

SECTION 509

DRILLED SHAFT FOUNDATIONS

DESCRIPTION

509.01.01 General. This work consists of constructing drilled shaft foundations.

509.01.02 Qualifications of Drilled Shaft Contractors. No later than 30 days prior to constructing drilled shafts, submit in writing, qualifications to perform the drilled shaft construction as specified and provide a list of 4 projects successfully completed using drilled shaft construction. The list of projects shall contain names and current phone numbers of owner's representatives who can verify participation on those projects.

A minimum of one year experience installing drilled shafts of both diameter and length similar to those shown on the plans is required for signal, soundwall and overhead sign foundations.

A minimum of 3 years experience installing drilled shafts of both diameter and length similar to those shown on the plans is required for retaining wall and bridge foundations. In addition, the drilled shaft installations must also have been in conditions similar to those indicated by the contract documents and a site inspection.

509.01.03 Submittals. Provide a signed statement from the drilling contractor that inspection has been made of both the project site and all the subsurface information made available, including any soil or rock samples referenced in the contract documents. Submit this statement as part of the installation plan required herein.

Submit an installation plan for review a minimum of 15 days prior to constructing drilled shafts. This plan shall provide information on the following:

- (a) Name and experience record of the drilled shaft superintendent who will be in charge of the drilled shaft operations.
- (b) List of proposed equipment to be used, including, but not limited to: cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, core sampling equipment, tremies or concrete pumps, casing, etc.
- (c) Details of overall construction operation sequence and sequence of shaft construction in bents or groups.
- (d) Details of shaft excavation methods and procedures.
- (e) When the use of slurry is anticipated, details of the mix design and its suitability for the subsurface conditions at the construction site, mixing and storage methods, maintenance methods, and disposal procedures.
- (f) Discussion of methods to clean the shaft excavation.
- (g) Details of reinforcement placement, including support and centralization methods.
- (h) Details of concrete placement, including concrete delivery schedule and proposed operational procedures for tremie and pumping methods.
- (i) Details of casing installation and removal methods.

The drilled shaft installation plan will be evaluated for conformance with the contract requirements. Notification will be given within 14 days after receipt of the installation plan of any additional information required and/or changes necessary. Approval of the plan shall not operate to relieve the responsibility under the contract for the successful completion of the work, nor shall approval of the plan operate as a warranty that the plan will succeed or will be the most economical or efficient method of completing the work. Adhere to the approved plan for the remainder of the contract. Subject to acceptable field performance, or if changes in equipment or construction methods occur, submit a revised plan for review and approval.

MATERIALS

509.02.01 General. Material shall conform to the following Sections:

Portland Cement Concrete	Section 501
Reinforcing Steel	Section 505
Concrete Curing Materials and Admixtures	Section 702

Concrete shall be Class D Portland cement concrete with the following exceptions:

Minimum Compressive Strength	28 MPa (4,000 psi)
Maximum Aggregate Size	100% passing 19 mm (3/4 in.) Sieve
Maximum Water/Cement Ratio	0.45
Slump	175 to 225 mm (7 to 9 in.)*

*Test Method No. Nev. T438. In addition, the concrete shall maintain a minimum slump of 150 mm (6 in.) at 2 hours and 100 mm (4 in.) at 3 hours. For 2 hour, 3 hour or extended time slump tests, store a sufficient quantity of concrete in sealed five gallon buckets at room temperature.

CONSTRUCTION

509.03.01 Construction Sequence. Complete excavation to top of shaft elevation before shaft construction begins, unless otherwise noted or approved. Recompact and regrade any disturbance to the footing or pile cap area prior to the footing or pile cap concrete placement.

When drilled shafts are to be installed in conjunction with embankment placement, construct drilled shafts after the placement of embankment, unless otherwise noted or approved. In the case of drilled shafts constructed prior to the completion of the embankment, place pile caps or footings after the embankment has been placed as near to final grade as possible. Leave only the necessary work room for construction of the caps or footings.

509.03.02 Construction Methods. Perform excavations required for shafts, and bell footings if shown on the plans, through whatever materials are encountered to the dimensions and elevations shown in the plans or as required. Use construction methods suitable for the intended purpose and materials encountered. The permanent casing method shall be used only at locations shown on the plans or when authorized. Blasting will not be permitted unless noted on the plans or authorized in writing. Construct drilled shaft foundations according to the following methods:

- (a) **Dry Construction Method.** The dry construction method consists of drilling the shaft excavation, removing accumulated water and loose material from the excavation, placement of the reinforcing cage, and placement of concrete in a relatively dry excavation. Use the dry construction method only when: less than 0.3 m (1 ft) of ground water accumulates above the base of the excavation over a one hour period when no pumping is permitted; the sides and bottom of the excavation remain stable, with no detrimental caving, sloughing, or swelling occurring prior to placement of reinforcement; the sides and bottom of the shaft can be visually inspected prior to placement of reinforcing steel and/or concrete.
- (b) **Wet Construction Method.** The wet construction method consists of using water or mineral slurry to maintain stability of the borehole perimeter while advancing the excavation to the specified bottom elevation, placement of the reinforcing cage, and concreting the shaft. Where drilled shafts are located in open water areas, extend exterior casings from above the water elevation into the ground to protect the shaft concrete from water action during placement and curing. Install exterior casings in a manner that will produce a positive seal at the bottom of the casing so that no piping of water or other materials occurs into or from the shaft excavation. Use the wet construction method at sites where a dry excavation can not be maintained for placement of the shaft concrete.
- (c) **Casing Construction Method.** The casing construction method consists of placing a casing into a predrilled hole or advancing a casing through the ground by twisting, driving or vibration before being cleaned out. Use the casing method when shown on the plans or at sites where the dry or wet construction methods are inadequate to prevent caving or excessive deformation of the hole.

Method (c) Casing Construction Method may be used in conjunction with Method (a) Dry Construction Method or Method (b) Wet Construction Method.

509.03.03 Excavation and Drilling Equipment. Use excavation and drilling equipment having adequate capacity, including power, torque and down thrust to excavate a shaft of the required diameter and to a depth 20% greater than required. Excavation and overreaming tools shall be of adequate design, size and strength to perform the work.

When the material encountered cannot be drilled using conventional earth augers with soil or rock teeth, drill buckets, grooving tools, and/or overreaming tools, provide special excavation equipment, including but not lim-