SECTION 02308

TUNNEL SHAFTS

NOTE TO SPECIFIER: THIS SPECIFICATION IS INCLUDED FOR REFERENCE BUT SHALL BE THOROUGHLY REVIEWED FOR APPLICABILITY AND REVISED AS NECESSARY FOR PROJECT SPECIFIC REQUIREMENTS.

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Construction, maintenance, and backfilling requirements of tunnel shafts.

1.02 UNIT PRICE

A. Tunnel shafts, both those shown on Drawings and those needed for Contractor's access, are bid as a lump sum for all shafts, collectively. Prior to construction, the Contractor shall provide a schedule of values as specified in Section 01292 - Schedule of Values. Itemize the cost by station for each shaft designated on the Drawings and additionally required for construction operations. Seventy-five percent of the itemized amount will be submitted on a pay estimate upon shaft installation; twenty-five percent will be submitted on a pay estimate upon backfill and site restoration (including topsoil, sodding and hydromulching). Payment will include excavation, disposal of excavated materials, ground support systems, backfilling, and cleanup. Manholes constructed in tunnel shafts are to be paid separately at the contract unit price as specified in Section 02601 - Precast Concrete Manholes or 02600 - Cast in Place Manholes.

B. Removal and replacement of surface improvements necessary for shaft construction, such as sidewalks, asphaltic and concrete pavement, base and subbase, curbs, curb and gutter, driveways, topsoil, sodding and hydromulch shall be included in the lump sum for shafts.

C. Relocation of Owner’s utilities shall be paid for at the contract unit price, only when included in the bid proposal.

1.03 SUBMITTALS

A. Make submittals in accordance with all sections and provisions of these specifications.

B. Shaft design submittals by the Contractor shall be signed and sealed by a Professional Engineer registered in the State of Texas.

C. Submit shaft construction drawings together with calculations to the Owner's Representative. Include:

1. Shaft dimensions, design criteria, and details for ground support system, such as sheeting, shoring, bracing, and stabilization, protection of the excavation, special requirements for shaft penetrations, tunnel "eye", starter and back tunnels, and seal slabs. Allowable surcharge loads and any restrictions on surcharge capacity, including live loads, shall be clearly shown on the shaft construction drawings. Thrust blocks or other reactions required for pipe jacking shall be shown, if applicable.

2. Location of shafts by station and limits of working sites.

3. Description of site security arrangements in conformance with paragraph 3.03, Shaft Construction.

4. Description of method of extending the shaft above the flood level in compliance with paragraph 3.03, Shaft Construction.

5. Any geotechnical / boring undertaken by the Contractor for whatever purpose connected to the work.

D. Shaft Monitoring Plan: Submit for review prior to construction, a shaft monitoring plan that includes a schedule of instrumentation design, layout of instrumentation parts, equipment installation details, manufacturer's catalog literature, and monitoring report forms.

E. Structures Assessment. Preconstruction and post-construction assessment reports shall be provided for critical structures located within a radius of the shaft center equal to the shaft depth plus the shaft radius, measured in plan. Photographs or a video of any existing damage to structures in the vicinity of shafts shall be included in the assessment reports.

F. Submit a shaft surface settlement monitoring plan for review prior to construction. The plan shall identify the location of settlement monitoring points, reference benchmarks, survey frequency and procedures, and reporting formats.

G. The readings of all monitoring to be submitted to the Owner's Representative as soon as the readings have been taken.

H. Contractor shall submit shaft temporary deck drawings and calculations to the Owner's Representative, signed and sealed by Contractor's Professional Engineer in the event that a shaft is not needed for immediate construction activity, in conformance with paragraph 3.03, Shaft Construction.

1.04 PERFORMANCE REQUIREMENTS

A. Shaft design must include allowance for contractor's equipment and stored material and spoil stockpile as appropriate. Design must also allow for H-20 highway loading if located in the vicinity of a paved area.

B. Shaft shall be designed to not fail under full hydrostatic head. In the case of common shaft in conformance to Section 02309 - Common Tunnel Shafts, shaft shall be designed with adequate factor of safety for full hydrostatic head.

C. Shaft located within the 100-year flood plane shall be designed with a water retaining liner extending 2 feet above the 100-year flood elevation. It is acceptable if liner is stored at the site for immediate installation, in lieu of it being installed at the shaft, provided that the shaft liner extends at least 2 feet above existing ground elevation.

D. Shaft cover, if used in lieu of shaft perimeter security fencing, shall be designed for a minimum 25 pounds per square foot distributed load plus a 300 pound point load.

E. Steel plate deck, if such is required, shall be designed for H-20 loading.

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 LOCATION OF ACCESS SHAFTS

A. Contractor shall have sole responsibility for selection of shaft sites needed for construction operations but not indicated on the Drawings. Location will be subject to Owner's Representative's approval.

B. Locate shafts and associated work areas to avoid blocking driveways and cross streets, and to minimize disruption to business and commercial interests. Avoid shaft locations near areas identified as residential, potentially contaminated.

C. Plan shaft locations to minimize interference with storm drainage channels, ditches, water mains, sanitary sewers, storm water sewers or culverts, which, if damaged, could result in ground washout or flooding of shafts and tunnels.

3.02 UTILITY RELOCATION

A. Relocate utilities as shown on the Drawings. Any utility relocation required by Contractor for shaft construction shall take into account the zone of potential settlement in the vicinity of the shaft.

3.03 SHAFT CONSTRUCTION

A. Ground support systems shall be in accordance with the following:

1. Liner elements, bracing and shoring structural members shall be installed at the locations and in the method sequence and tolerances defined on shaft construction drawings as the excavation progresses.

2. The bracing and shoring shall be in contact with the liner to provide full support as shown in shaft construction drawings. Any modifications to liner, bracing and shoring shall be evaluated, checked and approved by Contractor's Professional Owner's Representative, and submitted to the Owner's Representative.

3. A seal slab, in accordance with Section 03311- Seal Slabs, shall be installed as soon as final depth and stable bottom conditions have been reached and accepted by the Owner's Representative. The seal slab shall be capable of withstanding the full piezometric pressure, either by pressure relief using under drains, or in the case of more permeable ground condition, by the use of a structural reinforced slab. In either case, the seal slab shall be constructed in accordance with the design provided by the Contractor's Professional Engineer. Seal slabs shall be constructed in accordance with Section 03311- Seal Slabs.

B. The entire shaft shall be designed and constructed to appropriate factors of safety against yield, deformation, or instability as determined by Contractor's Professional Engineer, and shall withstand a full hydrostatic head without failure.

1. Special framing, bracing or shoring required around tunnel "eyes" or other penetrations shall be in-place according to shaft construction drawings before the liner or any bracing or shoring at the penetration is cut or removed.

2. Conduct annular space grouting in accordance with Section 02330 - Tunnel Grout.

C. Install suitable thrust or reaction blocks as required for pipe jacking equipment.

D. Provide drainage from shafts while work is in progress and until adjacent pipe joints have been sealed and the shaft is backfilled. Conform to the requirements of Section 01563 - Control of Ground Water and Surface Water.

E. Surface Water Control. Divert surface water runoff and discharge from dewatering system away from the shaft and protect the shafts from infiltration or flooding.

F. Each surface work site is to be surrounded by a security fence meeting the requirements of Section 01500 - Temporary Facilities and Controls, which shall be secure at any time the site is unattended by Contractor's personnel.

G. In addition to the above, the shaft, when not in use shall be protected by a second security fence at the perimeter of the shaft, or alternatively by a cover designed in accordance with Paragraph 1.04, Performance Requirements.

H. Portable concrete traffic barriers must be provided at all locations where a work site is situated adjacent to a highway, road, driveway, or parking lot. Traffic barriers shall be angled in the direction of lane flow, and shall not be placed perpendicular to on-coming traffic.

I. Traffic control system shall be provided and maintained in accordance with the provision of Section 01570 - Traffic Control and Regulation.

J. A shaft which is constructed more than 60 days in advance of its intended need shall be covered by a steel plate deck designed by the Contractor's Professional Engineer, and the surface restored to permit full traffic flow during the time the shaft is not in use. All other Contractor's material including portable concrete traffic barriers, traffic control system, fencing and other materials and equipment must be removed from the site and reinstalled at the time the shaft is re-opened for use.

3.04 BACKFILL

A. Cement stabilized sand shall be provided to a minimum depth of 10 feet above the crown of the sanitary sewer, but where shaft is located in a paved area, cement stabilized sand shall be used to within 1 foot of the pavement subgrade elevation. Cement stabilized sand shall be in accordance with Section 02252 - Cement Stabilized Sand. Compaction shall be in accordance with Section 02227 - Excavation and Backfill for Utilities. In locations where the backfill is not subject to traffic loading, the depth above the initial cement stabilized sand may be backfilled with select backfill in accordance with Section 02226 - Excavation and Backfill of Structures. Grouting of manhole or structure annular space will be permitted in cases where insufficient work space exists, in accordance with Section 02330 - Tunnel Grout.

B. Remove the shaft liner above the level of 8 feet below ground surface, unless otherwise indicated on the Drawings. The Contractor must maintain sufficient ground support to meet excavation safety requirements while removing the shaft structure.

C. Where common shafts are indicated, refer to Section 02309 - Common Tunnel Shafts.

3.05 MONITORING

A. Monitoring Instrumentation. Instrumentation requirements are shown on the Drawings. Instrumentation specified and the readings shall be accessible at all times to the Owner's Representative.

1. Install and maintain an instrumentation system to monitor and detect movement of the ground surface and adjacent structures. Establish vertical survey control points at a distance from the construction areas that avoids disturbance due to ground settlement.

2. Installation of the instrumentation shall not preclude the ,Owner's Representative through an independent contractor or consultant, from installing instrumentation in, on, near, or adjacent to the construction work. Access shall be provided to the work for such independent installations.

3. Instruments shall be installed in accordance with the Drawings and the manufacturer's recommendations.

B. Surface Settlement Monitoring

1. Establish monitoring points on all critical structures.

2. Record location of settlement monitoring points with respect to construction baselines and elevations. Record elevations to an accuracy of 0.01 feet for each monitoring point location. Monitoring points should be established at locations and by methods that protect them from damage by construction operations, tampering, or other external influences.

3. Monitoring points to measure ground elevation are required at a distance of 10 feet and 20 feet from the perimeter of the shaft on each of four radial lines, the radial lines being at 90 degrees to each other.

4. Railroads. Monitor ground settlement of track subbase at centerline of each track if within the zone of potential settlement.

C. Reading Frequency and Reporting. The Contractor shall submit to the Owner's Representative records of readings from the various instruments and survey points.

1. Record all shaft monitoring readings at least once per week starting prior to shaft construction and continuing until shaft has been backfilled and until no more detectable movement occurs.

2. Immediately report to the Owner's Representative any movement, cracking, or settlement which is detected.

3. Following substantial completion, but prior to final completion, make a final survey of all shaft related monitoring points.

3.06 DISPOSAL OF EXCESS MATERIAL

A. Remove spoil in accordance with Section 01564 - Waste Material Disposal.

END OF SECTION