

100 HELICAL SCREW PILE FOUNDATION: ITEMS 701 004, 701 996 thru 701 999

(A) GENERAL - Work under these items consists of geotechnical and structural design and furnishing all materials for and installation of helical screw piles to support pedestrian bridges, boardwalks and deadmen according to the specifications contained herein, including the installation of all necessary mechanisms to connect helical screw piles to the supported structures.

The Contractor shall select the helical screw pile type, size, installation means and methods, and means and methods of connecting the helical screw pile caps to the supported structures. The Contractor shall perform all geotechnical and structural design. Loading, as indicated on the plan sheets, is based on AASHTO Guide Specifications for Design of Pedestrian Bridges, dated August 1997. Structural design shall be per AASHTO Guide Specifications for Design of Pedestrian Bridges, dated August 1997. Geotechnical design shall be per the 2012 International Building code and manufacturer's recommendations. The Contractor shall also coordinate the foundation design with the bridge manufacturer. Pile load testing shall be required per this specification. The helical screw piles shall be designed with a minimum Factor of Safety equal to 2.0 for bearing capacity.

Contractor shall not alter the layout of helical screw piles shown on the Contract Drawings unless approved by the Engineer. If Contractor decides to alter the number or layout of the helical screw piles, Contractor shall submit all plan changes as necessary. No additional time or compensation will be allowed.

Additional soil borings, test piles or other in-situ tests can be conducted as part of the construction if the Contractor deems more soil information is required. This subsurface exploration will be incidental to the cost of this item.

A geotechnical report has been prepared for this project by Rummel, Klepper & Kahl, LLP (RK&K). This report is for informational purposes only and shall not be considered as part of the contract documents. The opinions and conclusions of RK&K represent an interpretation of the subsurface conditions and the planned construction at the time of the report preparation. The data in this report may not be adequate for the Contractor's purposes.

(B) SUBMITTALS – Prior to commencement of construction, verification of the following requirements and documents shall be submitted for approval in accordance with 105.02.

1. Qualifications

- (a) The Contractor shall be experienced in the installation of helical screw piles and have successfully constructed at least three (3) projects in the last five (5) years involving installation of helical screw piles of similar scope including foundation loads and access conditions to this project.

- (b) The Contractor shall have previous helical screw pile installation experience in soil similar to the project conditions. The Contractor shall submit construction and structural details and point of contact information for at least three (3) previous successful projects utilizing helical screw pile foundations of similar scope to this project.
- (c) The Contractor shall assign an Engineer to supervise the work with experience on at least two (2) projects of similar scope to this project completed over the past five (5) years. The Contractor shall not use a manufacturer's representatives to satisfy the supervising Engineer requirement of this section. A manufacturer's representative, however, is required to be on-site during installation of at least the first helical screw pile. The on-site foreman, who will be in charge full time of all operations, shall also have experience on at least two (2) projects over the past five (5) years installing helical screw pile foundations.
- (d) The helical screw piles shall be designed by a licensed Professional Engineer, licensed in the District of Columbia or State of Maryland depending on the location of the pile, with experience in the design of at least three (3) successfully completed helical screw pile foundation projects over the past five (5) years. The helical screw pile designer may be either an employee of the Contractor or a separate Consultant designer meeting the stated experience requirements.
- (e) The Contractor shall submit the completed project reference list and personnel. The project reference list shall include a brief project description with the owner's name and current phone number. The personnel list shall identify the supervising project Engineer, personnel who will install the helical screw piles, and on-site foremen to be assigned to the project. The personnel list shall contain a summary of each individual's experience and be complete for the Engineer to determine whether each individual satisfies the required qualifications. Additional time required due to incomplete or unacceptable submittals will not be cause for time extension or impact or delay claims. All costs and delays associated with incomplete or unacceptable submittals shall be borne by the Contractor.
- (f) The Independent Testing Agency (ITA) shall submit a resume to the Engineer indicating experience as described in Section (E) of this specification.

2. Design/Working Drawing Submittals

- (a) The Contractor shall submit complete design calculations and Shop Drawings for review and approval. The drawings and calculations shall be signed and sealed by the Contractor's Professional Engineer licensed in the District of Columbia. For work in Maryland, the drawings and calculations shall also be signed by the Contractor's Professional Engineer licensed in the State of Maryland.
- (b) The design calculations shall include, but not be limited to, the following:

1. Written summary describing the overall helical screw pile design;
 2. Applicable code requirements and design references;
 3. Helical screw pile critical design cross section including the provision for corrosion, soil strata and magnitude and direction of design applied loadings;
 4. Design criteria including soil shear strengths, unit weight, and helical screw pile strength;
 5. Safety factors used in the design;
 6. Design calculation sheets with the project number, helical screw pile structural location, designation, date of preparation, initials of designer and checker, and page number at the top of each page. Provide an index page with the design calculations;
 7. Design notes including an explanation of any symbols and computer programs used in the design. If a computer program is used for design, provide a hand calculation of at least one computer based calculation for verification;
 8. Clear identification of the estimated installation torque and available options to revise pile configuration if this installation torque is not achieved;
 9. All required structural calculations including critical design typical section. Structural calculations shall include effects of possible scour and all critical loading combinations. Contractor to design all embedment of piles into concrete structures. Contractor may need to modify details currently shown on the plans to coordinate with their pile system. All details shall be submitted for approval. No additional compensation or time extension will be given to modify the current details.
- (c) Provide shop drawings indicating product components and accessories, and indicating the following:
1. Helical screw pile number.
 2. Location and pattern by assigned identification number.
 3. Helical screw pile design load.
 4. Type and size of central steel shaft.
 5. Helix configuration (number, vertical spacing, and diameter of helix plates).
 6. Required minimum effective installation torque.
 7. Displacement plates/ centralizers and their location.
 8. Minimum overall length.
 9. Inclination of helical screw piles.
 10. Grout column length.
 11. Minimum cased length.
 12. Grout column diameter(s).
 13. Cutoff elevation.
 14. Detail showing helical screw pile attachment to structure relative to grade beam, column pad, etc.
- (d) Design parameters and justification/back-up for development of soil parameters.

- (e) General notes for constructing and installing the structures with a helical screw pile foundation including construction sequencing or other special construction requirements.
- (f) Contingency plans should refusal be encountered.
- (g) A listing of the summary of quantities on the elevation drawing of each structure with a helical screw pile foundation showing pay item estimated quantities.
- (h) Within twenty-four (24) hours after installation, submit to Engineer the installation record(s).

3. Construction Submittal

The Contractor shall prepare and submit for review and approval a detailed step-by-step description of the proposed helical screw pile installation procedure, including personnel and equipment to assure quality control. This step-by-step procedure shall be indicated on the working drawings in sufficient detail to allow the Engineer to monitor construction and quality.

4. Quality Assurance/Control Submittals

- (a) Certified test reports showing compliance with specified characteristics and physical properties.
- (b) Manufacturer's certificate that products meet or exceed specified requirements.
- (c) Mill test reports.
- (d) Accurately record the type, size and actual locations of helical screw piles, torque installation records on all helical screw piles and torque monitoring calibration data.
- (e) Grout mix design.
- (f) Pile load testing procedures.
- (g) Proposed construction QA/QC methods.
- (h) Durability data for review by DDOT's engineer.

5. Final Location Drawings

- (a) Within thirty (30) days after completion of required work, the Contractor shall submit an accurate print or prints showing the locations and top and bottom elevations of all installed helical screw piles.

- (b) Within thirty (30) days after completion of required work, the Contractor shall submit as-built drawings, including installation records. Provide revised design calculations signed by the approved licensed Professional Engineer for all design changes made during the construction and installation of the helical screw piles.

(C) MATERIALS - All materials for this work shall be new and without defect. Defective materials shall be removed from the jobsite at no additional cost. All helical screw piles shall be hot dipped galvanized for corrosion protection.

1. Central Steel Shaft:

Consists of lead sections, helical extensions and plain extensions. Hot-rolled-round or round-cornered-square pipe meeting dimensional and workmanship requirements of ASTM A29. The bar shall be either modified medium carbon steel grade with torsional strength rating of 5,500 ft-lb and a minimum yield strength of 70 ksi, or high-strength low-alloy, low-to-medium carbon steel grade with a minimum torsional strength rating of 15,000 ft-lb and minimum yield strength of 90 ksi. Minimum diameter of central steel shaft is 5 3/4 inches and a minimum thickness is 0.5 inch or structurally equivalent.

2. Helix Bearing Plate:

(a) Hot rolled carbon steel sheet, strip or plate formed on matching metal dies to true helical shape and uniform pitch. Bearing plate material shall conform to the following ASTM specifications:

1. ASTM A572, or ASTM A1018 or ASTM A656 with minimum yield strength of 50 ksi. Plate thickness $\frac{3}{8}$ -inch.
2. ASTM A656 or ASTM A1018 with minimum yield strength of 80 ksi. Plate thickness $\frac{3}{8}$ -inch.
3. ASTM S656 or ASTM A1018 with minimum yield strength of 80 ksi. Plate thickness $\frac{1}{2}$ -inch.
4. ASTM A36, or ASTM A572, or ASTM A1018 or ASTM A656 depending on helix diameter, per the minimum yield strength requirement cited above. Plate thickness $\frac{3}{8}$ -inch.

3. Bolts:

The size and shape of bolts used to connect the central steel shaft section together shall conform to the following ASTM specification:

- (a) $\frac{3}{4}$ -inch diameter bolt per ASTM A320 Grade L7.

- (b) $\frac{7}{8}$ -inch diameter bolt per ASTM A193 Grade B7.
 - (c) $1\frac{1}{8}$ -inch diameter bolt per ASTM A193 Grade B7.
 - (d) $1\frac{1}{4}$ -inch diameter bolt per ASTM A 193 Grade B7.
 - (e) $\frac{3}{4}$ -inch diameter bolts (3 per coupling) per SAE J429 Grade 5.
4. Couplings shall be formed as integral part of the plain and helical extension material.
 5. Fabricate displacement plates from steel or other material that will not affect the structural integrity of the central steel shaft or grout column. Do not use wood for this purpose.
 6. For structural steel plates and shape for helical screw piles top attachments, conform to ASTM A36 or ASTM A572, Grade 50 (Grade 345).
 7. Steel casing shall conform to requirements of ASTM A53 Type E or S Grade B, ASTM A252 Grade 2, ASTM A500 Grade B or ASTM A618.
 8. For PVC casing relied upon for grout containment, fissured or void-filled solid, or as a bond breaker, the pipe shall conform to ASTM D1784, ASTM D1785 and ASTM D3034.
 9. The designer shall assume 0.125-inch loss of section, per face, to account for corrosion.
 10. Accessories:
 - (a) Cement for Helical screw piles grout shall be Portland cement conforming to ASTM C150 Type I or Type II.
 - (b) Admixtures and Chemical Admixtures shall conform to the requirements of ASTM C494. Do not use accelerators. Chemical admixtures shall be compatible with the central steel and mixed in accordance with the grout manufacturer's recommendations.
 - (c) Mineral Admixtures shall conform to the requirements of ASTM C618 (coal fly ash) or C1240 (silica fume).
 - (d) Mineral Admixtures shall be compatible with the central steel shaft and mixed in accordance with the grout manufacturer's recommendations.

11. Mixes:

The grout mix shall be designed by the Contractor and submitted for approval. The grout mix shall be proportioned to produce a hardened grout which will achieve the design Compressive Strength of 4,000 psi within 28 days.

(D) CONSTRUCTION METHODS - The following minimum procedures shall be performed.

Work shall not start, nor materials ordered until the Engineer's written approval of the Contractor's experience qualifications is given. The Engineer may suspend work if the Contractor uses non-approved personnel. If work is suspended, the Contractor shall be fully liable for all resulting costs and no adjustment in contract time or cost will result from the suspension.

The Contractor shall visit the site to assess the site geometry, equipment access conditions, and location of existing structures and utilities. The Contractor is responsible for field location and verifying the locations of all utilities shown on the plans prior to starting work. In addition, the Contractor shall conduct all work in accordance with the Specifications regarding Safety and Protection of Railroad Traffic and Property, dated February 3, 2006, as included in the Temporary Permit to Enter Upon Property, as issued by the National Railroad Passenger Corporation ("Amtrak") and/or by its subsidiaries in areas required by Amtrak.

All helical screw pile material shall be handled and transported carefully to prevent any deformation or damage. Care should be taken to prevent the accumulation of dirt, mud or other foreign matter on the steel materials. Such accumulation shall be completely removed prior to the installation.

1. General

- (a) Comply with the instructions and recommendations of the helical screw pile manufacturer.
- (b) Verify that site conditions are acceptable and installation of helical screw piles are in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.
- (c) The helical screw piles installation technique shall be consistent with the geotechnical, logistical, environmental and load carrying conditions of the project.
- (d) Installation equipment shall be rotary type, hydraulic power driven torque motor with clockwise and counterclockwise rotation capabilities.
- (e) Utilize a torque motor capable of continuous adjustment to number of revolutions per minute (RPM) during installation and with a torque capacity 15 percent greater than the torsional strength rating of the central steel shaft to be installed. Do not use percussion drilling equipment.

- (f) Utilize equipment capable of applying adequate downward pressure and torque simultaneously to suit project soil conditions and load requirements and capable of continuous position adjustment to maintain proper helical screw piles alignment.
- (g) A calibrated torque indicator shall be used during helical screw piles installation. The torque indicator may be an integral part of the installation equipment or mounted inline with the installation tooling.

2. Installation

- (a) Engage and advance helical screw piles into soil in a smooth, continuous manner at a rate of 5-20 RPM. Provide extension sections to obtain the required minimum overall length and installation torque as shown on the shop drawings. Connect sections together using coupling bolt and nut tightened to torque of at least 40 ft-lb or as specified in approved shop drawings.
- (b) Apply sufficient down pressure to uniformly advance the helical screw pile sections approximately 3 inches per revolution. Adjust rate of rotation and magnitude of down pressure for different soil conditions and depths.
- (c) Position a lead displacement plate of appropriate diameter on the central steel shaft at the location necessary to install the grout column as shown on the shop drawings. Do not position the lead displacement plate closer than 12 inches above the top helix plate. Position additional lead displacement plates or extension displacement plates no more than 7 feet apart. Displacement plates shall permit the free flow of grout without misalignment of the central steel shaft.
- (d) Contractor shall place grout to achieve minimum grout column length as shown on the approved shop drawings. Allow grout to attain the minimum design strength prior to being loaded.
- (e) If required, install casing in segments corresponding to the section of the central steel shaft. Advance casing into the soil by direct connection with lead and extension displacement plates. Fill each casing segment with grout immediately after placement.
- (f) Satisfy the minimum installation torque and minimum overall length criteria as shown on the shop drawings prior to terminating the helical screw piles. The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.
- (g) The uppermost helix shall be installed at least three diameters into competent load-bearing soil.
- (h) Center-to-center spacing of adjacent piles shall be greater than or equal to five diameters of the largest helix.

- (i) If a helical screw pile is refused or deflected by a subsurface obstruction, Contractor shall terminate the installation and remove the pile. Remove the obstruction or pre-drill through the obstruction and reinstall the helical screw pile.
- (j) Install helical screw piles to the following allowable tolerances:
 - 1. Centerline of piling shall not be more than 3 inches from the indicated plan location.
 - 2. Pile plumbness shall be within 2 degrees of design alignment.
 - 3. Top elevation of pile shall be within +1 inch to -2 inches of the design vertical elevation.
 - 4. Centerline of central steel shaft shall not be more than $\frac{3}{4}$ inch from the centerline of the pile.

3. Testing

- (a) Perform static load test in accordance with ASTM D1143 Quick Procedure. Load tests shall be performed for representative helical screw piles as noted on the AB Sheets within the plans.
- (b) Site Test Records: Provide the District with copies of field test reports within 24 hours after completion of the load tests. Include, at a minimum, the following information.
 - 1. Name of project and Contractor.
 - 2. Name of Contractor's supervisor during installation.
 - 3. Name of third party test agency, if applicable.
 - 4. Date, time and duration of test.
 - 5. Location of helical screw piles by assigned identification number.
 - 6. Type of test (i.e., tension or compression).
 - 7. Description of calibrated testing equipment and test setup.
 - 8. Actual helical screw pile type and configuration, including lead section, number and type of extension sections.
 - 9. Steps and duration of each load increment.
 - 10. Cumulative pile-head movement at each load step.
 - 11. Comments pertaining to interruptions, obstructions or other relevant information.
 - 12. Signed and sealed by the ITA representative and a Professional Engineer licensed in the jurisdiction where the test is being performed.
- (c) No production piles shall be installed until pile test results have been reviewed and accepted by the District.

4. Protection

Protect installed work from damage due to subsequent construction activity on the site.

(E) INDEPENDENT TESTING AGENCY - The services of a qualified independent testing agency (ITA) shall be employed for inspection and testing for installation of the helical screw pile foundations. The ITA shall be a Professional Engineer licensed in the District of Columbia, have a demonstrated record of experience with at least three (3) similar helical installations in the last five (5) years and be approved prior to beginning installation of helical screw piles. The ITA shall not be contracted to perform construction work on this project.

(F) MEASURE AND PAYMENT - All design, material, labor, equipment, tools, and incidentals necessary for complete installation of the helical screw piles shall be considered incidental to the substructure unit being constructed. No separate measurement will be made.

Static load tests including all work related to the mobilization, installation, instrumentation, performance and documentation will be incidental to the substructure unit being constructed. No separate measurement will be made.

No separate payment shall be made for salvaging, abandoning or removing and disposing of existing facilities and cost for such required work shall be incidental to the installation of the item.