MODEL SPECIFICATION FOR

HELICASTTM PILE FOUNDATIONS

COMPRESSION AND TENSION APPLICATIONS

# SCOPE

## The work consists of designing, furnishing and installing HelicastTM piles and load transfer devices used to support compression and tension loads according to the project Plans and these specifications.

## The parties and contract terms referred to in this specification are as follows:

### The Owner is the person or entity that owns the facility or will own the facility once it is completed. The Owner may have contractual agreements with, and be represented by, other parties such as engineers, architects or contractors that perform services under the direction of the Owner. Where Owner is used in this specification, it refers to the Owner or the Owner’s contracted representatives separate from the Installing Contractor.

### The Pile Designer is the individual or firm generally hired by the Installing Contractor to design the Helicast piles.

### The Installing Contractor installs and tests (if necessary) the Helicast piles, and possibly performs other tasks associated with the project.

### The Plans refer to the contract documents; including but not limited to the drawings and specifications for the project.

## The work may include Helicast pile load testing.

## The Owner will be responsible for obtaining any right-of-way or easement access permits necessary for the Helicast pile installation.

## Unless otherwise noted, the Installing Contractor shall provide all labor, tools, equipment and materials necessary to accomplish the work.

## The Owner will provide suitable access to the construction site for the Installing Contractor’s personnel and equipment.

## Unless specifically noted otherwise in the contract documents, the Owner will remove and replace any structures, utilities, pavements, landscaping or other surficial improvements in the work area as necessary to facilitate the work.

## The Owner will be responsible for overall construction oversight to preclude the development of unsafe conditions.

## The Owner will be responsible for a horizontal field survey of the Helicast pile locations prior to Helicast pile installation and an elevation survey to determine pile shaft cutoff height subsequent to Helicast pile installation.

## The work does not include any post-construction monitoring of pile performance unless specifically noted otherwise in the contract documents.

# references

## American Institute of Steel Construction (AISC)

### AISC 360: Specification for Structural Steel Buildings

## American Petroleum Institute (API)

### API RP13B-2: Recommended Practice for Field Testing Oil-Based Drilling Fluids

## American Society for Testing and Materials (ASTM)

### ASTM A29: Steel Bars, Carbon and Alloy, Hot-Wrought

### ASTM A36: Carbon Structural Steel

### ASTM A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

### ASTM A123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

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

### ASTM A252: Standard Specification for Welded and Seamless Steel Pipe Piles

### ASTM A500: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

### ASTM A513: Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing

### ASTM A572: High-Strength Low-Alloy Columbian-Vanadium Structural Steel

### ASTM B695: Coatings of Zinc Mechanically Deposited on Iron and Steel

### ASTM C33: Standard Specification for Concrete Aggregates

### ASTM C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)

### ASTM C150: Specification for Portland Cement

### ASTM C494: Chemical Admixtures for Concrete

### ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

### ASTM C942: Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory

### ASTM C1240: Standard Specification for Silica Fume Used in Cementitious Mixtures

### ASTM D1143: Standard Test Methods for Deep Foundations Under Static Axial Compressive Load

### ASTM D1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

### ASTM D3689: Standard Test Methods for Deep Foundations Under Static Axial Tensile Load

## International Code Council Evaluation Services (ICC-ES)

### Acceptance Criteria 358 (AC358): Acceptance Criteria for Helical Pile Systems and Devices

## Society of Automotive Engineers (SAE)

### SAE J429: Mechanical and Material Requirements for Externally Threaded Fasteners

# DEFINITIONS

## The following terms apply to Helicast piles used to support compression and tension loads:

### Allowable Stress Design: A structural and geotechnical design methodology that states that the summation of the actual estimated loads (nominal loads) must be less than or equal to the allowable design load (required strength).  Allowable loads are obtained by dividing a nominal resistance (strength) by an appropriate factor of safety.

### Bearing Stratum: The soil layer (or layers) that provide the Helicast pile end-bearing capacity through load transfer from the helix plates.

### Crowd: Axial compressive force applied to the central steel shaft as needed during installation to ensure the pile advances at a rate approximately equal to the helix pitch for each revolution.

### Design Load: A generic and ambiguous term used to describe any load used in design. It is not specific to factored or unfactored loads or any particular design methodology. It is a term; therefore, that should be avoided when specifying load requirements. FSI recommends using the term service load, nominal load or factored load, as described herein, where applicable.

### Design Strength: A term used in structural design which is defined as the product of the nominal strength and the applicable resistance factor. An equivalent term typically used in geotechnical design is factored resistance (Load and Resistance Factor Design).

### Extension Displacement Plate: Round steel plates with grout holes generally used at each extension coupling to maintain the grout column annulus during advancement of the central steel shaft. Cased extension displacement plates are used to attach steel or PVC outer casings.

### Extension Section: Helical pile shaft sections connected to the lead section or other extension sections to advance the helix plates to the required bearing depth.

### Factor of Safety: The ratio of the ultimate pile capacity or nominal resistance (strength) to the nominal or service load used in the design of any Helicast pile component or interface (Allowable Stress Design).

### Factored Load: The product of a nominal load and an applicable load factor (Load and Resistance Factor Design).

### Factored Resistance: The product of a nominal resistance and an applicable resistance factor (Load and Resistance and Factor Design).

### Geotechnical Capacity: The maximum load or the load at a specified limit state, that can be resisted through the pile’s interaction with the bearing soils (see also Ultimate Pile Capacity).

### Grout: Portland cement based grout that may be modified with fine aggregate or admixtures to improve grout strength, workability or corrosion protection. Admixtures may also be added to control shrinkage or induce expansion during curing.

### HelicastTM Pile: A helical pile consisting of an ungrouted lead section followed by grout-encased extension sections. Helicast piles may have permanent steel or PVC outer casings and a load transfer device that allows attachment to structures. Helicast piles are installed into the ground by application of torque and axial compressive force (“crowd”). The grout is gravity fed during advancement of the central steel shaft with the grout annulus formed by steel displacement plates at each central steel extension section or with a maximum center-to-center spacing of 7 feet.

### Helix (Helical) Plate: Generally round steel plate formed into a helical spiral and welded to the central steel shaft. When rotated in the ground, the helix shape provides thrust along the pile’s longitudinal axis thus aiding in pile installation. The plate transfers axial load to the soil through bearing.

### Helix Pitch: The distance measured along the axis of the shaft between the leading and trailing edges of the helix plate.

### Lead Displacement Plate: A round steel plate with soil cutting blades or paddles generally located at the connection of the lead section and the first extension section. The lead displacement plate creates the annulus for grout placement. Cased lead displacement plates are used to attach steel or PVC outer casings.

### Lead Section: The first helical pile shaft component installed into the soil. It consists of one or more helical plates welded to a central steel shaft.

### Limit State: A condition beyond which a Helicast pile component or interface becomes unfit for service and is judged to no longer be useful for its intended function (serviceability limit state) or to be unsafe (ultimate limit state (strength)).

### Load and Resistance Factor Design: A structural and geotechnical design methodology that states that the Factored Resistance (Design Strength) must be greater than or equal to the summation of the applied factored loads.

### Load Factor: A factor that accounts for the probability of deviation of the actual load from the predicted nominal load due to variability of material properties, workmanship, type of failure and uncertainty in the prediction of the load (Load and Resistance Factor Design).

### Load Test: A process to test the ultimate pile capacity and relation of applied load to pile head deflection by application of a known load on the Helicast pile head and monitoring movement over a specific time period.

### Loads: Forces that result from the weight of all building materials, occupants and their possessions, environmental effects, differential movement, and restrained dimensional changes. Permanent loads are those loads in which variations over time are rare or of small magnitude. All other loads are variable loads (see also Nominal Loads).

### Mechanical Strength: The maximum load or the load at a specified limit state that can be resisted by the structural elements of a Helicast pile.

### Net Deflection: The total deflection at the pile head minus the theoretical elastic deformation of the pile shaft during a load test.

### Nominal Loads: The magnitude of the loads specified, which include dead, live, soil, wind, snow, rain, flood and earthquakes (also referred to as service loads or working loads).

### Nominal Resistance: The pile capacity at a specified ultimate limit state (Load and Resistance Factor Design). See Ultimate Pile Capacity.

### Nominal Strength: A term used in structural design which is defined as the structure or member capacity at a specified strength limit state. See Ultimate Pile Capacity.

### Resistance Factor: A factor that accounts for the probability of deviation of the actual resistance (strength) from the predicted nominal resistance (strength) due to variability of material properties, workmanship, type of failure and uncertainties in the analysis (Load and Resistance Factor Design).

### Service Loads: See “Nominal Loads” above.

### Ultimate End Bearing Capacity: The end bearing component of Ultimate Pile Capacity for a Helicast pile.

### Ultimate Frictional Resistance: The skin friction component of Ultimate Pile Capacity for a Helicast pile.

### Ultimate Pile Capacity: The Helicast pile capacity based on the least capacity determined from applicable ultimate limit states for mechanical and geotechnical capacity. The Helicast Ultimate Pile Capacity may be a combination of Ultimate End Bearing Capacity and Ultimate Frictional Resistance.

# APPROVED HELICASTTM PILE MANUFACTURERS

## Foundation Supportworks®, Inc., 12330 Cary Circle, Omaha, NE 68128; Phone: (800) 281-8545; Fax: (402) 393-4002.

## Due to the special requirements for design and manufacturing of Helicast piles, the piles shall be obtained from Foundation Supportworks®, Inc., or other qualified manufacturer with an approved equivalent product. A request to substitute any other manufactured Helicast product must be submitted to the Owner for review not less than seven (7) calendar days prior to the bid date. The request must include:

### Documentation of at least five years of production experience manufacturing helical piles,

### Documentation that the manufacturer’s helical piles have been used successfully in at least five engineered construction projects within the last three years,

### Product acceptance by the local building code official(s) having jurisdiction over the project, and/or

### Current ICC-ES product evaluation report for the central steel shaft components or complete description of product testing and manufacturing quality assurance programs used to assess and maintain product quality and determine product mechanical strength and geotechnical capacity.

# acceptable productS FOR CENTRAL STEEL SHAFT

## Solid Square Shaft Helical Anchor Models HA150 and HA175 manufactured in accordance with the requirements of Sections 5 and 6 of this specification.

### Helix plates shall meet the following geometry and spacing criteria to minimize soil disturbance:

#### True helix-shaped plates that are normal to the shaft such that the leading and trailing edges are within ¼-inch of parallel.

#### Helix pitch is 3 inches ± ¼-inch.

#### All helix plates have the same pitch.

#### Helix plates have generally circular edge geometry.

#### Helix spacing along the shaft shall be between 2.4 and 3.6 times the helix diameter.

#### Helix plates are arranged along the shaft such that they all theoretically track the same path as the proceeding plate.

# Materials

## Model HA150 or HA175 Helical Anchor System

### Central Steel Shaft: The central steel shaft of the lead and extension sections are 1.50-inch (HA150) or 1.75-inch (HA175), solid, round-corner square (RCS) hot-rolled steel bars conforming to ASTM A29 with a minimum yield strength of 90 ksi and a minimum tensile strength of 115 ksi. The shaft finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### Shaft Coupling Material: The extension shaft sections have an internally forged upset socket coupling at one end. Since the socket coupling is internally forged from the parent shaft material, the material properties of the coupling are similar to the central steel shaft. The shaft coupling finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### Helix Plate Material: The helix plates are factory welded to the shaft lead or extension sections. Helix plates with outer diameters of 6, 8, 10, 12 or 14 inches are either 0.375 or 0.500-inch thick and 16-inch diameter helix plates are 0.500-inch thick. The helix plates are manufactured with ASTM A572 Grade 50 steel with a minimum yield strength of 50 ksi and a minimum tensile strength of 65 ksi. The helix plate finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### HA150 Shaft Coupling Hardware: The lead and extension shaft sections are coupled with one (1) bolt and nut per coupled shaft section. The coupling hardware consists of 0.750-inch standard hex bolts conforming to SAE J429 Grade 8 and jam nuts. The bolts and nuts are mechanically galvanized in accordance with ASTM B695.

### HA175 Shaft Coupling Hardware: The lead and extension shaft sections are coupled with two (2) bolts and nuts per coupled shaft section. The coupling hardware consists of 0.750-inch standard hex bolts conforming to SAE J429 Grade 8 and standard hex jam nuts. The bolts and nuts are mechanically galvanized in accordance with ASTM B695.

## Displacement Plates

### Lead Displacement Plates: The lead displacement plates are manufactured from 0.250-inch thick steel plate conforming to ASTM A36 and consist of a circular steel plate with two (2) factory-welded soil cutting blades and central square openings sized for the HA150 or HA175 shafts. HA150 lead displacement plates have circular steel plate diameters of 5, 6 or 7 inches and HA175 lead displacement plates have circular steel plate diameters of 5, 6, 7 or 9 inches. The lead displacement plate finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### Extension Displacement Plates: The extension displacement plates are manufactured from 0.250-inch thick steel plate conforming to ASTM A36 and consist of a circular steel plate with two (2) 0.750-inch grout holes and central square openings sized for the HA150 or HA175 shafts. HA150 extension displacement plates have circular steel plate diameters of 5, 6 or 7 inches and HA175 extension displacement plates have circular steel plate diameters of 5, 6, 7 or 9 inches. The extension displacement plate finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### HA150 Cased Lead Displacement Plates: The HA150 cased lead displacement plates consist of a 5-inch diameter HA150 lead displacement plate with a 1.250-inch long factory-welded steel collar for the attachment of a 4-inch Schedule 40 nominal steel or PVC pipe. The steel collars are 4-inch outer diameter by 0.049-inch wall thickness, hollow structural section in conformance with ASTM A513, Type 5, Grade 1026 with a minimum yield strength of 70 ksi and a minimum tensile strength of 80 ksi. The cased lead displacement plate finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### HA175 Cased Lead Displacement Plates: The HA175 lead cased displacement plates consist of a 7-inch diameter HA175 lead displacement plate with a 1.75-inch long factory-welded steel collar for the attachment of a 6-inch Schedule 40 nominal steel or PVC pipe. The steel collars are 6-inch outer diameter by 0.065-inch wall thickness, hollow structural section in conformance with ASTM A513, Type 5, Grade 1026 with a minimum yield strength of 70 ksi and a minimum tensile strength of 80 ksi. The cased lead displacement plate finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### HA150 Cased Extension Displacement Plates: The HA150 cased extension displacement plates consist of a 5-inch diameter HA150 extension displacement plate with a 1.25-inch long steel collar factory welded to each side for the attachment of a 4-inch Schedule 40 nominal steel or PVC pipe. The steel collars are 4-inch outer diameter by 0.049-inch wall thickness, hollow structural section in conformance with ASTM A513, Type 5, Grade 1026 with a minimum yield strength of 70 ksi and a minimum tensile strength of 80 ksi. The cased extension displacement plate finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### HA175 Cased Extension Displacement Plates: The HA175 cased extension displacement plates consist of a 7-inch diameter HA175 extension displacement plate with a 1.75-inch long steel collar factory welded to each side for the attachment of a 6-inch Schedule 40 nominal steel or PVC pipe. The steel collars are 6-inch outer diameter by 0.065-inch wall thickness, hollow structural section in conformance with ASTM A513, Type 5, Grade 1026 with a minimum yield strength of 70 ksi and a minimum tensile strength of 80 ksi. The cased extension displacement plate finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

## Grout Mixture

### Cement: Cement for Helicast piles shall be Portland cement conforming to ASTM C150 Type I or Type II.

### Chemical Admixtures: Unless directed otherwise by the Owner, chemical admixtures shall be used to provide a non-shrink grout mix. The Owner may also require specific chemical admixtures in order to meet strength, workability, setting time or other performance specifications. Chemical admixtures shall be suitable for use with the specified central steel shaft and structural components in contact with the grout mixture. Chemical admixtures for grout shall conform to the requirements of ASTM C494.

### Mineral Admixtures: Mineral admixtures such as fly ash, silica fume or natural pozzolans may be used at the direction of the Owner to control grout strength, workability, setting time or other performance specifications. Mineral admixtures shall be suitable for use with the specified central steel shaft and structural components in contact with the grout mixture. Mineral admixtures for grout shall conform to the requirements of ASTM C618 and ASTM C1240.

### Aggregate: Fine aggregate may be used at the direction of the Owner for grout column diameters greater than 6 inches. Fine aggregate, if used, shall consist of natural sand, manufactured sand or a combination thereof meeting the requirements of ASTM C33.

### Wet Density: A wet density value for the specified grout mixture should be established using a mud balance in accordance with API RP13B-1 for the maximum and minimum recommended water dosage. Once this range has been established, wet density can be monitored in the field with a mud balance in accordance with API RP13B-1 to ensure that grout water content is appropriate.

### Mixing Water: Mixing water shall be potable with no pronounced taste or odor.

### Grout Strength: The grout mixture shall be capable of providing a minimum grout strength of 3500 psi at seven days and 6000 psi at 28 days as determined by laboratory testing in accordance with ASTM C109 and ASTM C942.

### Grout mixtures where the constituent materials are batched on site may not always have uniform properties. Pre-blended grout mixtures are recommended in order to reduce problems related to grout variations. Pre-blended grout mixtures shall be stored, mixed and placed in accordance with the manufacturer’s recommendations. Cook® Brand PDP Grout (Micropile Grout) or similar is an approved pre-blended grout in concentrate form where it is mixed on site with appropriate proportions of Portland cement. Other pre-blended grout mixtures shall be approved by the Owner prior to use. Cook® Brand PDP Grout may be obtained from:

A.W. Cook Cement Products, Inc.

242 Amy Industrial Lane

Hoschton, GA 30548

Phone: 706-654-3677

[www.awcookcement.com](http://www.awcookcement.com)

## Permanent Casing

### Permanent Steel Casing: Permanent steel casing shall meet the dimensional properties shown on the Plans and meet or exceed the requirements of ASTM A53, Grade B Type E or S, ASTM A252 Grade 3 or ASTM A500 Grade B.

### Permanent PVC Casing: Permanent PVC casing shall meet dimensional properties shown on the Plans and the material requirements of ASTM D1784.

## Plates and Shapes

### Structural steel plates and shapes for Helicast pile top attachments (load transfer devices) shall conform to ASTM A36 or ASTM A572 Grade 50.

# design and performance requirements

Helicast piles generate geotechnical capacity through a combination of end bearing at the helix plates and skin friction along the grout column. The analysis to estimate proportions of end-bearing capacity and skin-friction capacity to total pile capacity is highly complex. The selection of an appropriate friction model for the specific site soil conditions is necessary to properly estimate the skin friction component of the pile system. End-bearing capacity is estimated using the methodology appropriate for standard helical piles in end bearing. The mechanical strength of the system should also be considered for the appropriate limit states of the grout column and central steel shaft.

## Helicast piles shall be designed to support the specified compression and tension loads as shown on the project Plans. The overall length, helix configuration and installation torque of a Helicast pile shall be such that the required ultimate end-bearing capacity is developed by the central steel shaft and helix plate(s) in an appropriate bearing stratum. The design shall also consider the mechanical limits of the central steel shaft, helix plates and termination device/bracket.

## The calculated ultimate frictional resistance of the Helicast pile grout column shall be determined using an industry standard analytical method considering the grout column length, diameter, outer surface finish and bond value(s) with the surrounding soil. The available skin friction used to determine pile capacity shall not exceed the nominal axial resistance of the grout column determined by generally accepted methods of analysis. When available skin friction is limited by this requirement, then the end bearing component at the helix plates should also be neglected in the calculated pile capacity.

## The frictional resistance of the Helicast grout column shall not be considered in the calculation of tension capacity, therefore the tension capacity shall be based solely on end bearing of the helix plates as described in Section 7.1.

## All structural steel pile components shall be designed within the limits provided by the American Institute of Steel Construction (AISC) Specification for Structural Steel Buildings (AISC-360). Either Allowable Stress Design (ASD) or Load and Resistance Factor Design (LRFD) are acceptable methods of analysis.

## When an LRFD analysis is required, the Owner shall provide applicable pile design information including but not limited to; factored loads, resistance factors and/or the required ultimate pile capacity. Factors of safety (ASD) or resistance factors (LRFD) may require modification to meet specific deflection criteria stated on the Plans or drawings.

## Except where noted otherwise on the project Plans, for ASD analysis, a minimum factor of safety of 2.0 shall be used for end-bearing capacity and a minimum factor of safety of 2.0 shall be used for skin friction capacity if compression load testing in accordance with Section 14 is performed; otherwise a minimum factor of safety of 2.5 shall be used for skin friction capacity.

## The end-bearing geotechnical capacity shall be estimated at each pile location during installation by monitoring and recording the final installation torque and applying default torque correlation factors for the central steel shaft per ICC-ES AC358.

## Except where noted otherwise on the project Plans, design of the structural steel components of the system shall consider the effects of corrosion including, at a minimum, a 50-year scheduled sacrificial loss in thickness per ICC-ES AC358.

## The pile design shall consider group efficiency from pile spacing, pile buckling potential and soil stratification.

# qualifications of installing contractor and designer

## The Installing Contractor and/or Pile Designer shall submit to the Owner a proposal including the documentation required in this Section. Work shall not begin until all the submittals have been received and approved by the Owner. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Installing Contractor.

## Evidence of Installing Contractor’s competence in the installation of helical piles shall be provided to the Owner’s satisfaction and may include any or all of the following:

### Pile manufacturer’s certificate of competency for the installation of helical piles,

### A list of at least three projects completed within the previous three years wherein the Installing Contractor installed helical piles with central steel shafts similar to those shown in the project Plans. Such list to include names and phone numbers of those project representatives who can verify the Installing Contractor’s participation in those projects, and/or

### A letter from the pile manufacturer or manufacturer’s representative expressing ability and intent to provide on-site supervision of the pile installation.

## A listing of all safety violations lodged against the Installing Contractor within the previous three years and the current status or final resolutions thereof. Descriptions of safety improvements instituted within the previous three years may also be submitted, at the Installing Contractor’s discretion.

## Evidence of Pile Designer’s competence shall be provided to the Owner’s satisfaction and may include any or all of the following:

### Registration as a Professional Engineer or recognition by the local jurisdictional authority,

### A list of at least three projects completed within the previous three years wherein the Pile Designer designed helical piles with central steel shafts similar to those shown in the project Plans. The list shall include names and phone numbers of those project representatives who can verify the Pile Designer’s participation in those projects, and/or

### Recommendation from the pile manufacturer or manufacturer’s representative.

# pre-construction submittals

## Within 2 weeks of receiving the contract award, the Installing Contractor and/or Pile Designer shall submit the following Helicast pile design documentation:

### Certification from the Pile Designer that the proposed piles meet the requirements of this specification.

### Qualifications of the Installing Contractor and Pile Designer per Section 8.

### Product designations for central steel shaft lead and extension sections, displacement plates and all ancillary products to be supplied at each Helicast pile location.

### Individual pile nominal loads, factors of safety, LRFD load and resistance factors and required ultimate torque correlated capacities, where applicable.

### Individual pile loading requirements (if any).

### Manufacturer’s published allowable system capacities for the proposed pile assemblies, including load transfer devices.

### Calculated mechanical and theoretical geotechnical capacities of the proposed piles.

### Minimum pile termination torque requirements.

### Maximum estimated installation torque and allowable installation torque rating of the proposed piles.

### Minimum and/or maximum embedment lengths for the grout column and central steel shaft lengths or other site specific embedment depth requirements as may be appropriate for the site soil profiles.

### Inclination angle and location tolerance requirements.

### Load test procedures and failure criteria, if applicable.

### Copies of certified calibration reports for torque measuring equipment and load test measuring equipment to be used on the project. The calibrations shall have been performed within one year of the proposed Helicastpile installation starting date or as recommended by the equipment manufacturer.

### Documentation that the proposed grout mixture material and proportions can meet the requirements of this specification.

### Provide proof of insurance coverage as stated in the general specifications and/or contract.

# placement requirements

## Helicast piles shall be installed within 3 inches of the indicated plan location.

## Helicast pile shaft alignment shall be within 2 degrees of the inclination angle shown on the Plans.

## Helicast piles shall not have inclination angles (from vertical) greater than 10 degrees unless directed otherwise by the Owner.

## Top elevation of the Helicast piles shall be within 2 inches of the design vertical elevation.

# pile installation

## The Installing Contractor shall furnish and install all Helicast piles per the project Plans and approved pile design documentation. In the event of conflict between the project Plans and the approved pile design documentation, the Installing Contractor shall not begin construction on any affected items until such conflict has been resolved.

## The Installing Contractor shall conduct their construction operations in a manner to insure the safety of persons and property in the vicinity of the work. The Installing Contractor’s personnel shall comply with safety procedures in accordance with OSHA standards and any established project safety plan.

## The Owner shall request marking of underground utilities by an underground utility location service as required by law, and the Installing Contractor shall avoid contact with all marked underground facilities.

## The portion of the construction site occupied by the Installing Contractor, including equipment and material stockpiles, shall be kept reasonably clean and orderly.

## Installation of Helicastpiles may be observed by representatives of the Owner for quality assurance purposes. The Installing Contactor shall give the Owner at least 24 hours’ notice prior to the pile installation operations.

## The Helicast pile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project. The central steel shaft lead section shall be positioned at the appropriate site survey stake location as determined from the plan drawings.

## The Helicast pile sections shall be advanced into the soil in a continuous manner at a rate of rotation less than 25 revolutions per minute (rpm). Sufficient crowd shall be applied to advance the pile sections at a rate approximately equal to the pitch of the helix plate per revolution. The rate of rotation and magnitude of down pressure shall be adjusted for different soil conditions and depths. Extension sections shall be provided to obtain the required minimum overall length and minimum torsional resistance as shown on the project Plans.

## A lead displacement plate (cased or uncased) shall be located on the lead section central steel shaft just below the first extension coupling and shall be at least six inches above the top helix plate.

## The Installing Contractor shall have appropriate means and methods of measuring the grout mixture proportions, temperature and specific gravity during mixing operations.

## The grouting equipment used shall produce a grout that is free of lumps and undispersed cement.

## After installation of the central steel shaft lead section, a grout reservoir shall be constructed that allows placement and measurement of grout during advancement of the remaining pile sections. The grout reservoir shall be constructed such that the grout is easily placed, has sufficient volume for the grout column diameter and prevents contamination of the grout from the surrounding soils or other surface elements. Temporary steel or PVC casing or cardboard column form are acceptable grout reservoir materials. Prior to grout placement, remove any loose soil at the bottom of the reservoir and lightly compact the remaining bottom soil to minimize grout contamination.

## The grout mixture shall be gravity fed from the surface by continuous filling of the grout reservoir during installation until the final termination depth is achieved. The Installing Contractor shall record the installed grout volume at each pile location.

## Extension displacement plates (cased or uncased) shall be added at maximum seven foot intervals as the central steel shaft is advanced. The maximum spacing of displacement plates may need to be reduced if soft or collapsible soils are present in order to maintain the specified grout annulus diameter. During installation, the Installing Contractor shall compare actual grout volume to theoretical grout volume to determine if closer displacement plate spacings are required.

## Prior to connection of the central steel shaft sections, the top of shaft shall be “buttered” by placing non-shrink grout per the manufacturers installation guidelines to fill the void between the top of shaft and the upset coupling

## Steel or PVC casing shall be provided in accordance with the Plans. Where multiple casing sections are required, the casing lengths shall be the same as the central steel shaft extension lengths and shall be connected by casing extension plates. The casings shall be filled with grout as they are installed.

# termination criteria

## The minimum final torsional resistance and/or any required pile length and embedment depth criteria, as specified in the Pre-Construction Submittals, must be satisfied prior to terminating the pile installation. In the event any Helicast pile fails to meet these production quality control termination criteria, the following remedies may be suitable if authorized by the Owner:

### If the installation fails to meet the minimum torsional resistance criterion at the minimum embedment length:

#### Continue the installation to greater depths until the torsional resistance criterion is met, provided that, if a maximum length constraint is applicable, continued installation does not exceed said maximum length constraint, or

#### Demonstrate acceptable pile performance through pile load testing, or

#### Replace the pile with one having a different helix plate configuration. The replacement pile must not exceed any applicable maximum embedment length criteria and either: (A) be embedded to a length that places the last helix plate at least equal to its own diameter beyond the depth of the first helix plate of the replaced pile for compression only piles and at least three diameters beyond the first helix plate for tension piles. The reinstalled pile must also meet the minimum torsional resistance criterion; or (B) pass pile load testing criteria.

### If the torsional resistance during installation reaches the Helicastpile’s allowable torque rating prior to satisfaction of the minimum embedment length criterion:

#### Terminate the installation at the depth obtained and demonstrate acceptable pile performance through pile load testing, or

#### Replace the pile with one having a shaft with a higher torsional strength rating. The replacement pile must be installed to satisfy the minimum embedment length criterion. It must also be embedded to a length that places the last helix plate at least equal to its own diameter beyond the depth of the first helix plate of the replaced pile for compression only piles, and at least three diameters beyond the first helix plate for tension piles. The reinstalled pile must meet any applicable maximum embedment length requirements and it must meet the minimum final torsional resistance criterion, or

#### Replace the pile with one having a different helix plate configuration. The replacement pile must be installed to satisfy the minimum embedment length criterion. It must also be embedded to a length that places the last helix plate at least equal to its own diameter beyond the depth of the first helix plate of the replaced pile for compression only piles, and at least three diameters beyond the first helix plate for tension piles. The reinstalled pile must meet any applicable maximum embedment length requirements, and it must meet the minimum final torsional resistance criterion.

### If the installation reaches a specified maximum embedment length without achieving the minimum torsional resistance criterion:

#### If allowed, remove and reinstall the pile at a position at least three times the diameter of the largest helix plate away from the initial location. Original embedment length and torsional resistance criteria must be met. The pile repositioning may require the installation of additional Helicast piles with nominal loads adjusted for these spacing changes, or

#### Demonstrate acceptable pile performance through pile load testing, or

#### De-rate the load capacity of the Helicast pile based on default or site specific torque correlation factors and install additional piles as necessary. Additional piles must be installed at positions that are at least three times the diameter of the largest helix plate away from any other pile locations, or

#### Replace the pile with one having a different helix plate configuration. The replacement pile must be installed to satisfy the minimum and/or maximum embedment length criterion and it must meet the minimum final torsional resistance criterion.

### If a Helicast pile fails to meet the acceptance criteria in a pile load test:

#### Install a new Helicast test pile to a greater depth and installation torque and re-test; provided that, if a maximum embedment length constraint is applicable, continued installation will not exceed said maximum length constraint, or

#### Replace the pile with one having more and/or larger helix plates or a larger grout column. The replacement pile must be embedded to a length that places the last helix plate at equal to its own diameter beyond the depth of the first helix plate of the replaced pile without exceeding any applicable maximum embedment length requirements. The replacement pile must be re-tested, or,

#### De-rate the load capacity of the Helicast pile based on the results of the load test and install additional piles. Additional piles must be installed at positions that are at least three times the diameter of the largest helix plate away from any other pile locations.

### If a Helicast pile fails a production quality control criterion as described in this Section or for any reason other than described in this Section, any proposed remedy must be approved by the Owner prior to initiating its implementation at the project site.

### In the event that pile replacement is required due to any of the above conditions, it should be recognized that removal of the original pile may produce a volume of spoils that may not be acceptable for the project site conditions, or the owner. Further consideration must be given in the event that contaminated soils have been identified on the site that would require approved abatement methods for the spoils produced by removal of any piles. It should also be understood that any effort to remove and replace a pile in the original location should be performed prior to any partial setup of the grout that may hinder removal or replacement of the pile.

# installation record submittals

## The Installing Contractor shall provide the Owner copies of the individual Helicast pile installation records within 24 hours after each installation is completed. Formal copies shall be submitted within 30 days following the completion of the Helicast pile installation. These installation records shall include, but are not limited to, the following information:

### Date and time of installation

### Location of Helicast pile and pile identification number

### Installed Helicast pile components and configuration

### Grout mixture contents and proportions for each batch

### Grout mixture temperature and specific gravity during placement (if recorded)

### Time, date and pile location for any grout samples collected for laboratory testing

### Termination depth, pile head depth, grout column length and diameter, and total length of installed pile

### Actual inclination of the pile

### Final torsional resistance

### Calculated geotechnical capacity based on final torsional resistance

### Comments pertaining to interruptions, obstructions, or other relevant information

# field Load testing

## If field compression or tension load testing is required, the Installing Contractor shall furnish all labor, equipment and pre-production Helicast pile components necessary to accomplish the testing as shown in 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. Helicast pile testing shall be in general accordance with the quick test methods of ASTM D1143 for compression load testing and ASTM D3689 for tension load testing. The load testing must also meet the following criteria:

### Failure criteria shall be in accordance with AC358 and is when plunging occurs or when the net deflection exceeds 10% of the average helix plate diameter, whichever occurs first.

### An alignment load equal to 5% of the anticipated failure load or maximum anticipated test load may be applied prior to the start of the test to take out slack in the load test frame.

### Loading increments shall be performed at 5% of the anticipated failure load or maximum anticipated test load with a minimum hold time of 4 minutes at each increment.

### Upon completion of the maximum test load hold increment, the pile shall be unloaded in 5 to 10 even decrements with minimum hold times of 4 minutes at each decrement.

## Installing Contractor shall provide the Owner copies of raw field test data within 24 hours after the completion of each load test. Formal test reports shall be submitted within 30 days following test completion. Formal test reports shall include the following information:

### Name of project and Installing Contractor’s representative(s) present during load testing

### Name of manufacturer’s representative(s) present during load testing, if any

### Name of third party test agency and personnel present during load testing, if any

### Date, time, duration and type of load test

### Unique test identifier and map showing the test pile location

### Helicast test pile installation records per Section 13 of this specification

### Calibration records for applicable pile installation and test equipment

### Tabulated test results including cumulative pile head movement, loading increments and decrements and hold times

### Plots showing load versus deflection for each loading/unloading interval

# Cleanup

## Within one week of completion of the work, the Installing Contractor shall remove any and all material, equipment, tools, debris or other items belonging to the Installing Contractor or used under the Installing Contractor’s direction.