Division 0200

SonicStop Standard Specification

Drilled Caissons

RELATED SECTIONS

Excavation.
Earthwork Clearing and Grubbing.
Noise Barrier Construction.

DESCRIPTION

This work is construction of reinforced concrete drilled caisson foundations consisting of shaft sections with or without casings left in place, as indicated or directed, and with or without rock sockets or belled footings, all formed within drilled excavations.

The following definitions apply:

(a) End Bearing Drilled Caisson.

Cast-in-place foundation element consisting of shaft section with or without enlarged bearing area at its base, a minimum of 750 mm (30 inches) in diameter, and deriving the majority of its compression load capacity through load transfer to the shaft base.

(b) Bell Footing.

Enlargement at base of shaft.

(c) Bearing Strata.

Layer(s) of soil and/or rock providing principal support at base of shaft.

(d) Rock Socket.

Length of excavation extending through rock which cannot be drilled with conventional earth augers and/or under reaming tools and requires the use of special rock augers, core barrels, air tools, blasting, and/or other methods of hand excavation. Rock is defined as a geomaterial having an unconfined compressive strength equal to or greater than 1.7 MPa (250 psi).

(e) Permanent Casing.

Steel pipe, typically of cylindrical shape, installed by drilling, driving, or vibrating, which, when filled with concrete, becomes a permanent part of the drilled caisson.

(f) Temporary Casing.

Protective steel pipe, typically of cylindrical shape, installed by drilling, driving, or vibrating, which provides lateral earth support during shaft excavation, cleaning, and inspection; controls groundwater infiltration; and is removed as part of the concrete placement operation.

(g) Obstruction.

Cobble, boulder, or any other natural or man made object above designated rock socket elevation which cannot be drilled with conventional earth augers and/or under reaming tools, and which requires the use of special rock augers, core barrels, air tools, blasting, and/or other methods of hand excavation.

MATERIALS

(a) Casing.

Smooth, clean, rust-free metal casing, of sufficient strength to withstand handling stresses; the pressure of concrete, water, and the surrounding earth; and installation stresses, and to prevent water seepage.

(b) Concrete.

For Tremie placement. Provide concrete having a slump of 150 mm ± 25 mm (6 inches) for the free fall method of placement.

(c) Reinforcement Bars.

Use deformed bars.

(d) Bentonite Slurry.

A mixture of fully hydrated bentonite and clean fresh water, of adequate unit mass (weight). Submit specifications, type, and properties of the slurry to the Engineer for approval.

CONSTRUCTION

(a) Excavation.

Excavate to the dimensions and elevations indicated, or as required by the site conditions and as directed by the Engineer. Unless otherwise indicated, bore excavations for vertical caissons plumb to within a tolerance equal to 2% of the shaft length; and for battered caissons, as indicated, or to within a tolerance equal to 5% of the shaft length. If holes are more than 150 mm (6 inches) out of plumb, redesign

(b) Drilled Caissons.

Do not place the top of a caisson out of the indicated position by more than 1/24th of the shaft diameter or 75 mm (3 inches), whichever is less. When belled footings are

required, excavate to form a bearing area of the size and shape indicated. Blasting may be used, if permitted. Submit blasting plan to the Engineer for review and approval 3 weeks prior to the start of blasting operations. Do not disturb formations below or outside the limits of the caisson under construction or any previously constructed caissons adjacent to the excavation.

Do not excavate within 3 diameters of caissons with new concrete until 24 hours after concrete placement. If satisfactory foundation materials are encountered at other than the indicated elevations, adjust drilling depths as directed by the Engineer.

If a caving condition or excess groundwater is encountered, discontinue the drilling operation and employ a construction method which satisfactorily prevents caving and groundwater infiltration, such as the installation of casings. As an alternate, drilling in a bentonite slurry with removal of cuttings or dewatering, or other construction methods which control the size of the excavation, will be permitted provided the Contractor can demonstrate the ability to perform such work to the satisfaction of the Engineer.

When bentonite slurry is used to support the caisson excavation, provide slurry mix design for review and approval prior to construction. As a minimum, provide mix design criteria for density, viscosity, shear strength, and pH and procedures for mixing, quality control, maintaining level in excavation, cleaning, reuse, and disposal.

Remove caked material from the sidewalls and loose cuttings from the bottom of the excavation, as directed, so that such material will not cause unanticipated settlement, reduce caisson capacity, or affect concrete strength. Provide casing through soil and broken or unstable rock at all times during hand cleaning and inspection of the excavation. When joining two or more sections of casing to obtain the required length, weld sections together so as to develop the full tensile strength of each section.

(c) Test Holes.

For caissons founded on rock, drill standard NW (NX) size core borings at each caisson location, to a minimum depth of 3000 mm (10 feet) below the bottom of the excavation (caisson or rock socket), unless otherwise specified or directed. Drill, log, store, and ship the samples in accordance with these specifications and the contract documents. The samples will be used to determine whether there is material of sufficient strength and thickness to support the required load and for proper founding of caissons.

(d) Probe Holes.

Drill 50 mm (2-inch) diameter unsampled holes at the specified locations, to the specified depth below the bottom of the excavation (caisson or rock socket), or as directed. The rate of drilling of the holes will be used by the Engineer to determine whether there is satisfactory material or rock of sufficient thickness and type to support the required load, and/or to locate the presence of open joints, voids, soft rock, or other deleterious material which may be inadequate for support of the required load.

(e) Inspection.

Do not place concrete until the foundation excavation has been inspected and accepted. If access to the bottom of the excavation for visual inspection cannot be provided

because of inability to dewater the excavation using acceptable pumping methods, provide drilling logs and core samples, or other acceptable data, for determining the condition of the excavation and the quality of the foundation material. As a minimum, inspect each shaft which cannot be dewatered with an underwater video camera.

Follow safety practices as specified in the contract documents and include, as a minimum, the following items specifically required for inspection of drilled caisson excavations: Provide casing through soil cavities and broken or unstable rock for inspection of the excavation.

Cover any open excavation immediately upon completion, or when work is discontinued for any period of time, with a cover capable of preventing persons from falling into or entering the excavation without proper authorization. Secure the cover by approved methods.

(f) Reinforcement.

Do not place reinforcement bars until all loose material has been removed from the bottom of the excavation and immediately before the start of concreting operations. Support reinforcement a minimum of 75 mm (3 inches) above bearing level and from the sides using precast concrete spacer blocks or other approved spacer devices, and secure in position so that the required concrete cover is maintained throughout concrete placement. Vibration of the concrete is required, unless the clear distance between bars is more than 3 times the bar diameter or 3 times the maximum aggregate size. Unless otherwise indicated or specified, place No. 20 (No. 6) deformed bars vertically around the circumference, at a 150 mm (6-inch) spacing, and No. 10 (No. 4) bars as tie bars, on 250 mm (12-inch) centers. Furnish bars with hooks meeting seismic requirements.

(g) Dewatering.

Unless otherwise specified, dewater all excavations prior to placing concrete. A drilled caisson excavation is considered dry if less than 75 mm (3 inches) of groundwater is present in the bottom of the excavation at the start of concrete placement and the groundwater infiltration rate is less than 6 mm (1/4-inch) rise per minute. Remove water which has accumulated in the excavation after final inspection and prior to concrete placement, using approved methods.

CONCRETE PLACEMENT.

Submit the method of concrete placement, including details on equipment, rate of placement, concrete head, etc., to the Engineer for approval 3 weeks prior to anticipated first placement. Do not start concrete placement without written approval. Mix, place, vibrate, and cure concrete as specified Place concrete within 18 hours of the completion of excavation and within 3 hours of final inspection. Keep the excavation free from accumulated seepage water and loose material until concrete is placed. Place the concrete for each caisson in one continuous operation. Thoroughly work and vibrate the upper 1500 mm (5 feet) of concrete. If it is determined by the Engineer that water seepage will be detrimental to the quality of the caisson or hinder proper placement of concrete by the free fall method, fill the excavation to the surrounding groundwater level with clean, fresh water and place concrete to the cutoff elevation by the tremie method, as specified in one continuous operation. Provide documentation to satisfactorily

demonstrate experience in the use of tremie or pumping procedures for placement of concrete for drilled caissons, and submit details of the placement method for review and acceptance. Do not allow concrete to come in contact with aluminum during placement.

(a) Placement by Free Fall Method.

Place concrete by free fall only in dry, clean, unobstructed excavations, which are at least 750 mm (30 inches) in diameter. Provide a hopper and a section of rigid pipe not less than 1500 mm (5 feet) long and 250 mm (10 inches) in diameter to direct concrete fall and avoid impact with reinforcement on the sides of the excavation. Unless otherwise directed, limit depth of free fall to 7600 mm (25 feet).

(b) Placement by Tremie Method.

Place concrete, using a rigid, watertight, ferrous metal tremie pipe, Begin placement with the tremie pipe discharge not more than 150 mm (6 inches) off the bottom of the excavation, and maintain a concrete head of not less than 1500 mm (5 feet) above the discharge at all times.

(c) Placement by Pumping Method.

Pumping will be permitted only as a last available means of concrete placement. Place concrete by pumping through a flexible; ferrous metal, rubber, or plastic pipe having a minimum diameter of 150 mm (6 inches), in a manner which will not permit segregation of the concrete. Begin pumping with the pipe discharge positioned not more than 150 mm (6 inches) off the bottom of the excavation, and maintain a concrete head of not less than 1500 mm (5 feet) above the discharge at all times.

(d) Placement Within Casing.

Use the free fall or tremie method to place concrete in dewatered excavations supported by casing. Pumping will also be permitted, but only as a last available means of placement. Use the tremie method to place concrete under water in casing supported excavations. If the top of shaft elevation is below ground level at the time of concrete placement, provide an oversized casing from ground elevation to a point below the top of shaft to prevent extraneous material from falling into fresh concrete during and after placement and until concrete has cured at least 24 hours. For permanently cased drilled caissons which carry lateral loads, grout the area between casing and excavation to provide adequate bearing.

(e) Placement Under Bentonite Slurry.

Use the tremie method to place concrete in excavations supported with bentonite slurry. Pumping will also be permitted, but only as a last available means of placement. Displace slurry with concrete beginning at the bottom of the excavation and proceeding upward, forcing the slurry out of and away from the top of the excavation.

CASING REMOVAL.

When temporary casing is used, withdraw each section, except the final section, in partial stages, as concrete is deposited, at a rate which keeps the bottom of the casing below the top of the fresh concrete. During removal, ensure that there is no reduction in shaft cross section and that displacement of steel reinforcement is less than 50 mm (2 inches) upward and less than 50 mm (2 inches) downward per 6000 mm (20 feet) of shaft length. Maintain the specified 75 mm (3-inch) reinforcement bar clearance at bearing level and on the sides during casing removal. If observations indicate otherwise, reduce the rate of casing removal and establish a head of concrete within the casing sufficient to offset the forces tending to cause concrete arching and/or displacement of the reinforcing cage. As concrete is deposited, withdraw the final section of casing to a point 600 mm (2 feet) below existing ground elevation and allow it to remain for approximately 2 hours, depending on the temperature, then, completely withdraw the section or cut it off flush with existing ground. If at any time cavities or unstable materials are encountered and the danger exists of losing concrete or of the concrete becoming mixed with extraneous material, cut off the casing at the top of shaft elevation and leave in place, as directed.

RECORDS.

Prepare and submit detailed inspection reports for each shaft, including the following information as required:

Accurate location and dimensions of the excavation.

Accurate top and bottom elevations.

Measurement data for plumbness.

Methods of excavation used.

Description of materials encountered during excavation.

Description of groundwater conditions encountered.

Description of obstructions encountered and whether obstruction removal was achieved.

Description of temporary or permanent casing placed including purpose, length, and wall thickness, and anchorage or sealing methods used, if any.

Measurements of slurry quality including, as a minimum, density, viscosity, shear strength, and pH.

Elevation at which bearing material was encountered. Description of bearing material. Probe holes made, along with method of probing, rate of drilling in rock, samples taken, tests made, and conclusions reached with regard to adequacy of bearing material.

Shaft, bell footing and rock socket measurements.

Description of clean-out methods and adequacy of initial clean-out and final clean-out just prior to concrete placement.

Record of depth of water in excavation and rate of water infiltration prior to concrete placement.

Record of reinforcing steel inspection for position and adequacy.

Method of concrete placement and casing removal, if any.

Record of concrete head during removal of casing.

Record of concrete elevation when vibration started.

Difficulties encountered including soil inclusion, voids, shaft squeeze-in, and casing collapse.

Concreting curves showing actual versus theoretical volume of concrete required to fill caisson excavation.

Condition of concrete delivered to site including record of slump, density, air content, and other tests.

Record of cylinders made for compression testing.

Any deviations from the specifications.

QUALIFICATIONS.

Be experienced, or choose a subcontractor who is experienced, in the construction of drilled caissons and meet the following qualifications:

Submit a list containing at least 5 projects which demonstrate a minimum of 3 years experience in the construction of drilled caissons including the proposed method of concrete placement. Include a brief description of each project and the name and phone number of owner's representative knowledgeable in each project listed.

Furnish the name of a registered Professional Engineer having at least 3 years of experience in the design and construction of drilled caissons, who is to supervise the work.

Furnish the names of drill operators and on-site supervisors having at least 1 year of experience in the construction of drilled caissons.

Do not use only the company names of consultants or manufacturers to meet the requirements of this section. Submit documentation of staff qualifications to the Engineer and allow at least 21 calendar days for approval.

MEASUREMENT AND PAYMENT

(a) Drilled Caissons, Shaft Section.

1. Shaft Section in Soil.

Meter (Linear Foot): Measured from the shaft top to the top of rock.

2. Shaft Section in Rock.

Meter (Linear Foot): Measured from the top of rock to the shaft bottom.

(b) Drilled Caissons, Bell Footing.

Each

(c) Drilled Caissons, Rock Socket.

Meter (Linear Foot): Measured from the shaft bottom to the socket bottom. For uneven rock surfaces, measure length of rock excavation from the rock surface at shallowest depth to the socket bottom.

(d) Permanent Casing for Drilled Caissons.

Meter (Linear Foot): Temporary casing left in place, as specified will be measured and paid for as permanent casing.

(e) Test Holes.

Meter (Linear Foot): Augering through overburden, from existing ground surface to the elevation at which NW (NX) core boring is to begin (bottom of caisson or rock socket excavation as specified) will be considered incidental to this item of work and will not be paid for separately.

(f) Probe Holes.

Meter (Linear Foot)

MISCELLANEOUS

Where this specification differs from other Contract documents the more stringent conditions shall apply without invalidating any of the other provisions of either document.

END OF SECTION.