

The Contractor shall provide equipment to determine if reaction piles are moving. A scale attached to the reaction piles that can be monitored with a transit shall be used for this purpose.

If at any stage during the test, the Engineer detects malfunctioning of any apparatus furnished by the Contractor, or the load is being eccentrically applied, or the anchor piles are yielding, the Engineer will order the test abandoned and the Contractor shall replace it with another test at no additional cost to the Administration. The Contractor shall have all necessary personnel present at the site at all times during the performance of the test to maintain the required load.

After the pile test program is complete, anchor (reaction) piles shall be removed or cut off as specified in 410.03.10.

Steel pipe piles shall be load tested before filling.

411.04 MEASUREMENT AND PAYMENT. When the project includes an item for load test, it will be measured and paid for at the Contract unit price per each for the pertinent Load Test item. The payment will be full compensation for furnishing and installing all equipment, drawings, monitoring, recording, removal of all devices at the completion of the tests, and for all material, labor, equipment, tools and incidentals necessary to complete the work. In the event that the properly conducted load test fails to achieve the designated capacity, the additional tests will be measured and paid for at the Contract unit price per each under the Load Test item.

SECTION 412 — DRILLED SHAFTS (CAISSONS)

412.01 DESCRIPTION. This work shall consist of constructing drilled shafts (caissons) as specified in the Contract Documents, or as directed by the Engineer.

412.02 MATERIALS. Materials shall conform to 420.02 except as modified herein.

Concrete Mix No. 4	902.10
Reinforcement Steel	908
Steel Casings	A 252, Grade 2 or A 36

412.03 CONSTRUCTION. Construction shall conform to 402.03, 419.03, and 420.03, except as modified herein.

412.03.01 Subfoundation Investigation. When the Contract includes an item for Subfoundation Investigation, the Contractor shall conduct a subfoundation investigation program prior to ordering or fabricating reinforcement for drilled shafts. This program shall be used to determine the elevation of suitable bearing stratum and the required depth of the drilled shafts. Test holes shall be drilled at approximately a third of the drilled shaft locations, as selected by the Contractor, spread over the number of shaft locations. Test holes shall be drilled a minimum of 10 ft below the estimated drilled shaft length unless otherwise directed by the Engineer. After drilling the test holes, the data obtained will be evaluated by the Engineer to determine the uniformity/variability of the foundation materials. If the evaluation determines that more test holes are required, additional test holes shall be drilled at locations approved by the Engineer.

412.03.02 Shaft Installer. The Contractor shall obtain the services of a shaft installer having a proven record of experience, having successfully completed not less than three projects with similar subsurface conditions, shaft sizes, depths and minimum volumes of work as contained in the project. The Contractor shall submit evidence of pertinent experience to the Engineer for approval before proceeding with drilled shaft work.

The Contractor shall furnish a Certified Drilled Shaft report for each drilled shaft. The report shall record the following:

- (a) Top and bottom elevations.
- (b) Final center line location at top.
- (c) Variation of shaft from plumb.
- (d) Results of tests performed.
- (e) Levelness of bottom.
- (f) Seepage of water.
- (g) Top and bottom elevation of any casings left in place.
- (h) Any unusual conditions.
- (i) Variation of dimensions from planned.
- (j) Dates of start and completion of excavation.
- (k) Inspection, testing, and placement of concrete (including any delays in concreting and location of construction joints in shafts).

- (l) Reinforcement steel.
- (m) Any additional information relevant to the as-built drilled installation.

The Contractor shall record and maintain information pertinent to each drilled shaft and shall provide required data to other testing and inspection personnel.

The Contractor shall provide all facilities as are reasonably required for the safe and convenient conduct of the Engineer's inspection and testing procedures.

412.03.03 Geotechnical Engineer. When specified in the Contract Documents, the Contractor shall employ the services of a qualified geotechnical engineer for inspection and testing for installation of drilled shafts. The geotechnical engineer shall be a professional engineer registered in the State of Maryland, have a demonstrated record of experience with similar drilled installations, and shall be approved by the Engineer prior to beginning augering for the drilled shafts.

The geotechnical engineer shall submit a plan containing the proposed methods to be used to inspect the drilled shafts in conformance with this Specification.

The geotechnical engineer shall visually inspect the bottom of each drilled shaft and perform tests as necessary to verify the bearing capacity. Drilled shafts shall be founded in material having a minimum design bearing capacity specified in the Contract Documents. The geotechnical engineer shall provide certification that the drilled shafts were properly drilled to a satisfactory depth and bearing.

412.03.04 Holes. Holes for drilled shafts shall be excavated by auguring, drilling, or hand excavation as necessary to reach the required bearing strata. Casings or slurry shall be installed as excavation proceeds when earth walls cannot be maintained without spilling into the shaft. Casings shall be full-length, watertight, of sufficient thickness to withstand compressive, displacement and withdrawal stresses, and to maintain the shaft walls. Casings shall be withdrawn as concrete is placed unless otherwise specified in the Contract Documents, or directed by the Engineer.

The final bottom elevation of drilled shafts shall be determined by the geotechnical engineer when the services are required. All holes shall be approved by the Engineer.

Holes for successive drilled shafts shall not be excavated until adjacent holes are filled with concrete and allowed to set.

Drilled shafts shall be constructed within the following tolerances:

- (a) Maximum permissible variation of center line locations shall be not more than 1/24th of the shaft diameter or 3 in., whichever is less.
- (b) Shafts shall not be out of plumb by more than 1.5 percent of the depth, 12.5 percent of the shaft diameter, or 15 in., whichever is less.
- (c) The top of the shaft or concrete cut-off elevation shall be within 1 in. of the design elevation.

If the specified tolerances are exceeded, corrective construction shall be provided to compensate for excessive eccentricity at no additional cost to the Administration. Proposed methods of corrective construction shall be submitted to the Engineer for approval before proceeding.

The bottom of drilled shafts shall be excavated to an undisturbed, level plane. All loose material shall be removed prior to placing concrete.

Drilled shafts shall be dewatered as required to facilitate excavation, inspection and concreting.

Each drilled shaft shall be inspected before placing concrete.

Reinforcement Steel. Reinforcement steel cages for each drilled shaft shall be fabricated and erected as one continuous unit. Reinforcement shall be placed accurately and symmetrically about the axis of the hole, and held securely in position during concrete placement.

Exposed ends of extended reinforcement shall be protected from damage.

Concrete. Drilled shafts shall be filled with concrete immediately after inspection and approval by the geotechnical engineer and the Engineer.

Concrete shall be placed in one continuous operation, in a smooth flow without segregating. Mechanical vibration for consolidation shall be provided for at least the top 25 ft of each shaft. Concrete shall be placed by means of bottom discharge bucket, flexible drop chute, elephant trunk hopper, tremie, or pumping. Chutes, tremies or pumping shall be used where a drop of more than 8 ft is required.

Concrete shall be placed in the dry insofar as practicable. If excessive water occurs and it is not feasible to dewater the drilled pier shaft for concreting, then concrete shall be placed by the tremie method in conformance with 420.03.05. Tremie placement operations shall be controlled to ensure that tremie is not broken during continuous placing from bottom to top. Other methods of depositing concrete underwater may be used if approved by the Engineer.

A sufficient head of concrete shall be maintained to prevent any reduction in the diameter of the drilled pier shaft by earth pressure and to prevent extraneous material from mixing with the concrete. The withdrawal of temporary casings shall be coordinated with concrete placement operations to maintain a head of concrete approximately 5 ft above the casing bottom.

Concrete placement shall be stopped at the top cut-off elevations as shown on the Contract Documents. The tops of drilled shafts shall be screeded level and given a roughened surface finish. Where the cut-off elevation is above ground elevation, the top section shall be formed to extend the shaft to the required elevation.

Construction joints will be permitted in drilled shafts if concrete placement operations must be interrupted, as accepted by the Engineer. The surface of any construction joint shall be screeded level and given a roughened surface. An approved bonding compound shall be applied to the construction joint surface prior to placing additional concrete.

The Engineer may require full-depth continuous coring of drilled concrete shafts where observations of temporary casing removal and concrete placement operations indicate cause for suspicion of quality of concrete, presence of voids, segregation or other defects. This work shall be performed at no additional cost to the Administration.

Defective Drilled Shafts. Drilled shafts found to be defective shall be repaired or replaced as directed by the Engineer at no additional cost to the Administration.

412.04 MEASUREMENT AND PAYMENT. The payment for the items specified in the Contract Documents will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

412.04.01 Drilled shafts including furnishing and setup of augering equipment, auguring, drilling, excavating, dewatering, inspection, testing, services of the shaft installer and geotechnical engineer, sleeves, reinforcement, concrete, etc., will be paid for at the Contract unit price per linear foot for the pertinent Drilled Shaft item.

412.04.02 When subfoundation investigation is specified, it will be measured and paid for in conformance with 419.04.

SECTIONS 413 — 417 RESERVED

SECTION 418 — PROTECTIVE JACKETS FOR PILES

418.01 DESCRIPTION. This work shall include cleaning piles, fabricating, furnishing and placing wire fabric, fabricating, furnishing, installing and sealing the protective jackets, and filling the void between pile and jacket with grout as specified in the Contract Documents or as directed by the Engineer.

418.02 MATERIALS.

Fine Aggregate	901.01
Portland Cement	902.03, Type II
Concrete Admixture	902.06
Water	921.01
Welded Wire Fabric	908.08
Fiberglass Protective Pile Jackets	921.11 and 418.02.01
Anchor/Standoff Devices	A 185
Stainless Steel Screws	A 193, Type 303

418.02.01 Jackets. The jackets for new piles shall be fabricated in one solid piece with no longitudinal joint. The closure joint on jackets for existing piles need not be self-locking provided the joint can be field formed with fiberglass and is approved by the Engineer. The field formed closure joint shall conform to the tensile strength of the jacket. All jackets shall be a minimum thickness of 1/4 in. The surfaces of the fiberglass shall be free of bond inhibiting agents.

Jackets for steel and concrete piles shall be provided with noncorrosive standoffs on the inside face to maintain the jackets in the required positions.

418.02.02 Closure Joint Warranty. When closure joints are used for existing piles, the manufacturer and Contractor shall both furnish the Administration a written 5 year warranty against manufacturing and installation defects prior to starting the installations.