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**INSTRUCTIONS TO PREPARER**

* 1. Review all sections and verify they are applicable to your specific project
	2. [red] Indicates information to be review and modified job dependent
	3. When complete print pages 2-X.

SECTION 31 [60] [00] HELICAL PILES

# GENERAL

## SUMMARY

This section specifies the furnishing of all necessary engineering and design services (if required), supervision, labor, materials, and equipment to perform all work to install and test the helical piles for the following project and location:

* 1. Project:
	2. Location:

## DESIGN CRITERIA

* 1. All piles shall be designed to meet the following minimum allowable design (working) loads:

Axial Compressive: kips

Axial Tension: kips

Lateral: kips

* 1. RELATED SECTIONS

Section \_\_\_\_\_\_\_ - Earthwork

Section \_\_\_\_\_\_\_ - Structural Concrete

* 1. REFENCES

ACI - American Concrete Institute- ACI 301 - "Specifications for Structural Concrete for Buildings"

API - American Petroleum Institute

ASTM - American Society for Testing and Materials

ASTM A29/A 29M - "Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished"

ASTM A53 - "Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless"

ASTM 123- “Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products”

ASTM A153 - "Zinc Coating (Hot-Dip) on Iron and Steel Hardware"

ASTM SAE J429 - "Mechanical and Material Requirements for Externally Threaded Fasteners"

ASTM A572 - "Latest Revision, HSLA Columbian-Vanadium Steels of Structural Quality"

ASTM A607 - "Steel, Shaft and Strip, High-Strength, Low-Alloy Chromium or Vanadium, for Both, Hot-Rolled and Cold-Rolled"

D1143/D1143M – Test Methods for Deep Foundations Under Static Axial Compressive Load.

D3689 – Test Methods for Deep Foundations Under Static Axial Tensile Load.

D3966/D3966M – Test Methods for Deep Foundations Under Lateral Load.

AWS - American Welding Society- AWS D1.1 “Structural Welding Code- Steel”

PTI - Post Tensioning Institute

## SUBMITTALS

* 1. Comply with requirements of Section \_\_\_\_\_\_\_.
	2. Helical Pier Contractor Qualifications
		1. Design Experience: The helical pier contractor or contractor’s engineer shall be fully experienced in all aspects of design and have more than [5] years of relevant design experience.
		2. Installation Experience: The helical pier contractor shall submit evidenced to the Owner that he has been engaged in the successful installation of helical piles for at least [5] years, has completed no less than [5] similar projects, and is a certified installer by the manufacturer.
	3. Construction Submittals:
1. Construction submittals shall be prepared by the contractor and submit to the Owner, for review and approval, at least [14] calendar days prior to the planned start of construction.
2. Provide details of installation sequence and equipment to be used in pile construction and example copies of daily installation records.
3. The working drawings shall include at a minimum, the following:
4. Pile number, location, and spacing
5. Submit the following data, sealed by a Registered Professional Engineer, currently licensed in the State of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
6. Calculations for pile design capacities for both structural and geotechnical capacities. Lateral analysis shall use LPile software by Ensoft, Inc.
7. Minimum (if required), and/or estimated pile length
8. Minimum installation torque
9. Pile top attachment
10. Load testing requirements
11. Shop drawings showing pile shaft diameters, helical plate data, length, and other pertinent data.

## QUALITY ASSURANCE

* 1. Installation records: The following records will be prepared for the Owner and completed within [24] hours after each pier installation is completed. The records shall include the following minimum information:

Date of installation

Pile number

Pile location

Pile cut-off elevation (PCOE)

Installed depth to tip

Final installation torque, averaged, over the last 3-feet of pile depth.

Comments on whether obstructions were encountered, refusal, or change in location, etc.

* 1. Installation Tolerances:
		1. Centerline of piling shall not deviate horizontally more than [3] in. from indicated plan location.
		2. Installed vertical alignment shall be within [2] % of plumb or design batter angle as specified within plan.

## STORAGE AND HANDLING

* + 1. All products shall be handled and transported with care to prevent any damage or deformation. Store and stack as recommended by manufacturer.

# PRODUCTS

### GENERAL

* 1. All welding to be by certified welders in accordance with AWS D1.1, “Structural Welding Code – Steel”.
	2. Pile components as specified herein shall be manufactured by a facility whose quality systems comply with ISO (International Organization of Standards) 9001 requirements. Certificates of Registration denoting ISO Standards Number shall be presented upon request to the Engineer or their representative.

### CENTRAL STEEL SHAFT

* 1. Each pile shall be manufactured by IDEAL Manufacturing located at 999 Picture Pkwy, Webster, NY 14580.
	2. The pile shaft shall be [select all that apply]:

1-1/2” Round Corner Square Shaft, conforming to ASTM A29/A576 with a min yield of 90 KSI and with a torque limit of 7,000 ft-lbs. and evaluated in ICC ESR-3750.

1-3/4” Round Corner Square Shaft, conforming to ASTM A29/A576 with a min yield of 90 KSI and with a torque limit of 11,000 ft-lbs.

2-7/8” diameter x 0.203” wall thickness tubing, conforming to ASTM A500 with a min yield of 80 KSI and with a torque limit of 8,300 ft-lbs. and evaluated in ICC ESR-3750.

2-7/8” diameter x 0.276” wall thickness tubing, conforming to ASTM A500 with a min yield of 80 KSI and with a torque limit of 10,000 ft-lbs. and evaluated in ICC ESR-3750.

3” square x 0.250” wall thickness tubing, conforming to ASTM A500 Grade B/C with a torque limit of 11,000 ft-lbs.

3” square x 0.313” wall thickness tubing, conforming to ASTM A500 Grade B/C with a torque limit of 15,000 ft-lbs.

3-1/2” diameter x 0.216” wall thickness tubing, conforming to ASTM A500 with a min yield of 80 KSI and with a torque limit of 13,400 ft-lbs. and evaluated in ICC ESR-3750.

3-1/2” diameter x 0.300” wall thickness tubing, conforming to ASTM A500 with a min yield of 80 KSI and with a torque limit of 17,200 ft-lbs. and evaluated in ICC ESR-3750.

4-1/2” diameter x 0.290” [0.337”] (2-bolt) wall thickness tubing, New Mill Secondary Steel with a min yield of 80 KSI and with a torque limit of 26,500 ft-lbs.

4-1/2” diameter x 0.290” (3-bolt) wall thickness tubing, New Mill Secondary Steel with a min yield of 80 KSI and with a torque limit of 33,500 ft-lbs.

4-1/2” diameter x 0.337” (3-bolt) wall thickness tubing, New Mill Secondary Steel with a min yield of 80 KSI and with a torque limit of 37,500 ft-lbs.

5-1/2” diameter x 0.361” [0.415”] (2-bolt) wall thickness tubing, New Mill Secondary Steel with a min yield of 80 KSI and with a torque limit of 40,000 ft-lbs.

5-1/2” diameter x 0.361” (3-bolt) wall thickness tubing, New Mill Secondary Steel with a min yield of 80 KSI and with a torque limit of 60,000 ft-lbs.

5-1/2” diameter x 0.415” (3-bolt) wall thickness tubing, New Mill Secondary Steel with a min yield of 80 KSI and with a torque limit of 60,000 ft-lbs.

7-00” diameter x 0.408” (Internal Coupler) wall thickness tubing, New Mill Secondary Steel with a min yield of 80 KSI and with a torque limit of 70,000 ft-lbs.

7-00” diameter x 0.408” (External Coupler) wall thickness tubing, New Mill Secondary Steel with a min yield of 80 KSI and with a torque limit of 120,000 ft-lbs.

7-00” diameter x 0.453” wall thickness tubing, New Mill Secondary Steel with a min yield of 80 KSI and with a torque limit of 130,000 ft-lbs.

[Other]

### LEAD SECTIONS

* 1. Each lead shall have a 45-degree bevel cut to aid in starting the helical pier with the other end having holes to accept a helical extension assembly. Welded to the lead shall be helical plate(s) consisting of ASTM A572, Grade 50 with a specified thickness of [3/8”] [1/2”] [5/8”] [3/4”] and a [3-inch] [6-inch] pitch on leading edge. Helical plate diameter shall be specified with increasing diameters in increments of 2”. Plate diameters shall be [6] [8] [10] [12] [14] [16] [18] [20] [22] [24] [26] [28] [30] [specify all that apply] inches. Lead sections shall be [hot dipped galvanized per ASTM A153] [bare steel].

### EXTENSION SECTIONS

* 1. Extensions fabricated from tubing shall have an equal to or greater than strength of the connected tubing and shall be [hot dipped galvanized per ASTM A153] [bare steel]. Each end shall have bolt holes to match the previous and subsequent hole locations.

### BOLT HARDWARE

* 1. Each extension shall be supplied with [two ASTM A325] [three ASTM A325] [two Grade 8 (plain finish)] [three Grade 8 (plain finish)] [two Grade B7 (galvanized)] [three Grade B7 (galvanized)] and nuts, [hot dipped galvanized per ASTM A153] [plain finish].

# EXECUTION

#### INSTALLING PILES

* 1. Prior to installation a surveyor or other licensed professional shall lay out all lines and grades as required by the contractor documents and approved submittals.
	2. Prior to installation verify the location of all underground utilities.
	3. Continuously drive piles to the elevations and depths indicated within the approved submittal in accordance with the manufacturer’s written instructions and recommendations. Maintain established axial alignment of leads during driving.
	4. Verify with all other trades that the project is ready for the pile installation. Any discrepancies shall be resolved prior to installation and after confirmation with the Owner.

#### INSTALLATION EQUIPMENT

* 1. The pile shall be engaged into the soil in a smooth, continuous manner with enough down pressure or crowd for uniform advancement at a rotation rate of 5 to 20 revolutions per minute (RPM’s). The amount of crowd shall be varied to maintain a downward advancement of approximately 2-3-inches per revolution.
	2. Install helical piles using a rotary type, hydraulic gear motor with clockwise and counter-clockwise rotational capabilities. The installation torque rating of the gear motor shall be at least 20% higher than the torque rating of the central steel shaft.

#### PRE-DRILLING

* 1. All pre-drilling shall be performed in accordance with diameter(s) and depth(s) under written approval by Contractor’s design professional engineer.
	2. Except where subgrade soils are frozen, installation shall be first attempted without predrilling.
	3. Where pre-drilling is required to install the piles, the auger diameter shall be at least 2 inches less than the shaft diameter. Larger pre-drill diameters shall be backfilled with a non-compressible material, as determined by the Contractor’s design professional engineer and approved by the Engineer. Pre-drilling shall be limited in depth such that no reduction in capacity occurs, or piles deepened to compensate for any reduction, as determined by the Contractor’s design professional engineer.

#### INSTALLATION REQUIREMENTS

* 1. Utilize a torque motor capable of continuous adjustment to number of revolutions per minute (RPM) during installation, a torque capacity at least 20% greater than the torsional strength rating of the central steel shaft to be installed, a minimum torque capacity of 15% greater than the design installation torque, and be provided with an in-line pressure relief valve or other means to prevent installation torques greater than the rated capacity of the pile. Do not use percussion drilling equipment.
	2. The minimum installation torque and minimum installed length shall be satisfied prior to terminating the installation. The minimum installation torque shall be taken as the average torque over the last three feet of penetration (the last three readings recorded at one-foot intervals). Install additional extension sections as necessary to maintain these requirements.
	3. The torsional strength rating of the central steel shaft shall not be exceeded at any time during the installation.
	4. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length, the Contractor shall do one of the following:
		1. Terminate the installation at the depth obtained subject to the review and acceptance of the Engineer.
		2. Remove the existing helical pier and install a new one with fewer and/or smaller diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Engineer. If re-installing in the same location, the top-most helix of the new helical pier shall be terminated at least 3-feet beyond the terminating depth of the original helical pier.
	5. Once the helical pier has satisfied the minimum installation torque and the minimum installation depth the pier top can be trimmed to the required elevation at 90-degress to the central steel shaft.

#### FIELD QUALITY CONTROL

* 1. The Engineer shall determine if a load test is required. If required, the number and locations of the tests shall be determined by the Engineer.
	2. Load tests shall be completed in accordance with the following ASTM standards:

Axial Compressive Load Test: ASTM D1143

Axial Tension Load Test: ASTM D3689

Lateral Load Test: ASTM D3966

* 1. Pile testing shall utilize the “Quick Test” Method in increments stated in the standard. Additional load steps may be required depending on the production loading conditions as determined by the Engineer.
	2. The installation torque of the test and reaction piles shall be monitored and recorded in one-foot intervals. Installation torque shall be monitored using calibrated electronic torsional monitoring equipment. Pressure gauges shall also be used, as backup, displaying the differential pressure across the motor.
	3. Loading shall be carefully monitored utilizing a calibrated load cell and matched readout equipment with enough plating at load cell/test beam interface to disperse the load through the cell. Submit calibration for review and approval by the engineer. Calibration shall be dated within three (3) months of the test date.
	4. A calibrated test jack and pump with inline gauge shall be used. Calibration shall be dated within three (3) months of the test date.
	5. For axial compression and tension testing, piles shall be monitored for movement of the head utilizing a minimum of (2) analog gauges with accuracy to 0.001” placed at points opposing each other across the bearing plate.
	6. For Lateral testing, piles shall be monitored for movement of the pile head utilizing a minimum of two (2) analog gauges with accuracy to 0.001” placed along and in line with the test pile to monitor the deflection and rotation of the pile head.
	7. Excessive Test Pile Movements:

Axial Compression Test:

1. If excessive pile movement (i.e. failure) occurs prior to reaching the maximum anticipated test load under compression loading or plunging as defined as continued movement of the pile without the ability to support the load.
2. Failure of the pile is considered when the deflection curve exceeds the limits of [elastic shortening (PL/AE) plus 10% of the average flight diameter] or plunging of the pile.

Axial Tension Test:

1. If excessive pile movement (i.e. failure) occurs prior to reaching the maximum anticipated test load under tension loading or plunging as defined as continued movement of the pile without the ability to support the load.
2. Failure of the pile is considered when the deflection curve exceeds the limits of [elastic shortening (PL/AE) plus 10% of the average flight diameter] or plunging of the pile.

Lateral Test:

1. If excessive pile movement (i.e. failure) occurs prior to reaching the maximum anticipated test load under lateral loading, continue jacking the pile until the total lateral movement equals 2 inches.
2. Failure of the pile is determined through analysis of the test results when compared to the adjusted soil model in LPile.
	1. Production piling shall not be installed until after the pile test results have been reviewed and approved by the Engineer.

END OF SECTION