

Guide to Model Specification Helical Anchors, Inc

Helical Piles and Helical Anchors

1. GENERAL

1.1 Scope

This work consists of furnishing all necessary engineering and installation for helical piles according to the drawings and this specification. This may also include connection details where it is required. The Contractor shall install helical piles to attain the load capacities detailed on the plans. This specification includes provisions for load testing that may be part of the work.

1.2 Definitions

- A. Helical Pile: Consists of 1) One or more helical deformed plates ("helix plates") attached to a central shaft and 2) Load transfer device for attachment to structure. It may also include surface coating or other corrosion protection means. It is installed by screwing into the soil with down pressure ("crowd"), and thereafter resists compressive loads through bearing of helical plates on soil in which they are embedded.
- B. Helical Anchor: Also known as a Helical Pile. Term used when axial tension is the main service load.
- C. Lead Section: The first section of a Helical Pile or Helical Anchor installed into the soil. Lead Sections consist of a central shaft with a single or multiple helix plates welded to the shaft.
- D. Extension Section: Helical pile component installed immediately behind the lead section extending the helical pile to the desired depth. Extension shaft ends are adapted to interconnect with helical lead sections, other extension sections and the load transfer device. Extension section consists of a central shaft and may have a single or multiple helix plates welded to the shaft.
- E. Helix Plate: Generally round steel plate formed into a helical spiral and welded to the central steel shaft. When rotated in the ground, the helical shape provides thrust along its longitudinal axis thus aiding in pile installation, plus the plate transfers axial load to the soil through bearing.
- F. Pile Cap: Connection that is bolted or welded, which transfers load from structure to the Helical Pile. Connections will vary depending on requirements of the project.

- G. Installation Torque: Resistance generated by helical pile when installed in the soil. Installation resistance is dependent on soil type and dimensions of the helical pile and helices.
- H. Safety Factor: The ratio of the ultimate compression resistance to the nominal load used for the design of any helical pile component or interface (Allowable Stress Design).
- I. Ultimate Bearing Resistance: Point at which no additional load can be applied based on the lesser of the mechanical strength or geotechnical capacity of the pile.

1.3 Qualifications & Quality Assurance

- A. All helical piles are to be manufactured by Helical Anchors Inc. Helical Piles are to be installed by an authorized Helical Anchors Inc. contractor. These contractors shall have satisfied the certification requirements related to the technical aspects of the product and installation techniques. Proof of certification is required to install Helical Anchors Inc. piles. The Helical Pile Contractor may not outsource any part of the project without written permission of the owner or their representative.
- B. Prior to bidding by any installer that is not trained, using a manufactured Helical Pile system that is not produced by Helical Anchors Inc., written approval to bid must be received from the Engineer. Engineer shall grant approval based on the above criteria. The Engineer's decision is final.
- C. Helical Anchors Inc. provides a standard one-year warranty on all materials and workmanship of the product. Any additional warranties shall be added as an addendum to this specification
- D. Design of Helical Piles shall be performed by an entity as required in accordance with existing local code requirements or established local practices. This design work may be performed by a licensed engineer, Helical Anchors Inc. certified installer, or independent agency depending on local requirements or practices.
- E. Unless otherwise specified on the drawings or local codes, the Engineer, Pile Design Professional, or inspection agency approved by the Engineer shall observe and document 10 percent of Helical Pile installations

2. **REFERENCED CODES AND STANDARDS**

This specification is based on nationally recognized codes and standards including the references listed below. In case of a conflict between the reference and this specification, this specification shall govern.

2.1 American Society for Testing and Materials (ASTM):

- A. ASTM A29/A29M Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished.
- B. ASTM A36/A36M Structural Steel

Helical Piles and Anchors Specifications

- C. ASTM A123-02 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- D. ASTM A153-05 Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
- E. ASTM A572 HSLA Columbium-Vanadium Steels of Structural Quality
- F. ASTM A656 Hot-Rolled Structural Steel, High-Strength Low-Alloy Structural Tubing.
- G. ASTM A1018 Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability
- H. ASTM D1143/D1143M-07 Standard Test Method for Piles Under Static Axial Compressive Load
- I. ASTM D3689 Standard Test Method for Individual Piles Under Static Axial Tensile Load
- J. ASTM D3966-07 Standard Test Method for Piles Under Lateral Loads

2.2 American Society of Mechanical Engineers (ASME):

- A. ANSI/ASME Standard B18.2.1-1996, Square and Hex Bolts and Screws, Inch Series

2.3 ICC-Evaluation Services, Inc.:

- A. AC308 Acceptance Criteria for Helical Foundation Systems and Devices

2.4 American Welding Society

- A. ANSI/AWS B2.1-00 Standard for Welding Procedure and Performance Qualification
- B. ANSI/AWS C6.1 Recommended Practices for Friction Welding

3. SUBMITTALS

3.1 The Contractor or Engineer shall prepare and submit to the Owner for review and approval, Shop Drawings and design calculations for the Helical Piles and Attachments intended for use on the project at least 14 calendar days prior to planned start of installation. The Shop Drawings and Design Calculations shall include the following:

- A. Helical Pile location, number, and pattern denoted by an identification number
- B. Helical Pile design load
- C. Type and size of the central shaft along with helix configurations (number and diameter)
- D. Manufacturer's recommended capacity to installation torque ratio
- E. Product identification numbers and designations for all Helical Pile attachments to the structure
- F. Inclination of Helical Pile
- G. Cut off elevation
- H. Minimum effective installation torque(s)
- I. Considerations for downdrag, expansion of soils, and buckling (as appropriate).
- J. Minimum installation depth to reach bearing stratum and to achieve pullout capacity (if required).
- K. Soil bearing and pullout capacity.
- L. Lateral resistance of the shaft (if required).

M. Estimated pile head movement at design loads.

3.2 Contractor shall submit to the Owner copies of the calibration reports for the torque measurement device and all load testing and monitoring equipment to be used on the project. Calibration information shall have been tested within the last year of the date submitted. Calibration information shall include, but is not limited to, name of the project, name of the testing agency, identification number or serial number of device calibrated, and the date of calibration.

3.3 Work shall not begin until all the submittals have been received and approved by the Owner. The Contractor shall allow the Owner a reasonable number of days to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

4. PRODUCTS

4.1 All Helical Pile and Bracket Assemblies shall be manufactured by Helical Anchors Inc.

4.2 Helical Shaft:

A. All pipes shall be in accordance with the chemical and physical requirements of API 5CT N80 or better Seamless Pipe.

B. Typical Pier Sizes & Strength Ratings:

Product Series	Pipe OD	Wall Thickness	Tensile Strength (ksi)	Yield Strength (ksi)	Ultimate Tension Strength (lbs)	Ultimate Torsional Strength (ft-lbs)
TS238190	2-3/8"	0.190	110 (min)	80 (min)	125,000	7,500
TS238254	2-3/8"	0.254			125,000	9,000
TS278276	2-7/8"	0.276			180,000	16,000
TS312368	3-1/2"	0.368			250,000	27,000
TS412337	4-1/2"	0.337			360,000	48,000

Note: Above are the most common shaft sizes, but we can manufacture piers to suit your specific requirements.

4.3 Helix Plate:

A. Standard helices are available in 3/8" or 1/2" thicknesses with custom sizes available and must meet ASTM A572, A1018, or A656 grade 50 material.

B. Standard Helix Diameters are available in 8", 10", 12", 14", and 16" diameters with custom sizes available

4.4 Couplings:

- A. All couplings shall have a pin and box joint connection, inertia welded to the pipe. Each coupling will have three holes for connecting the shafts together

4.5 Coupling Bolts:

Standard diameter bolts are available from 5/8" to 1-1/8" and must meet requirement per SAE J429 Grade 5 or ASTM A325, $F_y(\text{min}) = 92 \text{ ksi}$, $F_u(\text{min}) = 120 \text{ ksi}$.

- A. TS238 5/8" diameter bolt (3 per coupling)
- B. TS278 3/4" diameter bolt (3 per coupling)
- C. TS312 7/8" diameter bolt (3 per coupling)
- D. TS412 1-1/8" diameter bolt (3 per coupling)

- 4.6 Pile Caps shall be a welded assembly consisting of a structural steel shapes designed to fit helical piles and transfer load. Pile Caps shall be affixed to the end of helical piles via bolts or welded connection meeting the requirements given previously in this specification

- 4.7 Corrosion Protection: If corrosion protection is needed, material shall be hot dipped galvanized per ASTM A153 after fabrication.

5. EXECUTION

5.1 Site Inspection

- A. Prior to starting installation Contractor shall take reasonable effort to locate all utilities and structures above and underground in the area of the Work. 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 Owner as extra work.
- B. Contractor shall review Drawings and soil borings in the Contract Documents to determine subsurface conditions for sizing and installation of the Helical Piles. Prior to beginning installation Contractor must visit the site at least once to verify that all other work that would restrict the installation of Helical Piles has been sufficiently completed.
- C. Contractor shall notify Engineer of any discrepancies that would hinder the installation of the helical piles as soon as they arise. Installation may not continue until said discrepancies are resolved. Costs associated with construction delays, product substitutions, pile or anchor relocations, or other related costs shall be the responsibility of the Owner.

5.3 Installation Equipment

- A. Torque Motor: Shall be rotary type and have forward and reverse rotation capabilities. Motors may be either hydraulically or electrically powered. Torque Motor shall be capable of constant adjustment in revolutions per minute (RPM's) to keep the installation smooth and continuous. The torque motor must have a torque capacity at least 15% greater than the installation torque required.

- B. Installation Equipment: The installation equipment shall be capable of applying adequate downward pressure (crowd) and torque simultaneously to ensure smooth advancement of the Helical Piles. The equipment must be capable of maintaining proper position and alignment.
- C. Drive Tool and Connection Pins: Drive Tool and Connection Pins should be maintained in good working condition and safe to operate at all times. Worn and damaged tooling should be replaced. The connection between the torque motor and Helical Pile shall be in-line, straight, and rigid to ensure a proper connection. The adapters shall be used in accordance with the manufacturer's installation instructions.
- D. Torque Indicator: A torque indicator shall be used to measure installation torque during Helical Pile installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. The indicator shall be capable of providing constant measurement of applied torque for the duration of the installation. The indicator shall be able to take torque measurements 500 ft-lb or less. Torque indicators shall have been calibrated within 1-year prior to start of Work. Torque indicators that are an integral part of the installation equipment shall be calibrated on-site. Torque indicators that are mounted in-line with the installation tooling 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 re-calibrated following any maintenance performed on the torque motor. Torque indicators shall be re-calibrated if, in the opinion of the Engineer, reasonable doubt exists as to the accuracy of the torque measurements.

5.6 Installation Procedures

- A. Lead sections shall be positioned at the location as shown on the working drawings. Battered piles can be positioned perpendicular to the ground to help with initial advancement into the soil. After this the required batter angle shall be established.
- B. Connect the lead section to the Torque Motor using the Adapters approved by the Engineer. At the start of installation position and align the Lead Section at the location and to the inclination shown on the drawings. Sufficient downward pressure (crowd) shall be applied to advance the Lead Section into the soil. Continue to add Extension Sections until the termination criteria is achieved. All sections shall be advanced into the soil in a smooth, continuous manner at a rate of rotation between 5 to 20 revolutions per minute. All bolts shall be installed and tightened to approximately 40 ft-lb of torque.
- C. Sufficient down pressure (crowd) shall be applied while rotating Helical Piles to uniformly advance the sections approximately 3 inches per revolution into the ground. The rate may be adjusted depending on soil conditions and depths.
- D. Helical Anchors with damaged bolt holes shall not be implemented. A bolt hole that has been elongated over ¼ inch due to torsion shall be considered damaged.

- E. Once Helical Piles or Helical Anchors have been installed to the Termination Criteria, they cannot be reversed in any manner to adjust height requirement. The end of the anchor must be adjusted by cutting and re-drilling bolt holes to adjust the anchor to appropriate installation requirements. “Backing out” of the anchor compromises the strength of the installation.
- F. Pre-tensioning of Helical Anchors shall take place after installation if specified on the Drawings.

5.7 Termination Criteria

- A. The minimum overall length criteria and the minimum effective torsional resistance criteria as specified in the Design Documentation Submittals must be satisfied prior to terminating the Helical Pile installation.
- B. If installation fails to meet the minimum effective torsional resistance criterion at the minimum embedment length the following options may be used:
 - 1. Continue the installation to greater depths using extension sections until minimum torque requirement is met.
 - 2. Remove the existing helical anchor and install an anchor with one having a different helix configuration. If re-installation in the same location, the top helix of the new helical pile shall be terminated at least three times its own diameter beyond the position of the first helix of the replaced anchor.
 - 3. Run a test to demonstrate pile capacity if adequate for foundation.
- C. If the torsional resistance during installation reaches the helical anchor’s ultimate strength rating prior to reaching the minimum depth require the following options may be used:
 - 1. Terminate installation at depth obtained subject to the review and acceptance of Engineer or person responsible for the project.
 - 2. Replace the anchor with one having a shaft with a higher torsional strength rating. The replacement anchor must satisfy the minimum effective torsional resistance and embedment constraints.
 - 3. Remove existing helical anchor and install an anchor with smaller and/or fewer helices. If re-installation in the same location, the top helix of the new helical pile shall be terminated at least three times its own diameter beyond the position of the first helix of the replaced anchor.
- D. If the Helical Pile is refused or deflected by a subsurface obstruction the installation must be terminated and pile removed. If the obstruction is removed, then pile can be

re-installed otherwise the helical pile shall be installed at an adjacent location subject to review and acceptance of the owner or person responsible for the project.

- E. The average torque is taken as the average of the last three readings recorded. This will be used as a basis in comparison with the installation torque.

5.8 Allowable Final Tolerances

- A. Helical Piles shall be installed as close to the specified installation and orientation angles as possible. Deviation from installation and orientation angles shall be limited to +/- 5 degrees.
- B. Helical Piles and Adapters shall be installed at the locations and to the elevations shown on the Plans. Tolerances for Adapter placement shall be +/- 1 inch in both directions perpendicular to the shaft and +/- 1/4 inch in a direction parallel with the shaft unless otherwise specified.

5.8 Installation Records

The Contractor shall provide the Owner with copies of the installation observation records within 24 hours of each installation. Formal copies shall be submitted on a weekly basis. These installation records shall include, but are not limited to, the following information:

- A. Name of the Project, project number, and project location
- B. Date and time of Installation
- C. Minimum Required Depth
- D. Required Torque
- E. Elevation including, planned top of pile and ground elevation
- F. Deviations in horizontal, vertical, and angular directions
- G. Total length of installed helical pile and its cut off elevation
- H. Actual helical pile type and configuration installed
- I. Installation torque at 1 ft intervals for the last 10 feet
- J. Final installation torque
- K. Installation Contractor and Equipment
- L. Method of Torque Measurement
- M. Comments pertaining to interruptions, obstructions, or other relevant information

6. **LOAD TESTING**

6.1 Pile Testing

If pile testing is required, the installing contractor shall furnish all labor, equipment and pre-production piles necessary to accomplish the testing as shown on the approved pile design documentation. Installing contractor shall apply the specified loads for the specified durations and record the specified data, for the specified number of piles. No deviations from the test plan(s) will be allowed without explicit approval in writing from the owner or owner's

representative. Pile testing shall be in accordance with the load-testing procedures and performance requirements deemed suitable by the Owner, owner's representative, or pile designer.

6.2 Records

Installing Contractor shall provide the owner or owner's representative copies of field test data within 24 hours after completion of each load test. Formal test reports shall include, but are not limited to, the following,

- A. Name of project and Installing Contractor
- B. Name of Installing Contractor's supervisor during installation
- C. Name of third party test agency, if any
- D. Pre-production or production test
- E. Date, time, and duration of test
- F. Unique identifier and location of helical pile tested
- G. Type of test (performance or proof)
- H. Description of calibrated testing equipment and test set-up
- I. Actual helical anchor type and configuration
- J. Steps and duration of each load increment
- K. Cumulative anchor-head movement at each load step
- L. Signatures as required by local jurisdiction

END OF SPECIFICATION

NOTE: Because Helical Anchors Inc. has a policy of continuous product improvement; we reserve the right to change design and specifications without notice.