SECTION 316329 – DRILLED CONCRETE PIERS AND SHAFTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes cast-in-place concrete drilled piers and shafts.

B. Comply with requirements of Division 3 Section “Cast-In-Place Concrete.”

C. Related Sections include the following:

1. Division 1 Section “Unit Prices.”
2. Division 1 Section “Construction Facilities and Temporary Controls.”
3. Division 1 Section “Structural Special Inspection.”

1.3 UNIT PRICES

A. Basis of Bids: Base bids on indicated number of drilled concrete piers; design length from top elevation to bottom of shaft; and diameter of shaft.

The drilled pier Contractor shall provide a base bid for quantities shown on the drawings. Final payment for work will be adjusted from the base bid quantities (not from zero) based on unit costs submitted with the bid on the form of proposal (UNIT PRICES). Unit prices for additive/deductive shall be the same.

The test hole required by specification shall be drilled into the rock from the bottom of the excavation shall be included in the base bid.

If the actual bearing elevation is determined (by the Special Inspector) to be deeper or shallower, adjustments will be made to the base bid. The price adjustment would depend on if the added length was excavated in soil or rock. No distinction shall be made between weathered rock and solid rock with respect to unit costs.

Conversely, if the overall length was decreased because solid limestone was encountered at a shallower depth than the lengths given for base bid, the Contractor’s pay will be reduced by the same unit costs provided for additional length.

All drilled piers shall be assumed to include temporary casing for the full height of the drilled pier as part of the base bid. Casing shall be included in the submitted complete installed unit costs of the drilled piers.

B. Basis for Payment: Payment for drilled concrete piers and shafts will be made on a lump sum basis with adjustments made for net variation of total quantities, based on design dimensions for shafts, and unit prices included with the base bid. The actual length and shaft diameter may vary to coincide with elevations where satisfactory bearing strata are

encountered, and with actual bearing value of bearing strata determined by an independent testing and inspecting agency.

1. No additional compensation will be made for excavation, concrete fill, reinforcement, casings, or other costs due to unauthorized overexcavating of shafts.
2. No payment will be made for rejected work.
3. Unit prices include labor, materials, tools, equipment, and incidentals required for soil excavation, rock excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, test holes, and other items for a complete drilled-pier installation. Unit prices for additive and deductive adjustments shall be the same.
4. Adjustments for payment to the base bid for excavation (soil augering or rock drilling) shall be material dependent, not elevation dependant. Additional depth of soil excavation shall be paid at the unit cost submitted for soil excavation regardless if the excavation occurs below bottom of drilled pier elevation specified on plan. Rock excavation unit costs will only be paid where rock is required to be excavated.
5. See Division 1 Section “Unit Prices” for a schedule of unit prices.

1.4 SUBMITTALS

A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.

B. Product data, reinforcing shop drawings, and concrete mix design including laboratory test reports per Section 033000 – Cast-In-Place Concrete.

C. Qualification Data: For firms and persons specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Record drawings at Project closeout according to Division 1 Section “Contract Closeout.”

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has specialized in installing drilled piers similar to those required for this Project.

B. Drilled-Pier Standard: Comply with provisions of ACI 336.1, “Specification for the Construction of Drilled Piers,” unless modified in this Section.

1. The slurry displacement method of installation will not be permitted.

C. Survey Work: Engage a registered surveyor or licensed professional engineer to perform surveys, layouts, and measurements for drilled piers. Lay out each drilled pier to lines and levels required before excavation and record actual measurements of each drilled pier’s location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each drilled pier and cooperate with Owner’s testing and inspecting agency to provide data for required reports.

D. Welding Standards: Qualify welding procedures and welding personnel to perform the welding processes for this Project according to the following AWS standards:

1. AWS D1.1, “Structural Welding Code – Steel.”

1.6 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

1. 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.

B. Site Information: A geotechnical report is being prepared for this Project and will be made available for information only. The report is not part of the Contract Documents. Opinions expressed in this report are those of the geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by the geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

PART 2 – PRODUCTS

2.1 REINFORCING MATERIALS

A. See Section 033000 - Cast-In-Place Concrete.

2.2 CONCRETE MATERIALS

A. See Section 033000 - Cast-In-Place Concrete.

2.3 SAND-CEMENT GROUT

A. Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Unless otherwise indicated, mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with sufficient water to permit flow during placement.

2.4 STEEL CASINGS

A. Steel Pipe Casings: ASTM A 283 (ASTM A 283M), Grade C; or ASTM A 36 (ASTM A 36M) carbon-steel plate, with vertical joints full-penetration welded according to AWS D1.1.

PART 3 – EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

A. Classified Excavation: Excavation is classified and includes excavation to bearing elevations. Excavation will be classified as standard excavation, special excavation, and obstruction removal, as follows:

1. Standard excavation includes excavation accomplished with conventional augers fitted with solid or rock teeth, drilling buckets, and under-reaming equipment attached to drilling equipment of size, power, torque, and down thrust necessary for the work.
2. Special excavation includes excavation that requires special equipment or procedures above or below indicated depth of drilled piers where drilled-pier excavation equipment used in standard excavation, operating at maximum power, torque, and down thrust, cannot advance the shaft.

    a. Special excavation requires use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation.
    b. Special excavation through rock “floaters” in the soil strata would apply over the depth of the rock only. Soil strata between rock floaters and bedrock would be considered standard excavation.
    c. Earth seams, rock fragments, and voids included in rock excavation area will be considered rock for full volume of shaft from initial contact with bedrock.

3. Obstructions: Removal of unanticipated boulders, concrete, masonry, or other unforeseen obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or under-reaming tools attached to drilling equipment of size, power, torque, and down thrust necessary for the work, will be paid according to Contract provisions for changes in the Work.

B. Dewatering: Prevent surface and ground water from entering excavated shafts. Dewater excavated shafts before concreting. Conduct water to site drainage facilities.

C. Excavate shafts for drilled piers to elevations dictated by the Special Inspector after completion of their rock coring. Minimum length of any drilled pier will be 2 times the pier diameter.

1. Excavate bottom of drilled piers to level plane.
2. Remove loose material and water from bottom of excavation.

D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.

1. Do not excavate shafts deeper than elevations indicated, unless approved by Architect.

E. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.

1. Remove temporary casings during concrete placement.
2. Temporary casings may be left in place or may be withdrawn during concrete placement at Contractor’s option.

F. Tolerances: Construct drilled piers to remain within the following tolerances:

1. Maximum Variation from Location: Not more than the lesser of 4.2 percent of pier diameter or 3 inches (76 mm) from design center location.
2. Out-of-Plumb: Not more than 12.5 percent of pier diameter.
3. Out-of-Plumb: Not more than 1.5 percent of pier length.
4. Concrete Cutoff Elevation: Plus 1 inch (25 mm), minus 3 inches (76 mm).
5. Bottom Area of Pier: Not less than 96 percent of pier area required.
6. Shaft Diameter: Not less than 98 percent or more than 110 percent of shaft diameter indicated.

G. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Engineer for review before proceeding.

3.3 PERMANENT STEEL CASINGS

A. Install steel pipe casings of minimum wall thickness indicated with inside clear diameter not less than diameter of drilled pier.

1. Install casings as excavation proceeds, to maintain sidewall stability.
2. Fabricate bottom edge of lowest casing section with a cutting shoe capable of penetrating rock and achieving a water seal.
3. Connect casing sections by continuous penetration welds to form a watertight, continuous casing.
4. Remove and replace, or repair, casings that have been damaged during installation and that could impair strength or efficiency of drilled pier.
5. Fill annular void between casing and shaft wall with sand-cement grout.

3.4 REINFORCEMENT

A. Comply with recommendations of CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover to reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

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

3.5 CONCRETE PLACEMENT

A. Place concrete in a continuous operation and without segregation immediately after inspection and approval of the shaft by an independent testing and inspecting agency.

B. Place concrete by means of bottom discharge bucket, flexible drop chute, elephant-trunk hopper, or tremie. Use chutes or tremies for placing concrete where a drop of more than 25 feet (7.6 m) is required, or pump concrete into place.

C. Place concrete in a dry shaft, unless placement underwater or by slurry displacement is approved by Architect.

1. Place concrete in slurry-filled shafts or underwater by tremie method or pumping. Control placement operations to ensure tremie is embedded no less than 60 inches (1500 mm) into concrete, and the flow of tremied concrete is continuous from bottom to top of drilled pier.
2. Other methods of depositing concrete may be used, if approved by Architect.

D. Coordinate withdrawal of temporary casings with concrete placement operations to maintain a head of concrete no less than 60 inches (1500 mm) above casing bottom.

E. Screed concrete at cutoff elevation level and apply a scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

F. Construct a cold joint if concrete placement is delayed more than one hour. Level top surface of concrete and insert joint dowel bars. Before placing remainder of concrete, clean surface laitance, roughen, and slush with a commercial bonding agent or with a sand-cement grout mixed at the ratio of 1:1.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: The Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during excavation and concrete placement for drilled piers.

B. Inspection: Each drilled pier must be inspected and tested by Special Inspector before placing concrete.

1. Provide and maintain facilities with equipment required for testing and inspecting excavations. Cooperate with testing and inspecting personnel to expedite the Work.
2. Notify Engineer and testing agency at least 6 hours before excavations are ready for tests and inspection.

END OF SECTION 316329