – Utility Backfill Material. For water lines adhere to the following subparagraph numbers 1 and 2; for utility installation other than water, adhere to numbers 3 and 4 below:

1. Class I, II, and III Embedment Materials:
   a. Maximum 6 inch compacted lift thickness.
   b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
   c. Moisture content to be within –3 percent to +5 percent of optimum as determined according to ASTM D 698, unless otherwise approved by Owner’s Representative.

2. Cement Stabilized Sand:
   a. Maximum 6 inch compacted thickness.
   b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
   c. Moisture content to be on dry side of optimum as determined according to ASTM D 698 but sufficient for effective hydration.

3. Class I Embedment Materials.
   a. Maximum 6 inch compacted lift thickness.
3.09 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only minimum length of trench open as necessary for construction.

B. For water lines, under pavement and to within one foot back of curb, use backfill materials described by trench limits.

1. For water lines 20 inches in diameter and smaller, use bank run sand or select backfill materials up to pavement base or subgrade.

2. For water lines 24 inches in diameter and larger, backfill with suitable on-site material (random backfill) up to 12 inches below pavement base or subgrade. Place minimum of 12 inches of select backfill below pavement base or subgrade.

C. For sewer pipes under pavement and to within one foot back of curb, use backfill materials described by trench limits.

1. For sewer pipes 36 inches in diameter and smaller use cement stabilized sand up to pavement base or subgrade.
2. For sewer pipes 42 inches in diameter and larger, backfill with suitable on-site material (random backfill) up to 12 inches below pavement base or subgrade. Place minimum of 12 inches of select backfill below pavement base or subgrade.

D. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave sheeting in place. Cut off sheeting 1.5 feet or more above crown of pipe. Remove trench supports within 5 feet from ground surface.

E. Where shown on the Drawings, remove unsuitable material from the site and backfill with suitable material.

F. Unless otherwise shown on Drawings. Use one of the following trench zone backfills under pavement and to within one foot of edge of pavement. Place trench zone backfill in lifts and compact. Fully compact each lift before placement of next lift.

1. Class I, II, or III or combination thereof:
   a. Place in maximum 12-inch thick loose layers.
   b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
   c. Moisture content within zero percent to +5 percent of optimum determined according to ASTM D 698, unless otherwise approved by Owner’s Representative.

2. Cement-Stabilized Sand:
   a. Maximum lift thickness determined by Contractor to achieve uniform placement and required compaction, but do not exceed 12 inches.
   b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 538.
   c. Moisture content on dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.

3. Class IVA and IVB (Clay Soils):
   a. Place in maximum 8-inch thick loose lifts.
   b. Compact by vibratory Sheepfoot Roller to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
c. Moisture content within zero percent to +5 percent above optimum determined according to ASTM D 698, unless approved by Owner’s Representative.

G. Unless otherwise shown on Drawings, for trench excavations not under pavement, random backfill of suitable material may be used in trench zone.

1. Class IVA and IVB (Clay Soils) may be used as trench zone backfill outside paved areas.

2. Place in maximum 12-inch thick loose lift.

3. Compaction by appropriate equipment to minimum of 90 percent of maximum dry density determined according to ASTM D 698.

4. Moisture content as necessary to achieve density.

H. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.

I. Buried warning and identification tape for non-metallic pipe.

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on roles, 18 inch minimum width, blue color for water line with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, “CAUTION, BURIED WATER LINE BELOW” or similar wording. Color and printing shall be permanent, unaffected by moisture or soil. Warning and identification tape shall be centered above water main and buried 36-inches below finished grade.

Detectable Warning Tape for Non-Metallic Piping shall be polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 5.0 mil. Tape shall have a minimum tensile strength of 1,500 psi lengthwise and 1,250 psi crosswise. Tape shall be manufactured with integral wires, foil, or other means of enabling detection by a metal detector when tape is buried up to 36-inches. Encase metallic element of the tape in a protective jacket or provide other means of corrosion protection.

3.10 MANHOLES, JUNCTION BOXES, AND OTHER PIPELINE STRUCTURES

Encapsulate manhole, junction box and other pipeline structures with cement stabilized sand; minimum of 1 foot below base, minimum 1 foot around walls, up to within 12 inches of pavement subgrade. Compact in accordance with Paragraph 3.09.F.2 of this Section.
3.11 FIELD QUALITY CONTROL

A. Test for material source qualifications as defined in Section 31 23 32 – Utility Backfill Materials.

B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction at no additional cost to Owner.

C. Tests will be performed on minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity, or when requested by Owner’s Representative.

D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement-stabilized sand in accordance with ASTM D 558. Perform additional moisture-density relationship tests once a month or whenever there is noticeable change in material gradation or plasticity.

E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions.

1. For open cut construction projects and auger pits: Unless otherwise approved by Owner’s Representative, successful compaction to be measured by one test per 40 linear feet measured along pipe for compacted embedment and two tests per 40 linear feet measured along pipe for compacted trench zone backfill material. Length of auger pits to be measured to arrive at 40 linear feet.

2. A minimum of three density tests for each full shift of Work.

3. Density tests will be distributed among placement areas. Placement areas are: foundation, bedding, haunching, initial backfill, and trench zone.

4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.

5. Density tests may be performed at various depths below fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.
6. Two verification tests will be performed adjacent to in-place tests showing density less than acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.

7. Recompacted placement will be retested at same frequency as first test series, including verification tests.

8. Identify elevation of test with respect to natural ground or pavement.

F. Recondition, recompact, and retest at Contractor’s expense if tests indicate Work does not meet specified compaction requirements. For hardened soil cement with nonconforming density, core and test for compressive strength at Contractor’s expense.

G. Acceptability of crushed rock compaction will be determined by inspection.

3.12 DISPOSAL OF EXCESS MATERIAL

Dispose of excess materials in accordance with requirements of Section 01 74 00 – Waste Material Disposal.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Material Classifications.

B. Utility Backfill Materials:
   1. Concrete sand
   2. Gem sand
   3. Pea gravel
   4. Crushed stone
   5. Crushed concrete
   6. Bank run sand
   7. Select backfill
   8. Random backfill

C. Material Handling and Quality Control Requirements.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for backfill material. Include payment in price for applicable utility installation.

1.03 DEFINITIONS

A. Unsuitable Material:
   1. Materials classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
   2. Materials that cannot be compacted to required density due to either gradation, plasticity, or moisture content.
3. Materials containing large clods, aggregates, or stones greater than 4 inches in any dimension; debris, vegetation, or waste; or any other deleterious materials.

4. Materials contaminated with hydrocarbons or other chemical contaminants.

B. Suitable Material:

1. Materials meeting specification requirements.

2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.

C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.

E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.

F. Embedment Material: Soil material placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.

G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.

H. Foundation: Either suitable soil of trench bottom, or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.
I. Source: Source selected by Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.

J. Refer to Section 31 23 18 - Excavation and Backfill for Utilities for other definitions regarding utility installation by trench construction.

1.04 REFERENCES


H. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).


L. TxDOT Tex-110-E - Determining Particle Size Analysis of Soils.

M. TxDOT Tex-460-A - Material Finer Than 75 µm (No.200) Sieve In Mineral Aggregates (Decantation Test for Concrete Aggregates).
1.05 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Submit description of source, material classification and product description, production method, and application of backfill materials.

C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.03, Material Testing, of this specification.

D. Before stockpiling materials, submit copy of temporary easement or approval from landowner for stockpiling backfill material on private property.

E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off-site sources or is being paid as specific bid item.

1.06 TESTS

A. Perform tests of sources for backfill material in accordance with Paragraph 2.03B.

B. Verification tests of backfill materials may be performed by the Owner in accordance with Section 01 45 29 - Testing Laboratory Services and in accordance with Paragraph 3.03, Field Quality Control, of this specification.

PART 2 PRODUCTS

2.01 MATERIAL CLASSIFICATIONS

A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02.

B. Class Designations Based on Laboratory Testing:

1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):

   a. Plasticity index: non-plastic.
b. Gradation: $D_{60}/D_{10}$ - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.

2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):
   b. Gradations:
      1. Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
      2. Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
      3. Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.

3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
   a. Plasticity index: greater than 7.
   b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.

   a. Plasticity Indexes:
      1. Plasticity index: greater than 7, and above A line.
   b. Liquid limit: less than 50.
   c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
   d. Inorganic.

5. Class IVB: Fat clays (CH)
   a. Plasticity index: above A line.
b. Liquid limit: 50 or greater.

c. Gradation: amount passing No. 200 sieve - greater than 50 percent.

d. Inorganic.

6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

2.02 PRODUCT DESCRIPTIONS

A. Soils classified as silt (ML) silty clay (CL-ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Owner's Representative. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification. Refer to Section 02316 - Excavation and Backfill for Structures, of the City of Houston standard specifications and Section 31 23 18 - Excavation and Backfill for Utilities.

B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:

1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.

2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.

3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.

C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification, and approved by Owner’s Representative provided that physical property criteria are determined to be satisfactory by testing.

D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D 2487) meeting following requirements:
1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D 1140. Amount of clay lumps or balls not exceeding 2 percent.

2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318: Plasticity index: not exceeding 7.

E. Concrete Sand: Natural sand, manufactured sand, or combination of natural and manufactured sand conforming to requirements of ASTM C 33 and graded within following limits when tested in accordance with ASTM C 136:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95 to 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>80 to 100</td>
</tr>
<tr>
<td>No. 16</td>
<td>50 to 85</td>
</tr>
<tr>
<td>No. 30</td>
<td>25 to 60</td>
</tr>
<tr>
<td>No. 50</td>
<td>10 to 30</td>
</tr>
<tr>
<td>No. 100</td>
<td>2 to 10</td>
</tr>
</tbody>
</table>

F. Gem Sand: Sand conforming to requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>95 to 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>60 to 80</td>
</tr>
<tr>
<td>No. 8</td>
<td>15 to 40</td>
</tr>
</tbody>
</table>

G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>½&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>85 to 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>10 to 30</td>
</tr>
<tr>
<td>No. 8</td>
<td>0 to 10</td>
</tr>
<tr>
<td>No. 16</td>
<td>0 to 5</td>
</tr>
</tbody>
</table>
H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for same construction activity from single source, unless otherwise approved by Owner’s Representative.

2. Non-plastic fines.

3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.

4. Crushed aggregate shall have minimum of 90 percent of particles retained on No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A, Part I.

5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable material for embedment where crushed stone is shown on applicable utility embedment drawing details.

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

7. Gradations, as determined in accordance with Tex-110-E.

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing by Weight for Pipe Embedment by Ranges of Nominal Pipes Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;15&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
<td>95 - 100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>60 - 90</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>25 - 60</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>-</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 - 5</td>
</tr>
<tr>
<td>No. 8</td>
<td>-</td>
</tr>
</tbody>
</table>
I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Section 02951 - Pavement Repair and Resurfacing of the City of Houston standard specifications, to meet plasticity criteria.

J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by applicable backfill installation specification. Refer to Section 02316 - Excavation and Backfill for Structures of the City of Houston standard specifications and Section 31 23 18 - Excavation and Backfill for Utilities.

K. Cement Stabilized Sand: Conform to requirements of Section 02321 - Cement Stabilized Sand of the City of Houston standard specifications.

L. Concrete Backfill: Conform to Class B concrete as specified in Section 03315 - Concrete for Utility Construction of the City of Houston standard specifications.

M. Flowable Fill Material: Where shown on Drawings, controlled low-strength material consisting of fluid mixture of cement, fly ash, aggregate, water, and with admixtures as necessary to provide workable properties. Long-term unconfined compressive strength shall be 300 psi minimum.

2.03 MATERIAL TESTING

A. Source Qualification. Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:


2. Plasticity of material passing No. 40 sieve

3. Los Angeles abrasion wear of material retained on No. 4 sieve

4. Clay lumps

5. Lightweight pieces
6. Organic impurities

B. Production Testing. Provide reports to Owner’s Representative from an independent testing laboratory that backfill materials to be placed in Work meet applicable specification requirements.

C. Assist Owner’s Representative in obtaining material samples for verification testing at source or at production plant.

D. Testing of Flowable Fill Material shall be performed in accordance with ASTM D 4832-02 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

PART 3 EXECUTION

3.01 SOURCES

A. Use of existing material in trench excavations is acceptable, provided applicable specification requirements are satisfied.

B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that Owner’s Representative may obtain samples for verification testing.

C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once material is approved by Owner’s Representative, expense for sampling and testing required to change to different material will be credited to the Owner through change order.

D. Bank run sand, select backfill, and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.

E. The Owner does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.
3.02 MATERIAL HANDLING

A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.

B. Establish temporary stockpile locations for practical material handling, control, and verification testing by Owner’s Representative in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.

C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.

D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.03 FIELD QUALITY CONTROL

A. Quality Control

1. The Owner’s Representative may sample and test backfill at:

   a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.

   b. On-site stockpiles.

   c. Materials placed in Work.

2. The Owner’s Representative may re-sample material at any stage of work or location if changes in characteristics are apparent.

END OF SECTION
Section 31 50 01

TRENCH SAFETY SYSTEM

PART 1  GENERAL

1.01  SECTION INCLUDES

A.  Trench safety system for construction of trench excavations.

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

10.2  Measurement and Payment

A.  No separate payment will be made for trench safety systems used on trench excavations or for structural excavations, tunnel shafts, auger pits, or excavation for trenchless installations under this section. Include payment for Trench Safety Systems in applicable structural or utility installation sections.

1.03  DEFINITIONS

A.  Trench.  Narrow excavation (in relation to its depth) made below surface of ground. In general, depth is greater than width, but width of trench (measured at bottom) is not greater than 15 feet.

B.  Trench safety system requirements shall apply to larger open excavations if erection of structures or other installations limits space between excavation slope and installation to dimensions equivalent of a trench as defined.

C.  Trench safety systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage. Trench safety system is Contractor's methods and means of construction.

D.  Trench Safety Program is the safety procedures governing the presence and activities of individuals working in and around trench excavations.

1.04  SUBMITTALS

A.  Conform to requirements of Section 01 33 00 - Submittal Procedures.

B.  Submit trench safety program specifically for construction of trench excavation. Design trench safety program in accordance with OSHA 29 CFR standards.
C. Trench safety system and special designs containing deviations from OSHA standards to be sealed by a Professional Engineer registered by State of Texas.

D. Review of trench safety system by Owner’s Representative shall only be in regards to compliance with this specification and shall not constitute approval by Owner’s Representative nor relieve Contractor of obligations under State and Federal trench safety laws.

E. Submit certification that trench safety system will not be subjected to loads exceeding those which the system was designed to withstand according to the available construction and geotechnical information. When trench box is used in a manner other than what is indicated and certified in manufacturer's technical data, submit trench box manufacturer certifications of proposed usage.

1.05 REGULATORY REQUIREMENTS

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

B. Reproduction of OSHA standards included in “Subpart P - Excavations” from Federal Register Vol. 54, No. 209 is available upon request to Contractors bidding on projects. The Owner assumes no responsibility for accuracy of reproduction. Obtain copy of this section of Federal Register.


1.06 INDEMNIFICATION

A. Contractor to indemnify and hold harmless the Owner and the Owner’s Representative, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and cost of investigation), judgments or claims by anyone for injury or death of persons resulting from collapse or failure of trenches constructed under this Contract.

B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner and the Owner’s Representative, its employees and agents, in case the Owner and the Owner’s Representative is negligent either by act or omission in providing for trench safety, including, but not limited to
safety program and design reviews, inspections, failures to issue stop work orders, and hiring of Contractor.

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

PART 3  E X E C U T I O N

3.01  INSTALLATION

A. Install and maintain trench safety systems in accordance with provisions of OSHA 29 CFR.

B. Install specially designed trench safety systems in accordance with Contractor’s trench excavation safety program for locations and conditions identified in program.

C. A competent person, as identified in Contractor’s Trench Safety Program, to verify that trench boxes and other pre-manufactured systems are certified for actual installation conditions.

3.02  INSPECTION

A. Contractor, or Contractor’s independently retained consultant, to make daily inspections of trench safety systems to ensure that installed systems and operations meet OSHA 29 CFR and other personnel protection regulations requirements.

B. If evidence of possible cave-ins or slides is apparent, immediately stop work in trench and move personnel to safe locations until necessary precautions have been taken to safeguard personnel entering trench.

C. Maintain permanent record of daily inspections.

3.03  FIELD QUALITY CONTROL

Verify specific applicability of selected or specially designed trench safety systems to each field condition encountered on project.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Section includes dry-installed drilled piers.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for 31 63 29 DRILLED CONCRETE PIERS AND SHAFTS. Include price for all DRILLED CONCRETE PIERS AND SHAFTS in Bid Form line item 03 30 00 CAST-IN-PLACE CONCRETE. The price shall include all work and material required for DRILLED CONCRETE PIERS AND SHAFTS as described in the plans and specifications.

B. Extra depth drilled concrete shaft, per approval of Owner’s Representative, will be paid by the unit price per vertical linear foot under the bid item “Extra Depth Drilled Shaft”. Price for “Extra Depth Drilled Shaft” will be inclusive of all concrete, reinforcing, temporary casings (if required), bentonite slurry (if required), any additional testing, inspections, and all other work necessary.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to drilled piers including, but not limited to, the following:

   a. Review geotechnical report.

   b. Discuss existing utilities and subsurface conditions.

   c. Visit site and review: obstructions, site limits, locations for equipment setup, and requirements for site access.

   d. Review coordination with temporary controls and protections.

   e. Review measurement and payment of unit prices.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Design Mixtures: For each concrete mixture. Submit alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Shop Drawings: For concrete reinforcement, detailing fabricating, bending, supporting, and placing.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: From manufacturer, for the following:

1. Cementitious materials.

2. Admixtures.

3. Steel reinforcement and accessories.

C. Material Test Reports: For each material below, by a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Record drawings.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work.

1.08 FIELD CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in
keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of utility.

2. Do not proceed with interruption of utility without Owner's written permission.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.

2. The geotechnical report is included elsewhere in the Project Manual.

D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each drilled pier and indicate on record Drawings. Cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Drilled-Pier Standard: Comply with ACI 336.1 except as modified in this Section.
2.02 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.03 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150/C 150M, Type I, Type II, or Type I/II.

B. Normal-Weight Aggregate: ASTM C 33/C 33M, graded, 3/4-inch- nominal maximum coarse-aggregate size. Provide aggregate from a single source with documented service record data of at least 10 years’ satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

3. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.04 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.
C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Proportion normal-weight concrete mixture as follows:

1. Compressive Strength (28 Days): As indicated on Drawings.

2. Maximum Water-Cementitious Materials Ratio: 0.50 unless otherwise indicated.

3. Minimum Slump: Capable of maintaining the following slump until completion of placement:
   a. 4 inches unless otherwise indicated.

4. Air Content: Do not air entrain concrete.

2.05 REINFORCEMENT FABRICATION

A. Fabricate steel reinforcement according to CRSI’s “Manual of Standard Practice.”

2.06 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.02 EXCAVATION

A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
1. Obstructions: Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. No changes in the Contract Sum or the Contract Time are authorized for removal of obstructions.

2. Obstructions: Unclassified excavated materials may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. Payment for removing obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work is according to Contract provisions for changes in the Work.

B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

C. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
   1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
   2. Remove water from excavated shafts before concreting.

D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
   1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
   2. Payment for additional authorized excavation is according to Contract provisions for changes in the Work.

E. End-Bearing Drilled Piers: Probe with auger to a depth of 96 inches below bottom elevation of shaft, and visually inspect and classify soil. Verify continuity and thickness of strata.
   1. Test first three drilled piers and one of every six drilled piers thereafter.

F. Temporary Casings may be required. Reference geotechnical report that was prepared for this site for recommendations. Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete, or leave temporary casings in place.

G. Bentonite Slurry may be required. Reference geotechnical report that was prepared for this site for recommendations. Pour concrete through bentonite with a tremie. At end of work, remove bentonite from the jobsite.

1. Bentonite slurry is to be used if water intrusion prevents verification that bottom of excavation is acceptable.

H. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.

1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit corrective construction proposals to Architect for review before proceeding.

### 3.03 STEEL REINFORCEMENT INSTALLATION

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

### 3.04 CONCRETE PLACEMENT

A. Place concrete immediately after verification that excavation is correct. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by a qualified testing agency.

B. Place concrete with a tremie or pump hose.
1. Vibrate top 60 inches of concrete.

C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.

1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.

D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.

1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions sealed under plastic or other effective means for a minimum of seven days.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.

1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities are determined by testing and inspecting agency. Final evaluations and approval of data are determined by Architect.

C. Concrete Tests and Inspections: ASTM C 172/C 172M except modified for slump to comply with ASTM C 94/C 94M.
1. Slump: ASTM C 143/C 143M; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.

2. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and 80 deg F and above, and one test for each set of compressive-strength specimens.

3. Compressive-Strength Tests: ASTM C 39/C 39M; one set for each drilled pier. Test one specimen at seven days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.

4. If frequency of testing provides fewer than five strength tests for a given class of concrete, conduct tests from at least five randomly selected batches or from each batch if fewer than five are used.

5. If strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

6. Strength of each concrete mixture is satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

7. Report test results in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.

8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but not be used as sole basis for approval or rejection of concrete.

9. Additional Tests: Testing and inspecting agency to make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Architect.

   a. Continuous coring of drilled piers may be required, at Contractor’s expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient
concrete quality, presence of voids, segregation, or other possible defects.

10. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports for each drilled pier as follows:

1. Actual top and bottom elevations.

2. Actual drilled-pier diameter at top, bottom, and bell.

3. Description of soil materials.

4. Description, location, and dimensions of obstructions.

5. Final top centerline location and deviations from requirements.

6. Variation of shaft from plumb.

7. Shaft excavating method.

8. Design and tested bearing capacity of bottom.

9. Levelness of bottom and adequacy of cleanout.

10. Properties of slurry and slurry test results at time of slurry placement and at time of concrete placement.

11. Ground-water conditions and water-infiltration rate, depth, and pumping.

12. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.

13. Description of soil or water movement, sidewall stability, loss of ground, and means of control.

14. Date and time of starting and completing excavation.
15. Inspection report.
17. Position of reinforcing steel.
18. Concrete placing method, including elevation of consolidation and delays.
20. Locations of construction joints.
21. Concrete volume.
22. Concrete testing results.
23. Remarks, unusual conditions encountered, and deviations from requirements.

3.06 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner’s property.

END OF SECTION
PART 1  GENERAL

1.1 SECTION INCLUDES

A. Reinforced concrete sidewalks.
B. Wheel chair ramps.
C. Reinforced slope paving.

1.2 MEASUREMENT AND PAYMENT

1. Payment for concrete sidewalks is on a lump sum and will include all work, labor and materials for concrete and base requirements. Limits of concrete walk shown on the drawings are approximate. Contractor shall replace all concrete walk disturbed for the installation of the escalator, canopy, and affected utilities whether shown on plans or not, at no additional cost to the owner.

2. No additional payment will be made for work outside these limits or in areas where pavement, curbing, driveway or similar items have been removed or replaced for Contractor’s convenience. Contractor shall replace all items damaged by the construction, to pre-construction quality at no additional cost to Owner.

1.3 REFERENCES

A. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in Field.
C. ASTM C 42 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
D. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
F. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

G. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN·m/m³).

H. Texas Accessibility Standards of Architectural Barriers Act, Article 9102, Texas Civil Statues.

1.4 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Submit certified testing results and certificates of compliance.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Section 02751 - Concrete Paving of the City of Houston standard specifications.

B. Reinforcing Steel: Conform to material requirements of Section 02751 - Concrete Paving of the City of Houston standard specifications and Section 03 21 15 – Reinforcing Steel.

C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 32 13 75 - Concrete Pavement Joints.

D. Expansion Joint Filler: Conform to material requirements for expansion joint material of Section 32 13 75 - Concrete Pavement Joints.

E. Forms: Use straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. The use of 2 inch by 4 inch lumber as forms will not be allowed.

F. Sand Bed: Conform to material requirements for bank run sand of Section 31 23 32 – Utility Backfill Materials.

G. Sodding: Conform to material requirements for sodding of Section 32 92 23 - Sodding.

H. Coloring for wheelchair ramps: Conform to material requirements as shown
PART 3 EXECUTION

3.1 REPLACEMENT

A. Replace sidewalks and slope paving which are removed or damaged during construction with thickness and width equivalent to one removed or damaged, unless otherwise shown on Drawings. Finish surface (exposed aggregate, brick pavers, etc.) to match existing sidewalk.

B. Provide replaced and new sidewalks with wheelchair ramps when sidewalk intersects curb at street or driveway.

3.2 PREPARATION

A. Identify and protect utilities which are to remain.

B. Protect living trees, other plant growth, and features designated to remain.

C. Conduct clearing and grubbing operations and removal of existing landscape items in the proposed improvement locations, per plan drawings; including relocation of irrigation as needed. Ensure irrigation to other areas to remain unpaved is maintained; re-locating irrigation piping as needed; at no additional cost to the Owner.

D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to line, grade and cross section. For soils with plasticity index above 40 percent, stabilize soil with lime in accordance the City of Houston Standard Specification Section 02336 – Lime-Stabilized Subgrade. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D 698.

E. Immediately after subgrade is prepared, cover with compacted sand bed to depth as shown on Drawings. Lay concrete when sand is moist but not saturated.

3.03 PLACEMENT

A. Setting Forms: Straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. Use of 2 by 4's as forms will not be allowed. Securely stake forms to line and grade. Maintain position during concrete placement.

B. Reinforcement:
1. Install reinforcing bars.

2. Install reinforcing steel as shown on the drawings. Lay longitudinal bars in walk continuously, except through expansion joints.

3. Use sufficient number of chairs to support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.

4. Drill dowels into existing paving, sidewalk and driveways, secure with epoxy, and provide headers as required.

5. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

C. Expansion Joints: Install expansion joints with load transfer units in accordance with Section 32 13 75 - Concrete Pavement Joints.

E. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.

F. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.

G. Apply coating to wheelchair ramp with contrasting color.

H. Unless otherwise indicated on Drawings, mark off sidewalk joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.

I. Finish edges with tool having 1/4 inch radius.

J. After concrete has set sufficiently, refill space along sides of sidewalk to one-inch from top of walk with suitable material. Tamp until firm and solid, place sod as applicable. Dispose of excess material in accordance with Section 01 74 00 - Waste Material Disposal. Repair driveways and parking lots damaged by sidewalk excavation.

3.4 CURING

A. Conform to requirements of Section 03 39 15 - Concrete Pavement Curing.
3.5 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01 45 29 - Testing Laboratory Services.

B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made in accordance with ASTM C 31 for each 30 cubic yards or less of sidewalk that is placed in one day. Two specimens will be tested at 7 days. Remaining two specimens will be tested at 28 days. Specimens will be tested in accordance with ASTM C 39. Minimum compressive strength: 2500 psi at 7 days and 3000 psi at 28 days.

C. Yield test for cement content per cubic yard of concrete will be made in accordance with ASTM C 138. When cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.

D. If the Contractor places concrete without notifying the laboratory, the City will have the concrete tested by means of core test as specified in ASTM C 42. When concrete does not meet specification, cost of test will be deducted from payment.

E. Sampling of fresh concrete shall be in accordance with ASTM C 172.

F. Take slump tests when cylinders are made and when concrete slump appears excessive.

G. Concrete shall be acceptable when average of two 28 day compression tests is equal to or greater than minimum 28 day strength specified.

H. If either of two tests on field samples is less than average of two tests by more than 10 percent, that entire test shall be considered erratic and not indicative of concrete strength. Core samples will be required of in-place concrete in question.

I. If 28 day laboratory test indicates that concrete of low strength has been placed, test concrete in question by taking cores as directed by Project Manager. Take and test at least three representative cores as specified in ASTM C 42 and deduct cost from payment due.

3.6 NONCONFORMING CONCRETE

A. Remove and replace areas that fail compressive strength tests, with concrete of thickness shown on Drawings.
B. Replace nonconforming sections at no additional cost to City.

3.7 PROTECTION

A. Maintain newly place concrete in good condition until completion of Work.

B. Replace damaged areas.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Joints for concrete paving; concrete sidewalks; concrete driveways, curbs, and curb and gutters.
B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for Work under this section. Include payment in price for applicable concrete work.

1. No separate payment will be made for expansion joints.
2. No separate payment will be made for horizontal dowels.
3. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include payment in unit price for Concrete Paving.
4. No separate payment will be made for joints for Curb, Curb and Gutter, Saw-Tooth Curb, Concrete Sidewalks, and Concrete Driveways. Include payment in unit price for Curb and Gutter, Concrete Sidewalks, and Concrete Driveways.

1.03 REFERENCES

A. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
E. TxDOT Tex-525-C – Tests for Asphalt and Concrete Joint Sealers

1.04 SUBMITTALS
A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Submit product data for joint sealing compound and proposed sealing equipment for approval.

C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval. Submit manufacturer’s recommendation for placing sealant(s).

PART 2  P R O D U C T S

2.01 MATERIALS

Filler board of selected stock. Use wood of density and type as follows:

1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.

2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

2.02 PREFORMED EXPANSION JOINT MATERIAL

Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.

2.03 JOINT SEALING COMPOUND

A. Conform joint sealants to one of sealant classes described in this section.

B. Conform hot-poured rubber-asphalt compound conforming to ASTM D 3405.

C. Two-component Synthetic Polymer.

1. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles.

2. Cure sufficiently at average temperature of 25 ± 1°C (77 ± 2°F) so as not to pick up under wheels of traffic in maximum 3 hours.

3. Performance requirements, when tested in accordance with TxDOT Tex-525-C, shall meet above curing times and requirements as follows:
Cold-Extruded and Cold-Pourable (Self-Leveling) Specifications

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration, 25°C (77°F) 150 g Cone, 5 s, 0.1 mm (in.), maximum</td>
<td>130</td>
</tr>
<tr>
<td>Bond and Extension 50%, -29°C (-20°F), 3 cycles:</td>
<td></td>
</tr>
<tr>
<td>- Dry Concrete Block</td>
<td>Pass</td>
</tr>
<tr>
<td>- Steel blocks (Primed, if recommended by manufacturer)</td>
<td>Pass</td>
</tr>
<tr>
<td>*Steel blocks shall be used when armor joints are specified</td>
<td></td>
</tr>
<tr>
<td>Flow at 70°C (158°F)</td>
<td>None</td>
</tr>
<tr>
<td>Water content % by mass, maximum</td>
<td>5.0</td>
</tr>
<tr>
<td>Resilience:</td>
<td></td>
</tr>
<tr>
<td>- Original sample, % min. (cured)</td>
<td>50</td>
</tr>
<tr>
<td>- Oven-aged at 70°C (158°F), % min.</td>
<td>50</td>
</tr>
<tr>
<td>Cold-extruded material only – Cold Flow (10 minutes)</td>
<td>None</td>
</tr>
</tbody>
</table>

After bond and extension test, there shall be no evidence of cracking, separation, or other opening that is over 3 millimeters (⅛ inch) deep in sealer or between sealer and test blocks.

4. Provide cold-extruded type for vertical or sloping joints.

5. Provide self-leveling type for horizontal joints.

D. Self-Leveling, Low Modulus Silicone or Polyurethane Sealant for Asphaltic Concrete and Portland Cement Concrete Joints. This shall be a single component self-leveling silicone or polyurethane material that is compatible with both asphalt and concrete pavements. The sealer shall not require a primer for bond; a backer rod shall be required which is compatible with the sealant; no reaction shall occur between rod and sealant.
When tested in accordance with TxDOT Tex-525-C, self-leveling sealant shall meet following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tack Free Time, 25 ± 1°C (77 ± 2°F), minutes</td>
<td>120 maximum</td>
</tr>
<tr>
<td>Nonvolatile content, % by mass</td>
<td>93 minimum</td>
</tr>
<tr>
<td>Tensile Strength and 24 Hour Extension Test:</td>
<td></td>
</tr>
<tr>
<td>- Initial, 10-day cure, 25 ± 1°C (77 ± 2°F), kPa (psi)</td>
<td>• 21 to 69 (3 to 10)</td>
</tr>
<tr>
<td>- After Water Immersion, kPa (psi)</td>
<td>• 21 to 69 (3 to 10)</td>
</tr>
<tr>
<td>- After Heat Aging, kPa (psi)</td>
<td>• 21 to 69 (3 to 10)</td>
</tr>
<tr>
<td>- After Cycling, -29°C (-20°F), 50%, 3 cycles, kPa (psi)</td>
<td>• 21 to 69 (3 to 10)</td>
</tr>
<tr>
<td>- 24 Hour Extension</td>
<td>• Pass (All Specimens)</td>
</tr>
</tbody>
</table>

After 24 hours, there shall be no evidence of cracking, separation or other opening that is over 3 mm (⅛ in.) deep at any point in the sealer or between the sealer and test blocks.

2.04 LOAD TRANSMISSION DEVICES

A. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.

B. Deformed steel tie bars conforming to ASTM A 615, Grade 60.

2.05 SUPPORTS FOR REINFORCING STEEL AND JOINT ASSEMBLY

Employ supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by Owner’s Representative.

PART 3 EXECUTION

3.01 PLACEMENT

A. When new Work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.

B. If the limit of removal of existing concrete or asphaltic pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling or cracks.
3.02 CONSTRUCTION JOINTS

Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.03 EXPANSION JOINTS

Place ¾ inch expansion joints as follows:

1) At location of existing/proposed concrete interface transverse joints (detail 1 sheet C-502)

2) At locations where proposed concrete meets structure or casting to serve as an isolation joint (detail 4 sheet C-502)

No expansion joints shall be placed in the new proposed concrete except at locations identified above.

3.04 CONTRACTION JOINTS

Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted, and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

3.05 LONGITUDINAL WEAKENED PLANE JOINTS

Place longitudinal weakened plane joints at spaces indicated on Drawings. If more than 15 feet in width is poured, longitudinal joint must be saw cut. Seal groove with joint sealing compound.

3.06 SAWED JOINTS

A. Use sawed joints as alternate to contraction and weakened plane joints. Use circular cutter capable of cutting straight line groove minimum of ¼-inch wide. Maintain depth of one quarter of pavement thickness. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and prior to initiation of cracks. Once sawing has commenced, it shall be continued until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.

B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Maintain ample supply of saw blades at work site during sawing operations. Maintain sawing equipment on job during concrete placement.
3.07 JOINTS FOR CURB, CURB AND GUTTER

Place ¾ inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement; at end of radius returns at street intersections and driveways; and at curb inlets. Maximum spacing shall be 120-foot centers.

3.08 JOINTS FOR CONCRETE SIDEWALKS

Provide ¾-inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 36 feet. Provide expansion joint material conforming to ASTM D 994 for small radius curves and around fire hydrants and utility poles. Extend the expansion joint material full depth of the slab.

3.09 JOINTS FOR CONCRETE DRIVEWAYS

Provide ¾ inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

3.10 JOINT SEALING

A. Seal joints only when surface and joints are dry, ambient temperature is above 50°F and less than 85°F, and weather is not foggy or rainy.

B. Use joint sealing equipment in like new working condition throughout joint sealing operation, and be approved by Owner’s Representative. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.

C. Clean joints of loose scale, dirt, dust, and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.

D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be ¼ inch above level of adjacent surface or at elevation as directed.

3.11 PROTECTION

A. Maintain joints in good condition until completion of Work.

B. Replace damaged joints material with new material as required by this Section.
END OF SECTION
Section 32 91 13

TOPSOIL

PART 1  G E N E R A L

1.01  SECTION INCLUDES

Furnishing and placing topsoil for finish grading and for seeding, sodding, and planting.

1.02  MEASUREMENT AND PAYMENT

A.  No separate payment will be made for topsoil under this Section. Include payment for item in Lump Sum price for Division 32 – Exterior Improvements, item “All Sitework Including New Concrete Paving, Grading, Sodding…”.

PART 2  P R O D U C T S

2.01  TOPSOIL

A.  Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having following characteristics:

1.  pH value of between 5.5 and 6.5
2.  Liquid limit: 50 or less
3.  Plasticity index: 20 or less
4.  Gradation: maximum of 10 percent passing No. 200 sieve

B.  Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials, and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.

C.  Obtain topsoil from naturally well-drained areas where topsoil occurs at minimum depth of 4 inches and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3  E X E C U T I O N

3.01  EXAMINATION
A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by Owner’s Representative.

B. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

C. Provide temporary fencing protection to protect/limit Transit Center patrons from stockpile.

3.03 PLACEMENT

A. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to minimum depth of 4 inches, or as indicated on Drawings. Remove vegetation and foreign inorganic material. Place 4 inches of topsoil on loosened material and roll lightly with appropriate lawn roller to consolidate topsoil.

B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Section 31 23 32 - Utility Backfill Material.

C. For areas to receive shrubs or trees, excavate existing material and place topsoil to depth and dimensions shown on Drawings.

D. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Section 01 74 00 - Waste Material Disposal.

E. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for minimum depth 6 inches, fill in, and recompact areas of settlement.

3.04 PROTECTION

Protect topsoil from wind and water erosion until planting is completed.

END OF SECTION
PART 1  G E N E R A L

1.01  SECTION INCLUDES

A. Restoration of existing lawn areas disturbed by construction shall be by installation of new sod.

B. Planting of sod within areas designated on Drawings for purpose of surface stabilization, channel stabilization or vegetation buffer strips.

C. Sod is defined as blocks, squares, strips of turf grass, and adhering soil used for vegetative planting. To be placed edge to edge for complete coverage.

D. Lawn is defined as ground covered with fine textured grass kept neatly mowed.

1.02  MEASUREMENT AND PAYMENT

No separate payment for Sod in place or for topsoil, water, fertilizer, weed and pest control treatments and maintenance or other items as described below. Include payment for item in Lump Sum price for Division 32 – Exterior Improvements, item “All Sitework Including New Concrete Paving, Grading, Sodding…”.

1.03  SUBMITTALS

Conform to requirements of Section 01 33 00 - Submittal Procedures.

1.04  QUALITY ASSURANCE

A. Sod only when weather and soil conditions are deemed by Owner’s Representative to be suitable for proper placement.

B. Water and fertilize new sod.

C. Guarantee sod to be growing 30 days after substantial completion.
D. **Maintenance Period:**

1. Begin maintenance immediately after each section of grass sod is installed and continue for 30 day period from date of substantial completion.

2. Resod unacceptable areas.

3. Water, fertilize, control disease and insect pests, mow, edge, replace unacceptable materials, and perform other procedures consistent with good horticultural practice to ensure normal, vigorous, and healthy growth. Install disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.

E. Notify Owner’s Representative 10 days before end of maintenance period for inspection.

**PART 2 PRODUCTS**

2.01 **SOD**

A. **Species:** Bermuda (Cynodon Dactylon), Buffalo (Buchloe Dactyloides), or St. Augustine (Stenotaphrum Secundatum) Gulf Coast variety to match existing sod.

B. **Contents:** 95 percent permanent grass suitable to climate in which it is to be placed; not more than 5 percent weeds and undesirable grasses; good texture, free from obnoxious grasses, roots, stones, and foreign materials.

C. **Size:** 12 inch wide strips, uniformly 2 inches thick with clean-cut edges.

D. Sod is to be supplied and maintained in healthy condition as evidenced by grass being normal green color.

2.02 **FERTILIZER**

**Available nutrient percentage by weight:** 12 percent nitrogen, 4 percent phosphoric acid, and 8 percent potash; or 15 percent nitrogen, 5 percent phosphoric acid, and 10 percent potash.

2.03 **WEED AND INSECT TREATMENT**

Provide acceptable treatment to protect sod from weed and insect infestation. Submit treatment method to Owner’s Representative for approval. Install insect and disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.
2.04 WATER

Potable, available on-site through Contractor’s water trucks. Do not use private resident’s water.

2.05 BANK SAND

Free of clay lumps, roots, grass, salt, or other foreign material.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that soil placement and compaction have been satisfactorily completed. Verify that soil is within allowable range of moisture content.

B. Top soil shall be free of weeds and foreign material immediately before sodding. Topsoil shall be placed to 4-inches on loosened material or at an increased depth of 6-inches when placed over sand bedding and backfill materials; as specified in Section 32 91 13 - Topsoil.

C. Do not start work until conditions are satisfactory. Do not start work during inclement or impending inclement weather.

D. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges, or depressions.

E. Spread 2 inch layer of bank sand over areas to be sodded prior to planting of sod.

F. Apply fertilizer at rate of 25 pounds per 1000 square feet. Apply after raking soil surface and not more than 48 hours prior to laying sod. Mix thoroughly into upper 2 inches of soil. Lightly water to aid in dissipation of fertilizer.

3.02 APPLICATION

A. Full Sodding: Lay sod with closely fitted joints leaving no voids and with ends of sod strips staggered. Lay sod within 24 hours of harvesting.

B. On slopes 2:1 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.

C. Prior to placing sod, on slopes 3:1 or where indicated, place Hold/Gro or Roll Lite or equal over topsoil. Securely anchor in place with posts sunk firmly into
ground at maximum 16 feet on center along pitch of slope and equal to width of wire mesh horizontally across slopes.

D. After sod is laid, irrigate thoroughly to secure 6-inch minimum penetration into soil below sod.

E. Tamp and roll sod with approved equipment to eliminate minor irregularities and to form close contact with soil bed immediately after planting and watering. Submit type of tamping and rolling equipment to be used to Owner’s Representative for approval, prior to construction.

3.03 MAINTENANCE

A. Watering:

1. Water lawn areas once a day with minimum ½ inch water for first 3 weeks after area is sodded.

2. After 3 week period, water twice a week with ¾ inch of water each time unless comparable amount has been provided by rain.

3. Make weekly inspections to determine moisture content of soil unless soil is in frozen condition.

4. Water in afternoon or at night to enable soil to absorb maximum amount of water with minimum evaporation.

B. Mowing:

1. Mow sod at intervals which will keep grass height from exceeding 3½ inches.

2. Set mower blades at 2½ inches.

3. Do not remove more than one-half of grass leaf surface.

4. Mow sodded areas requiring mowing within 1 month after installation with light-weight rotary type mower. Mow sod only when dry and not in saturated or soft condition.

5. Remove grass clippings during or immediately after mowing.

C. Fertilizer and Pest Control:

1. Evenly spread fertilizer composite at rate of 40 pounds per 5,000 square feet or as recommended by manufacturer. Do not place fertilizer until 2 weeks after placement of sod.
2. Restore bare or thin areas by topdressing with mix of 50 percent sharp sand and 50 percent sphagnum peat moss.

3. Apply mixture ¼ to ½ inch thick.

4. Treat areas of heavy weed and insect infestation as recommended by treatment manufacturer.

D. Restrict all traffic from sodded areas until sod is established or for minimum 10 days during growing season. Use wood lath and plastic tape to cordon sodded areas. Maintain tape and lath throughout for minimum 30 days during growing season.

3.04 CLEANUP

A. During course of planting, remove excess and waste materials; keep lawn areas clean and take precautions to avoid damage to existing structures, plants, grass, and streets.

B. Remove barriers, signs, and other Contractor material and equipment from project site at termination of establishment period.

C. Dispose of unused materials and rubbish in accordance with Section 01 74 00 - Waste Material Disposal.

END OF SECTION
PART 1  G E N E R A L

1.01  SECTION INCLUDES

Adjusting elevation of manholes, inlets, and valve boxes to new grades.

1.02  MEASUREMENT AND PAYMENT

A. No separate payment will be made for adjusting proposed manhole frames and covers, inlets, valve boxes, meter boxes and other appurtenances to grade for new construction under this Section. Include payment in price for related item.

B. No separate payment will be made for adjusting existing manholes, frame and cover, inlets, valve boxes, meter boxes and other appurtenances to new finished grade. Include payment in price for related item.

PART 2  P R O D U C T S

2.01  CONCRETE MATERIALS

A. Provide concrete, conforming to requirements of Section 03315 - Concrete for Utility Construction of the City of Houston standard specifications.

B. Provide precast concrete manhole sections and adjustment rings conforming to city standards.

C. Provide mortar conforming to requirements of city standards.

2.02  CAST-IRON MATERIALS

Provide cast-iron materials conforming to requirements of Section 33 49 15 - Frames, Grates, Rings, and Covers.

2.03  PIPING MATERIALS

For riser pipes and fittings, refer to city standards for Ductile-iron Pipe and Fittings through Polyethylene Wrap.

2.04  MASONRY MATERIALS FOR STORM SEWER MANHOLES AND INLETS

Provide brick masonry units conforming to the requirements of city standards.

PART 3  E X E C U T I O N
3.01 EXAMINATION

Examine existing structure, valve box, frame and cover or inlet box, frame and cover or inlet, piping and connections for damage or defects affecting adjustment to grade. Report damage or defects to Owner’s Representative.

3.02 ESTABLISHING GRADE

Coordinate grade related items with existing grade and finished grade or paving, and relate to established benchmark or reference line.

3.03 ADJUSTING MANHOLES AND INLETS

A. Rebuild adjustment portion of manhole or inlet by adding or removing Adjustments. Follow procedures for the type of structure being adjusted detailed in the following sections of the city of Houston Standard Construction Specifications:

1. Section 02081 - Cast-In-Place Concrete Manholes
2. Section 02082 - Precast Concrete Manholes
3. Section 02083 - Fiberglass Manholes
4. Section 02087 - Brick Manholes for Storm Sewers
5. Section 02632 - Cast-In-Place Inlets, Headwalls and Wingwalls
6. Section 02633 - Precast Concrete, Inlets, Headwalls and Wingwalls

B. Salvage and reuse cast-iron frame and cover or grate.

C. Protect or block off manhole or inlet bottom using wood forms shaped to fit so that no debris or soil falls to bottom during adjustment.

D. Verify that manholes and inlets are free of visible leaks as result of reconstruction. Repair leaks in manner subject to Owner’s Representative approval.

3.04 ADJUSTING VALVE BOXES

A. Salvage and reuse valve box and surrounding concrete block as approved by Owner’s Representative. No separate pay.

B. Remove and replace 6 inch ductile iron riser pipe with suitable length for depth of cover required to establish adjusted elevation to accommodate actual finish grade.
C. Reinstall valve box and riser piping plumbed in vertical position. Provide minimum 6 inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box for vertical movement damping.

D. After valve box has been set, aligned, and adjusted so that top lid is level with final grade, pour 24 inch by 24 inch by 8 inch thick concrete pad around valve box. Center valve box horizontally within concrete slab.

3.05 BACKFILL AND GRADING

A. Backfill area of excavation surrounding each adjusted manhole, inlet, and valve box and compact according to requirements of city standards for Excavation and Backfill for Structures.

B. Grade ground surface to drain away from each manhole and valve box. Place earth fill around manholes to level of upper rim of manhole frame. Place earth fill around valve box concrete slab.

C. In unpaved areas, grade surface at uniform slope of 1 to 5 from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Section 32 91 13 - Topsoil. Provide sodding in accordance with Section 32 92 23 – Sodding, as plans require.

END OF SECTION
SANITARY SEWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gravity sanitary sewers and appurtenances, including stacks, service connections, clean-outs, Oil Water separator, and sanitary forcemain.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for sanitary sewers under this section. Include price for sanitary sewers with the Lump Sum price for Division 22 – Plumbing; which item includes provide and install complete Sanitary Waste and Vent System. Include all work, materials, backfilling, excavation, piping, cleanouts, oil water separator, clean-outs, service piping, forcemain, connection to existing sanitary system, dewatering and all work necessary to provide and install the sanitary sewer, complete in place.

1.03 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations so as to minimize disruption of utilities to occupied facilities or adjacent property.

C. Test Reports: Submit test reports and inspection videos as specified in Part 3 of this Section. Video tapes become property of Owner.

1.04 QUALITY ASSURANCE

A. Qualifications. Install sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Section 02533 – Acceptance Testing for Sanitary Sewers; of the City of Houston standard specifications.

B. Regulatory Requirements.
   1. Install sewer lines to meet minimum separation distance from potable water line, as scheduled below. Separation distance is defined as distance between outside of water pipe and outside of sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be
achieved, new sanitary sewers shall be installed as specified in this section.

2. Make notification to Owner when water lines are uncovered during sanitary sewer installation where minimum separation distance cannot be maintained.

3. Lay gravity sewer lines in straight alignment and grade.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Inspect pipe and fittings upon arrival of materials at job site.

B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along ground. Do not roll pipe unrestrained from delivery trucks.

C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with interior surface of pipe to lift or move lined pipe.

1.06 MEASUREMENT AND PAYMENT

No separate payment will be made for Work described in this section. Include cost with Lump Sum item of Division 22 – Plumbing, which price includes the complete Sanitary Waste system including but not limited to connection to existing system, all cleanouts, manholes, sump pumps, gravity and forcemain, testing requirements and coordination with others.

PART 2  P R O D U C T S

2.01 PIPE

A. Provide piping materials for gravity sanitary sewers of sizes and types indicated on Drawings or as specified.

B. Unlined reinforced concrete pipe is not acceptable.

2.02 PIPE MATERIAL SCHEDULE

A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in one or more of following Sections of the City of Houston standard specifications:

1. Section 02501 - Ductile Iron Pipe and Fittings.
2. Section 02504 - Fiberglass Reinforced Pipe for gravity pipe.
3. Section 02506 - Polyvinyl Chloride Pipe for gravity pipe.
B. Where shown on Drawings, provide pipe meeting minimum class, dimension ratio, or other criteria indicated.

C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

D. Pipe material for force main piping shall be as specified on MEP drawings and in accordance with TCEQ requirements.

2.03 APPURtenances

A. Stacks. Conform to requirements of Section 02534 - Sanitary Sewer Service Stubs or Reconnections of the City of Houston standard specifications.

B. Service Connections. Conform to requirements of Section 02534 - Sanitary Sewer Service Stubs or Reconnections of the City of Houston standard specifications.

C. Roof, street or other type of surface water drains shall not be connected or reconnected into sanitary sewer lines.

2.04 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill: Conform to requirements of Section 31 23 18 - Excavation and Backfill for Utilities, Section 31 23 32 - Utility Backfill Materials, and Section 02321 - Cement Stabilized Sand of the City of Houston standard specifications.

B. Topsoil: Conform to requirements of Section 32 91 13 - Topsoil.

PART 3 E X E C U T I O N

3.01 PREPARATION

B. Provide barricades, flashing warning lights, and warning signs for excavations. Maintain barricades and warning lights where work is in progress or where traffic (vehicular and pedestrian) is affected by work.

C. Perform work in accordance with OSHA standards. Employ trench safety system as specified in Section 31 50 01 - Trench Safety System for excavations over 5 feet deep.

D. Immediately notify agency or company owning utility line which is damaged, broken or disturbed. Obtain approval from Project Manager and agency or utility company for repairs or relocations, either temporary or permanent.
E. Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Section 02 41 14 - Removing Existing Pavements and Structures.

F. Install and operate dewatering and surface water control measures in accordance with Section 01 57 25 - Control of Ground Water and Surface Water of the COH standard specifications.

G. Do not allow sand, debris or runoff to enter sewer system.

3.02 DIVERSION PUMPING

A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Project Manager.

B. Design piping, joints and accessories to withstand twice maximum system pressure or 50 psi, whichever is greater.

C. No sewage shall be diverted into area outside of sanitary sewer.

D. In event of accidental spill or overflow, immediately stop overflow and take action to clean up and disinfect spillage. Promptly notify Project Manager so that required reporting can be made to TCEQ and Environmental Protection Agency by Project Manager.

3.03 EXCAVATION

A. Earthwork. Conform to requirements of Section 31 23 18 - Excavation and Backfill for Utilities. Use bedding as indicated on Drawings.

B. Line and Grade. Establish required uniform line and grade in trench from benchmarks identified by Project Manager. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect boards and location stakes from damage or dislocation.

C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Section 31 23 18 - Excavation and Backfill for Utilities.

3.04 PIPE INSTALLATION BY OPEN CUT

A. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.
B. Install pipe only after excavation is completed, bottom of trench fine graded, bedding material is installed, and trench has been approved by Project Manager.

C. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.

D. Install pipe with spigot ends toward downstream end of flow such that water flows into bell and out the spigot.

E. Form concentric joint with each section of adjoining pipe so as to prevent offsets.

F. Keep interior of pipe clean as installation progresses. Remove foreign material and debris from pipe.

G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Project Manager.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.

J. Where gravity sanitary sewer is to be installed under existing water line with separation distance of at least 2 feet and less than 9 feet, install new sewer pipe so that one full 18 foot long pipe is centered on water line crossing. Embed sewer pipe in cement stabilized sand for minimum distance of 9 feet on each side of crossing.

K. Where gravity sanitary sewer is to be installed under existing water line with separation distance of less than 2 feet, install new sewer using pressure-rated pipe as shown on Drawings. Maintain minimum 1 foot separation distance.

L. Where the length of the stub is not indicated, install the stub to the right-of-way line and seal the free end with an approved plug.

3.06 INSTALLATION OF APPURTEENANCES
A. Service Connections. Install service connections to conform to requirements of Section 02534 - Sanitary Sewer Service Stubs or Reconnections of the City of Houston standard specifications.

B. Stacks. Construct stacks to conform to requirements of 02534 - Sanitary Sewer Service Stubs or Reconnections of the City of Houston standard specifications.

C. Construct manholes to conform to requirements of Section 02081 - Cast-in-Place Concrete Manholes, Section 02082 - Precast Concrete Manholes, and Section 02083 – Fiberglass Manholes, as applicable, all of the City of Houston standard specifications. Install frames, rings, and covers to conform to requirements of Section 33 49 15 - Frames, Grates, Rings, and Covers.

3.07 INSPECTION AND TESTING

A. Visual Inspection: Check pipe alignment in accordance with Section 02533 – Acceptance Testing for Sanitary Sewers of the City of Houston standard specifications.

B. Mandrel Testing. Use Mandrel Test to test flexible pipe for deflection. Refer to Section 02533 - Acceptance Testing for Sanitary Sewers of the City of Houston standard specifications.

C. Pipe Leakage Test. After backfilling line segment and prior to tie-in of service connections, visually inspect gravity sanitary sewers where feasible, and test for leakage in accordance with Section 02533 - Acceptance Testing for Sanitary Sewers of the City of Houston standard specifications. Maintain piezometer installed to conform with Section 01 57 25 - Control of Ground Water and Surface Water, until acceptance testing is completed.

3.08 BACKFILL AND SITE CLEANUP

A. Backfill and compact soil in accordance with Section 31 23 32 – Utility backfill Materials.

B. Backfill trench in specified lifts only after pipe installation is approved by Project Manager.

C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified in Section 02951 - Pavement Repair and Resurfacing of the City of Houston standard specifications.

D. Provide soding over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of
topsoil as specified in Section 32 91 13 - Topsoil. Provide minimum of 4 inches of topsoil per Section 32 91 13 - Topsoil. Apply solid sod according to requirements of Section 32 92 23 - Sodding. Grade surface at uniform slope to natural grade as indicated on Drawings.

3.09 POST-INSTALLATION TELEVISION INSPECTION

A. Prior to final acceptance of newly constructed gravity sanitary sewers, perform cleaning and closed circuit television inspection. Cleaning shall include utilizing variable pressure water nozzles (3000 psi) and collection, removal, transportation and disposal of sand, debris, and liquid wastes to legal disposal sites.

B. Select and use closed-circuit television equipment that will produce color video tape. Produce video tape using pan-and-tilt, radial viewing, pipe inspection camera that pans plus and minus 275 degrees and rotates 360 degrees. Use camera with accurate footage counter which displays on monitor exact distance of camera from starting manhole. Use camera with camera height adjustment so that camera lens is always centered at one-half inside diameter, or higher, in pipe being televised. Provide lighting system that allows features and condition of pipe to be clearly seen. Reflector in front of camera may be necessary to enhance lighting in dark or large diameter pipe.

C. Perform television inspection of gravity sanitary sewers as follows:
   1. Videos shall pan beginning and ending manholes to demonstrate that debris has been removed. Camera operator shall slowly pan each service connection and where sewer transitions from one pipe material to another.
   2. Video tapes shall be continuous for pipe segments between manholes. Do not leave gaps in video taping of segment between manholes and do not show single segment on more than one video tape.
   3. No flow is allowed in gravity sanitary sewer while performing post-installation television inspection.

D. Provide video tapes in VHS format, recorded at Standard Play (SP). Two labels are required. Place one label on spine and other on face of each video tape. Permanently label each video tape with following information.

   Spine of Tape
   Wastewater File No.: Contractor's Name:
   Inspection Type: [ ] Survey [ ] Pre-Installation [ ] Post-Installation. Provide inspection as required by City of Houston.
   Tape No.: Date Televised: Date Submitted:
   Basin No:
   Face of Tape
   Manhole No. From Manhole No. To Pipe Diameter Pipe Length Street
E. For each video tape provide completed TV Inspection Report, as attached at end of this section. TV Inspection Report is written/narrated log of pipe conditions and service connections, indexed to footage counter.

F. Upon completion of video tape reviews by METRO Project Manager, Contractor will be notified regarding final acceptance of sewer segment.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. New storm sewers and appurtenances, modifications to existing storm sewer system and installation of roadside ditch culverts.

1.2 MEASUREMENT AND PAYMENT
   A. Payment for storm sewers, installed by open-cut is on Lump Sum basis. Payment shall include all work for complete storm drain system including materials, backfilling, excavation, piping, basins, inlets and manholes, covers and grates, tie-in to existing storm system, dewatering, trenching, trench safety and all work necessary to provide and install the storm sewers, complete in place.

1.3 SUBMITTALS
   A. Conform to requirements of Section 01330 - Submittal Procedures.
   B. Submit manufacturer's literature for product specifications and installation instructions.
   C. Submit proposed methods, equipment, materials, and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

1.4 QUALITY ASSURANCE
   A. The Condition for acceptance shall be watertight storm sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections.
   B. Provide manufacturer's certification to Specifications.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING
   A. Comply with manufacturer's recommendations.
B. Handle pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks or trailers. Do not use Materials cracked, gouged, chipped, dented, or otherwise damaged shall not be use materials for installation.

C. Store pipe and fittings on heavy timbers or platforms to avoid contact with ground.

D. Unload pipe, fittings, and appurtenances as close as practical to location of installation to avoid unnecessary handling.

E. Keep interiors of pipe and fittings free of dirt and foreign matter.

F. Store PVC pipe out of direct sunlight.

PART 2 - PRODUCTS

2.1 PIPE

A. Provide piping materials for storm sewers shall be of sizes and types specified unless otherwise indicated on Drawings.

B. In diameters where material alternatives are available, provide pipe from single manufacturer for each pipe diameter, unless otherwise approved by Owner's Representative or otherwise shown on Drawings.

C. Existing pipe that has been removed during construction cannot be reused.

2.2 PIPE MATERIAL SCHEDULE

A. Storm Sewer Pipe: Use pipe materials that conforming to requirements specified in one or more of the following Sections or as shown on the Drawings. All technical specification sections not included in this package refer to the standard COH technical specifications.

1. Section 02506 - Polyvinyl Chloride Pipe; of the City of Houston standard specifications. Not allowed in the following applications:
   a. Potentially Petroleum Contaminated Areas (PPCA).
   b. Augering/ jacking
2. Section 02505 - High Density Polyethylene (HDPE) Solid and Profile Wall Pipe; of the city standard specifications. For use only where Storm Sewers are associated with Local Streets.

3. Section 02611 - Reinforced Concrete Pipe; of the city standard specifications.

4. Section 02641 - Monolithic Reinforced Concrete Sewers; of the city standard specifications.

5. Section 02612 - Precast Reinforced Concrete Box Sewers; of the city standard specifications.

6. Section 02642 - Corrugated Metal Pipe; of the city standard specifications. Use only where Corrugated Metal Pipe is shown on Drawings.

B. Driveway Culvert Pipe for Streets with Open Ditches: Use pipe materials conforming to requirements specified in one or more of the following Sections as shown on the Drawings.

1. Section 02505 - High Density Polyethylene (HDPE) Solid and Profile Wall Pipe; of the city standard specifications. Use for Residential Culverts only. Use Concrete Pipe for long run culverts.

2. Section 02611 - Reinforced Concrete Pipe; of the city standard specifications.

3. Section 02641 - Monolithic Reinforced Concrete Sewers; of the city standard specifications.

4. Section 02612 - Precast Reinforced Concrete Box Sewers; of the city standard specifications.

C. Provide pipe meeting minimum class, dimension ratio, or other criteria indicated.

D. Pipe materials other than those listed above shall not be used for storm sewers.

2.3 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill Material: Conform to requirements of Sections 02317 - Excavation and Backfill for Utilities, Section 02320 - Utility Backfill
Material, and Section 2321 – Cement Stabilized Sand, and 02322 – Flowable Fill; of the city standard specifications.

B. Topsoil: Conform to requirements of Section 32 91 13 - Topsoil.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affects traffic. Conform to requirements of Section 01555 Traffic Control and Regulation; of the City of Houston standard specifications.

B. Provide barricades, flashing warning lights, and signs for excavations. Conform to requirements of Section 01555 - Traffic Control and Regulation. Maintain barricades and warning lights for streets and intersections while Work is in progress or where traffic is affected by Work.

C. Immediately notify agency or company owning utility lines which are damaged, broken, or disturbed. Obtain approval from Owner’s Representative and agency for repairs or relocations, either temporary or permanent.

D. Remove old pavements and structures, including sidewalks and driveways in accordance with requirements of Section 02 41 14 - Removing Existing Pavements and Structures.

E. Install and operate dewatering and surface water control measures in accordance with Section 01 57 25 - Control of Ground Water and Surface Water.

3.2 EXCAVATION

A. Earthwork. Conform to requirements of Section 31 23 18 - Excavation and Backfill for Utilities. Use bedding as indicated on Drawings.

B. Line and Grade. Establish required uniform line and grade trench from benchmarks identified by Owner’s Representative. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of Work. Or use appropriately sized grade boards which are substantially supported.
C. Trench Excavation. Excavate pipe trenches to level as indicated on Standard Details. Backfill excavation with specified bedding material to level of lower one-third of pipe barrel. Tamp and compact backfill to provide bedding at indicated grade. Form bedding foundation to minimum depth of one-eighth of pipe diameter, but not less than 12 inches.

3.3 PIPE INSTALLATION

A. Install in accordance with pipe manufacturer's recommendations and as specified in this section.

B. Install pipe only after excavation is completed, bottom of trench is shaped, bedding material is installed, and trench has been approved by Owner's Representative.

C. Install pipe to line and grade indicated on Drawings. Place pipe so that it has continuous bearing of barrel on bedding material with no voids, and is laid in trench so interior surfaces of pipe follows grades and alignments indicated.

D. Install pipe with bells of pipe facing upstream of anticipated flow.

E. Form concentric joint with each section of adjoining pipe to prevent offsets.

F. Place and drive home newly laid sections with a sling or come-a-long winches to eliminate damage to sections. Unless otherwise approved by Owner's Representative, provide end protection to prevent damage while using back hoes or similar powered equipment to drive home newly laid sections.

G. Keep interior of pipe clean as installation progresses.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover exposed ends of pipes with pipe plug specifically designed to prevent foreign material from entering pipe.

J. For PVC Pipe:
   1. Provide a minimum cover from top of pavement to top of pipe, but no less than 2 feet.
   2. Accomplish transitions to different material of pipe in a manhole or inlet box. No adapter, coupling for dissimilar pipe, or saddle...
connections allowed.

3. Provide pipe sections in standard lengths with minimum length of 13 feet. Pipe may be field modified to shorten length no less than 4 feet, unless otherwise approved by Owner’s Representative. Field modify pipe per manufacturer’s recommendations.

4. No beveling at joint allowed. Cut to be perpendicular to longitudinal axis.

5. Provide gasketed bell and spigot joints installed per manufacturer’s recommendations. Gasketed pipe joints; clean and free of debris, show no leakage after installation.

3.4 INSTALLATION OF APPURTEANCES

A. Install frames, grate rings, and covers to conform to requirements of Section 33 49 15 - Frames, Grates, Rings, and Covers.

B. Install PVC pipe culverts with approved end treatments. Approved end treatments include concrete headwalls, wingwalls and collars. Refer to City Standards detail for end treatment requirements.

C. Install HDPE pipe culverts with approved end treatments. Approved end treatments include concrete headwalls, wingwalls and collars. Refer to City Standards detail for end treatment requirements.

D. Install inlets, headwalls, and wingwalls to conform to requirements of Section 02633 - Precast Concrete Inlets, Headwalls, and Wingwalls; of the City of Houston standard specifications.

E. Adjust manhole covers and inlets to grade conforming to requirements of Section 33 05 14 - Adjusting Manholes, Inlets, and Valve Boxes to Grade.

3.5 INSPECTION AND TESTING

A. Perform post installation television inspection in accordance with Section 02531 – Gravity Sanitary Sewers, of the city standard specifications and Section 33 33 13 – Sanitary Sewers. Hand held cameras may be used in storm sewers in lieu of requirements of Paragraph 3.09 of Section 02531 – Gravity Sanitary Sewers. Clearly stencil distance markings on each joint of pipe to indicate distance from starting manhole when using hand held cameras.
3.6 BACKFILL AND SITE CLEANUP

A. Backfill trench after pipe installation is inspected and approved by Owner’s Representative.

B. Backfill and compact soil in accordance with Section 31 23 18 - Excavation and Backfill for Utilities.

C. Repair and replace removed or damaged pavement as specified in Section 02951 - Pavement Repair and Restoration of the City of Houston standard specifications.

D. Replace removed or damaged sidewalks as specified in Section 32 13 10 – Concrete Sidewalks.

E. In unpaved areas, grade surface as uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and Section 32 92 23 - Sodding, as required.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Repair, rehabilitation or replacement of deteriorated, leaking or structurally unsound manholes and cleanouts.
   1. Stopping Leaks by repair and sealing of the concrete and/or masonry bench, channel, invert, pipe inlets, walls, cone, chimney and frame of all manholes to include removal of unsound materials, preparation, chemical grouting, structural grouting, patching, plugging and sealing compounds.
   2. Surface preparation, and installing of Structural Linings, Corrosion Protection Coating, and/or Flexible Corrosion Protection Lining, to include protection of surfaces not to be treated, touch-up, clean-up and appurtenant work all in accordance with the requirements of the Contract Documents and this Specification.

1.2 MEASUREMENT AND PAYMENT

A. Rehabilitated Manholes:
   a) No separate payment will be made for manhole rehabilitation. Work is considered incidental to pipeline construction.

1.3 REFERENCES

B. ASTM C 496 – Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
C. ASTM C 882 – Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
E. ASTM D 698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft).
F. ASTM (cube specimens)
G. ICRI Technical Guideline No. 03732 – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
J. ICRI Technical Guideline No. 03732 – Guide for Selecting and Specifying Concrete Surface Preparation for Coatings, Sealers, and Polymer Overlays
K. SSPC-SP 13/NACE No. 6 – Surface Preparation of Concrete.
L. SSPC-SP 10/NACE No. 2 – Near White Metal Blast Cleaning.
M. SSPC-SP 11 – Power Tool Cleaning to Bare Metal.
O. NACE SP 0188 – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

1.4 PERFORMANCE REQUIREMENTS
A. Perform work needed to make manholes structurally sound, improve flow, prevent entrance of inflow or groundwater, prevent entrance of soil or debris, and provide protection against hydrogen sulfide gas attack.
B. Manufacturer’s Product Support: When requested by the Engineer, provide a representative employed by the manufacturer having technical training in admixture and manhole wall liner available for consultation on site with 48 hours notice. The manufacturer’s representative shall submit a written report within one week of each site visit summarizing observations, recommendations with special notes about corrective actions, and photo(s).

1.5 QUALITY ASSURANCE
A. Obtain all chemical grouting materials from a single manufacturer.
B. Installation shall be completed by firms and individuals trained in methods of installation by the manufacturer with at least five years of experience.
C. Personnel shall have confined space entry certification.
D. Field verification shall be completed by the contractor prior to commencement of work.
E. Contractor shall verify the finished thickness of each rehabilitation method prior to starting the next layer and upon completion of the work. The Engineer may obtain core samples at his discretion.

1.6 SUBMITTALS

A. Submittals: Comply with Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit product data, including surface preparation instructions and application instructions, from pre-approved manufacturer of (cementitious, chemical, or resin) wall repair materials, hydraulic cements, quick-set mortars, specialized sealants, grouts, manhole inserts, manhole frame covers and frame-to-manhole seals.

C. Installer Qualifications: Installers of liners and wall repair systems shall submit qualifications to the Engineer. List installer’s personnel who have satisfactorily completed manufacturer’s training in product application within the previous 2 years. Include date of certification for each person.

1.7 PROJECT CONDITIONS

A. Manholes Containing Mechanical or Electrical Equipment:
   1. Drawings may not show locations of flow monitoring equipment. If a manhole contains any mechanical hardware or electrical flow monitoring equipment, immediately notify the Engineer. Reschedule work based on instructions provided by the Engineer.
   2. Do not subject manholes with mechanical hardware or electrical equipment to diversion or bypass pumping.
   3. Damage to installed equipment, due to Contractor’s failure to adhere to this instruction, will be repaired by the City and cost of repairs charged to the Contractor.

B. Field Location of Manholes, Cleanouts and End of Lines:
   1. Contractor is responsible for locating and uncovering all manholes, cleanouts and ends of lines. If Contractor is unable to locate manholes, cleanouts or ends of lines, Contractor shall notify the Engineer in writing.
   2. Manholes may be located within project limits which are not part of the system being rehabilitated. Properly identify manholes before starting work.

1.8 SALVAGE

A. Manhole covers and frames from abandoned manholes remain the property
of the City. Unless indicated to be re-used in the work, deliver salvaged items to location(s) designated by the Engineer.

1.9 MATERIAL HANDLING, DELIVERY AND STORAGE

A. Materials shall be delivered in the original unopened containers. Each container shall be clearly labeled with the following:

1. Product name
2. Manufacturers name
3. Component designation
4. Product mix ratio
5. Health and safety information

B. Provide equipment and personnel to handle the materials which prevent damage. The contractor shall promptly inspect delivered materials for damage.

C. Store materials in accordance with manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 SURFACE PREPARATION

A. Concrete, Brick, or CMU substrates.

1. When using cementitious materials prepare surfaces using SSPC-SP 13 to a minimum surface profile per ICRI 03732, CSP 5-9.
2. When using resin materials prepare surfaces using SSPC-SP 13 to a minimum surface profile per ICRI 03732, CSP 3-5.

B. Miscellaneous Metals.

1. When using resin materials prepare surfaces using SSPC-SP 11 to a minimum surface profile of 1 mil or SSPC-SP 10 to a minimum surface profile of 3 mil.

2.2 WALL REPAIR MATERIALS

A. Hydraulic Cements: Use a blend of cement powders or hydraulic cement to stop active leaks in the manhole structure that meet the following:

1. Compressive strength of 5500 psi in 28-days
2. Tensile strength of 650 psi in 28-days
3. Bond strength of 880 psi in 28 days

B. Quick-set Mortar: Use a quick-set mortar to repair wide cracks, holes or
disintegrated mortar.

2.3 MANHOLE WALL LINERS, BENCH FORMING AND REPAIR MATERIAL
   A. Use City of Conroe Standard Products.

2.4 MANHOLES COVERS, FRAME INSERTS AND FRAME-TO-MANHOLE SEALS
   A. New Covers/Frames: Comply with Section 33 49 13 - Frames, Grates, Rings, and Covers, and with the Contract Drawing.
   B. Watertight Covers and Frames shall each have at least three bolts and a gasket to seal cover to frame, as manufactured by Neenah Foundry Company, Vulcan, or approved equal. (NOTE: Buy America requirements apply. Provided list of manufacturer’s does not preclude contractor’s requirement to provide documentation that the product meets the Buy America nor does it ensure that the product is compliant. Fabricate watertight frames and covers to comply with details shown on the Drawings and Section 33 49 15 - Frames, Grates, Rings, and Covers.
   C. Provide manhole inserts including new dishes, gaskets and relief valves. Select appropriate watertight inserts to fit walls and frames of manholes.
      1. Stainless steel (18 gauge minimum) inserts; Southwestern Packing and Seals “Rain Stopper,” or approved equal.
      2. Stamp inserts with the words, "Property of City of Houston”.
      3. Inserts shall have a handle of plastic-coated stainless steel installed on the body of the insert dish. The handle shall be attached with a #6 high-grade stainless steel rivet. Each dish shall have a factory-installed 5-foot-long, 3/16” braided stainless steel retaining cable to connect the dish to the manhole frame.
   D. Frame-to-Manhole Seals: As manufactured by Cretex, or approved equal.
   E. Sealing materials between adjustments rings and manhole frame shall be Adeka Ultraseal P201 or approved equal.

PART 3 - EXECUTION

3.1 PROTECTION
   A. Provide barricades, warning lights and signs for manhole or cleanout removal excavations. Comply with Section 01 51 00 - Temporary Facilities.
   B. Do not allow soil, sand, debris or runoff to enter sewer system.

3.2 EXCAVATION
A. Excavate in accordance with Section 31 23 18 - Excavation and Backfill for Utilities.

B. Perform work in accordance with OSHA standards. Employ a trench safety system as required in Section 31 50 01 - Trench Safety System.

C. Install and operate necessary dewatering and surface water control measures as required in Section 01 57 25 - Control of Ground and Surface Water.

3.3 DIVERSION PUMPING

A. Install and operate diversion pumping equipment to maintain sewage flow and to prevent backup or overflow as specified in Section 01506 - Diversion Pumping; of the City of Houston standard specifications.

B. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify the Engineer so that required reporting can be made to the Texas Commission on Environmental Quality and U.S. Environmental Protection Agency.

3.4 CLEANOUT/END OF LINE REMOVAL AND REPLACEMENT

A. Replace removed cleanouts/ends of lines with shallow manholes complying with Drawing No. 02082-01, if the depth is less than or equal to 5 feet. For cleanouts/ends of lines greater than 5 feet, replace with 4-foot-diameter manholes complying with Drawing No. 02082-02. (Drawing No’s per the City of Houston standard details.)

3.5 ABANDONMENT OF CLEANOUTS AND MANHOLES

A. Abandon manholes that are designated on Drawings or directed by the Engineer to be abandoned.

B. Dismantle manholes to be abandoned, including frames, to 2 feet below ground level.

C. If a manhole is to be abandoned on a rehabilitated line, install a carrier pipe through the manhole structure and fill the manhole with cement-stabilized sand, compacted to a level 2 feet above the top of carrier pipe.

D. If a manhole is to be abandoned on an abandoned line, plug all lines in the manhole and backfill in accordance with Section 31 23 18 - Excavation and Backfill for Utilities.

E. If a manhole to be abandoned is in a paved street, backfill manhole as described above, but with cement-stabilized sand to underside of pavement repair in lieu of select backfill material. Patch paving in accordance with
Section 02951 - Pavement Repair and Resurfacing.

F. If an abandoned manhole is not located in a paved street, fill remainder of manhole with select backfill material to 2 feet below ground level. Restore surface in accordance with Section 01740 - Restoration of Site Improvements; of the City of Houston standard specifications. Provide at least 4 inches of topsoil complying with Section 32 91 13 - Topsoil, and Sod according to Section 32 92 23 - Sodding, as required.

3.6 MANHOLE WALL CLEANING

A. Clean bench/invert floor and interior walls of manholes by removing deleterious material, including dirt, grease and other debris. Use high pressure water at a minimum force of 3500 psi. If required, use detergent or muriatic acid to remove grease, oil and other matter which would interfere with bond between existing manhole wall and approved repair materials.

B. Prepare interior surfaces as recommended by the wall liner material manufacturer. Remove brick steps and cast iron steps prior to wall lining.

3.7 MANHOLE WALL SEALING

A. Seal active leaks in manhole structures with a blend of cement powder or hydraulic cement.

B. Remove loose or defective wall material. Wipe or brush surfaces clean prior to application of hydraulic cements.

C. Stopping Leaks: Drill weep holes at bottom of manhole walls to relieve hydrostatic pressure. Plug pressure-relief holes after leaks are stopped using hydraulic cement materials.

D. Repair wide cracks, holes and disintegrated mortar with quick-set mortars following manufacturer’s instructions and recommendations.

E. Reshape manhole inverts before wall-sealing work. Apply concrete to cleaned manhole benches as specified in Section 03315 - Concrete for Utility Construction; of the City of Houston standard specifications.

F. After active leaks have been stopped, clean and prepare walls for application of selected liner material.

G. Properly apply sealing compound to provide the minimum required uniform coating to the wall surface.

H. Prevent foreign material from entering adjoining pipes. Remove droppings of foreign and wall sealant materials before they harden on the bottom of
the manhole.

I. Strictly follow product manufacturers’ published instructions and recommendations for surface preparation, application and proportioning.

3.8 MANHOLE REMOVAL AND REPLACEMENT

A. When indicated on the Drawings or instructed by the Engineer, excavate and properly remove and dispose of the existing manhole, including base. Employ a trench safety system and keep the excavation dry from sewage flow and surface or ground water.

B. Replace manhole with a new manhole as specified in Section 02082 - Precast Concrete Manholes or Section 02083 - Fiberglass Manholes; of the City of Houston standard specifications.

C. Construct or reconstruct drop connections whenever the flowline elevation of an influent line is more than 24 inches above the bench elevation.

D. Sewer pipe up to 6 feet outside new manholes may be replaced with new sewer pipe in conjunction with manhole removal and replacement.

E. Properly backfill replacement manholes as required in Section 02082 - Precast Concrete Manholes or Section 02083 - Fiberglass Manholes; of the City of Houston standard specifications.

F. Furnish replacement manholes with new 32-inch frames and covers as indicated on Drawing 02084-1 and specified in Section 33 49 15 - Frames, Grates, Rings and Covers.

3.9 MANHOLE BENCHES/INVERTS

A. Remove obstructions and loose materials from benches prior to shaping inverts. Form smooth, U-shaped inverts having minimum depths of one-half the pipe diameter and channel it across the floor of the manhole using an approved manhole rehabilitation material. Control flow to allow sufficient setting time for material used.

B. If no bench and invert exists in the manhole or if the manhole is new with a poured-in-place base then construct invert channels to provide a smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to the following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inches per foot maximum.

2. Construct full pipe depth inverts (equal in depth to the diameter of the largest or outgoing/ downstream pipe).
3. Construct inverts for laterals (upstream) sewer(s) that enters the manhole such that the flowline elevation of the lateral sewer is between the crown of the outgoing/downstream pipe and manhole invert.

4. Trim all sewer pipes that enter or exit the manhole such that they have a smooth edge and are flush with the manhole wall.

5. Begin the invert channel from where the lateral pipe enters the manhole to where the lateral invert channel intersects the invert of the through outgoing/downstream pipe.

6. The maximum depth of the lateral invert shall be up to full pipe (equal in depth to the diameter of the lateral pipe when the top of the proposed sloped bench is the same elevation as the crown of the lateral sewer) at the upstream end and full pipe diameter of the outgoing pipe at the downstream end.

7. If no inverts exist in the manhole then inverts shall be constructed such that the inverts for all laterals shall have a smooth, uniform curvature, with a maximum radius of curvature that sweeps into the direction of flow (towards the downstream/outgoing pipe.)

C. If inverts already exist in the manhole then:

1. Trim all sewer pipes that enter or exit the manhole so that they are smooth edges and flush with the manhole wall.

2. Build up the existing invert until it is full pipe depth (equal in depth to the diameter of the largest/outgoing pipe) across the manhole bottom.

3. Build inverts for all lateral sewers entering the manhole whose flowline elevation is between the crown and flowline elevations of the outgoing/downstream pipe. Maximum depth of lateral invert shall be up to full pipe (equal in depth to the diameter of lateral/upstream sewer when the top of the proposed sloped bench is the same elevation as the crown of the lateral sewer) at the upstream end and full pipe diameter of the outgoing/downstream sewer at the downstream end.

4. Invert shall match the sweep (or curvature, if any) of the existing lateral sewer invert.

5. If no inverts exist in the manhole then inverts shall be constructed such that the inverts for all laterals shall have smooth, uniform curvature.
curvature, with a maximum radius of curvature that sweeps into the
direction of flow (towards the downstream/outgoing pipe)

D. All benches and invert channels shall be smooth and free of sharp edges,
protrusions and concrete droppings.

3.10 MANHOLE COVERS AND FRAMES

A. Adjust manhole frames and covers found above or below grade and reset
loose frames. Combine precast concrete adjustment rings so that the
elevation of the installed frame and cover extends 6 inches above the
natural ground in unpaved areas. In paved areas, set flush and smooth with
pavement grades. An approved sealant shall be applied between the top
adjustment ring and the manhole frame. No less than two beads shall be
applied 1/2-inch wide and 3/4-inch high. An approved manhole cementitious
lining material shall be applied between the rings and no less than 1-inch of
lining material shall be applied to the inside and outside face of the
adjustment rings.

B. Install new watertight manhole covers and frames at locations shown on the
Drawings or where instructed by the Engineer. Use new frames and covers.

3.11 MANHOLE INSERTS

A. Install stainless steel manhole inserts at locations shown on the Drawings
or where directed by the Engineer.

B. Exercise care in selecting the proper insert dish to fit properly with the
manhole frame and cover. The insert flange should have an outside
diameter 3/16 inch less than the inside diameter of the manhole frame.
Once proper fit is established, clean manhole frame surface of all dirt, grit
and debris with a wire brush. Fully seal insert on the manhole frame,
providing a watertight seal.

C. Securely attach retaining tether to the manhole frame following
manufacturer’s instructions with a tamper-proof anchoring device.

D. Replace damaged, tight-fitting or missing inserts identified prior to final
inspection at no cost to the City.

E. For new sanitary sewer manholes subject to loading or differential
movement at manhole frames, and for rehabilitated manholes, install
manhole chimney seals to prevent inflow between manhole frames and
masonry chimneys. Refer to Section 33 49 15 - Frames, Grates, Rings and
Covers.
3.12 FRAME-TO-MANHOLE SEALS

A. Surfaces on which the sleeve or extension is to be compressed shall be circular, clean, reasonably smooth and free of loose material and excessive voids. If a surface is rough or irregular and would not provide an effective seal, smooth it with an approved cementitious structural repair mortar. Repair flaws in manhole frames, such as cracks, pits or protrusions, by filling with concrete or grinding smooth. This type of surface work will need to be done on manholes that have not been lined; manholes that have been lined should not need any surface work in order to install the seal.

B. Install seals following manufacturer’s installation instructions. Arrange for manufacturer’s representative to train Installer’s personnel in proper methods of installing seals and assist the Installer and Contractor with any problems they might encounter installing the seals.

C. If internal surfaces of the chimney or corbel section of the manhole exceed a slope of 1 in 3, do not use a frame-to-manhole seal.

D. Install frame-to-manhole seals so as to prevent water migration between manhole frames and manhole structures.

3.13 FIELD QUALITY CONTROL

A. Inform the Engineer immediately if materials being used are not producing required results or need modification. The Engineer has the right to stop the use of any material at any time.

3.14 INSPECTION

A. After manhole wall sealing or manhole rehabilitation is complete, visually inspect manholes in the presence of the Engineer. Check for cleanliness and for elimination of active leaks.

B. At completion of manhole rehabilitation, assist the Engineer in verifying installation of minimum coating thickness of concrete liner. Test several points on manhole walls. Repair verification points prior to final acceptance for payment.

3.15 TESTING

A. Perform leakage testing for manholes, refer to Section 02533 - Acceptance Testing for Sanitary Sewers of the City of Houston standard specifications.

B. Perform Testing on cementious products according to ASTM C1140.

3.16 BACKFILL

A. Backfill and compact soil in area of excavation surrounding manholes in
accordance with Section 31 23 18 - Excavation and Backfill for Utilities.

B. In unpaved areas, grade surface at a uniform slope of 1 to 5 from the manhole frame to natural grade. Provide at least 4 inches of topsoil complying with Section 32 91 13 - Topsoil, and sod according to Section 32 92 23 - Sodding, as required.

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES

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

B.  Ring grates.

C.  Buy America Requirements apply.

1.02  MEASUREMENT AND PAYMENT

A.  No separate payment will be made for frames, grates, rings, covers, and seals.  Include payment in price for related item.

B.  No separate payment shall include setting top to finished grade and all work necessary for structure to proper grade.

1.03  REFERENCES

A.  AASHTO - American Association of State Highway and Transportation Officials Standard Specification for Highway Bridges


C.  ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

D.  AWS - D 12.1 Welding Reinforcing Steel.

1.04  SUBMITTALS

A.  Conform to requirements of Section 01 33 00 - Submittal Procedures.

B.  Submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.

C.  Submit shop drawings for fabrication and installation of casting assemblies.  Include plans, elevations, sections, and connection details.  Show anchorage
and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

PART 2  P R O D U C T S

2.01  C A S T I N G S

A. Use castings for frames, grates, rings and covers conforming to ASTM A 48, Class 35B. Provide locking covers if indicated on Drawings.

B. Use clean castings capable of withstanding application of AASHTO M306-40,000 pound proof loading without detrimental permanent deformation.

C. Fabricate castings to conform to shapes, dimensions, and with wording or logos shown on Drawings. Standard dimensions for manhole covers are 32 inches in diameter.

D. Use clean castings, free from blowholes and other surface imperfections. Use clean and symmetrical cast holes in covers, free of plugs.

2.02  B E A R I N G  S U R F A C E S

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

2.03  S P E C I A L  F R A M E S  A N D  C O V E R S

A. Where indicated on Drawings, provide watertight manhole frames and covers with minimum of four bolts and gasket designed to seal cover to frame. Supply approved watertight manhole covers and frames.

B. Where shown on Drawing, provide manhole frames and covers with 48 inch diameter clear opening, with inner cover for 22 inch diameter clear opening. Provide approved inner cover with pattern shown on Drawings.

2.04  F I N I S H

Unless otherwise specified, uncoated coat iron.

2.05  F A B R I C A T E D  R I N G  G R A T E S

A. Fabricate ring grates from reinforcing steel conforming to ASTM A 615.

B. Conform to welds connecting bars to AWS D 12.1.
2.06 ADJUSTMENT RINGS FOR ASPHALT OVERLAYS

A. Use castings conforming Section 2.01.

B. One piece casting with dimensions to fit frame and cover.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install castings according to approved shop drawings, instructions in related specifications, and applicable directions from manufacturer’s printed materials.

B. Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true, and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in form work until permanently set.

C. Fabricate ring grates in accordance with standard detail. Set in mortar in mouth of pipe bell.

D. Install adjustment rings in existing frames with clean bearing surfaces that are free from rocking.

END OF SECTION