



SECTION 31 66 13 HELICAL PILES AND HELICAL ANCHORS

PART 1 GENERAL

1.01 Description

This work pertains to furnishing and installing Helical Piles, Helical Anchors, and Bracket Assemblies shown in the Contract in accordance with the Drawings and this specification. Each Helical Pile and Helical Anchor shall be installed at the location and to the elevation, minimum length, installation torque, and allowable capacities shown on the Plans or as established. This work also pertains to load testing and pre-loading Helical Piles and Helical Anchors (if required on the Drawings).

1.02 Related Work

Section 31 23 33 Trenching, Backfilling and Compacting

Section 31 23 00 Excavation and Fill

1.03 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.

A. American Society for Testing and Materials (ASTM):

1. ASTM A36/A36M Structural Steel
2. ASTM A123-02 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. ASTM A153-05 Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
4. ASTM A450/A450M-07 Standard Specification for General Requirements for Carbon and Low Alloy Steel Tubes
5. ASTM D1143/D1143M-07 Standard Test Method for Piles Under Static Axial Compressive Load
6. ASTM D3689 Standard Test Method for Individual Piles Under Static Axial Tensile Load
7. ASTM D3966-07 Standard Test Method for Piles Under Lateral Loads

B. American Society of Mechanical Engineers (ASME):

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

C. Occupational Safety and Health Administration (OSHA):

1. Excavation Safety Guidelines



D. ICC-Evaluation Services, Inc.:

1. AC308 Acceptance Criteria for Helical Foundation Systems and Devices

E. American Welding Society

1. ANSI/AWS B2.1-00 Standard for Welding Procedure and Performance Qualification

1.04 Definitions

- A. Helical Pile: Manufactured steel foundation with one or more helical bearing plates that is rotated into the ground to support structures.
- B. Helical Anchor: Same as a Helical Pile. Term generally used when axial tension is the primary service load.
- C. Engineer: Individual or firm retained by Owner or General Contractor to verify Helical Pile and Helical Anchor quality assurance with the Contract, the Drawings, and this specification.
- D. Allowable Bearing Capacity: Ultimate bearing capacity of the bearing stratum divided by a factor of safety.
- E. Lead Section: The first section of a Helical Pile or Helical Anchor to enter the ground. Lead Sections consist of a central shaft with a tapered end and one or more helical bearing plates affixed to the shaft.
- F. Extension Section: Helical Pile or Helical Anchor sections that follow the Lead Section into the ground and extend the Helical Lead to the appropriate depth. Extension Sections consist of a central shaft and may have helical bearing plates affixed to the shaft.
- G. Brackets: Cap plate, angle, thread bar, or other termination device that is bolted or welded to the end of a Helical Pile or Helical Anchor after completion of installation to facilitate attachment to structures or embedment in cast-in-place concrete.
- H. Augering: Rotation of the shaft with little or no advancement. It can occur when the helical bearing plates pass from a relatively soft material into a comparatively hard material. Augering can also result from insufficient crowd or downward pressure during installation. In some cases, augering may be (temporarily) necessary in order to grind through an obstruction.
- I. Pile Design Professional: Individual or firm responsible for the design of Helical Piles, Helical Anchors, and Brackets.



1.05 Qualifications

- A. Due to the special requirements for manufacture and quality control of Helical Piles, Helical Anchors, and Brackets, all Helical Piles, Helical Anchors, and Brackets shall be obtained from Magnum Piering, Inc.

A request to substitute any other manufactured Helical Pile and Helical Anchor products for use on this project must be submitted to the Engineer for review not less than seven (7) calendar days prior to the bid date. The request must include:

1. A product catalog and all necessary technical data sufficient to qualify the proposed product substitution.
2. Evidence showing manufacturer has at least ten (10) years experience in the design and manufacture of Helical Piles and Helical Anchors.
3. Current ICC-ES product evaluation report or complete description of product testing and engineering calculations used to assess product capacity.
4. Current ISO 9001:2008 certification.

- B. Due to the special requirements for installation of Helical Piles, Helical Anchors, and Brackets, all Helical Piles, Helical Anchors, and Brackets shall be installed by an organization specializing in the installation of those products. Contractor shall be an authorized Magnum Piering Installer and shall have completed training from Magnum Piering, Inc. in the proper methods of installation of Helical Piles and Helical Anchors and the mounting of Brackets.

Any Contractor desiring to bid as the Helical Pile and Helical Anchor installer for this project that is not trained and authorized by Magnum Piering, Inc. shall submit a request to the Engineer for review not less than seven (7) calendar days prior to the bid date. The request must include:

1. A recent company brochure indicating experience in this type of work.
2. Evidence of having installed Helical Piles and Helical Anchors on at least ten (10) projects, including project name, number and type of Helical Piles or Helical Anchors, project location, and client contact information.
3. Resume of Contractor's foreman including experience in the oversight of Helical Pile and Helical Anchor installation on at least five (5) projects in the last five (5) years, including project name, number and type of Helical Piles or Helical Anchors installed, project location, and client contact information.
4. List of installation and testing equipment and detailed description of proposed method of installation and load testing Helical Piles and Helical Anchors (if testing is required).
5. Current ANSI/AWS welding certificate and documentation of welder experience within the last 5 years (if welding is required).

- C. Due to the special requirements for design of Helical Piles, Helical Anchors, and Brackets, all Helical Piles, Helical Anchors, and Brackets shall be designed by Magnum Geo-Solutions, LLC.



Contractors desiring to use other Pile Design Professionals shall submit a request to the Engineer for review not less than seven (7) calendar days prior to the bid date. The request must include:

1. The curriculum vitae of the designated Pile Design Professional indicating at least ten (10) years experience in this type of work as well as graduate education in structural and/or geotechnical engineering.
 2. Evidence of Pile Design Professional having designed Helical Piles and Helical Anchors on at least ten (10) projects, including project name, number and type of Helical Piles or Helical Anchors, project location, and client contact information.
 3. Professional errors and omissions liability insurance certificate.
 4. Evidence of current license to practice engineering in the project state.
- D. Prior to bidding by any installer that is not trained and authorized by Magnum Piering, Inc., using a manufactured Helical Pile and Helical Anchor system that is not produced by Magnum Piering, Inc., or using a Pile Design Professional that is not Magnum Geo-Solutions, LLC, written approval to bid must be received from the Engineer. Engineer shall grant approval based on compliance with specific criteria herein. The Engineer's decision is final.

1.06 Submittals

- A Contractor shall prepare and submit to the Engineer for review and approval, Shop Drawings and specifications for the Helical Piles 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 Pile and Helical Anchor product identification number(s) and designation(s)
 2. Maximum allowable mechanical compression and tensile strength of the Helical Piles and Helical Anchors
 3. Number of Helical Piles and Helical Anchors and respective design allowable capacities from the Drawings
 4. Planned installation depth and the number of lead and extension sections
 5. Preliminary 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 designations for all Bracket Assemblies and number and size of connection bolts or concrete reinforcing steel detail
 9. Corrosion protection coating on Helical Piles, Helical Anchors, and Bracket Assemblies
- B. Contractor's Pile Design Professional shall submit to the Engineer design calculations for the Helical Piles, Helical Anchors, and Brackets 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. Reduction in shaft dimension and strength by the sacrificial thickness anticipated based on corrosion loss over the design life for project soil conditions.
 2. Considerations for downdrag, buckling, and expansive soils (as appropriate).
 3. Minimum installation depth to reach bearing stratum and to achieve pullout capacity (if required).
 4. Soil bearing and pullout capacity.
 5. Lateral resistance of the shaft (if required).
 6. Estimated pile head movement at design loads.
- C. Contractor shall submit to the Engineer calibration information certified by an independent testing agency 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, the name of the testing agency, identification number or serial number of 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. Manufacturer shall provide a one year warranty against manufacturing defects on Helical Pile, Helical Anchor, and Bracket products. Any additional warranty provided by the Contractor shall be issued as an addendum to this specification.
- F. Work shall not begin until all the submittals have been received and approved by the Engineer. The Contractor shall allow the Engineer 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.

1.07 Shipping, Storage, and Handling

- A. All Helical Pile, Helical Anchor, and Bracket Assemblies shall be free of structural defects and protected from damage. Store Helical Piles, Helical Anchors, and Bracket Assemblies on wood pallets or supports to keep from contacting the ground. Damage to materials shall be cause for rejection.

PART 2 PRODUCTS

2.01 Helical Piles, Helical Anchors, and Brackets



- A. All Helical Pile, Helical Anchor, and Bracket Assemblies shall be manufactured by Magnum Piering, Inc. Unless noted otherwise, it is the Contractor's Pile Design Professional's responsibility to select the appropriate size and type of Helical Piles, Helical Anchors, and Brackets to support the design loads shown on the Drawings. These specifications and the Drawings provide minimum requirements to aid the Contractor in making appropriate materials selections. The size and number of helical bearing plates must be such that the Helical Piles and Helical Anchors achieve the appropriate torque and 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 Piles and Helical Anchors as appropriate to support the required loads. All material replacements shall be acceptable to Engineer.
- B. The design strength of the helical bearing plates, shaft connections, Brackets, and the pile shaft itself shall be sufficient to support the design loads specified on the Drawings times appropriate service load factors. In addition, all Helical Piles and Helical Anchors shall be manufactured to the following criteria.
 1. Central Shaft: The central shaft shall be 3-inch, 4.5-inch, or 5.72-inch outside diameter (O.D.) high strength structural steel tube meeting the requirements of ASTM A450 Grade 65. The central shaft shall have design wall thicknesses of 0.125, 0.25, 0.31, 0.37, or 0.46 inches.
 2. Helical Bearing Plates: One or more helical bearing plates shall be affixed to the central shaft. Helical bearing plates shall be 8, 10, 12, 14, 16, 20, or 24 inches in diameter depending on required bearing area. Helical bearing plates mounted to 3-inch, 4.5-inch, or 5.72-inch O.D. shafts shall have a minimum thicknesses of 3/8, 5/8, or 7/8 inches, respectively, and shall meet the requirements of ASTM A36. Helical bearing plates shall be attached to 3-inch, 4.5-inch, or 5.72-inch O.D. shafts via 3/16, 5/16, or 7/16 inch fillet welds, respectively, continuous on top and bottom and around the leading edges. Helical bearing plates shall be cold pressed into a near perfect helical shape that when affixed to the central shaft are perpendicular with the central shaft, of uniform pitch, and such that the leading and trailing edges are within 3/8 inch of parallel. Average helical pitch shall be within plus or minus 1/4 inch of the thickness of the helical bearing plate plus 3 inches.
 3. Corrosion Protection: Depending on project requirements and soil corrosivity, Helical Piles, Helical Anchors, and Brackets shall be bare steel, powder coated, or hot-dip galvanized (per ASTM A123 or A153 as applicable).
 4. Shaft Connections: The Helical Pile and Helical Anchor shaft connections shall consist of an external sleeve connection or a welded connection. External sleeve connections shall be in-line, straight and rigid and shall have a maximum tolerable slack of 1/16-inch. Welded connections shall consist of a full penetration groove weld all-around the central shaft. Shaft connections shall have a flexural strength at least as great as the shaft itself.
 5. Bolts: External sleeve connections for 3-inch, 4.5-inch, or 5.72-inch O.D. shafts shall be made via one, two, or three bolts, respectively. Bolts shall be either 7/8, 1, 1-1/4, or 1-1/2-inch diameter as required for strength.



Bolt holes through the external sleeve and central shaft shall have a diameter that is 1/16th inch greater than the bolt diameter. Bolts and nuts used to join Helical Pile and Helical Anchor sections at the shaft connections shall be bare steel, epoxy coated, or zinc coated to match the corrosion protection used for the central shaft. Bolts shall be ASME SAE Grade 8 for MH325R piles or ASME SAE Grade 5 for all other piles. All Helical Pile and Helical Anchor bolts shall be securely snug tightened.

6. Plug Welds: Alternatively, external sleeve connections may be made using plug welds matching the diameter and number of bolt holes.
 7. External sleeve: External sleeve Helical Pile and Helical Anchor shaft connections shall consist of a 3.375-inch diameter by 0.13-inch thick wall, 3.625-inch diameter by 0.25-inch thick wall, 3.75-inch diameter by 0.31-inch thick wall, 5.25-inch diameter by 0.31-inch thick wall, or 6.77-inch diameter by 0.46-inch thick wall high strength structural steel tube outer sleeve meeting the requirements of ASTM A450 Grade 65. The outer sleeve shall be welded to the central shaft via a continuous fillet weld all-around. The fillet weld shall have a throat thickness equal to the external sleeve tube thickness.
 8. Reinforced connections: Reinforced shaft connections shall have a 2.75-inch diameter by 0.125-inch thick wall, 2.500-inch diameter by 0.25-inch thick wall, 4-inch diameter by 0.25-inch thick wall, 3.88-inch diameter by 0.25-inch thick wall, 5.22-inch diameter by 0.25-inch thick wall, 4.97-inch diameter by 0.375 thick wall, or 4.80-inch diameter by 0.46-inch thick wall high strength structural steel tube inner sleeve meeting the requirements of ASTM A450 Grade 65. The inner sleeve shall be welded to the central shaft via plug welds oriented 90 degrees from and located slightly below the bolt holes.
- C. Helical Piles and Helical Anchors shall be fitted with a manufactured Bracket that facilitates connection to the structure. Brackets shall be rated for the design loads shown on the Drawings. Brackets shall be affixed to the end of Helical Piles and Helical Anchors via bolts, plug welds, or continuous penetration welds meeting the requirements for shaft connections given previously in these specifications.

PART 3 EXECUTION

3.01 Examination

- A. Contractor shall take reasonable effort to 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 a distance from a Helical Pile or Helical Anchor equal to three times the maximum helix diameter. 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 Helical Piles and Helical Anchors. In addition, Contractor shall make a site visit to observe conditions prior to the start of Work.



- C. Contractor shall notify Engineer of any condition that would affect proper installation of Helical Piles and Helical Anchors immediately after the condition is revealed. Contractor shall halt installation work until the matter can be resolved upon mutual satisfaction of Contractor, Owner, and Engineer. Costs associated with construction delays, product substitutions, pile or anchor relocations, or other related costs shall be the responsibility of the Owner if the result of an unforeseen condition that could not be inferred by a reasonable Contractor from the Drawings and Construction Documents.
- D. If the number and size of helical bearing plates required for the project is not shown on the working drawings, the contractor shall have the option of performing subsurface tests using methods subject to the review and acceptance of the Owner. The data collected along with other information pertinent to the project site shall be used to determine the required helical bearing plate configuration.
- E. If excavation is required for proper installation of Helical Piles 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.
- F. Contractor shall notify Engineer at least 24 hours prior to installation of Helical Piles or Helical Anchors to schedule quality assurance observations required on the Drawings.

3.02 Installation Equipment

- A. **Torque Motor:** Helical Piles and Helical Anchors should be installed with high torque, low RPM 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 equal to or greater than the minimum final installation torque required for the project. The connection between the torque motor and the installation rig shall have no more than two pivot hinges oriented 90 degrees from each other. Additional hinges promote wobbling and affect lateral capacity.
- B. **Installation Equipment:** The installation equipment shall be capable of applying adequate crowd and torque simultaneously to ensure normal advancement of the Helical Piles and Helical Anchors. The equipment shall be capable of maintaining proper alignment and position.
- C. **Drive Tool:** The connection between the torque motor and Helical Pile and Helical Anchor shall be in-line, straight, and rigid, and shall consist of a hexagonal, square, or round kelly bar adapter and helical shaft socket. To ensure proper fit, the drive tool shall be manufactured by the Helical Pile



manufacturer and used in accordance with the manufacturer's installation instructions.

- D. **Connection Pins:** The central shaft of the Helical Pile or Helical Anchor shall be attached to the drive tool by ASME SAE Grade 8 smooth tapered pins matching the number and diameter of the specified shaft connection bolts. The connection pins should be maintained in good condition and safe to operate at all times. The pins should be regularly inspected for wear and deformation. Pins should be replaced with identical pins when worn or damaged.
- E. **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 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.

3.03 Installation Procedures

- A. Unless shown on the Drawings, the number and size of helical blades shall be determined by the Contractor's Pile Design Professional in order to achieve the required torque and tensile/bearing capacity for the soil conditions at the site. The ratio of design load to the total area of the helical bearing plates shall not exceed the Allowable Bearing Capacity.
- B. Connect the lead section to the Torque Motor using the Drive Tool and Connection Pins. Position and align the Lead Section at the location and to the inclination shown on the Drawings and crowd the pilot point into the soil. 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 between 10 and 40 revolutions per minute. Snug tight all coupling bolts.
- C. Constant axial force (crowd) shall be applied while rotating Helical Piles and Helical Anchors into the ground. The crowd applied shall be sufficient to ensure that the Helical Pile and Helical Anchor advances into the ground a distance equal to at least 80% of the blade pitch per revolution during normal advancement.
- D. The torsional strength rating of the Helical Pile or Helical Anchor shall not be exceeded during installation. For Magnum Piering products, the torsional strength ratings are listed below.
 - 1. MH313 – 4,000 ft-lbs; MH313R – 6,000 ft-lbs



2. MH325 – 8,700 ft-lbs; MH325R – 12,700 ft-lbs
 3. MH425 – 24,000 ft-lbs; MH425R – 28,000 ft-lbs
 4. MH431 – 29,000 ft-lbs; MH431R – 34,000 ft-lbs
 5. MH625 – 40,000 ft-lbs; MH625R – 45,000 ft-lbs
 6. MH637 – 58,000 ft-lbs; MH637R – 65,000 ft-lbs
 7. MH646 – 74,000 ft-lbs; MH646R – 83,000 ft-lbs
- E. Bolt hole elongation due to torsion of the shaft of a Helical Anchor at the drive tool shall be limited to ¼ inch. Helical Anchors with bolt hole damage exceeding this criterion shall be uninstalled, removed, and discarded.
- F. When the Termination Criteria of a Helical Pile 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 Brackets to the orientation shown on the Drawings. Alternatively, installation may continue until the final elevation and orientation of the pre-drilled bolt holes are in alignment. Contractor shall not reverse the direction of torque and back-out the Helical Pile or Helical Anchor to obtain the final elevation.
- G. The Contractor shall install Brackets in accordance with Helical Pile manufacturer's details or as shown on the Drawings.
- H. All Helical Pile and Helical Anchor components including the shaft and Bracket shall be isolated from making a direct electrical contact with any concrete reinforcing bars or other non-galvanized metal objects since 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 Piles and Helical Anchors shall be advanced until all of the following criteria are satisfied.
1. Axial capacity is verified by achieving the final installation torque as shown on the Drawings, as provided by the Pile Design Professional, or as specified here. Helical Pile and Helical Anchor capacity in soil and on bedrock depends on the geometric configuration of the helical bearing plates and the subsurface conditions. The torque applied during installation provides a verification of axial capacity. An ultimate capacity to torque ratio of 8 ft⁻¹, 5.7 ft⁻¹, and 4.6 ft⁻¹ shall be used to verify capacity for 3-inch, 4.5-inch, and 5.72-inch O.D. shafts, respectively. A minimum factor of safety of 2.0 shall be used to determine allowable capacity. Hence, all Helical Piles and Helical Anchors shall be advanced until a final installation torque is achieved equal to the design loads shown on the Drawings times a factor of safety of 2.0 divided by the capacity to torque ratio (e.g. final installation torque, ft-lbs = design loads, lbs x 2.0 / capacity to torque ratio, ft⁻¹).



2. Minimum depth is obtained. The minimum depth shall be as shown on the Drawings, that which corresponds to the planned bearing stratum, or the depth at which the final installation torque is measured, whichever is greater. In addition, Helical Anchors shall be advanced until the average torque over the last three (3) feet equals or exceeds the required final installation torque.
- B. If the torsional strength rating of the Helical Pile or Helical Anchor and/or the maximum torque of the installation equipment has been reached or 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 Engineer and Owner.
 2. Remove the Helical Pile 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 Engineer and Owner.
 3. Remove the Helical Pile or Helical Anchor and pre-drill a 4-inch diameter pilot hole in the same location and reinstall the anchor/pile.
 4. If the obstruction is shallow, remove the Helical Pile or Helical Anchor and remove the obstruction by surface excavation. Backfill and compact the resulting excavation and reinstall the anchor/pile.
 5. Remove the Helical Pile or Helical Anchor and relocate 1-foot to either side of the installation location subject to the review and acceptance of Engineer and Owner.
 6. Reverse the direction of torque, back-out the Helical Pile 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 Pile or Helical Anchor and sever the uppermost helical bearing plate from the Lead Section if more than one helical bearing plate is in use, or reshape the helical bearing plates to create the patented Magnum dual cutting edge shape by cutting with a band saw. Reinstall the anchor or pile with revised helical bearing plate configuration.
- C. If the final installation torque is not achieved at the contract length, the Contractor shall have the following options:
1. Until the maximum depth is achieved (if any), install the Helical Pile or Helical Anchor deeper using additional Extension Sections.
 2. Remove the Helical Pile 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 Pile or Helical Anchor and install additional Helical Piles or Helical Anchors. The rated capacity and additional unit location shall be subject to the review and acceptance of the Engineer and Owner.

3.05 Allowable Tolerances

- A. Helical Piles and Helical Anchors shall be installed as close to the specified installation and orientation angles as possible. Tolerance for departure from installation and orientation angles shall be +/- 5 degrees.
- B. Helical Piles, Helical Anchors, and Bracket Assemblies shall be installed at the locations and to the elevations shown on the Plans. Tolerances for Bracket Assembly 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.

3.06 Quality Assurance

- A. The Contractor shall provide the Engineer and Owner 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 Pile 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. Verified axial load capacity
- B. Unless specified otherwise on the Drawings or by local codes, the Engineer, the Pile Design Professional, or an inspection agency accepted by the Engineer shall observe and document at least 10 percent of Helical Pile and Helical Anchor installations.

3.07 Load Testing

A. Helical Pile Compression Tests

1. Contractor shall perform the number of compression tests shown on the Drawings, if any
2. Compression tests shall be performed following the “quick test” procedure described in ASTM D1143 specifications
3. Load tests shall be observed and documented by the Engineer
4. Unless otherwise shown on the Drawings, the maximum test load shall be 200% of the allowable load shown on the Drawings
5. The locations of Helical Piles to be tested shall be determined by the Contractor, unless noted on the Drawings
6. Installation methods, procedures, equipment, products, and final installation torque shall be identical to the production Helical Piles to the extent practical except where otherwise approved by the Owner or Engineer
7. A load test shall be deemed acceptable provided the maximum test load is applied without Helical Pile failure and the deflection of the pile head at the design 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 Tests

1. Contractor shall perform the number of proof load tests shown on the Drawings, if any
2. Proof load tests shall be performed following the procedure described in ASTM D3689 specifications
3. Proof load tests shall be observed and documented by the Engineer
4. Unless otherwise shown on the Drawings, the maximum test load shall be 150% of the allowable load shown on the Drawings
5. The locations of Helical Anchors to be tested shall be determined by the Contractor, unless shown on the Drawings
6. Installation methods, procedures, equipment, products, and final installation torque shall be identical to the production anchors to the extent practical except where otherwise approved by the Owner or Engineer



7. A proof 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 Pile Lateral Load Tests

1. Contractor shall perform the number of lateral load tests shown on the Drawings, if any
2. Lateral load tests shall be performed following the “free head” procedure described in ASTM D3966 specifications
3. Lateral load tests shall be observed and documented by the Engineer
4. Unless otherwise shown on the Drawings, the maximum test load shall be 200% of the allowable lateral load shown on the Drawings
5. The locations of test Helical Piles shall be determined by the Contractor, unless shown on the Drawings
6. Installation methods, procedures, equipment, products, and final installation torque shall be identical to the production piles to the extent practical except where otherwise approved by the Owner or Engineer
7. 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 Helical Pile or Helical Anchor design and/or installation methods and retest the modified pile or anchor, as directed by the Owner or Engineer. These modifications 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 configuration, or changing the product (i.e., duty). Modifications that require changes to the structure shall have prior review and acceptance of the Owner. Any modifications of design or construction procedures, and any retesting required shall be at the Contractor's expense.

- E. The Contractor shall provide the Owner and Engineer copies of load test reports confirming configuration and construction details within 1 week after completion of the load tests. This written documentation will either confirm the load capacity as required on the working 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 Pile 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 calibrated testing equipment and test set-up



7. Type and configuration of Helical Pile 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
10. Comments pertaining to test procedure, equipment adjustments, or other relevant information

PART 4 MEASUREMENT AND PAYMENT

4.01 Helical Piles, Helical Anchors and Bracket Assemblies

- A. Per Unit: Payment will be at a per unit price with one unit consisting of the labor, equipment, and materials required to furnish and install a Helical Pile or Helical Anchor and associated Bracket at the location and to the elevation, orientation, inclination, length, and capacity shown in the Drawings. Unless established in the Contract, there shall be no payment for additional Helical Pile or Helical Anchor length.
- B. Per Load Test: Payment will be at a per unit price with one unit consisting of the labor, equipment, and materials required to perform each required load test.

END OF SPECIFICATION

NOTE: Because Magnum has a policy of continuous product improvement, we reserve the right to change design and specifications without notice.

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