

**SECTION 31 63 26
DRILLED CAISSONS**

SPEC WRITER NOTE: Use this section only
for NCA projects. Delete text between
// _____ // not applicable to project.
Edit remaining text to suit project.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation and concrete required for construction of foundation caissons.

SPEC WRITER NOTE: Obtain from Structural
Engineer bearing material name as it
appears in SUB-SURFACE EXPLORATION
REPORT. Insert name in following
paragraph.

1.2 RELATED REQUIREMENTS

- A. Contract Time and Price Adjustment: Section 01 00 01, GENERAL REQUIREMENTS, Clause FAR 52.243-4.
- B. Surveyor Qualifications: Section 01 00 01, GENERAL REQUIREMENTS, Article, PROFESSIONAL SURVEYING SERVICES.

1.3 DEFINITIONS

- A. Satisfactory Bearing Material: // _____ // and is assumed to occur at bottom of caisson elevations shown on drawings.

1.4 CONTRACT BASIS

- A. Contract price for caissons will be based upon total length for each type of caisson shown on drawings. Length of caissons will be measured from bottom elevation to top elevation of caisson. Diameter of caisson is defined as minimum diameter of shaft.
 1. Adjustment of contract price will be based upon total length of each type of caisson placed and not on lengths of individual caissons. When total length of each type of completed caisson is determined by the Contracting Officer's Representative (COR) to be greater or less than length shown on drawings due to unsuitable soils or design modifications by the COR, contract price adjustment will be made according to Clauses of Section 01 00 01, GENERAL REQUIREMENTS, as applicable.

2. Contract price and time will be adjusted according to Clauses of Section 01 00 01, GENERAL REQUIREMENTS as applicable, when artificial materials not shown on drawings are encountered.

1.5 CLASSIFICATION OF EXCAVATION

A. Soil/Weathered Rock Excavation:

SPEC WRITER NOTE: Requirements for track mounted power excavators may vary. Discuss with soils consultant and modify as required.

1. Soil or weathered rock that can be reasonably excavated with rock auger, i.e. rock auger advancement greater than 150 mm (6 inches) in 15 minutes. (See rock auger refusal in Paragraph 1.5.C.2., below.).

B. Sloping Weathered Rock Excavation:

1. Excavation of soil/weathered rock that can typically be excavated with rock auger, except when steeply sloping orientation of stratum causes rock auger to run askew.

C. Rock Excavation:

1. Excavation of material that meets rock auger refusal criteria and requires rock core barrel or other hard rock excavation techniques for removal.
2. Rock auger refusal is defined as penetration rate of less than 150 mm (6 inches) in 15 minutes, while operating a caisson drilling rig, rated with a torque capacity of minimum 110 kN-meters (1,000,000 inch-pounds), applying continuous down pressure of minimum 220 kN (50,000 pounds), equipped with a rock auger that contains conical carbide-tipped ("Kennemetal") teeth.

D. Nominal Soil or Weathered Rock Seams:

1. Nominal soil or weathered rock seams below rock auger refusal will be excavated and considered as rock for rock excavation quantities. A nominal soil or weathered rock seam is one which is less than 600 mm (2 feet) thick. Where soil or weathered rock seams or voids of 600 mm (2 feet) or greater are excavated within a mixed rock/soil or rock/weathered rock profile, excavation is classified as soil/weathered rock excavation until rock auger refusal is again established.

1.6 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION

- A. Measurement: Excavation type in units of length will be considered to change at upper contact with a different excavation type as defined by Article 1.5.
- B. Payment: Provide contract unit rates per length of each type of caisson for each excavation condition type noted above in Article 1.5. Contract price and time will be adjusted for overruns or underruns according to Clauses of Section 01 00 01, GENERAL REQUIREMENTS as applicable.
- C. Payment for Differing Site Conditions: No payment will be made for any rock excavation beyond caisson limits unless additional excavation is directed by COR. When rock excavation, as classified, is encountered, contract price and time will be adjusted according to Clauses of Section 01 00 01, GENERAL REQUIREMENTS, as applicable.

SPEC WRITER NOTES: Obtain following allowable tolerances from Structural Engineer.

1.7 TOLERANCES

- A. Install caissons with maximum the lesser of 1/24th of caisson shaft diameter or 75 mm (3 inches) from design center location. Caissons out of plumb more than 25 mm (1 inch) in 3000 mm (10 feet) for full depth will not be acceptable.

1.8 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Concrete Institute (ACI):
 1. 211.1-91 (2009) - Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 2. 301-10 - Specifications for Structural Concrete.
 3. 305R-10 - Guide to Hot Weather Concreting.
 4. 306R-10 - Guide to Cold Weather Concreting.
 5. 318-14 - Building Code Requirements for Structural Concrete and Commentary.
- C. American Welding Society (AWS):
 1. D1.1/D1.1M: 2015 - Structural Welding Code - Steel.
- D. ASTM International (ASTM):
 1. A36/A36M-14 - Carbon Structural Steel.
 2. A283/A283M-13 - Low and Intermediate Tensile Strength Carbon Steel Plates.

3. A615/A615M-16 - Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
4. A929/A929M-01(2013) - Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe.
5. A996/A996M-16 - Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
6. C33/C33M-16 - Concrete Aggregates.
7. C94/C94M-16 - Ready-Mixed Concrete.
8. C150/C150M-16 - Portland Cement.
9. C494/C494M-15a - Chemical Admixtures for Concrete.
10. C618-15 - Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
11. C989/C989M-14 - Slag Cement for Use in Concrete and Mortars.
12. C1017/C1017M-13e1 - Chemical Admixtures for Use in Producing Flowing Concrete.

1.9 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.

SPEC WRITER NOTE: Edit participant list to ensure entities influencing outcome attend.

1. Required Participants:
 - a. COR.
 - b. // Architect/Engineer. //
 - c. // Inspection and Testing Agency. //
 - d. Contractor.
 - e. Installer.
 - f. // Manufacturer's field representative. //
 - g. Other installers responsible for adjacent and intersecting work, including // _____ //.

SPEC WRITER NOTE: Edit meeting agenda to incorporate project specific topics.

2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Installation schedule.
 - b. Installation sequence.

- c. Preparatory work.
 - d. Protection before, during, and after installation.
 - e. Installation.
 - f. Terminations.
 - g. Transitions and connections to other work.
 - h. Inspecting and testing.
 - i. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.10 SUBMITTALS

- A. Submit according to Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Detailed location plan and description of proposed method of caisson installation, subject to review and approval of COR.
 - 2. // Detailed plan showing load test arrangement, location, and Contractor's qualifications and results for review and approval by COR. //
- C. Test Reports:
 - 1. Caisson Record: Data as specified.
 - 2. Rock Excavation: Data as specified.
 - 3. Soil Testing Agency Reports: Show material type and allowable bearing capacity at bottom of shaft within 24 hours after testing each caisson.
 - 4. Caisson Field Record: Record actual elevation of bottom, elevation of rock (if applicable), final centerline location of top, variation of shaft from plumb, bell dimension (if applicable), result of tests and observations performed, material type and actual allowable bearing capacity of bottom, depth of socket into rock, levelness of bottom, seepage of water, still water level ((if allowed to flood)), elevation ((top and bottom)) of lining left in place, variation of shaft diameter (from those shown), and evidence of seams, voids or channels below bottom of each caisson.
- D. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Welders and welding procedures.
- E. Delegated Design Drawings and Calculations: Signed and sealed by responsible design professional.

1. Show detailing, fabricating, bending, and placing of concrete reinforcement complying with ACI 318.

1.11 QUALITY ASSURANCE

- A. Welders and Welding Procedures Qualifications: AWS D1.1/D1.1M.
- B. Delegated Design: Professional engineer licensed in State where project is located.

1.12 DELIVERY

- A. Deliver steel reinforcement to prevent damage.
- B. Before installation, return or dispose of distorted or damaged steel reinforcement.
- C. Bulk Products: Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants.

1.13 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.

1.14 FIELD CONDITIONS

- A. Hot Weather Concreting Procedures: ACI 305R.
- B. Cold Weather Concreting Procedures: ACI 306R.

1.15 WARRANTY

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Delegated Design: Prepare submittal documents including design calculations and drawings signed and sealed by registered design professional, licensed in state where work is located.
 1. Minor deviations to details shown on drawings to accommodate manufacturer's standard products may be accepted by COR when deviations do not affect design concept and specified performance.

2.2 MATERIALS

SPEC WRITER NOTE: Delete this Article if unreinforced-concrete drilled piers are used.

- A. Steel Reinforcement: ASTM A615/A615M, or A996/A996M, Grade 60, deformed.
- B. Portland Cement: ASTM C150/C150M, Type I or II.

SPEC WRITER NOTES: Select mineral or cementitious admixtures from two subparagraphs below if permitted. Ready-mix plant blends fly ash or slag with Portland cement.

- C. Fly Ash/Slag:
 - 1. Fly Ash Admixture: ASTM C618, Class C or F.
 - 2. Ground Granulated Blast-Furnace Slag: ASTM C989/C989M, Grade 100 or 120.
- D. Normal-Weight Aggregate: ASTM C33/C33M, uniformly graded, 19 mm (3/4 inch) maximum aggregate size.
- E. Water: Potable, complying with ASTM C94/C94M requirements.
- F. Admixtures: Certified by manufacturer to contain maximum 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

SPEC WRITER NOTES: If desired, select admixtures from subparagraphs below.

- 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 - 3. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type G.
 - 4. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- G. Steel Casings: ASTM A283/A283M, Grade C; or ASTM A36/A36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1/D1.1M, or ASTM A929/A929M, steel sheet, zinc coated corrugated steel. Design shells to withstand drilling forces and earth pressures and reinforce bottom cutting edge as required for proper drilling and sealing of shells into rock. Provide cutting edge capable of coring through minimum 3000 mm (10 feet) of broken or solid rock. Consider minimum 2

percent out of roundness of diameter in design of the shell. Weld all seams to be watertight.

2.3 CONCRETE MIXES

- A. Concrete Mix: Prepare design mixes according to ACI 211.1 and ACI 301 for each type and strength of concrete determined by either laboratory trial mix or field test data bases. Qualified testing agency to prepare and report proposed mix designs for laboratory trial mix basis. Proportion mixes according to ACI 211.1 and ACI 301 for normal-weight concrete as follows:
1. Compressive Strength (28 Days): 34.5 MPa (5000 psi).
 2. Minimum Slump: Maintain slump of 125 mm (5 inches) plus or minus 25 mm (1 inch).
 3. Do not air entrain concrete for caissons.
 4. Limit water-soluble, chloride-ion content in hardened concrete to // 0.15 // 0.3 // percent by weight of cement.
 5. Concrete-mix design adjustments may be considered if characteristics of materials, project conditions, weather, test results, or other circumstances warrant. Resubmission and approval of proposed changes to concrete-mix proportions is Contractor's responsibility.
- B. Concrete Mixing: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and provide batch ticket information. Do not add water to concrete mix after mixing, unless procedure per ACI 301 is submitted to and approved by COR. Maintain concrete temperature less than 32 degrees C (90 degrees F).

PART 3 - EXECUTION

3.1 GENERAL

- A. Size: Minimum sizes and types of caissons are shown on drawings. Proposal to use caissons of sizes and types different from those shown may be accepted if submitted in writing to COR for approval and provided the following conditions are met:
1. Least dimension of caisson is equal to or greater than least dimension shown.
 2. Enlargement at base of caisson is in bell-form with dimensions equal to or greater than minimum shown.

SPEC WRITER NOTES: Consult Structural Engineer for bearing value required in following paragraph (3).

3. If volume of caisson as constructed is greater than that shown, bearing area at base is increased so that additional weight is distributed to bearing material at no more than // _____ kPa (____ psf) //.
 4. Entire caisson receives full lateral support from surrounding material.
- B. Changes: Accompany requests for change in size or type of caisson from those shown on drawings with calculations and other documentation necessary to show that proposed changes will meet load requirements. Do not proceed with changes before receiving written approval from COR.
- C. Temporary Steel Casings: Install casings for protection of workers and inspection personnel, for prevention of cave-ins or displacement of earth walls, and for retention of ground water.
- D. Defective Casings: Do not install buckled, distorted or otherwise damaged casings. Replace casings damaged or disturbed during construction, casings that are not mud-tight or otherwise not according to drawings or specifications, at no additional cost to the Government.
- E. Survey: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 01, GENERAL REQUIREMENTS, to establish lines and levels and stake caisson locations.

3.2 PREPARATION

- A. Excavation and construction methods to result in minimum disturbance of surrounding material and full lateral support of caissons by surrounding material.
- B. Remove boulders and rock in caissons such as rock seams underlain with soil seams, sloping rock or rock otherwise unsatisfactory for bearing. If materials with satisfactory bearing strength occur at elevations higher or lower than those shown on drawings, place bottom of caissons at higher or lower elevations, subject to approval of COR.

SPEC WRITER NOTES: Delete following paragraph if not required.

- C. Test Drilling: Percussion drill one test hole, 50 mm (2 inches) in diameter to depth equal to twice caisson diameter, but minimum 1800 mm

(6 feet) deep, in bottom of each caisson which has been excavated to rock to determine if rock seams are underlain by soil seams or voids.

- D. Excavate caissons to dimensions and required bearing strata or elevations shown on drawings. Maintain sidewall stability during drilling. Excavate holes for closely spaced caissons, and those occurring in fragile strata, only after adjacent holes are filled with concrete and allowed to set. Excavate by hand or machine as required. Caisson drilling equipment to have minimum torque capacity and downward force capacity for project site conditions. Remove soft and loose materials and level bottoms of caissons. If bottoms are sloping rock, excavate to level plane or step with maximum step height less than 1/4 width or diameter of bearing area. Dispose material off-site removed from caisson holes around casing before concrete placement, in areas submitted to and approved by COR.
- E. Maintain excavations for utilities, support of excavations, or other purposes minimum two shaft diameters away from caisson outer edge.

3.3 PLACING CONCRETE

- A. Engage testing agency approved by COR to observe and approve caisson tip before placing concrete. Clear shaft of mud, water, loose material, and debris.
- B. Place concrete using down pipe to direct flow of concrete. Except in presence of water, concrete may fall freely from maximum 9.14 meters (30 feet) provided concrete does not hit sides of caisson. Use tremie pipe or pump if distance is greater than 9.14 m (30 feet).
- C. Remove casings, as concrete is deposited, maintaining top surface of concrete constantly minimum 1800 mm (6 feet) above lower end of casings. Place concrete to form a monolithic cylindrical shaft having full lateral support from surrounding undisturbed materials. Strike finished top surface to true plane at required elevation.
- D. Place concrete in each caisson in one continuous operation. If placing operation has to be stopped, leave surface approximately level. If concrete has hardened, clean surface and slush with a 1 to 1 cement-sand grout before placing operation is resumed. Do not begin concrete pours within one hour of darkness. In the event that this type of continuous sequential operation cannot be performed, submit a method of securing open excavation for COR approval. Do not leave excavations open overnight without receiving COR prior written approval.

- E. When water is present, control water level to within 50 mm (2 inches) of caisson bottom by pumping. If impossible or impractical to control water, secure written permission from COR to place concrete through water by means of a watertight tremie.
 - 1. When placing concrete under water, submerge tremie discharge end in fresh concrete and maintain tremie shaft full of concrete to point above water level.
 - 2. Increase cement content of concrete required to be placed in water by one sack per 0.76 cu. m (1 cu. yd.) of concrete.

3.4 FIELD QUALITY CONTROL

- A. For each caisson placed and before superstructure framing is installed, submit certified report by Registered Professional Land Surveyor or Licensed Civil Engineer for COR approval, including the following:
 - 1. Caisson number, length, and bearing material.
 - 2. Location.
 - 3. Concrete and steel reinforcement properties.
 - 4. Plumbness.
 - 5. Dates:
 - a. Excavation completed.
 - b. Concrete placed.
 - 6. Diameters:
 - a. Top of shaft.
 - b. Bottom of shaft.
 - 7. Bell.
 - 8. Elevations:
 - a. Top of ground.
 - b. Top of concrete.
 - c. Top of rock.
 - d. Bottom of caisson.

3.5 CLEANING

- A. Remove and dispose debris off-site.
- B. Clean project site at frequent intervals with no material obstructing easy access of equipment and personnel.

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