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ICC-ES Evaluation Report

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DIVISION: 31 00 00—EARTHWORK
Section: 31 63 00—Bored Piles

REPORT HOLDER:

GEOTECH ENTERPRISES, INC.

EVALUATION SUBJECT:

GEOTECH ENTERPRISES 4.5-INCH HSS ROUND HELICAL PILE FOUNDATION SYSTEM

1.0 EVALUATION SCOPE

Compliance with the following codes:

2015, 2012 and 2009 *International Building Code*® (IBC)

Properties evaluated:

Structural and geotechnical

2.0 USES

Geotech Enterprises 4.5-inch HSS Round Helical Pile Foundation System is used to form deep foundations for new structures, and is designed to transfer compression, tension, and lateral loads from supported structures to soil bearing strata suitable for the applied loads. Deep foundations for new construction are obtained by attaching the helical piles to new construction brackets (direct-load brackets) that are embedded in concrete pile caps or grade beams, which support compression, tension and lateral loads.

3.0 DESCRIPTION

3.1 General:

The Geotech Enterprises 4.5-inch HSS Round Helical Pile Foundation System consists of a helical pile connected to a bracket that is in contact and connected with the load-bearing foundation of a supported structure. Each helical pile consists of a central lead shaft with one or more helical-shaped steel bearing plates, extension shafts, and shaft couplings that connect multiple shaft sections. The shafts with helix bearing plates are screwed into the ground until a suitable soil or bedrock bearing stratum is reached. The bracket is then installed to connect the pile to the concrete foundation of the supported structure.

3.2 System Components:

3.2.1 Helical Pile Lead Shafts and Extensions: The helical pile lead shafts consist of a central steel shaft of 4.5-inch-outside-diameter (114 mm) steel round structural tubing (HSS) having a nominal shaft thickness of 0.337 inch (8.6 mm) and one or more helical-shaped bearing plates (discs) shop-welded to the shaft. The helical plates are 10, 12, 14 or 16 inches (254, 305, 356 or 406 mm) in diameter, and are cut from ½-inch-thick (12.7 mm) steel plate. The helical plates have a 3.75-inch (95 mm) pitch, which is the distance between the leading and trailing edges. The helical lead shafts come in 7, 10.5, 14 and 21-foot-long (2.13, 3.20, 4.27 and 6.40 m) sections. Figure 1 illustrates a typical helical pile assembly. The extensions have shafts similar to the helical lead shaft section, except without helical plates. The extensions come in 7, 10.5, 14 and 21-foot-long (2.13, 3.20, 4.27 and 6.40 m) sections. The helical pile lead shaft and extensions are connected together at the job site by using a steel coupler with bolts shown in Figure 1. The coupler is made from steel round HSS with an outside diameter of 5.56 inches (141 mm) having a nominal wall thickness of 0.375 inch (9.5 mm). The coupler is shop-welded to one end of the extension section, and then fitted over the lead shaft or other extension sections. Connection of the extension sections to the lead shaft or other extension sections is made by two (2) one-inch-diameter (25.4 mm) through-bolt connections as shown in Figure 1.

3.2.2 New Construction Bracket: This bracket, as shown in Figure 2, is shop-welded and is used in new construction where the steel bearing plate of the bracket is cast into the new concrete foundations; such as, concrete footings, grade beams, or pile caps. The brackets can transfer compression, tension and lateral loads between the pile and the supported concrete foundation. The new construction bracket is a $^{3}/_{4}$-inch-thick-by-10-inch-wide-by-10-inch-long (19.1 by 254 by 254 mm) bearing plate shop-welded to a 5.563-inch (141 mm) outside diameter steel round HSS sleeve having a nominal wall thickness of 0.375-inch (9.5 mm). The steel round HSS sleeve is predrilled with two $1^{1}/_{16}$-inch-diameter (27mm) through-holes. The bracket is field-attached to the helical pile shaft with two 1-inch-diameter (25.4 mm) through-bolts for resisting tension forces.

3.3 Material Specifications:

3.3.1 Helical Plates: The steel plates conform to ASTM A36, having a minimum yield strength of 36 ksi (248 MPa) and a minimum tensile strength of 58 ksi (400 MPa). The plates may be bare steel or galvanized steel in accordance with ASTM A123.

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3.3.2 Helical Pile Shafts, Extensions and Couplers: The shafts, extensions and couplers are fabricated from steel round HSSs that conform to ASTM A500, Grade B, having a minimum yield strength of 42 ksi (290 MPa) and a minimum tensile strength of 58 ksi (400 MPa). The shafts, extensions and couplers may be bare steel or galvanized steel in accordance with ASTM A123.

3.3.3 New Construction Bracket:

3.3.3.1 Plates: The steel plates used to fabricate the bracket bearing plates conform to ASTM A36, having a minimum yield strength of 36 ksi (248 MPa) and a minimum tensile strength of 58 ksi (400 MPa). The plates may be bare steel or galvanized steel in accordance with ASTM A123.

3.3.3.2 Sleeves: The sleeve of the new construction bracket is carbon steel round HSS conforming to ASTM A500, Grade B, with a minimum yield strength of 42 ksi (290 MPa) and a minimum tensile strength of 58 ksi (400 MPa). The sleeves may be bare steel or galvanized steel in accordance with ASTM A123.

3.3.4 Bolts and Nuts: The heavy hex structural bolts, used to connect the helical pile lead shaft to the extension shafts or between two extension shafts, and to connect the helical pile shaft to the new construction bracket sleeve, conform to ASTM A354, Grade BD, with a minimum yield strength of 130 ksi (896 MPa) and a minimum tensile strength of 150 ksi (1034 MPa). The matching heavy hex nuts conform to ASTM A563 Grade DH. Bolts and nuts may be plain or zinc-coated in accordance with ASTM A354.

4.0 DESIGN AND INSTALLATION

4.1 Design:

Structural calculations and drawings, prepared by a registered design professional, must be submitted to the code official for each project, based on accepted engineering principles, as described in IBC Section 1604.4 and must conform to IBC Section 1810. The load values (capacities) shown in this report are based on the Allowable Strength Design (ASD) method described in IBC Section 1602 and AISC 360 Section B3.4. The engineering analysis must address helical foundation system performance related to structural and geotechnical requirements. The calculations must address the ability (considering strength and stiffness) of the supported foundation and structure to transmit the applied loads to the helical foundation system and the ability of the helical piles and surrounding soils to support the loads applied by the supported foundation and structure. The structural analysis must consider all applicable internal forces (shear, bending moments and torsional moments, if applicable) due to applied loads, structural eccentricity and maximum span(s) between helical foundations. The result of the analysis and the structural capacities must be used to select a helical foundation system. The minimum pile embedment into soil for various loading conditions must be included based on the most stringent requirements of the following: engineering analysis, tested conditions described in this report, site-specific geotechnical investigation report, and site-specific load tests, if applicable. For helical foundation systems subject to combined lateral and axial (compression or tension) loads, the allowable strength of the shaft under combined loads must be determined using the interaction equation prescribed in Chapter H of AISC 360.

The geotechnical analysis must address the suitability of the helical foundation system for the specific project. It must address the center-to-center spacing of the helical pile, considering both effects on the supported foundation and structure, and group effects on the pile capacity due to pile-soil interaction. The analysis must include estimates of the axial tension and/or compression capacities of the helical piles, whatever is relevant for the project, and the expected total and differential foundation movements due to single pile or pile group, as applicable.

A soils investigation report (geotechnical report) must be submitted to the code official as part of the required submittal documents, prescribed in Section 107 of the IBC, at the time of permit application. The geotechnical report must include, but is not limited to, all of the following:

1. A plot showing the location of the soil investigation.
2. A complete record of the soil boring and penetration test logs and soil samples.
3. A record of soil profile.
4. Information on groundwater table, frost depth and corrosion-related parameters, as described in Section 5.5 of this report.
5. Soil properties, including those affecting the design such as support conditions of the piles.
6. Soil design parameters, such as ultimate bearing capacity as required by Section 4.1.4; soil deformation parameters; and relative pile support conditions as defined in IBC Section 1810.2.1.
7. Confirmation of the suitability of helical foundation systems for the specific project.
8. Recommendations for design criteria, including but not limited to: mitigation of effects of differential settlement and varying soil strength; and effects of adjacent loads.
9. Recommended center-to-center spacing of helical pile foundations, if different from spacing noted in Section 5.11 of this report; and reduction of allowable loads due to the group action, if necessary.
10. Field inspection and reporting procedures (to include procedures for verification of the installed bearing capacity, when required).
11. Load test requirements.
12. Any questionable soil characteristics and special design provisions, as necessary.
13. Expected total and differential settlement.
14. The axial compression, axial tension and lateral load soil capacities if values cannot be determined from this evaluation report.

The allowable axial compressive or tensile load of the helical pile system must be based on the least of the following in accordance with IBC Section 1810.3.3.1.9:

- Sum of the areas of the helical bearing plates times the ultimate bearing capacity of the soil or rock comprising the bearing stratum divided by a safety factor of at least 2 (Method 1 described in Section 4.1.4). This capacity will be determined by a registered design professional based on site-specific soil conditions.
- Allowable capacity determined from well-documented correlations with installation torque. Section 4.1.4 of this report includes torque correlation factors used to establish pile axial load capacities based on documented correlations.
- Allowable capacity predicted by dividing the ultimate capacity determined from load tests by a safety factor of at least 2.0 (Method 2 described in Section 4.1.4). This capacity will be determined by a registered design professional for each site-specific condition.

- Allowable axial capacity of pile shaft. Section 4.1.2 of this report includes pile shaft capacities.
- Allowable axial capacity of pile shaft couplings. Section 4.1.2 of this report includes pile shaft coupling capacities.
- Sum of the allowable axial capacity of helical bearing plates affixed to pile. Section 4.1.3 of this report includes helical plate axial capacities.
- Allowable axial capacity of the bracket. Section 4.1.1 of this report includes bracket capacities.

4.1.1 Bracket Capacity: The concrete foundation must be designed and justified to the satisfaction of the code official with due consideration to the eccentricity of applied loads, including reactions provided by the brackets, acting on the concrete foundation, and all applicable limit states. Only localized limit states of supporting concrete foundation, including bearing and punching shear, have been evaluated in this evaluation report. Other limit states are outside the scope of this evaluation report and must be determined by the registered design professional. Reference Table 1 for the allowable bracket capacity ratings.

4.1.2 Pile Shaft Capacity: The top of shafts must be braced as described in IBC Section 1810.2.2, and the supported foundation structures such as concrete footings and concrete pile caps are assumed to be adequately braced such that the supported foundation structures provide lateral stability for the pile systems. In accordance with IBC Section 1810.2.1, any soil other than fluid soil must be deemed to afford sufficient lateral support to prevent buckling of the systems that are braced, and the unbraced length is defined as the length of piles standing in air, water, or in fluid soils plus an additional 5 feet (1524 mm) when embedded into firm soil or an additional 10 feet (3048 mm) when embedded into soft soil. Firm soils must be defined as any soil with a Standard Penetration Test blow count of five or greater. Soft soils must be defined as any soil with a Standard Penetration Test blow count greater than zero and less than five. Fluid soils must be defined as any soil with a Standard Penetration Test blow count of zero [weight of hammer (WOH) or weight of rods (WOR)]. Standard Penetration Test blow count must be determined in accordance with ASTM D1586. The shaft capacity of the helical foundation systems in air, water, and fluid soils must be determined by a registered design professional. Each pile includes a lead section, one or more extension sections, and couplings connecting lead section to extension section, or connecting two extension sections together. The allowable stress design (ASD) shaft capacities are shown in Table 3.

The elastic shortening/lengthening of the pile shaft will be controlled by the strength and section properties of the 4.5-inch-diameter (114 mm) shaft and coupler sections as shown in Table 4.

4.1.3 Helical Plate Capacity: Up to three helix plates can be placed on a single helical pile. The helix plates are spaced three times the diameter of the lower plate starting at the toe of the lead section. For helical piles with more than one helix, the allowable helix capacity for the helical pile foundation systems supporting axial compression and tension loads may be taken as the sum of the least allowable capacity of each individual helix. The helical plate ASD axial capacities are as follows:

- 10-inch (254 mm) diameter: ±49,200 lbf (219 kN)
- 12-inch (305 mm) diameter: ±48,226 lbf (215 kN)
- 14-inch (355 mm) diameter: ±41,939 lbf (187 kN)
- 16-inch (406 mm) diameter: ±45,293 lbf (201 kN)

± means the ASD values are applicable to axial tension and axial compressive loads

4.1.4 Soil Capacity: The allowable axial compressive or tensile soils capacity of helical piles must be determined by a registered design professional in accordance with a site-specific geotechnical report, as described in Section 4.1, combined with the individual helix bearing method (Method 1), or from field loading tests conducted under the supervision of a registered design professional (Method 2). For either Method 1 or Method 2, the predicted axial load capacities must be confirmed during the site-specific production installation, such that the axial load capacities predicted by the torque correlation method are equal to or greater than what is predicted by Method 1 or 2, described above.

With the individual bearing method, the total ultimate axial load capacity is determined as the sum of the individual areas of the helical bearing plates times the ultimate bearing capacity of the soil or rock comprising the respective bearing stratum for helix plates.

The design allowable axial load must be determined by dividing the total ultimate axial load capacity predicted by either Method 1 or 2, above, divided by a safety factor of at least 2.

The torque correlation method must be used to predict the ultimate capacity (Q_{ult}) of the pile and the final installation torque (Equation 1). A factor of safety of at least 2 must be applied to the calculated ultimate capacity to determine the allowable soil capacity (Q_{all}) of the pile (Equation 2), as follows:

$$Q_{ult} = K_t\, T \qquad \text{(Equation 1)}$$

$$Q_{all} = 0.5\, Q_{ult} \qquad \text{(Equation 2)}$$

where:

K_t = Torque correlation factor of 5.5 ft^{-1} (18.0 m^{-1}) for axial compression application of 4.5-inch-diameter (114 mm) pile. Torque correlation factor of 5.0 ft^{-1} (16.4 m^{-1}) for axial tension applications of 4.5-inch-diameter (114 mm) pile.

T = Final installation torque in ft-lbf or N-m. The final installation torque is defined as the last torque reading taken during the pile installation, using, for example, the torque reading instruments connected to the installation equipment.

The axial compression and tension capacities of the 4.5-inch-diameter helical pile must not exceed the following:

- 120 kips (534 kN) for ultimate axial compression capacity;
- 60 kips (267 kN) for allowable axial compression capacity;
- 110.5 kips (492 kN) for ultimate axial tension capacity;
- 55 kips (245 kN) for allowable axial tension capacity.

The allowable lateral soil capacity of the pile is 1.768 kips (7.9 kN) based on field testing of the 4.5-inch-diameter helical pile with a single 10-inch-diameter (254 mm) helix plate installed in a firm clay soil, having an average standard penetration test blow count of 20 blows per foot, at a minimum embedment of 15 feet (4.57 m). For soil conditions other than firm clay, the lateral capacity of the pile must be determined by a registered design professional.

4.2 Installation:

The Geotech Enterprises Helical Pile Foundation Systems must be installed by certified and trained pile installers approved by Geotech Enterprises. The Geotech Enterprises helical pile foundation systems must be installed in accordance with this section (Section 4.2), the manufacturer's installation instructions, IBC Section 1810.4.11, and approved site-specific construction documents. In case of a conflict, the most stringent requirement governs. For tension application, the helical pile must be installed such that the minimum depth from the ground surface to the uppermost helix is 12*D*, where *D* is the diameter of the largest helix. All field-cut or drilled pilings must be protected from corrosion as recommended by the registered design professional and approved by the code official.

4.2.1 Helical Pile Installation with New Construction Bracket: The installation of the bracket to support cast-in-place concrete foundations must be in accordance with the site-specific construction documents and calculations prepared by a registered design professional. Installation must conform to the geotechnical engineering reports and this evaluation report. New construction brackets must be placed over the top of the helical piles. The top of the pile elevation must be established and must be consistent with the specified elevation. If necessary, the top of the pile may be cut off level to the required length in accordance with the manufacturer's instructions and AISC 360 requirements so as to ensure full, direct contact (bearing) between the top of the pile shaft and the bracket. Two 1-inch-diameter (25.4 mm) bolts and matching nuts as described in Section 3.3.4 of this report must be installed. The bolts must be snug-tightened as defined in Section J3 of ASC 360. The embedment and edge distance of the bracket into the concrete foundation must be as described in the approved plans and as indicated in Table 1 of this report. The concrete foundation must be cast around the bracket in accordance with the approved construction documents.

4.3 Special Inspection:

Continuous special inspection in accordance with 2015 and 2012 IBC Section 1705.9 (2009 IBC Section 1704.10) is required for installation of the Geotech Enterprises Helical Pile foundation system. Where on-site welding is required, special inspection in accordance with 2015 and 2012 IBC Section 1705.2 (2009 IBC Section 1704.3) is required. Items to be confirmed by the special inspector must include, but are not necessarily limited to, the following:

1. Verification of the product manufacturer and the manufacturer's certification of the installers.
2. Verification of product types, and configurations for helical pile lead shaft sections, extensions, brackets, bolts/threaded rods, nuts, washers, and torque as specified in this report and the construction documents.
3. Installation procedures for helical pile shaft, installation equipment used, and the Geotech Enterprises installation instructions.
4. Anticipated and actual piling depth.
5. Required target installation torque of piles and depth of the helical foundation system.
6. Inclination and position of helical piles; top of pile extension in full contact with bracket; tightness of all bolts; and evidence that the helical pile foundation systems are installed by an approved Geotech Enterprises installer.
7. Other pertinent installation data as required by the registered design professional in responsible charge and compliance of installation with the approved geotechnical report, construction documents, and this evaluation report.

5.0 CONDITIONS OF USE

The Geotech Enterprises 4.5-inch HSS Round Helical Pile Foundation System described in this report comply with, or are suitable alternatives to what is specified in, those codes indicated in Section 1.0 of this report, subject to the following conditions:

5.1 The helical pile system is manufactured, identified, and installed in accordance with this report, the approved construction documents, and the manufacturer's published installation instructions, which must be available at the jobsite at all times during installation. In the event of a conflict between this report, the approved construction documents and the manufacturer's published installation instructions, the most restrictive governs.

5.2 The helical pile system has been evaluated for support of structures assigned to Seismic Design Categories (SDCs) A, B and C in accordance with IBC Section 1613. Helical foundation systems that support structures assigned to SDC D, E or F, or which are located in Site Class E or F, are outside the scope of this report and are subject to the approval of the building official, based upon submission of a design in accordance with the code by a registered design professional.

5.3 Installation of the helical pile system must be limited to support of uncracked normal-weight concrete, as determined in accordance with the applicable code.

5.4 The new construction bracket must be used only to support structures that are laterally braced as defined in IBC Section 1810.2.2 and Section 4.1.2 of this report.

5.5 The helical pile must not be used in conditions that are indicative of a potential pile deterioration or corrosion situation as defined by the following: (1) soil resistivity of less than 1000 ohm-cm; (2) soil pH less than 5.5; (3) soils with high organic content; (4) soil sulfate concentrations greater than 1000 ppm; (5) soils located in landfills; or (6) soil containing mine waste.

5.6 Zinc-coated steel and bare steel components must not be combined in the same system. All helical foundation components must be galvanically isolated from concrete reinforcing steel, building structural steel, or any other metal building components.

5.7 The helical piles must be installed vertically into the ground with a maximum allowable angle of inclination of 1 degree. To comply with the requirements found in IBC Section 1810.3.1.3, the superstructure must be designed to resist the effects of helical pile eccentricity.

5.8 Special inspection is provided in accordance with Section 4.3 of this report.

5.9 Engineering calculations and drawings, in accordance with recognized engineering principles and design parameters as described in IBC Section 1604.4, and in compliance with Section 4.1 of this report, are prepared by a registered design professional and approved by the building official.

5.10 A soils investigation for each project site must be provided to the building official for approval in accordance with Section 4.1.1 of this report.

5.11 In order to avoid group efficiency effects, an analysis prepared by a registered design professional must be submitted where the center-to-center spacing of axially loaded helical piles is less than three times the diameter of the largest helix plate at the depth of bearing. An analysis prepared by a registered design professional must also be submitted where the center-to-center spacing of laterally loaded helical piles is less than eight times the least horizontal dimension of the pile shaft at the ground surface. For laterally loaded piles, spacing between helical plates must not be less than 3*D*, where *D* is the diameter of the largest helical plate measured from the edge of the helical plate to the edge of the helical plate of the adjacent helical pile; or 4*D*, where the spacing is measured from the center-to-center of the adjacent helical pile plates.

5.12 Evaluation of compliance with IBC Section 1810.3.11.1 for buildings assigned to Seismic Design Category (SDC) C, and with IBC Section 1810.3.6 for all buildings, is outside the scope of this evaluation report. Such compliance must be addressed by the registered design professional for each site, and the work of the design professional is subject to approval by the code official.

5.13 When using the alternative basis load combinations prescribed in IBC Section 1605.3.2, the allowable stress increases permitted by material chapters of the IBC or the referenced standards are prohibited.

5.14 Settlement of the helical pile is outside the scope of this evaluation report and must be determined by a registered design professional as required in IBC Section 1810.2.3.

5.15 The adequacy of the concrete foundations that are supported by the Geotech Enterprises helical pile system must be verified by a registered design professional, in accordance with applicable code provisions and Section 4.1.1 of this report, and such verification is subjected to approval of the code official.

5.16 The applied loads must not exceed the allowable capacities described in Section 4.1 of this report.

5.17 Geotech Enterprises 4.5-inch HSS Round Helical Pile Foundation System is manufactured in Long Island City, New York, under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Helical Pile Systems and Devices (AC358), dated October 2016.

7.0 IDENTIFICATION

7.1 The Geotech Enterprises Helical Pile Foundation System components described in this report are identified by a tag or label bearing the name and address of Geotech Enterprises, Inc., a product description, and the evaluation report number (ESR-3742).

7.2 The report holder's contact information is the following:

GEOTECH ENTERPRISES, INC.
38-23 24TH STREET
LONG ISLAND CITY, NEW YORK 11101
(718) 267-0707
www.geotechnyc.com
geotechnyc@gmail.com

TABLE 1—NEW CONSTRUCTION BRACKET (BARE AND GALVANIZED STEEL) ALLOWABLE LOAD CAPACITIES [4,5,6] (kips)

COMPRESSION[1]	TENSION[2]	LATERAL[3]
60[7]	60[7]	3.1

For **SI:** 1 kip = 1000 lbf = 4.45 kN.

[1]The allowable compressive load capacity is based on the least of the following limit states: mechanical strength of the steel bracket, concrete punching shear capacity, and concrete bearing strength. The allowable load capacities have been determined assuming that minimum reinforcement has been provided as specified by ACI 318-14 Section 9.6.1.2 and ACI 318-11 Section 10.5.1. The minimum embedment of the bracket is 14.25 inches. The embedment depth is the distance between the top of the bracket bearing plate to the top of the concrete beam. End of helical pile shaft must be fully bearing on the bracket bearing plate. The concrete footing must have a minimum width of 37 inches and a minimum depth of 19 inches, and must be normal-weight concrete having a minimum compressive strength of 3000 psi.

[2]The allowable tensile load capacity is based on the least of the following limit states: mechanical strength of the steel bracket, punching shear capacity and concrete bearing strength. The allowable load capacities have been determined assuming that minimum reinforcement has been provided as specified by ACI 318-14 Section 9.6.1.2 and ACI 318-11 Section 10.5.1. The minimum embedment of the bracket is 15.50 inches. The embedment depth is the distance between the bottom of the bracket bearing plate to the bottom of the concrete beam. The capacity is based using two 1-inch through bolts as described in Section 3.3.4 of this report. The concrete footing must have a minimum width of 37 inches and a minimum depth of 19 inches, and must be normal-weight concrete having a minimum compressive strength of 3000 psi.

[3]The allowable lateral capacity is based on the least of the following limit states: mechanical strength of the steel bracket, concrete breakout strength computed in accordance with ACI 318, and bracket bearing strength on unreinforced concrete computed in accordance with ACI 318. The bracket must be installed with a minimum embedment depth of 4 inches measured from the bottom of the bracket bearing plate to the bottom of the concrete footing, a minimum edge distance of 6 inches measured from the bracket bearing plate edge to the concrete footing edge or end, and a minimum of 10 inches of concrete cover measured from the top of the bracket bearing plate to the top of concrete footing. The concrete footing must have a minimum width of 22 inches and a minimum depth of 16 inches, and must be normal-weight concrete having a minimum compressive strength of 3000 psi.

[4]The capacities listed in Table 1 assume the pile foundation system is sidesway braced per IBC Section 1810.2.2 and Section 4.1.2 of this report.

[5] Allowable capacities are based on bare steel accounting for loss of 0.036-inch steel thickness in accordance with Section 3.9 of AC358 for a 50-year service life.

[6] Allowable capacities are based on galvanized steel accounting for loss of 0.013-inch steel thickness in accordance with Section 3.9 of AC358 for a 50-year service life.

[7]Capacity based on limit in Section 3.8 of AC358.

TABLE 2—MECHANICAL PROPERTIES AFTER CORROSION LOSS OF 4$^1/_2$-INCH-DIAMETER HELICAL PILE SHAFT

PARAMETER	BARE[1]	GALVANIZED[2]
	VALUE	
Steel yield strength, F_y	42 ksi	
Steel ultimate strength, F_u	58 ksi	
Modulus of Elasticity, E	29,000 ksi	
Design wall thickness (inch)	0.277	0.307
Outside diameter (inch)	4.464	4.494
Inside diameter (inch)	3.909	3.879
Cross-sectional area (inch^2)	3.65	4.04
Moment of Inertia, I (inch^4)	8.03	8.90
Radius of Gyration, r (inch)	1.48	1.48
Section Modulus, S (inch^3)	3.60	3.96
Plastic Section Modulus, Z (inch^3)	4.87	5.39

For SI: 1 inch= 25.4 mm; 1 ksi= 6.89 MPa.

[1]Dimensional properties are based on 0.337-inch thick bare steel accounting for loss of 0.036 inch steel thickness in accordance with Section 3.9 of AC358 for a 50-year service life.

[2] Dimensional properties are based on 0.337-inch thick galvanized steel accounting for loss of 0.013 inch steel thickness in accordance with Section 3.9 of AC358 for a 50-year service life.

TABLE 3—ALLOWABLE DESIGN CAPACITIES OF 4.5-INCH-DIAMETER HELICAL PILE SHAFT AND EXTENSIONS[3,4,5] (kips)

PILE FINISH CONDITION	UNBRACED SHAFT LENGTH, L_U (ft)[1]	ALLOWABLE SHAFT AND EXTENSION CAPACITIES				
		Compression (kips)		Tension (kips)	Lateral Shear (kips)	Bending Moment (k-ft)
		0 Coupler	1 Coupler[2]			
Bare[5]	0	60.0[7]	60.0[7]	42.4	26.6	10.21
	5	52	32.7			
	10	34.1	24.6			
Galvanized[6]	0	60.0[7]	60.0[7]	48	29.5	11.31
	5	57.6	36.2			
	10	37.8	27.2			

For **SI:** 1 ft= 0.305 m; 1 kip = 1000 lbf = 4.45 kN.

[1]L_u= Total unbraced pile length per 2015, 2012 and 2009 IBC Section 1810.2.1, including the length in air, water or in fluid soils, and the embedment length into firm or soft soil (non-fluid soil). kL_u= total effective unbraced length of the pile, which is assumed 4 ft for a L_u = 5 ft, and 8 ft for L_u = 10 ft based on assumed an effective length factor, k, of 0.8, where kL_u=0 represent a fully braced condition, in that the total pile length is fully embedded in firm or soft soil and the supported structure is braced in accordance with 2015, 2012 and 2009 IBC Section 1810.2.2 as noted in Section 4.1.2 of this report.

[2] Number of couplings within L_u.

[3] Capacities based on the helical pile system installed vertical or plumb with a one-degree tolerance from vertical. The capacities are also based on the assumption that the pile shaft and extensions are concentrically loaded.

[4] Capacities based on two 1-inch diameter bolts with matching nuts complying with Section 3.3.4. The bolt threads are included in the shear plane.

[5] Allowable capacities are based on bare steel accounting for loss of 0.036-inch steel thickness in accordance with Section 3.9 of AC358 for a 50-year service life.

[6] Allowable capacities are based on galvanized steel accounting for loss of 0.013-inch steel thickness in accordance with Section 3.9 of AC358 for a 50-year service life.

[7]Capacity based on limit in Section 3.8 of AC358.

TABLE 4—ELASTIC SHORTENING/ELONGATION OF 4.5-INCH-DIAMETER HELICAL PILE SYSTEM

PILE FINISH CONDITION	Elastic shortening at Maximum Allowable Compression Load		Elastic Shortening at Maximum Allowable Tension Load		Slip in Coupler at Maximum Allowable Tension Load (inch)
	Shaft (inch per foot length of shaft)	Coupler (inch per coupler)	Shaft (inch per foot length of shaft)	Coupler (inch per coupler)	
Bare[1]	0.007	0.005	0.005	0.0034	0.161
Galvanized[2]	0.006	0.0044	0.004	0.0035	0.131

For **SI:** 1 inch=25.4; 1 foot= 0.305 m.

[1] Deformation values are based on bare steel accounting for loss of 0.036-inch steel thickness in accordance with Section 3.9 of AC358 for a 50 year service life.

[2] Deformation values are based on galvanized steel accounting for loss of 0.013-inch steel thickness in accordance with Section 3.9 of AC358 for a 50-year service life.

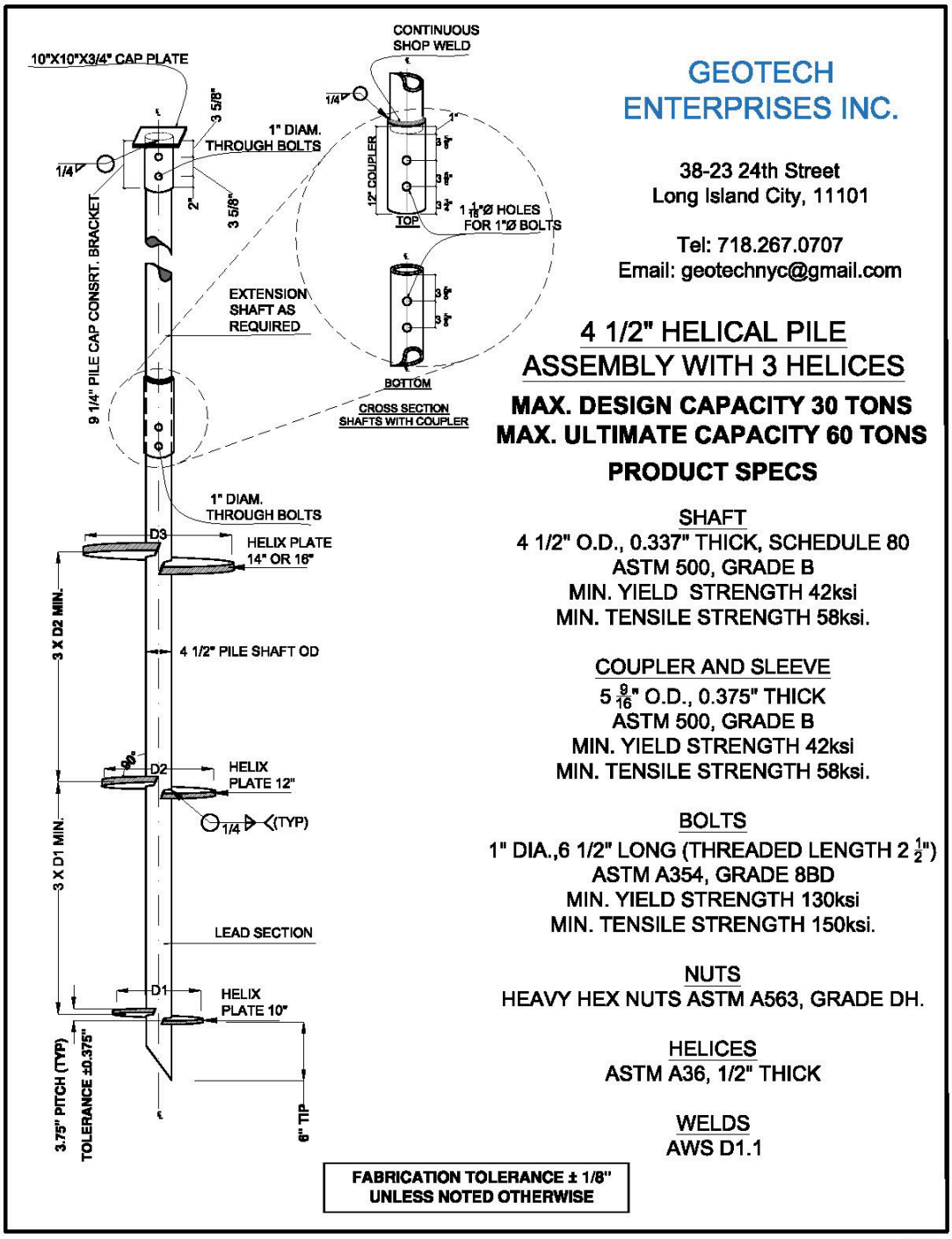
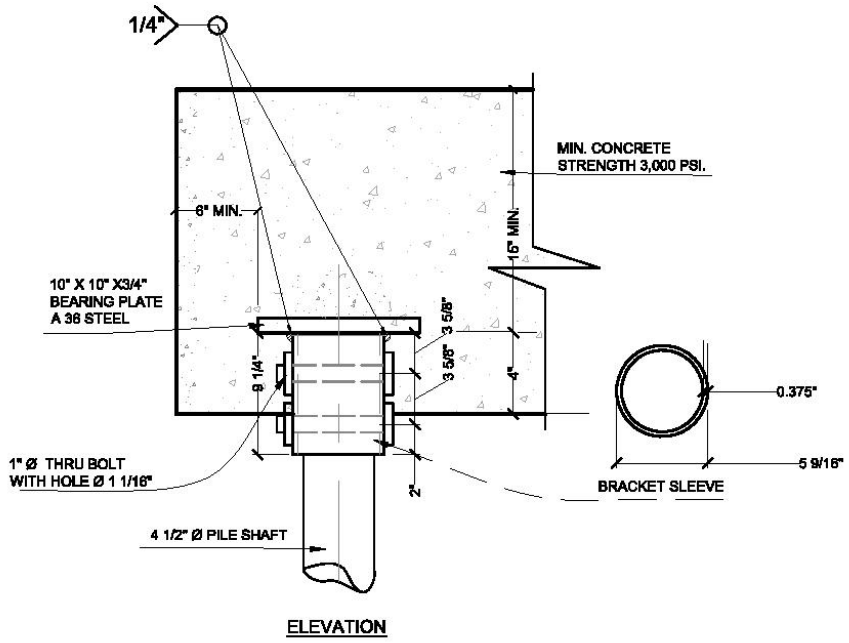
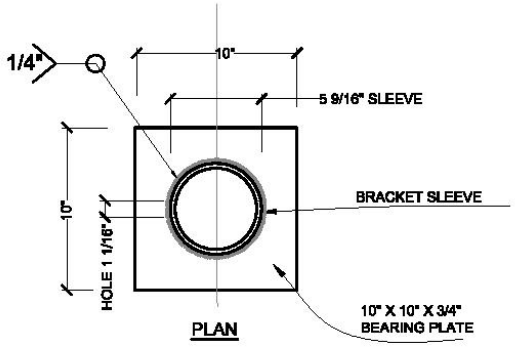


FIGURE 1—HELICAL PILE SYSTEM

NEW CONSTRUCTION BRACKET, DIRECT LOAD BRACKET



ELEVATION



PLAN

NOTE: FABRICATION TOLERANCE IS ± 1/8".

NEW CONSTRUCTION BRACKET

FOR 41/2" DIAMETER SHAFT

GEOTECH ENTERPRISES, INC.
38-23 24TH. STREET,
LONG ISLAND CITY, N.Y. 11101
TEL: 718 482-0738, 718 482-9238,
ADMINISTRATIVE OFFICE
34-01 BROADWAY
TEL. 718 726-1527
Email: geotechNYC@gmail.com
DATE: 2 / 11 / 16

FIGURE 2

DIVISION: 31 00 00—EARTHWORK
Section: 31 63 00—Bored Piles

REPORT HOLDER:

GEOTECH ENTERPRISES, INC.

EVALUATION SUBJECT:

GEOTECH ENTERPRISES 4.5-INCH HSS ROUND HELICAL PILE FOUNDATION SYSTEM

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Geotech Enterprises Helical Pile Foundation System, described in ICC-ES evaluation report ESR-3742, have also been evaluated for compliance with the code noted below.

Applicable code edition:

2014 *Florida Building Code—Building*

2.0 CONCLUSIONS

The Geotech Enterprises Helical Pile Foundation System, described in Sections 2.0 through 7.0 of the evaluation report ESR-3742, comply with the 2014 *Florida Building Code—Building*, provided the design and installation are in accordance with the *International Building Code®* provisions noted in the evaluation report and the following conditions apply:

- Design wind loads must be based on Section 1609 of the 2014 *Florida Building Code—Building*.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the 2014 *Florida Building Code—Building*, as applicable.

Use of the Geotech Enterprises Helical Pile Foundation System for compliance with the High-Velocity Hurricane Zone provisions of the 2014 *Florida Building Code—Building* has not been evaluated, and is outside the scope of this evaluation report.

For products falling under Florida Rule 9N-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued May 2023.

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