## **SECTION 12.03**

**SIDE MOUNTED SIGN FOUNDATION**

*Replace Section 12.03 with the following:*

**12.03.01—Description:** Work under this item shall consist of constructing reinforced concrete drilled shaft foundations for side mounted sign structures at the locations and to the details shown on the Plans.

**12.03.02—Materials:** The reinforcing steel shall be uncoated, ASTM A615, Grade 60 reinforcement meeting the requirements of M.06.01.

Concrete shall be Class PCC03340 meeting the requirements of Section 6.01 and Section M.03.

The slurry, if used, shall be Contractor designed mineral or polymer slurry that meets the range of values listed herein.

Topsoil shall meet the requirements of M.13.01.

Fertilizer shall meet the requirements of M.13.03.

Seed mixture shall meet the requirements of M.13.04, or the seed mix specified on the Plans.

Mulch shall meet the requirements of M.13.05.

Erosion control matting shall meet the requirements of M.13.09.

All other material shall meet the requirements shown on the Plans.

**12.03.03—Construction Methods:**

1. **Subsurface Conditions for Bidding**: For bidding this item of work, due to the potential for varying subsurface conditions at each foundation location, the Contractor shall assume that each drilled shaft foundation will be excavated and constructed entirely in soil overburden and that cobbles and small boulders will be encountered.

The excavation of rock, as defined in the Basis of Payment, will be paid for under the item "Rock in Foundation Excavation."

During excavation and construction of each foundation, should the Contractor encounter subsurface conditions that differ materially from those assumed at the time of bid, the Contractor shall notify the Engineer. All matters regarding increased cost relating to an agreed upon change in subsurface conditions will be handled per “1.04.04 – Differing Site Conditions.”

1. **Submittals:**
2. **Reinforcement:** The submittal of Shop Drawings is **not** required for reinforcement that is fabricated, furnished, assembled, and installed in accordance with these specifications and the details shown on the Plans.
3. **Concrete Mix Design:** The Contractor shall submit the concrete mix design, including admixtures, for review in accordance with 1.05.02 and M.03.02.
4. **Slurry Mix Design:** The Contractor shall submit the slurry mix design, including admixtures, for review in accordance with 1.05.02.
5. **Foundation Construction Procedure:** The Contractor shall submit a written foundation construction procedure outlining: the equipment; drilling methods for soil and rock excavation, including removal of obstructions and how spoils will be handled; temporary casing materials, placement and removal; slurry placement; reinforcement, anchorage placement; concrete placement and water containment required for the drilled shaft foundation construction for review in accordance with 1.05.02. The procedure shall include contingencies for the various soil, rock and subsurface water conditions that may be encountered during the foundation construction.

All procedures accepted by the Engineer shall be subject to trial in the field and shall not relieve the Contractor of the responsibility to satisfactorily complete the work as detailed in the Plans and specifications. The Contractor shall not commence construction of the drilled shafts until the Engineer has accepted the foundation construction procedure.

The foundation construction procedure may be submitted to the Engineer for review without inclusion of slurry if the Contractor chooses.  However, a slurry procedure and slurry mix design shall be required if the Contractor chooses to advance excavation ahead of the casings or if the Engineer determines that application of slurry is required to maintain soil stability.  The Contractor shall be responsible for any delays to the Project resulting from slurry construction procedure and mix design reviews submitted after approval of a dry and permanent or temporary casing method.

1. **Excavation and Construction Methodologies:**

Excavations required for shafts shall be performed through whatever materials are encountered, to the dimensions and elevations shown on the Plans for each side mounted sign structure.  The methods and equipment used shall be suitable for the intended purpose, materials encountered, and site conditions allowing the foundation concrete to be placed against undisturbed soil, undisturbed rock, or a casing that the Contractor chooses to leave in place. The Contractor is responsible for maintaining the stability of the shaft excavation during all phases of construction. Generally, excavation shall be performed using one of the following construction methodologies:

1. **Dry Construction Method:**  The dry construction method consists of drilling the shaft excavation, removing accumulated water and loose material from the excavation, and placing the shaft concrete in a relatively dry excavation. The dry construction method shall be used only at sites where the groundwater table and site conditions are suitable to permit construction of the shaft in a relatively dry excavation, and where the sides and bottom of the shaft excavation are stable, there are no facilities adjacent to the shaft requiring support, and the excavation’s sides and bottom may be visually inspected prior to placing the concrete. The use of the dry construction method is permitted if less than one foot of water accumulates in the bottom of a hole without pumping over a 1 hour period, the excavation remains stable and any loose material and water can be removed prior to placement of concrete.
2. **Wet Construction Method:** The wet construction method shall be used at sites where a dry excavation cannot be maintained for placement of the shaft concrete. Wet construction methods consist of using a polymer or mineral slurry to maintain stability of the hole perimeter while advancing the excavation to final depth, placing the reinforcing cage and shaft concrete. This procedure may require desanding and cleaning the slurry; final cleaning of the excavation by means of a bailing bucket, air lift, submersible pump or other devices; and placing the shaft concrete with a tremie. Unless it is demonstrated to the satisfaction of the Engineer that the surface casing is not required, temporary surface casings shall be provided to aid shaft alignment and position, and to prevent sloughing of the top of the shaft excavation. Surface casing is defined as the amount of casing required from the ground surface to a point in the shaft excavation where sloughing of the surrounding soil does not occur.
3. **Temporary Casing Construction Method:** The temporary casing construction method shall be used in lieu of the dry or wet construction methods or where the dry or wet construction methods are inadequate to prevent shaft caving, excessive deformation of the shaft or when temporary support of adjacent facilities is required. Temporary casing construction method consists of advancing the excavation through caving material with or without slurry. Temporary casing may be installed by either placing it in a predrilled shaft or twisting, driving or vibratory procedures in advance of excavation to the lower limits of the caving material. When a nearly impervious formation is reached, a casing is placed in the hole and sealed in the nearly impervious formation. After the drilling fluid is removed from the casing, drilling may proceed as with the dry method except that the casing is withdrawn when the shaft concrete is placed. If seepage conditions prevent use of the dry method, excavation is completed using the wet method. Slurry may be omitted if the casing is advanced ahead of drilling and only if minor caving of the hole is observed. Slurry shall be used in installation if drilling is to advance ahead of the casing or if the Engineer determines that the application of the slurry is required in order to maintain soil stability around the hole.

The use of a temporary casing is mandatory if shown on the Plans for a specific foundation location.

If an obstruction or rock is encountered, the Engineer shall be notified to inspect and determine the elevation of the top and bottom of the obstruction or elevation of the top of competent rock.

Obstructions are defined as impenetrable objects that (a) cannot be removed or excavated using conventional augers fitted with soil or rock teeth, underreaming tools, or drilling buckets; or (b) cause a significant decrease in the rate of excavation advancement, relative to the rate of advancement for the rest of the shaft excavation within the particular strata where the obstruction is located that had been achieved using the techniques and equipment that had previously been used successfully to excavate the shaft.

The Engineer will be the sole judge of the significance of any reduced rate of shaft advancement and of the classification of obstruction excavation. The Engineer will be present at the site of the obstruction in order to evaluate obstructions, to authorize measures for dealing with them, and to approve the designation each obstruction. Shallow obstructions are obstructions located within 5 feet of the top level of the shaft. Shallow obstructions at shaft locations shall be removed at the Contractor’s expense.

Excavated materials which are removed from the shaft excavation, ground water, and any supplemental materials required for the excavation methodology used by the Contractor, such as drilling fluids, shall be disposed of by the Contractor as directed by the Engineer and in accordance with Section 1.10.

Casings shall be metal, smooth, clean, watertight, and of ample strength to withstand both handling and driving stresses and the pressure of both concrete and the surrounding earth materials. The outside diameter of casing shall not be less than the specified size of the shaft. Temporary casings shall be removed while the concrete remains workable (i.e., a slump of 4.0 inches or greater). Before the casing is withdrawn and while the casing is being withdrawn, a 5.0 foot minimum head of fresh concrete in the casing shall be maintained so that all the fluid trapped behind the casing is displaced upward without contaminating the shaft concrete. The required minimum concrete head may have to be increased to counteract groundwater head outside the casing. Separation of the concrete by hammering or otherwise vibrating the casing, during withdrawal operations, is prohibited unless allowed by the Engineer. Casing extraction shall be at a slow, uniform rate with the pull in line with the shaft axis.

Temporary casings that the Contractor chooses to leave in place shall be removed a minimum of 12 inches below the finished grade.

Slurry used in the drilling process shall be a mineral or polymer slurry. The slurry shall have both a mineral grain size that will remain in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. The level of the slurry shall be maintained at a height sufficient to prevent caving of the hole.

The slurry shall be premixed thoroughly with clean fresh water at a temperature above 41° F and adequate time shall be allotted for hydration prior to introduction into the shaft excavation. The elevation of the slurry within the shaft foundation shall be maintained within 24.0 inches of the top casing and at least 48.0 inches above the existing water level during drilling and until the concrete placement is essentially complete. The slurry properties shall be maintained at all times, including non-working periods and stoppages. The slurry shall be circulated and agitated, continuously, if necessary, to maintain the slurry properties and to prevent it from setting up in the shaft.

The Contractor, in the presence of the Engineer, shall perform control tests on the slurry to ensure that the density, viscosity, and pH fall within the acceptable limits tabulated below. The Contractor shall provide all equipment required to perform the tests. If desanding is required, sand content shall not exceed 4% (by volume) at any point in the shaft excavation as determined by the American Petroleum Institute sand content test.

Range of Values (at 68°F)

|  |  |  |  |
| --- | --- | --- | --- |
| **Property (Units)** | **Time of Slurry**  **Introduction** | **Time of Concreting**  **(in Hole)** | **Test Method** |
| Density (pcf) | 64.3 to 69.1 | 64.3 to 75.0 | Density Balance |
| Viscosity (seconds per quart) | 28 to 45 | 28 to 45 | Marsh Cone |
| pH | 8 to 11 | 8 to 11 | pH paper or meter |

The control tests to determine unit weight (density), viscosity, and pH values of the slurry shall be done during the shaft excavation to establish a consistent working pattern.

Prior to placing shaft concrete, slurry samples shall be taken from the bottom and at intervals not exceeding 10.0 feet for the full height of slurry. Any heavily contaminated slurry that has accumulated at the bottom of the shaft shall be eliminated. The slurry shall be within specification requirements immediately before shaft concrete placement.

After completing the shaft excavation, all loose material existing at the bottom of the hole shall be removed.

The excavated holes shall be covered when left unattended.

1. **Reinforcement Assembly and Installation:** The reinforcing steel shall be fabricated and assembled in accordance with 6.02.03.  All reinforcement shall be assembled with wire ties.  All reinforcing bar intersections shall be tied. Welding to assemble the reinforcement is not permitted.

Immediately after the shaft excavation has been inspected and approved by the Engineer and prior to placement of the concrete, the assembled reinforcing steel cage, including cage stiffener bars, spacers, centralizers, and other necessary appurtenances, shall be carefully placed into the shaft excavation as a unit.  Dropping or forcing cages into the shaft will not be allowed.  The reinforcing steel in the shaft shall be tied and supported so that the reinforcing steel will remain within allowable tolerances of its intended position until the concrete will support the reinforcing steel.  When concrete is placed by tremie methods, temporary hold-down devices shall be used to prevent uplifting of the reinforcing steel cage during concrete placement.  After placement of the reinforcing cage, the Engineer will inspect the shaft to ensure that it has remained clean.  If the inspection indicates that loose material has accumulated at the bottom of shaft excavation, the Contractor shall remove the reinforcing cage and reclean the shaft excavation.

1. **Concrete Placement:** Concrete construction shall meet the requirements of 6.01.03.

The top of the foundation shall be formed as shown on the Plans. Embedded anchors, anchor rods, and stub post assemblies for side mounted sign structures shall be placed as shown on the Plans and supported on the forms.  A temporary template plate shall be used to hold the anchorage materials in the correct position.  All anchorage materials shall be installed plumb.

Concrete shall be placed in the shaft excavation as soon as possible after placement of the reinforcing steel cage. Concrete shall be monolithically placed in a continuous operation to the top of the shaft.  Concrete construction joints are not permitted. The concrete level shall be horizontal during the placement operations.  Concrete placement shall continue after the shaft is full and good quality concrete is evident at the top of the shaft.

In dry construction, concrete shall be placed in a single continuous operation with the freefall flow of concrete down the center of the shaft excavation so as to consolidate the concrete on impact. During placement operations, the concrete is not permitted to hit the reinforcing steel. A drop chute, consisting of a hopper and flexible hose, shall be used to direct the concrete down the center of the foundation and prevent the concrete from hitting the reinforcing steel. Accumulated water shall be removed before placing the concrete. At the time of concrete placement, no more than 2.0 inches of water may exist at the bottom of the excavation and loose sediment no more than 0.5 inches over one-half the base is acceptable.

If water accumulates in the excavation such that the concrete cannot be placed meeting the requirements of dry construction, the concrete placement shall meet the wet construction requirements. In wet construction, concrete is to be placed by the tremie method, where the concrete displaces the water or slurry from bottom of the excavation to the top. The tremies used to place concrete shall consist of a tube of sufficient length, weight, and diameter to discharge concrete at the shaft base. The tremie shall not contain aluminum parts that may come in contact with the concrete. The tremie’s inside diameter shall be at least 6 times the maximum size of aggregate used in the concrete mix but shall not be less than 10 inches. The inside and outside surfaces of the tremie shall be clean and smooth in order to permit flow of concrete and unimpeded withdrawal during concrete placement. The wall thickness of the tremie shall be adequate to prevent crimping or sharp bends, which would restrict concrete placement.

The tremie shall be watertight. Underwater placement shall not begin until the tremie is placed to the shaft base, and the concrete shall be kept completely separated from the water or slurry prior to the time that it is discharged. Valves, bottom plates or plugs may be used for this purpose only if concrete discharge can begin within 1 tremie diameter of the base of the drilled shaft excavation. Plugs shall either be removed from the excavation or be of a material approved by the Engineer that will not cause a defect in the shaft if not removed. The discharge end of the tremie shall be constructed to permit the free radial flow of concrete during placement operations. The tremie discharge end shall be immersed at least 5 feet in concrete at all times after starting the flow of concrete. The flow of the concrete shall be continuous. The level of the concrete in the tremie shall be maintained above the level of slurry or water in the excavation at all times, in order to prevent water intrusion into the shaft concrete.

The shaft concrete shall be vibrated or rodded to a depth of 5.0 feet below the ground surface except where soft uncased soil in the excavation will possibly mix with the concrete.

Exposed concrete shall be cured and finished in accordance with 6.01.03.

No construction operations that would cause soil movement adjacent to the shaft, other than mild vibration, shall be conducted for at least 48 hours after shaft concrete has been placed.

1. **Backfilling:** The top of the foundations shall be backfilled, and the adjacent disturbed ground surfaces restored to match the surrounding area after the concrete has cured and the forms are removed.  The Engineer will determine the type, thickness and horizontal limits of the surfaces to be restored.  Placement of topsoil shall meet the requirements of 9.44.01 and 9.44.03.  Seeding shall meet the requirements of 9.50.03 or the Contract special provisions.

The posts shall not be erected on the foundation until the concrete in the shaft has attained a compressive strength, f’c, greater than or equal to 3,000 psi.

**12.03.04—Method of Measurement:** The work for the side mounted sign foundations will be measured for payment by the number of each foundation unit completely installed and accepted.

The work to remove rock from the foundation excavation will be measured from the top of competent rock, as determined by the Engineer, to the bottom of rock excavation.

**12.03.05—Basis of Payment:** This work will be paid for at the Contract unit price each for "Side Mounted Sign Foundation," completed and accepted in place, which price shall include all equipment, material, tools and labor incidental to the fabrication and construction including excavation, disposal of excavation spoils, reinforcement, concrete forms, and concrete for the foundations at the locations specified on the Plans.

When rock is encountered within the limits of excavation, its removal will be paid for at the Contract unit price per vertical foot for "Rock in Foundation Excavation," which price shall include any additional excavation to remove the rock and any additional concrete required to fill the excavation beyond the specified foundation hole dimensions.  Rock, in so far as it applies to "Rock in Foundation Excavation," shall be defined as rock in definite ledge formation, boulders, or portions of boulders, cement masonry structures, concrete structures or Portland cement concrete pavement which has a cross-sectional area that exceeds 50% of the cross-sectional area of the specified foundation hole.

No additional payment will be made for temporary casings.

No additional payment will be made for the Contractor to test the slurry when it is used to construct a drilled shaft foundation

Backfilling and restoration of adjacent ground surfaces (slope protection, topsoil and seed, etc.) in all areas disturbed by the work will not be paid for separately but will be included as part of the work.

Pay Item Pay Unit

Side Mounted Sign Foundation ea.

Rock in Foundation Excavation v.f.