ITEM 551.9949NN17 - DRILLED SHAFTS
ITEM 551.9950NN17 - DRILLED SHAFTS (LOW OVERHEAD CLEARANCE)
ITEM 551.98020017 - TRIAL SHAFTS

DESCRIPTION

A. General. This work shall consist of furnishing the materials and installing drilled shafts at the locations, dimensions, and batters shown on the contract plans or where ordered by the Engineer and approved by the Deputy Chief Engineer Structures (DCES). This work includes excavating shafts, disposing of all excavated material and drilling mud, placing steel reinforcement, and placing concrete as detailed.

The intent of this work is for the Contractor or subcontractor to provide reinforced concrete shafts in cylindrical excavated holes which extend a sufficient depth into the soil and/or rock to support the structure and all externally applied loads for which it was designed.

The Contractor or subcontractor performing this work must have had prior experience installing drilled shafts, as described in this specification.

B. Definitions. Definitions that apply within this specification are:

Contractor. The contractor or subcontractor performing the work described in this specification.

Casing (Shell). A steel shell used to construct the drilled shaft. The casing can help advance the hole, and supports the sides of the hole. Casing can be permanent, interim or temporary.

Casing Method. A method of shaft construction, consisting of advancing and cleaning a cased hole, placing the reinforcing cage, and concreting the shaft while extracting temporary casing (if used).

Drilling Mud. A slurry made using bentonite or polymers (see Slurry).

Drilled Shaft. A cylindrical structural column transmitting loads to soil and/or rock. The drilled shaft is constructed in a hole with a circular cross section. The hole is filled with concrete and may be reinforced with steel.

Dry Construction Method. A method of shaft construction consisting of drilling the shaft, removing water and material from the excavation, placing the reinforcing cage, and concreting the shaft in a relatively dry condition.

Interim Casing. A casing that acts as a form, but remains in place permanently. It is not designed to carry structural loads.

Permanent Casing. A casing that is designed to carry structural loads. It acts as a form and remains in place permanently.

Quality Assurance. A test or procedure that acts to verify the quality of the work or product. Quality Assurance procedures would include static load testing, Osterberg cell testing, coring, cross hole sonic logging, and other non-destructive testing.

Rock. Rock is identified in the boring logs. Rock may also be defined at the shaft installation site by a Departmental Engineering Geologist.

Seat. The act of placing the tip of a casing in intimate contact on rock for its entire circumference.

Slurry. A mixture of water and bentonite, or water and polymers, which provides hydrostatic pressure that supports the sides and bottom of the hole, lubricates and cools the drill tools, and aids clean-out. Slurry cannot be made from native materials, or material from the excavation.

Surface Casing. Temporary casing installed to prevent sloughing of the surrounding soil near the surface of the shaft excavation.

Temporary Casing. A casing that serves its function during construction of the drilled shafts. It serves no permanent structural function, and is extracted during concreting.

Top of Socket. The highest location of the rock socket that is capable of resisting axial and lateral design loads. At any given location, the top of socket elevation is usually below the top of rock elevation. This distance depends on the type and quality of the rock, and the Contractors drilling methods and equipment.

Tremie. A method to place concrete under water. Refer to Section 555 *Structural Concrete.*

Trial Shaft. A hole for a drilled shaft constructed on the project site, but outside the proposed footing limits. It is not to be incorporated into a structure or foundation. A trial shaft is constructed prior to installing production drilled shafts, according to the methods detailed in the Contractor's submittals. Its function is to verify the proposed excavation methods, and permit the Inspectors to become familiar with the excavation procedure. Upon inspection and acceptance, the trial shaft is backfilled with unreinforced concrete.

Wet Construction Method. A method of shaft construction in which slurry is used to maintain stability of the hole while advancing the excavation to the final depth, placing the reinforcing cage, and concreting the shaft.

MATERIALS

Refer to the contract plans to determine which of the following materials will be required.

For all steel remaining as a permanent part of the work, all Buy America provisions shall apply.

A. Permanent Casing. Provide continuous permanent casing conforming to the limits shown on the contract plans.

Provide material conforming to the requirements of ASTM A252 Grade 2, unless specified otherwise in the contract plans. Furnish full length shells, consistent with requirements shown in

the contract documents. Unless otherwise specified in the contract documents, use of spiral welded casing is not permitted.

If needed, equip casing with an appropriate casing shoe to enable installation of casing to the elevations shown on the contract plans.

B. Interim Casing. Provide interim casing capable of withstanding all handling and installation stresses. If needed, equip casing with an appropriate casing shoe to enable installation of casing to the depths necessary to construct the drilled shaft to the elevations shown on the contract plans.

C. Temporary Casing. Provide temporary casing capable of withstanding all handling and installation and extraction stresses. If needed, equip casing with an appropriate casing shoe to enable installation of casing to the depths necessary to construct the drilled shaft to the elevations shown on the contract plans.

D. Reinforcing Steel. Provide bar reinforcement meeting the requirements of §709-01 *Bar Reinforcement, Grade 60* or ASTM A615 *Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*.

E. Concrete. Provide concrete conforming to the requirements of Section 501 Portland Cement Concrete - General, Class GG, as presented in Table 501-3 *Concrete Mixtures*. The Contractor is allowed the option of using admixtures to increase the slump to a maximum of 9 inches, provided all other mixture requirements set forth in Table 503-1 are achieved.

F. Centralizers. Provide centralizers for properly aligning the steel reinforcement, made of a material that is not detrimental to the reinforcement or the concrete. The type of centralizer utilized must be approved by the DCES.

G. Rebar Cage Feet. Provide cylindrical feet to support the rebar cage at the proper elevation, made of a material that is not detrimental to the reinforcement or concrete. The type of feet utilized must be approved by the DCES.

H. Protective Coating for Permanent Casing. Provide a Coal Tar Epoxy-Polymide Coating meeting the requirements of, and apply it in accordance with SSPC-PS 11.01: Black (or Dark Red) Coal Tar Polymide Painting System. Apply the coating between the limits shown on the contract plans.

I. Mineral Slurry. Provide a mineral (bentonite) slurry that will remain in suspension, and with sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. Provide a slurry with the percentage and specific gravity of the material used to make the suspension sufficient to maintain the stability of the excavation and to allow proper concrete placement.

The acceptable range of values for mineral slurry is as follows:

Range of Values (68°F)			
Property (Units)	**Time of Slurry Introduction**	**Time of Concreting (In hole)**	**Test Method**
Density (lb/ft^3)	64.3 to 69.1	64.3 to 75.0	Density Balance
Viscosity (seconds/quart)	28 to 45	28 to 45	Marsh Cone
pH	8 to 11	8 to 11	pH paper or meter

Increase density range values by 2 pcf in salt water.

Desand the slurry so that the sand content does not exceed 4 percent (by volume) prior to concrete placement as determined by the American Petroleum Institute sand content test.

J. Polymer Slurry. Provide a polymer slurry with sufficient viscosity and gel characteristics to hold the hole open, and transport excavated material to a suitable screening system.

Polymer slurry may be made from PHPA (emulsified), vinyl (dry), or natural polymers.

Desand the polymer slurry so that the sand content is less than 1 percent (by volume) prior to concrete placement, as determined by the American Petroleum Institute sand content test.

K. Water. Provide water conforming to the requirements of §712-01 *Water*, except with a pH conforming to the slurry requirements listed above.

CONSTRUCTION DETAILS

A. Prior Experience. Submit proof and details of the following:

1. Two projects in the past 5 years where the Contractor or subcontractor performing the work has successfully installed drilled shafts similar to the size and type on this project.

2. The foreman for this work having supervised the successful installation of drilled shafts on at least two projects in the last 2 years.

3. The drill operators having had at least one year of experience installing drilled shafts with similar diameters and lengths, and in similar conditions.

Include details describing the equipment and methods used, any difficulties encountered and how they were overcome, and the results of any testing performed. Include the name and telephone number of someone for each project cited who can be contacted as a reference. Submit this information to the DCES for review, evaluation, and approval prior to submitting detailed

information as stated in this specification under C. Submittals. The DCES will render a decision within 15 working days after the receipt of all information. A Contractor or subcontractor will not be permitted to install drilled shafts without this approval.

All approvals are subject to trial and satisfactory field performance. Departmental approval does not relieve the Contractor or subcontractor of his responsibility to satisfactorily complete the work detailed in the contract documents.

B. General. Provide the equipment and use procedures necessary to install drilled shafts at the locations and to the elevations shown on the contract plans, or as approved by the DCES.

Prior to preparing submittals, fully examine the existing site conditions and subsurface exploration logs.

The construction methods selected are directly related to the method of load transfer assumed in the project design. The type of drilling method, presence of permanent or interim casing, and clean out procedure all affect the drilled shaft load transfer behavior in skin friction and end bearing. Construct the drilled shafts using construction methods consistent with the load transfer mechanism shown on the contract plans.

C. Submittals. Submit the proposed procedure and equipment for installing drilled shafts to the DCES for review and approval prior to commencing the work. The DCES will render a decision within 15 working days, measured from the date of receipt of all pertinent information. The submittal should include, but not be limited to, the following information:

1. Method describing how the Contractor will progress through obstructions and rock.
2. Details and method describing how the Contractor will keep the hole for the drilled shaft open.
3. Drawings showing and details describing the proposed sequence of drilled shaft installation. Include the sequence for each shaft, the overall construction sequence, and the sequence of shaft construction in bents or groups.
4. Information describing the type of equipment to be used, including drill rig, cranes, drilling tools, final cleaning equipment, desanding equipment, slurry pumps, sampling equipment, tremie or concrete pumps, casing (including casing dimensions, material and splice details), etc.
5. Proposed method for cleaning out the shaft excavations. Include a description of how the Contractor will perform spoil removal and disposal.
6. Documentation that shows that the Contractor, Driller, and Foreman have the requisite prior experience in installing drilled shafts. Include the name and telephone number of someone for each project cited who can be contacted as a reference.
7. Shaft excavation methods, and final shaft dimensions.