

SECTION 31 66 15
HELICAL PIERS AND ANCHORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnishing and installation of Helical Piers and Helical Anchors.
- B. Design of Helical Piers and Helical Anchors.

1.02 UNIT PRICES - MEASUREMENT AND PAYMENT

- A. The base bid shall include all necessary costs for the installation of Helical Piers and Helical Anchors as shown on the plans. See Section 01 2200 - Unit Prices, for additional unit price requirements.
- B. Designed Helical Piers and Helical Anchors:
 - 1. Design Pier and Anchor Quantity: Determined by the quantity of Piers and Anchors indicated in the Contract Documents.
 - 2. Design Pier and Anchor Length: By the linear foot measured from assumed Pier and Anchor end to cut-off elevation as indicated. Base bid shall be the lengths indicated in the Contract Documents.
- C. Actual Helical Piers and Helical Anchors:
 - 1. Actual Pier and Anchor Quantity: Determined by the quantity of Piers and Anchors identified in the Project Record Documents.
 - 2. Actual Pier and Anchor Length: Determined by length of Piers and Anchors identified in the Project Record Documents, measured from actual Pier and Anchor end to cut-off elevation.

1.03 REFERENCES

- A. ASTM A 36 / A 36M - Structural Steel; 2005
- B. ASTM A 123 / A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002
- C. ASTM A 153 / A 153M - Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware; 2005
- D. ASTM A 500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2007
- E. ASTM D 1143 - Standard Test Method for Individual Piles Under Static Axial Compressive Load; 2007
- F. ASTM D 3689 - Standard Test Method for Individual Piles Under Static Axial Tensile Load; 2007
- G. ASTM D 3966 - Standard Test Methods for Deep Foundations Under Lateral Load; 2007
- H. ANSI/ASME - Standard B18.2.1, Square and Hex Bolts and Screws, Inch Series; 1996
- I. AWS D1.1 / D1.1M - Structural Welding Code - Steel; American Welding Society; 2006 and Errata.
- J. Occupational Safety and Health Administration (OSHA) Excavation Safety Guidelines; 2008

1.04 SUBMITTALS

- A. The Contractor shall prepare and submit to the Architect/Engineer for review and approval, Shop Drawings for the Helical Piers and Helical Anchors intended for use on the project at least 14 calendar days prior to planned start of installation. The Shop Drawings shall include the following:

1. Helical Pier and Helical Anchor product identification number(s) and designation(s) for each type and size pile.
 2. Maximum allowable mechanical compression and tensile strength of the Helical Piers and Helical Anchors.
 3. Number of Helical Piers and Helical Anchors and respective design allowable capacities from the Drawings.
 4. Planned installation depth and the number of lead and extension sections.
 5. Helical configuration (number and diameter of helical bearing plates).
 6. Manufacturer's recommended capacity to installation torque ratio.
 7. Minimum final installation torque(s).
 8. Product identification numbers and designation for all Bracket Assemblies and number and size of connection bolts or concrete reinforcing steel detail.
 9. Corrosion protection coating on Helical Piers, Helical Anchors, and Bracket Assemblies.
- B. Contractor shall submit to the Architect/Engineer certified calculations from a Professional Engineer licensed in the state of the project location showing Helical Pier and Helical Anchor design allowable capacities. Calculations shall include, but not be limited to, considerations for downdrag (if any), corrosion, expansive soils (if any), minimum installation depth, buckling, soil bearing and pullout capacity, and lateral resistance (if required).
- C. The Contractor shall submit to the Architect/Engineer calibration information certified by an independent testing agency for the torque measurement device to be used on the project. Calibration information shall have been obtained within the year of the date submitted. Calibration information shall include, but is not limited to, the name of the testing agency, identification number or serial number of the device calibrated and the date of calibration.
- D. If load tests or proof load tests are required on the Drawings, the Contractor shall submit for review and acceptance the proposed load testing procedure. The proposal shall provide the minimum following information:
1. Type and sensitivity of load equipment.
 2. Type and sensitivity of load measuring equipment.
 3. Type and sensitivity of pile-head deflection equipment.
 4. General description of load reaction system, including description of reaction anchors or bearing plate.
 5. Calibration reports for equipment, including hydraulic jack, pressure gauges, and deflection dial gauges.
- E. Helical Pier, Helical Anchor, and Bracket Assembly product warranty information.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: At least five (5) years experience in the design and manufacture of Helical Piers and Helical Anchors, and current ICC-ES /ICBO product evaluation report.
- B. Installer Qualifications: Minimum of five (5) projects in the last five (5) years, and be able to provide project name, number and type of Helical Piers or Helical Anchors installed, project location, and client contact information, a list of installation and testing equipment, and a detailed description of method of installation and load testing (if testing was required).

- C. Designer Qualifications: Helical Piers and Helical Anchors designed under the direct supervision of a Professional Engineer licensed in the State of the Project.

1.06 SHIPPING, STORAGE AND HANDLING

- A. All Helical Pier, Helical Anchor, and Bracket Assemblies shall be free of structural defects and protected from damage during shipping and delivery. Helical Piers, Helical Anchors, and Bracket Assemblies should be stored on wood pallets or supports to keep them from contacting the ground, and under protective cover from weather. Damage to materials shall be cause for

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chance Civil Construction; 210 N. Allen, Centralia, MO 65240, (573) 682-8414
- B. Earth Contact Products; 15612 South Keeler Terrace, Olathe, KS 66062, (913) 393-0007
- C. Magnum Piering; 6083 Schumacher Park Drive, West Chester, OH 45069, (800) 822-7437

2.02 HELICAL PIERS, HELICAL ANCHORS, AND BRACKET ASSEMBLIES

- A. Unless noted otherwise, it is the Contractor's responsibility to select the appropriate size and type of Helical Piers, Helical Anchors, and Bracket Assemblies to support the design allowable loads shown on the Drawings. The size and number of helical bearing plates must be such that the Helical Piers and Helical Anchors achieve the appropriate torque capacity in the soils at the site within the minimum and maximum length requirements. Failure to achieve proper torque and capacity shall result in Contractor replacing Helical Piers and Helical Anchors, at Contractor's expense, as appropriate to support the required loads. All material replacements shall be acceptable to the Architect/Engineer.
- B. All Helical Piers and Helical Anchors shall be manufactured to the following criteria:
1. Corrosion Protection: Helical Piers, Helical Anchors, and Bracket Assemblies shall be protected from corrosion by hot-dip galvanizing per ASTM A 123 or A 153, as applicable.
 2. Shaft Connections: The Helical Pier and Helical Anchor shaft connections shall be in-line, straight and rigid and shall have a maximum tolerable slack of 1/16-inch. Shaft connections shall have flexural strength at least as great as the shaft itself.
 3. Bolts: Helical Pier and Helical Anchor shaft connections shall be made via bolted connection, capable of developing maximum installation torque with a safety factor of not less than 2.0. All connection bolts shall be hot-dip galvanized.
- C. Helical Piers shall be fitted with a manufactured new construction or repair Bracket assembly rated for the design allowable loads shown on the Drawings. Helical Anchors shall be fitted with a manufactured adjustable Bracket Assembly that facilitates both post-tensioning and proof load testing.

2.03 WELDMENTS

- A. All welded connections shall conform to the requirements of the American Welding Society D1.1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Contractor shall locate all utilities and structures above and underground in the area of the Work. Contractor shall pot hole to determine the exact location of underground utilities and buried structures within three (3) feet of a Helical Pier or Helical Anchor installation. Contractor is responsible for protection of utilities and structures shown on the Drawings. Costs of avoiding, relocating, or repair of utilities not shown on Drawings shall be paid by the Owner as extra work.
- B. Contractor shall review the Contract Documents and soil borings to determine subsurface conditions for sizing and installation of Helical Piers and Helical Anchors. In addition, Contractor shall make a site visit to observe conditions prior to the start of Work.
- C. Contractor shall notify Architect/Engineer of any condition that would affect proper installation of Helical Piers and Helical Anchors immediately after the condition is revealed. Contractor shall halt Work until the matter can be resolved upon mutual satisfaction of Contractor and Architect/Engineer. Costs associated with construction delays, product substitutions, pier or anchor relocations, or other related costs resulting from an unforeseen condition, and if the result of the unforeseen condition could not be inferred by a reasonable Contractor from the Drawings and Construction Documents, shall be the responsibility of the Owner.
- D. If excavation is required for proper installation of Helical Piers and Helical Anchors, Contractor shall make safe excavations in accordance with OSHA standards. All excavations greater than 20 feet in depth or not in strict accordance with OSHA standard details shall be designed by a registered design professional specializing in the design of excavations and shoring. The costs of all excavations, shoring, and related design shall be born by the Contractor unless noted otherwise in the Contract.
- E. Contractor shall notify Architect/Engineer at least 48 hours prior to installation of Helical Piers or Helical Anchors to schedule quality assurance observations required on the Drawings.

3.02 INSTALLATION EQUIPMENT

- A. Torque Motor: Helical Piers and Helical Anchors should be installed with high torque, low speed torque motors, which allow the helical plates to advance with minimal soil disturbance. The torque motor shall be hydraulic power driven with clockwise and counter-clockwise rotation capability. The torque motor shall be adjustable with respect to revolutions per minute during installation. Percussion drilling equipment shall not be permitted. The torque motor shall have torque capacity at least 25 percent greater than the minimum final installation torque required for the project.
- B. Installation Equipment: The installation equipment shall be capable of applying adequate crowd and torque simultaneously to ensure normal advancement of the Helical Piers and Helical Anchors. The equipment shall be capable of maintaining proper alignment and position.
- C. Torque Indicator: A torque indicator shall be used to measure installation torque during installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. The torque indicator shall be capable of torque measurements with a sensitivity of 500 ft-lb or less. Torque indicators shall be calibrated prior to start of Work. Torque indicators shall be calibrated either on-site or at an appropriately equipped test facility.

Indicators that measure torque as a function of hydraulic pressure shall be calibrated at normal operating temperatures. Torque indicators shall be re-calibrated if, in the opinion of the COR, reasonable doubt exists as to the accuracy of the torque measurements.

3.03 INSTALLATION PROCEDURES

- A. Unless shown on the Drawings, the number and size of helical bearing plates shall be determined by the Contractor in order to achieve the required torque and tensile/bearing capacity for the soil conditions at the site. However, the ratio of design allowable capacity to the total area of the helical bearing plates shall not exceed the Maximum Plausible Bearing Capacity of the bearing stratum.
- B. Connect the lead section to the Torque Motor using the Drive Tool and Connection Pin. Position and align the Lead Section at the location and to the inclination shown on the Drawings. Advance the Lead Section and continue to add Extension Sections to achieve the Termination Criteria. All sections shall be advanced into the soil in a smooth, continuous manner at a rate of rotation not to exceed 30 revolutions per minute. Snug tight all coupling bolts.
- C. Constant axial force (crowd) shall be applied while rotating Helical Piers or Helical Anchors into the ground. The crowd applied shall be sufficient to ensure that the Helical Pier or Helical Anchor advances into the ground a distance equal to at least 80% of the blade pitch per evolution during normal advancement.
- D. The torsional strength rating of the Helical Pier or Helical Anchor shall not be exceeded during installation according to manufacturer's torsional strength ratings.
- E. Bolt hole elongation due to torsion of the shaft of a Helical Anchor at the drive tool shall be limited to $\frac{1}{4}$ inch. Helical Anchors with bolt hole damage exceeding this criterion shall be cause for rejection.
- F. When the Termination Criteria of a Helical Pier or Helical Anchor is obtained, the Contractor shall adjust the elevation of the top end of the shaft to the elevation shown on the Drawings or as required. This adjustment may consist of cutting off the top of the shaft and drilling new holes to facilitate installation of Bracket Assemblies to the orientation shown on the Drawings. Or, installation may need to continue until the final elevation and orientation of the pre-drilled bolt hole is in alignment. The Contractor shall not reverse the direction of torque and back out the Helical Pier or Helical Anchor to achieve final elevation or orientation.
- G. The Contractor shall install Bracket Assemblies in accordance with details shown on the Drawings.
- H. All Helical Pier and Helical Anchor components including the shaft and Bracket Assembly shall be isolated from making a direct electrical contact with any concrete reinforcing bars or other non-galvanized metal objects because these contacts may alter corrosion rates.
- I. After installation, Helical Anchors shall be pre-tensioned if indicated on the Drawings.

3.04 TERMINATION CRITERIA

- A. Helical Piers and Helical Anchors shall be advanced until all of the following criteria are satisfied:
 - 1. Design torque is achieved. The final installation torque is equal to the allowable capacity shown on the Drawings times a factor of safety of 2.0 divided by the manufacturer's capacity to torque ratio.

2. Minimum depth is obtained. The minimum depth shall be as determined by the Contractor's Engineer, that which corresponds to the planned bearing stratum, or the depth at which the final installation torque is measured, whichever is greater. For Helical Anchors, advancement shall continue while maintaining or exceeding the required final installation torque for a distance of at least three (3) feet without augering.
- B. If the torsional strength rating of the Helical Pier or Helical Anchor has been reached, or if the maximum torque of the installation equipment has been reached, or if augering occurs prior to achieving the minimum depth required, the Contractor shall have the following options:
 1. Terminate the installation at the depth obtained subject to the review and acceptance of the Architect/Engineer.
 2. Remove the Helical Pier or Helical Anchor and install a new one with fewer and/or smaller diameter helical bearing plates or with dual cutting edge helical bearing plates. The new helical configuration shall be subject to review and acceptance of the Architect/Engineer.
 3. Remove the Helical Pier or Helical Anchor and pre-drill a 4-inch diameter pilot hole in the same location, and reinstall the Helical Pier or Helical Anchor.
 4. If the obstruction is shallow, remove the Helical Pier or Helical Anchor and remove the obstruction by surface excavation. Backfill and compact the resulting excavation, and reinstall the Helical Pier or Helical Anchor.
 5. Remove the Helical Pier or Helical Anchor and relocate 1 foot to either side of the installation location subject to the review and acceptance of the Architect/Engineer.
 6. Reverse the direction of torque, back-out the Helical Pier or Helical Anchor a distance of 1 to 2 feet and attempt to reinstall by decreasing crowd and Augering through the obstruction.
 7. Remove the Helical Pier or Helical Anchor and sever the uppermost helical bearing plate from the Lead Section if more than one helical bearing plate is in use. Reinstall the anchor or pier with revised helical bearing plate configuration.
- C. If the final installation torque is not achieved within the estimated length, the Contractor shall have the following options:
 1. Until the Maximum Length is achieved (if any), install the Helical Pier or Helical Anchor deeper using additional Extension Sections.
 2. Remove the Helical Pier or Helical Anchor and install a new one with additional and/or larger diameter helical bearing plates.
 3. Decrease the rated load capacity of the Helical Pier or Helical Anchor and install additional Helical Piers or Helical Anchors. The rated capacity and additional unit location shall be subject to the review and acceptance of the Architect/Engineer.

3.05 ALLOWABLE TOLERANCES

- A. Helical Piers, Helical Anchors, and Bracket Assemblies shall be installed as close to the specified installation and orientation angles as possible. Allowable installation tolerances are as follows:
 1. Maximum variation of installation angle: +/- 5 percent
 2. Maximum variation from vertical for plumb piers or anchors: 1" in 10'-0"
 3. Maximum variation from top of pier or anchor elevation noted on Drawings: 1"
 4. Maximum variation of pier or anchor location: 3"

3.06 FIELD QUALITY CONTROL

- A. Field inspection shall be performed in accordance with Section 01 4000.
- B. The Contractor shall provide the Architect/Engineer copies of installation records within 48 hours after each installation is completed. These installation records shall include, but are not limited to, the following information:
 - 1. Name of project and Contractor.
 - 2. Name of Contractor's supervisor during installation.
 - 3. Date and time of installation.
 - 4. Name and model of installation equipment.
 - 5. Type of torque indicator used.
 - 6. Location of Helical Pier or Helical Anchor by grid location, diagram, or assigned identification number.
 - 7. Type and configuration of Lead Section with length of shaft and number and size of helical bearing plates.
 - 8. Type and configuration of Extension Sections with length and number and size of helical bearing plates, if any.
 - 9. Installation duration and observations.
 - 10. Total length installed.
 - 11. Final elevation of top of shaft and cut-off length, if any.
 - 12. Final plumbness or inclination of shaft.
 - 13. Installation torque at minimum three-foot depth intervals.
 - 14. Final installation torque.
 - 15. Comments pertaining to interruptions, obstructions, or other relevant information.
 - 16. Design allowable capacity.

3.07 LOAD TESTING

- A. Helical Pier Compression Load Tests
 - 1. Contractor shall perform one (1)compression load tests.
 - 2. Compression tests shall be performed as described in ASTM D1143 specifications.
 - 3. Unless otherwise shown on the Drawings, the maximum test load shall be 200% of the design allowable load shown on the Drawings.
 - 4. The locations of Helical Piers to be tested shall be determined by the Contractor, unless noted on the Drawings.
 - 5. Installation methods, procedures, equipment, products, and final installation torque shall be identical to the production Helical Piers to the extent practical except where approved otherwise by the Architect/Engineer.
 - 6. A load test shall be deemed acceptable provided the maximum test load is applied without Helical Pier failure and the deflection of the pile head at the allowable load is less than 1-inch unless noted otherwise on the Drawings. Failure is defined when continuous jacking is required to maintain the load.
- B. Helical Anchor Tension Load Tests
 - 1. Contractor shall perform one (1) tension load tests.
 - 2. Tension load tests shall be performed following the procedure described in ASTM D3689 specifications.
 - 3. Unless otherwise shown on the Drawings, the maximum test load shall be 150% of the design allowable load shown on the Drawings.
 - 4. The locations of Helical Anchors to be tested shall be determined by the Architect/Engineer, unless shown on the Drawings.

5. Installation methods, procedures, equipment, products, and final installation torque shall be identical to the production anchors to the extent practical except where approved otherwise by the Architect/Engineer.
 6. A tension load test shall be deemed acceptable provided the maximum test load is applied without helical anchor failure. Failure is when continuous jacking is required to maintain the load.
- C. Helical Pier Lateral Load Tests
1. Contractor shall perform [the number of lateral load tests shown on the Drawings OR (X)] lateral load tests.
 2. Lateral load tests shall be performed following the "free head" procedure described in ASTM D3966 specifications.
 3. Unless otherwise shown on the Drawings, the maximum test load shall be 200% of the design allowable lateral load shown on the Drawings.
 4. The locations of test Helical Piers shall be determined by the Architect/Engineer, unless shown on the Drawings.
 5. Installation methods, procedures, equipment, products, and final installation torque shall be identical to the production piers to the extent practical except where approved otherwise by the Architect/Engineer.
 6. A lateral load test shall be deemed acceptable provided the lateral deflection of the pile head measured at the ground surface at the maximum test load is equal to or less than 1-inch.
- D. If a load test fails the forgoing acceptance criteria, the Contractor shall modify the products and/or installation procedure and re-test as directed by the Architect/Engineer. These modifications may include, but are not limited to, de-rating the load capacity, modifying the installation methods and equipment, increasing the minimum final installation torque, changing the helical bearing plate configuration, or changing the Helical Pier or Helical Anchor type (i.e., duty). Modifications that require changes to the product(s) shall have prior review and acceptance by the Architect/Engineer. Costs associated with any modifications and any retesting that may be required shall be at the Contractor's expense.
- E. The Contractor shall provide the Architect/Engineer copies of load test reports confirming configuration and construction details within 48 hours after completion of the load tests. This written documentation will either confirm the load capacity as required on the Drawings or propose changes based upon the results of the tests. At a minimum, the documentation shall include:
1. Name of project and Contractor.
 2. Date, time and duration of test.
 3. Location of test Helical Pier or Helical Anchor by grid location, diagram, or assigned identification number.
 4. Test procedure (ASTM D1143, D3689, or D3966).
 5. List of any deviations from procedure.
 6. Description of testing equipment.
 7. Type and configuration of Helical Pier or Helical Anchor including lead section, number and type of extension sections, and manufacturer's product identification numbers.
 8. Load steps and duration of each load increment.
 9. Cumulative pile-head movement at each load step.

3.08 CLEAN UP

- A. Following installation of pile terminations, all equipment shall be removed from the site. Any disturbed soils in the area shall be restored to the dimensions and conditions specified by the Architect/Engineer.

END OF SECTION