# SECTION 316329 - DRILLED PIERS

## PART 1 - GENERAL

1.1 SUMMARY

A. Extent of drilled piers is shown on drawings, including locations, diameters of shafts, bottom elevations, and details of construction.

1.2 SUBSURFACE SOIL DATA

A. Subsurface soil investigations have been made and the results are available for examination by the Contractor. The Contractor is expected to examine the site and determine for himself the character of the materials to be encountered.

1.3 REFERENCES

A. American Concrete Institute (ACI), latest versions;
   1. ACI 301 - Specifications for Structural Concrete for Buildings
   2. ACI 336.1 - Standard Specification for the Construction of Drilled Piers

B. ASTM International (ASTM), latest versions;
   1. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   2. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field
   3. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
   4. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete
   5. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete
   6. ASTM C172-04/C172M - Standard Practice for Sampling Freshly Mixed Concrete
   7. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
   8. ASTM C231/C231M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
   9. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete
   10. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete

1.4 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Supplemental General Conditions which apply to work of this section.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of American Concrete Institute (ACI) "Standard Specification for the Construction of Drilled Piers" (ACI 336.1), and as herein specified.

B. Drilled Pier Installer Qualifications: Not less than three successfully completed contracts with similar soil conditions, shaft sizes, depths and volumes of work contained in this project. Submit satisfactory proof of compliance to Engineer.

C. Materials and installed work may require testing and retesting at any time during progress of work. Allow free access to material stockpiles and facilities. Tests, including retesting of rejected materials and installed work, will be Contractor's responsibility.

D. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing, when acceptable to Engineer. Certificates of compliance must be signed by materials producer and Contractor.

1.6 SUBMITTALS

A. Reports: Submit the following reports directly to Engineer, with copy to others as designated.
   1. Concrete Materials Test Reports as proposed for use in concrete mixes.

1.7 JOB CONDITIONS

A. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of continuity of such conditions. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn by Contractor. Data is made available for convenience of Contractor and is not guaranteed to represent conditions that may be encountered.

B. Additional test borings and other exploratory operations may be made by Contractor at no additional cost to Owner.

1.8 EXISTING UTILITIES

A. Locate existing underground utilities by careful hand excavation before starting drilled pier excavation operations. If utilities are to remain in place, provide protection from damage during drilled pier operations.

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

C. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when permitted in writing by Owner and after acceptable temporary utility services have been provided.

## PART 2 - PRODUCTS

2.1 CONCRETE AND RELATED MATERIALS

A. Concrete and related materials are specified in Division-3 sections.

B. Maximum Aggregate Size: Not larger than three-fourths of minimum clear spacing between individual reinforcing bars or bundles of bars.

C. Water: Clean, potable.

D. Air-Entraining Admixture: ASTM C 260.

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

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

2.2 CONCRETE MIX DESIGN

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

B. Design mix in accordance with Section 4 of ACI 301 to produce concrete for drilled piers with minimum 28-day compressive strength of 4000 psi.

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

D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement of 6 inches plus or minus 1 ½ inches.

2.3 CONCRETE MIXING

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

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.

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

## PART 3 - EXECUTION

3.1 DRILLED PIER EXCAVATION

A. General: Excavate holes for drilled piers to elevation as shown on drawings. Drilled pier design dimensions shown are minimums.

B. Construction Tolerances: Locate centerline of drilled piers within the following tolerances.
   1. Maximum permissible variation of location not more than 1/24th of shaft diameter or 3 inches, whichever is less.
   2. Shafts out of plumb:
      a. For unreinforced piers extending through materials offering minimal or no lateral restraint (i.e. water, normally consolidated organic soils, and soils that might liquefy during an earthquake) - 12.5 percent of pier diameter.
      b. For unreinforced piers extending through materials offering lateral restraint (soils other than those indicated in a.) - not more than 1.5 percent of pier length.
      c. For reinforced concrete shafts - Out-of-plumb tolerance shall be 2.0 percent of the pier length.
   3. Concrete cut-off elevation, plus 1 inch to minus 3 inches.
   4. If above tolerances are exceeded, provide corrective construction to compensate for excessive eccentricity. Submit proposed corrective construction methods to Engineer for review before proceeding.

C. Obstructions: If rock, boulders, or other unforeseen obstructions are encountered which cannot be removed by standard drilled pier excavation methods, and if 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.

D. Inspection
   1. Each drilled pier must be inspected before placing concrete. The Contractor shall engage the services of a Registered Professional Geotechnical Engineer under whose supervision full-time inspection of the drilling and casting of the piers will be performed.
   2. Provide facilities as required to assist inspection of excavations, and cooperate with inspecting personnel to expedite work.
   3. Notify Engineer and testing facility at least 24 hours prior to time excavations will be drilled.

E. Overexcavation: No payment will be made for extra length, when drilled pier shafts are excavated to a greater depth than required, due to overdrilling by Contractor. Complete drilled pier 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.

3.2 REINFORCING STEEL AND DOWELS

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

B. 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.

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

3.3 CONCRETE PLACEMENT

A. General: Fill drilled piers 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 through a hopper centered in the reinforcing cage so that stream of concrete does not hit reinforcing or sides of hole. Let concrete free-fall for entire depth of shaft. Place concrete continuously and in a smooth flow without segregating. Provide mechanical vibration for consolidation of top 5 feet of each shaft.

C. Place concrete in-the-dry unless placing underwater is acceptable to Engineer. If water occurs, and it is impracticable to dewater drilled pier 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 underwater, such as pump placement, may be used, subject to the approval of the Engineer.

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

3.4 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.
   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 173, or ASTM C 231, one for each set of compressive strength test specimens.
   4. Compression Test Specimens: ASTM C 31, one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
   5. Compressive Strength Tests: ASTM C 39, one set of four cylinders for every 30 cubic yards of concrete placed. One specimen tested at 7 days, 2 specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
   6. Report test results in writing to Engineer 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 drilled pier, 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 tests.

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

3.5 INSPECTION AND TESTS FOR DRILLED PIERS

A. Soil testing facility shall perform and report specified tests, and additional tests which may be required. Conduct tests and provide reports as soon as possible to not delay concreting operations for acceptable excavations.

END OF SECTION 316329