Section 02380-CAISSONS

Part 1-GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section

1.02 SUMMARY

A. This section includes drilled, cast-in-place reinforced concrete end-bearing caissons.

B. Extent of caissons into bedrock is shown on drawings, including locations, diameters of shafts, diameters of bells where required, estimated bottom elevations, and details of construction. For top elevation, refer to civil drawing for bedrock elevation with respect to finish floor elevation. Also refer to soil report for required details of construction and inspection.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Divisions 1 Specification Sections.

B. Concrete Materials Test Reports as proposed for use in concrete mixes.

C. Preliminary Caisson Report of actual allowable bearing capacity at bottom of each shaft, after testing each excavation.

D. Certified Caisson Report for each caisson, recording actual elevation at bottom and top, elevation of rock, final centerline location at top, variation of shaft from plumb, results of tests performed, actual allowable bearing capacity of bottom, depth of socket (if applicable), levelness of bottom, seepage of water, still water level (if allowed to flood), elevation of bottom and top of any casing left in place, any usual conditions, variation from original design, dates of starting excavation, completion of excavation, inspection, testing, and placement of concrete (include any delays in concreting and location of construction joints in shaft).

E. Concrete Design Mix Reports listing mixes required and their respective test result.

F. Concrete Test Reports, recording pertinent information and certification of compliance with Project requirements.

1.04 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of American Concrete Institute ACE 336. Standard Specifications for the Construction of End Bearing Drilled Piers and as herein specified.

B. Where provisions of above standard conflict with building regulations in effect for this Project, building regulations will govern, but only to establish minimum requirements.
C. Caisson Installer Qualifications: Not less than three successfully complete contracts with similar soil conditions, shaft sizes, depths, and volumes of Work contained in this Project.
D. Survey Work: Engage a registered surveyor of licensed professional engineer, in the state of Louisiana to perform surveys, layouts, and measurements for caisson work. Conduct layout work for each caisson to lines and levels required before excavation, and actual measurements of each caisson's location, shaft diameter, bottom and top elevations, deviations from specific tolerances, and other data as required.
E. Record and maintain information pertinent to each caisson and cooperate with other testing and inspection personnel to provide data for required reports.
F. Concrete Testing Service: Employ testing laboratory to perform material evaluation tests and to design concrete mixes.
G. Owner will employ separate testing laboratory to perform field quality control tests.
H. Materials and installed work may require testing and at any time during progress of Work. Allow free access to material stockpiles and facilities. Tests not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, a re-Contractor's responsibility.
I. Certificates of material properties, indicating, compliance with specific requirements, may be substitutes in lieu of testing when acceptable to Architect. Certificates of compliance must be signed by materials producer and Contractor.

1.05 JOB CONDITIONS

A. Site Information: Data on indicated subsurface conditions is not intended as representations or warranties of continuity of such conditions. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn there from Contractor. Data are made available for convivence of Contractor and are not guaranteed to represent conditions that may be encountered.
B. Additional test borings and other explanatory operations may be made by Contractor at no additional cost to Owner.

C. Existing Utilities: Locate existing underground utilities before starting caisson excavation operations. If utilities are to remain in place, provide protection from damage during caisson operations.

D. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult Architect immediately for directions as to procedure. Cooperate with Owner and utility companies in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

E. Do not interrupt existing utilities except when permitted in writing by Owner and after acceptable temporary utility services have been provided.

PART 2 - PRODUCTS

2.01 CONCRETE AND RELATED MATERIALS

A. Concrete and related materials are specified in Division 3 Sections.

B. Portland Cement: ASTM C 150, Type I or Type II as required.

C. Fly Ash: ASTM C 618, Type C or F.

D. Aggregates: ASTM C 33, and as herein specified.

1. Local aggregates not complying with ASTM C 33, but which have shown by test or actual service to produce concrete of adequate strength and durability, may be used when acceptable to Architect.
2. Maximum Aggregate Size: Not larger than three-fourths of minimum clear spacing between individual reinforcing bars or bundles of bars.

E. Water: Drinkable

F. Air-Entraining Admixture: ASTM C 260.

G. Water-Reducing Admixture: ASTM C 494, Type A, containing no set-accelerating or set-retarding compounds, chlorides, fluorides or nitrates.

H. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.

I. Reinforcing Bars and Dowels: ASTM A 615, Grade 60.

J. Galvanized Reinforcing Bars: ASTM A 767.

K. Reinforcing Spirals: ASTM A 82.

2.02 CONCRETE MIX DESIGNS

A. General: Use independent testing facility for preparing and reporting proposed mix designs and placement methods. Testing facility shall not be same as used for field quality control testing.

B. Design mix to produce concrete for caissons with minimum 28-day compressive strength of 4000 psi.

C. Proportion mixes by either laboratory trail batch or field experience methods using materials and placement methods to be employed on Project for each class of concrete required, complying with ACI 211.1.

D. Submit written reports to Architect of proposed mix for concrete at least 15 days prior to start of work. Do not begin concrete production until mix design has been reviewed by Architect.

E. Adjusted to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be accepted by Architect before using in Work.

F. Admixtures: Use air-entraining admixture in concrete, unless otherwise directed. Add air-entraining admixture at manufacturer's prescribed rate to ensure in concrete at point of placement having 4 percent to 6 percent air content.

G. Use water-reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete, may be used at Contractor's opinion.

H. Use amounts of admixtures as recommended by manufacturer for climatic conditions prevailing at time of placing concrete. Adjust quantities of admixtures as required to maintain quality control.

I. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement of not less than 3 inches and not more than 5 inches.

2.03 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.

1. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to batch will not be permitted.

B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reducing mixing and delivery time from 1-1/2 hours to 75 minutes; and when air temperature is above 90 deg F (32 deg C), reducing mixing and delivery time to 60 minutes.

2.04 STEEL CASING

A. Steel Pipe Casings: ASTM A 252, Grade 2 or ASTM A 36.

B. Corrugated Steel Casings; ASTM A 444.

PART 3 - EXECUTION

3.01 CAISSON EXCAVATION

A. General: Excavate holes for caissons to required bearing strata or elevations shown on drawings. Excavate holes for closely spaced caissons, and those occurring in fragile or sand strata, only after adjacent holes are filled with concrete and allowed to set.

B. Caisson design dimensions shown are minimums. The design of caissons is based on assumed strata bearing capacity. If bearing stratum is not capable of maintaining bearing capacity assumed, foundation system will be revised as directed by Architect. Revisions will be paid for in accordance with Contract conditions relative to changes in Work.

C. If required, install casings as excavation proceeds so earth walls are maintained without spilling into shaft.

D. Construction Tolerances: Locate centerline of caissons within the following tolerances:

1. Maximum permissible variation of location not more than $1/24^{th}$ of shaft diameter or 3 inches, whichever is less.

2. Shafts out of plumb not more than 1.5 percent of length nor exceeding 12.5 percent of shaft diameter or 15 percent, whichever is less.

3. Concrete cut-off elevation, plus 1 inch to minus 3 inches.

E. If above tolerances are exceeded, provide corrective construction to compensate for excessive eccentricity. Submit proposed corrective construction methods to Architect for review before proceeding.

F. Temporary Shaft Protections: When required, provide full-length watertight steel casings of sufficient thickness to withstand compressive, displacement, and withdrawal stresses and to maintain shaft walls. Temporary casings may be left in place or may be withdrawn as concrete Is placed at Contractor's opinion.

G. Shoring: Provide shoring as required in unstable soil conditions to preclude cave-in during hand excavation and inspection operations.

H. Obstructions: If rock, boulders, or other unforeseen obstructions are encountered which cannot be removed by standard caisson excavation methods, and is such obstructions are not indicated by available subsurface data, removal of such obstructions will be paid for in accordance with terms of Contract relative to changes in Work.

I. Remove such obstructions by hand labor using air-powered tools or by other methods recognized in construction industry.

J. Classification of Rock: Rock is defined as material which cannot be drilled with a conventional earth auger of underreaming tool, and requires use of special rock augers core barrels, air tools, blasting or other methods of hand excavation.

    1. Earth seams, rock fragments, and voids included in rock excavation area will be considered rock for full volume of shaft from initial contact with rock for pay purposes.

K. The work of this Section includes demolition and removal of rock boulders, concrete, masonry, and other subsurface obstructions which are clearly indicated by Contract Documents, or by available subsurface exploration data, and is not considered a change in Work.

L. Dewatering: Provide and maintain pumping equipment to keep excavations free of water before placing concrete. If excessive water is encountered and drilling operations must be halted, consult with Architect before using alternative methods of construction.

M. Conduct water to general site run-off ditches and disposal areas with discharge lines. Provide ditching as required to conduct water to site drainage facilities.

N. Bells: NOT APPLIED.

O. SECTION DELETED.

P. SECTION DELETED.

Q. Inspection: Each caisson must be inspected and tested before placing concrete.

R. Provide and maintain facilities with equipment required for inspection and testing of excavations. Cooperate with inspecting and testing personnel to expedite Work.

S. Notify Architect and testing facility at least 6 hours prior to time excavations will be ready for inspection and tests.

T. Depth of Bearing Stratum: If indicated depth of shaft excavation is reached without developing required stratum bearing capacity, immediately suspend excavation operations and inform Architect. Architect will determine procedures to be followed.

U. Where changes in indicated depth or dimensions are required, or additional soil borings are required, proceed with such work when directed in writing by Architect.

V. Overexcavation: No payment will be made for extra length, when caisson shafts are excavated to a greater depth than required or authorized by Architect, due to over drilling by Contractor. Complete caisson and fill extra depth with concrete if other conditions are satisfactory. Overexcavated shafts will be measured and paid for to original design or authorized depth

W. Excavated Material: Remove excavated material and legally dispose off site.

3.02 PERMANENT STEEL CASINGS (TO BE USED ONLY IF SITE CONDITION REQUIRE IT)

A. General: Provide permanent steel casings where shown on drawings of sufficient strength to withstand handling stresses and pressures from surrounding soil and water or concrete inside. Provide casings with inside clear diameter not less than diameter of caisson shaft.

1. Where shown, wall thickness is minimum permitted for any portion of casing remaining within completed caisson work.

B. Steel Pipe Casings: Casings may be delivered in sections of any convenient length. Connect section by continuous penetration welds during placement into caisson shaft excavation.

C. Design bottom edge of lowest casing section to provide cutting shoe for penetrating into rock strata and affecting water seal.

D. Corrugated Steel Casings: Provide corrugated steel casings formed of galvanized or bituminous-coated steel shafts.

E. Corrugated casings may be delivered in sections or panels of any convenient length, and field Connected in accordance with manufacturer's instructions.

F. Installation

3.03 REINFORCING STEEL AND DOWELS

A. Before placing clean reinforcing steel and dowels of loose rust, scale, dirt, grease, and other material which could reduce or destroy bond.

B. Fabricate and erect reinforcing cages in shafts as one continuous unit using inner ring resteel. Place reinforcement accurately and symmetrically about axis of hole and hold securely in position during concrete placement.

C. Use templates to set anchor bolts, leveling plates, and other accessories furnished under work of other sections. Provide blocking and holding devices to maintain required position during concrete placement.

D. Protect exposed ends of extended reinforcing, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.04 CONCRETE PLACEMENT

A. General: Fill caissons with concrete immediately after inspection and approval by testing laboratory. Use protection sheets (cut out to receive concrete) over excavation openings, extending at least 12 inches beyond edge.

B. Place concrete continuously and in a smooth flow without segregating. Provide mechanical vibration for consolidation of at least top 25 feet of each shaft.

C. Place concrete by means of bottom discharge bucket, flexible drop chute, elephant trunk hopper, or tremie. Use chutes or tremies for placing concrete here a drop of more than 25 feet is required, or pump concrete into place.

D. Place concrete in-the-dry unless placing under water is acceptable to Architect. If water occurs, and it is impracticable to dewater caisson excavation, and reasonable attempts to seal off water flow have failed, allow water level to attain its normal level and place concrete by tremie method. Control placement operations to ensure that tremie is not broken during continuous placing from bottom to top. Other methods of depositing concrete under water may be used, if acceptable to Architect.

E. Maintain a sufficient head of concrete to prevent reduction in diameter of caisson shaft by earth pressure and to prevent extraneous material from mixing with fresh concrete. Coordinate withdrawal of temporary casings with concrete placement operations to maintain a head of concrete approximately 5 feet above casing bottom.

F. Stop concrete placement at cut-off elevation shown, screed level, and apply a scoured, rough finish. Where cut-off elevation is above ground elevation. From top section above grade and extend shaft to required elevation.

G. Interrupted placing operations of over one-hour duration will require a cold join installation. Leave resulting shaft surface approximately level and insert steel dowels as shown as drawings. At resumption of concrete placing, clean off surface laitance, roughen as required, and slush with a 1-to1 cement grout or commercial bonding agent before remainder of concrete is placed.

H. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures in compliance with ACI 306 and as herein specified.

I. When air temperature has fallen or is expected to fall below 40 deg F (4 deg c) uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 def F (27 deg C) at point of placement.

J. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

K. Do not use calcium chloride, salt, or other mineral containing antifreeze agents or chemical accelerators, unless accepted by Architect.

L. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

M. Cool ingredients before missing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control

concrete temperature, provided water equivalent of ice is calculated into total amount of mixing water. Cooling concrete mixture by use of liquid nitrogen may be used if acceptable to Architect.

N. Place concrete immediately upon delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means.

O. Do not use retarding admixtures without acceptance of Architect.

3.05 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: Sample and test concrete for quality control during placement as follows:

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

2. Slump: ASTM C 143; one test for each concrete load at point of discharge, and one for each set of compressive strength test specimens.

3. Air Content: ASTM C 231, pressure method; one test for each set of compressive strength test specimens.

4. Compression Test Specimens: ASTM C 31; one set of four standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.

5. Concrete Temperature: Test when air temperature is 40 deg F (4deg C)

6. Compressive Strength Tests: ASTM C 39; one set of four cylinders per drilled pier but not more than one set per trunk. One specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

    1. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing in-place concrete.

B. Report test results, in writing to Architect and Contractor on same day tests are made. Include in reports Project identification name and number, date of concrete placement, name of contractor, name of concrete supplier and truck number, name of concrete testing service, concrete type, location of caisson, design compressive strength at 28 days, concrete mix

proportions and materials, compressive breaking strength and type of break for both 7-day test and 28-day test.

C. Additional Concrete Tests: Testing service may take core samples of in-place concrete when test results indicate such that there is a reasonable doubt that specified concrete strengths have not been attained.

1. Continuous coring of caissons may be required, at Contractor's expense, when time for Removal of temporary casings exceeds specified limits, or where observations of placement operations indicate suspicious of quality of concrete, presence of voids, segregation, or other possible defects.

D. Inspection and Tests for Caissons: Soil testing facility shall perform and report specified tests and additional test which may be required. Conduct tests and provide reports as soon as possible so as not to delay concreting operations for acceptable excavations.

E. Bottom elevations, bearing capacities, and length of caissons as shown on drawings are estimated from available soil data. Actual elevations and caisson lengths, and bearing capacities will be determined by soil testing facility from conditions found in excavations. Final evaluations and acceptance of data will be determined by Architect.

F. Conduct test as follows:

1. For hardpan bearing, make tests for first 3 caissons and one of every 6 caissons thereafter, unless otherwise directed by Architect.

2. For rock bearing, make tests for first 3 caissons, and additional tests as directed by architect.

G. Caissons bearing on Hardpan: Take undistributed samples, suitable for tests required, from caisson bottom. Make auger probe to a depth of 8 feet below bottom and visually inspect and classify soil. Verify continuity and thickness or stratum.

H. Conduct the following tests on each sample, and report results and evaluations to Architect.

1. Unconfined Compression Test (ASTM D 2166).

2. Moisture Content (ASTM D 2166).

3. Density.

I. Caissons Bearing on Rock: Inspect and test each caisson bottom by drilling and probing to a depth of 8 feet below bottom elevation to determine whether voids, clay seams, or solution channels exist.

J. Take undisturbed rock core samples from selected caisson bottoms. Conduct compression test for each sample and report results and evaluations to Architect.

3.06 MEASUREMENT AND PAYMENT

A. Basis of Bids: Bids shall be based on number of caissons, design length from top elevation to bottom of shaft, (extended through bell, if applicable), and diameter of shaft and bell, as shown on drawings

B. Basis for Payment: Payment for caissons will be made on actual net volume of caissons in place and accepted. The actual length, shaft diameter, and bell diameter (if applicable) may vary to coincide with elevations where satisfactory bearing strata are encountered, and with actual baring value of bearing strata determined by testing services, and with stability and characteristics of soil strata. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts and bells.

C. There will be no additional compensation for excavation, concrete fill, reinforcing, casings, or other costs due to unauthorized overexcavating of shafts or bells. No payment will be made for rejected caissons.

D. Prices quotes include full compensation for labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete, and other items for complete installation.

E. Unit Prices: Unit prices for the following items, as set forth in Contract conditions, will apply in even additions to or deductions form work are required and authorized by written order from architect to Contractor.

1. Soil excavation (per cu. yd)

2. Rock excavation (per cu. yd).

3. Permanent steel casings, installed (per lineal ft)

4. Reinforcing steel and dowels, installed (per lb).

5. Concrete (per cu. yd).

END OF SECTION 02380