ICC-ES Evaluation Report

ESR-3969

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Subject to renewal January 2025

This report also contains:

- CBC Supplement

- FBC Supplement

DIVISION: 31 00 00 — EARTHWORK Section: 31 63 00 — Bored Piles	REPORT HOLDER: PIERTECH SYSTEMS, LLC	EVALUATION SUBJECT: PIERTECH HELICAL FOUNDATION SYSTEMS

1.0 EVALUATION SCOPE

Compliance with the following code:

- 2021, 2018, 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2021, 2018, 2015, 2012 and 2009 *International Residential Code*® (IRC)

Properties evaluated:

- Structural
- Geotechnical

2.0 USES

2.1 IBC:

The PierTech helical foundation systems are used either to underpin foundations of existing structures or to form deep foundations for new structures; and are designed to transfer compression, tension and lateral loads from the supported structure to suitable soil bearing strata. Underpinning of existing foundations is generally achieved by attaching the helical piles to the side-load brackets, which support only compression loads. Deep foundations for new construction are generally obtained by attaching the helical piles to direct-load brackets that are embedded in concrete pile caps, footings, or grade beams, which support tension, compression, and lateral loads.

2.2 IRC:

Under the IRC, Piertech Helical Foundation Systems may be used as an alternative foundation system supporting light-frame construction, exterior porch deck, elevated walkway and stairway construction and accessory structures.

3.0 DESCRIPTION

3.1 General:

The PierTech helical foundation systems consist of a lead shaft section with one or more helical-shaped steel bearing plates (or helices), extension shaft section(s), couplings that connect multiple shaft sections, and a bracket that allows for attachment to the supported structures. The shafts with helix bearing plates are screwed into the ground by application of torsion and the shaft is extended until a desired depth or 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. See Figure 5 of this report.

3.2 System Components:

3.2.1 Helical Piles: The PierTech helical pile lead shaft sections consist of one or more (up to four) helical-shaped circular steel plates factory-welded to the lead steel shaft. The extension shaft sections have shafts similar to the lead shaft sections, except without the helical plates. The depth of the helical piles in soil is typically extended by adding one or more steel shaft extensions that are mechanically connected together by couplers to form one continuous steel pile.

The shaft lead sections and extension sections consist of a $2^7/_8$-inch-outside-diameter (73 mm) round hollow steel tubing having a nominal wall thickness of 0.217-inch (5.5 mm) minimum wall thickness.

Each helical steel bearing plate (helix) is $^3/_8$-inch (9.5 mm) thick and has spiral edge geometry with an outer diameter of 8, 10, 12 or 14-inches (203, 254, 305 or 356 mm). The helix plates are pressed to form a 3-inch (76.2 mm) pitch, which is the distance between the leading and trailing edges. The lead helix is located near the tip (bottom end) of the shaft lead section. For multiple helix installation, the helical bearing plates are spaced three times the diameter of the lowest plate apart starting at the toe of the lead section. Typically, the smallest diameter helical bearing plate is placed near the tip (bottom) of the lead section and the largest diameter helical bearing plate is placed nearest the top (trailing end) of the lead section or on an extension section.

The helical pile lead shaft sections and extension sections are connected together by bolting the male and female couplers. The male coupler consists of a 2.875-inch-oustside-diameter (59 mm) round hollow steel casting, as shown in Figure 3. The female coupler consists of a 3.42-inch-outside-diameter (87 mm) round hollow steel casting with a 3.31-inch-inside-diameter (84 mm), as shown in Figure 4. Each extension section consists of a female coupler and a male coupler which are welded, in the factory, to the opposing extension ends. Each lead shaft section consists of a male coupler that is welded, in the factory, to the top end of the lead shaft. Connection of extension sections to the lead shaft or other extension sections is made by through-bolted connections with two $^3/_4$-inch-diameter (19 mm) steel bolts through the extension section's female coupler and the connected lead section or extension section's male coupler. Figures 3 and 4 illustrate the female coupler and the male coupler.

Lead sections and extension sections may be either bare steel or hot-dipped galvanized in accordance with ASTM A123.

3.2.2 Brackets: Brackets are constructed from steel plate and steel pipe components, which are factory-welded together. The different brackets are described in Sections 3.2.2.1 and 3.2.2.2. All brackets may be either bare steel or hot-dipped galvanized in accordance with ASTM A123.

3.2.2.1 Type A Side Load Bracket: This bracket is used to support existing concrete foundations by transferring axial compressive loads from the existing foundations to the helical pile. The bracket shelf is constructed of a $^1/_2$-inch-thick (12.7 mm) steel plate measuring 13.75 inches (349 mm) wide by 12 inches (305 mm) long. The bracket shelf is factory-welded to ½-inch-thick (12.7mm) steel plate stiffeners to form the bracket main body. The bracket main body is factory-welded to a $3^1/_2$-inch-outside-diameter (89 mm) round hollow steel tubing having a nominal wall thickness of 0.25-inch (6.4 mm) minimum wall thickness and a length of 18 inches (457 mm). See Figures 2 and 5 of this report. A lifting T-bracket (Tru-Lift Slider) consists of steel plates factory-welded to a $2^1/_4$-inch-outside-diameter (57 mm) round hollow steel tubing having a nominal wall thickness of 0.344-inch (8.7 mm) and a length of 18 inches (457 mm). The lifting T-bracket (Tru-Lift Slider) is connected to the bracket main body with two $^7/_8$-inch-diameter steel threaded rods, four matching steel nuts, and matching steel washers. See Figures 2 and 5 of this report. The repair brackets may be either bare steel or hot-dipped galvanized in accordance with ASTM A123.

3.2.2.2 Type B Direct Load Bracket: This bracket is used with the helical pile system in new construction where the steel bearing plate of the bracket is cast into new concrete grade beams, footings, or pile caps. The brackets can transfer tension, compression, and lateral loads between the pile and the concrete foundation. Refer to footnotes in Table 1 for requirements of concrete cover and end/edge distance. The bracket consists of a 6-by-6-by-$^1/_2$-inch-thick (152 by 152 by 13 mm) bearing plate factory-welded to a round 3.43-inch-outside-diameter (89mm) round hollow steel casting with a 3-inch-inside-diameter (76 mm) and a length of 4.44 inches (113 mm). The bracket is attached to the shaft in the field with two ¾-inch (19 mm) standard hex bolts with matching ¾-inch (19 mm) standard hex nuts. See Figure 1 of this report. The brackets maybe either bare steel or hot-dipped galvanized in accordance with ASTM A123.

3.3 Material Specifications:

3.3.1 Helix Plates: The $^{3}/_{8}$-inch thick helix plates have an outer diameter of 8, 10, 12, or 14 inches (203, 254, 305 or 356 mm) which are made from carbon steel plates conforming to ASTM A572 Grade 50, and having a minimum yield strength of 50,000 psi (345 MPa) and a minimum tensile strength of 65,000 psi (488 MPa). The helix plates are factory-welded to the lead shafts and are either bare steel or hot-dipped galvanized in accordance with ASTM A123.

3.3.2 Helical Pile Lead Shafts and Extensions: The lead shafts and extensions are round hallowed steel tubes that conform to ASTM A500 Grade B/C and having a minimum yield strength of 60,000 psi (413 MPa) and a minimum tensile strength of 63,000 psi (434 MPa). The lead shafts and extensions may be either bare steel or hot-dipped galvanized in accordance with ASTM A123.

3.3.3 Male and Female Couplers: The male and female couplers are round hallowed steel casting conforming to ASTM A915 Grade SC8630, having a minimum yield strength of 116,000 psi (800 MPa) and a minimum tensile strength of 123,250 psi (850 MPa). The couplers are factory-welded to shaft leads and extensions. The couplers may be either bare steel or hot-dipped galvanized in accordance with ASTM A123.

3.3.4 Type A Side Load Brackets: The plates used to fabricate Type A bracket's main body and T-brackets conform to ASTM A572 Grade 50, having a minimum yield strength of 50,000 psi (344 MPa) and a minimum tensile strength of 65,000 psi (448 MPa). The $3^{1}/_{2}$-inch-outside-diameter round steel tubing that is factory-welded to the bracket main body and the $2^{1}/_{4}$-inch-outside-diameter (57 mm) round steel tubing which is a part of the lifting T-bracket are made from steel conforming to ASTM A500 Gr. C, having a minimum yield strength of 46,000 psi (317 MPa) and a minimum tensile strength of 62,000 psi (427 MPa). The fully threaded rods conforming to ASTM A449, having a minimum tensile strength of 120,000 psi (827 MPa). ASTM A563 Grade DH nuts and ASTM F436 washers are used to fasten the treaded rods to the bracket. Type A bracket may be either bare steel or hot-dipped galvanized in accordance with ASTM A123.

3.3.5 Type B Direct Load Brackets: The ½-inch steel bearing plate conforms to ASTM A572 Grade 50, having a minimum yield strength of 50,000 psi (344 MPa) and a minimum tensile strength of 65,000 psi (448 MPa). The round hallowed steel casting conforms to ASTM A915 Grade SC8630 and having a minimum yield strength of 116,000 psi (800 MPa) and a minimum tensile strength of 123,250 psi (850 MPa). When required, the bolts connecting the Type B bracket to the shaft/extension must comply with Section 3.3.6 of this report. Type B brackets are made from either bare steel or hot-dipped galvanized in accordance with ASTM A123.

3.3.6 All Other Fastening Assemblies (Including Brackets): The bolts, used to connect the lead and extension sections, or connect shaft to Type B bracket, conform to ASTM A325, having a tensile strength of 120,000 psi (827 MPa). The matching hex nuts conform to ASTM A563 Grade DH. The bolts and nuts can either be bare steel or hot-dipped galvanized in accordance with ASTM A153.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 General: Engineering calculations (analysis and design) and drawings, prepared by a registered design professional, must be submitted to and be subjected to the approval of the code official for each project, and must be based on accepted engineering principles, as described in IBC Section 1604.4, and must conform to IBC Section 1810. Under the IRC, the registered design professional must design the helical pile system and devices, including the bracket, used as a foundation element. The applied loads must not exceed the published capacities shown in this report for the helical pile system and devices. The registered design professional may determine the design forces in accordance with IRC Section R301 or, as an alternate, in accordance with IBC provisions. 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 design method for the steel components is Allowable Strength Design (ASD), described in IBC Chapter 2 and AISC 360 Section B3.4. The design method for the concrete components is Strength Design (also called LRFD) as described in ACI 318 and must comply with Section 3.7.1.2 of AC358 in order to utilize the ASD capacities described in this evaluation report. The design method for soil is ASD as prescribed in IBC Section 1801.2.

The structural analysis must consider all applicable internal forces (axial forces, shears, bending moments and torsional moments, if applicable) due to applied loads, structural eccentricity, the loading exerted on the supported structure by the connection brackets, and maximum span(s) between helical foundations. The result of this analysis and the structural capacities must be used to select a helical foundation system.

The PierTech direct load brackets (Type B brackets) exert a force on the footing or grade beam in which they are embedded. The force is equal in magnitude and opposite in direction to the force in the pile. A small lateral force is developed at the bracket embedment if the pile shaft is not perfectly plumb but within the permitted inclination from vertical of ±1°. The lateral shear is equal to sin(1°) or 0.0175 x the axial force exerted on the pile by the foundation.

The minimum embedment depth of piles for various loading conditions must be included based on the most stringent requirements of the following: engineering analysis, tested conditions described in this report, the 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 prescribed in Chapter H of AISC 360. The combined lateral and axial capacity for soil (P4) is outside the scope of this evaluation report.

The geotechnical analysis must address the suitability of the helical foundation system for the specific project. It must also 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-soil capacity. The analysis must include estimates of the axial tension, axial compression and lateral 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.

The allowable strengths (allowable capacities) of the steel components of the PierTech helical foundation systems are described in Table 1 (for brackets, P1); Table 2(A) (for shafts, P2); and Table 3 (for helical bearing plates, P3). The soil capacities, or capacities related to pile-soil interactions, (P4), are described in Section 4.1.5 and Table 4.

The overall allowable lateral capacity of the PierTech helical foundation systems depends upon the analysis of interaction of brackets, shafts, and soils, and must be the lowest value of those for bracket capacity, shaft capacity, and allowable soil capacity. The overall allowable axial compressive and tensile capacities of the PierTech helical foundation systems depends upon the analysis of interaction of shafts, helical plates and soils, and must be based on the least of the following conditions (P1, P2, P3 and P4), in accordance with IBC Section 1810.3.3.1.9:

- P4: Allowable load predicted by the individual helix bearing method (or Method 1) described in Section 4.1.5 of this report.
- P4: Allowable load predicted by the torque correlation method described in Section 4.1.5 of this report.
- P4: Allowable load predicted by dividing the ultimate capacity determined from load tests (Method 2 described in Section 4.1.5) by a safety factor of at least 2.0. This allowable load will be determined by a registered design professional for each site-specific condition. Under the 2021 IBC, the load tests must comply with 2021 IBC Section 1810.3.3.1.2.
- P3: Sum of the allowable axial capacity of helical bearing plates affixed to the pile shaft. See Section 4.1.4 of this report.
- P2: Allowable axial capacities of the shaft and shaft couplings as described in Section 4.1.3 of this report.
- P1: Allowable axial capacity of the bracket. See Section 4.1.2 of this report.

A written report of the geotechnical investigation must be submitted to the code official as part of the required construction (submittal) documents, prescribed in IBC Section 107, at the time of the permit application. Under the IRC, a site-specific soil investigation report is not required if the helical pile system described in the evaluation report is being installed to support IRC structures defined in Section 2.2 of this evaluation report and the soil capacity of the helical pile is established in accordance with Equation 3 in Section 4.1.5 of this report. The geotechnical report must include, but not be limited to, all of the following information:

- A plot showing the location of the soil investigation.

- A complete record of the soil boring and penetration test logs and soil samples.
- A record of soil profile.
- Information on ground-water table, frost depth and corrosion related parameters, as described in Section 5.5 of this report.
- Soil properties, including those affecting the design such as support conditions of the piles.
- Soil design parameters, such as shear strength parameters as required by Section 4.1.5; soil deformation parameters; and relative pile support conditions as defined in IBC Section 1810.2.1.
- Confirmation of the suitability of PierTech helical foundation systems for the specific project.
- Recommendations for design criteria, including but not be limited to: mitigations of effects of differential settlement and varying soil strength; and effects of adjacent loads.
- Recommended center-to-center spacing of helical pile foundations, if different from Section 5.14 of this report; and reduction of allowable loads due to the group action, if necessary.
- Field inspection and reporting procedures (to include procedures for verification of the installed bearing capacity when required).
- Load test requirements.
- Any questionable soil characteristics and special design provisions, as necessary.
- Expected total and differential settlement.
- The axial compression, axial tension and lateral load soil capacities for allowable capacities that cannot be determined from this evaluation report.
- Minimum helical pile depth, if any, based on local geologic hazards such as frost, expansive soils, or other condition.

4.1.2 Bracket Capacity (P1): Table 1 describes the allowable bracket capacity for Type A (Side Load) Brackets, and Type B (Direct Load) Brackets. The connections of the building structure to the helical pile brackets must be designed and included in the construction documents. Only localized limit states of steel and supporting concrete including 2-way punching shear and concrete bearing (and concrete breakout for the bracket's lateral shear capacity) have been evaluated in this evaluation report. 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. Refer to item 5.3 of this report for bracing requirement.

4.1.3 Shaft Capacity (P2): Table 2(A) describes the allowable capacities of the shaft. For capacities not reported in Table 2(A), they must be determined by a registered design professional. Table 2(B) describes the mechanical properties of the shaft which are based on a 50-year corrosion effect in accordance with Section 3.9 of AC358.

The top of shafts must be braced as prescribed in IBC Section 1810.2.2, and the supported foundation structures such as concrete footings 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 that is standing in air, water or in fluid soils plus additional 5 feet (1524 mm) when embedded into firm soil or additional 10 feet (3048 mm) when embedded into soft soil. Firm soils shall be defined as any soil with a Standard Penetration Test blow count of five or greater. Soft soil shall be defined as any soil with a Standard Penetration Test blow count greater than zero and less than five. Fluid soils shall 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 shall be determined in accordance with ASTM D1586. Under the IRC, when helical pile shafts are fully embedded into soil conditions defined in IRC Table R401.4.1 the helical pile shafts are deemed adequately supported to prevent buckling. The shaft capacity of the helical foundation systems is reported in Table 2(A) of this report. For shaft capacities not reported in Table 2(A), these capacities must be determined by a registered design professional. The shaft capacity of the helical foundation systems with an unbraced length more than zero must be determined by a registered design professional using parameters in Table 2(B) with due consideration of lateral support provided by the surrounding soil and/or structure.

The elastic shortening/lengthening of the pile shaft will be controlled by the strength and section properties of the shaft sections [See Table 2(B)] and coupler(s). For loads up to and including the allowable load limits found in this report, the elastic shortening of shaft can be estimated as:

Δ_{shaft} = P L/(A E)

where:

Δ_{shaft} = Length change of shaft resulting from elastic shortening, in (mm).

P = applied axial load, lbf (N).

L = effective length of the shaft, in. (mm).

A = cross-sectional area of the shaft, see Table 2(B), $in.^2$ (mm^2).

E = Young's modulus of the shaft, see Table 2(B), ksi (MPa).

For each galvanized coupler, an elastic shortening of 0.002 inch (0.051 mm) is estimated at allowable shaft load, and a slip of 0.260 inch (6.60 mm) is estimated at allowable shaft load. For shaft, an elastic shortening of 0.002 inch per foot of shaft (0.167 mm/m) is estimated at allowable shaft load.

4.1.4 Helix Capacity (P3): Table 3 describes the allowable axial tension and compression loads for helical bearing plates. For helical piles with more than one helix, the allowable helix capacity, P3, for the helical foundation systems and devices, may be taken as the sum of the least allowable capacity of each individual helix.

4.1.5 Soil Capacity (P4): Table 4 describes the geotechnical related properties of the piles. The allowable axial tensile and axial compressive load capacities of piles (P4) based on soil resistance must be determined by a registered design professional in accordance with a site-specific geotechnical report, as described in Section 4.1.1, 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 must be equal to or greater than what is predicted by Method 1 or 2, described above.

The individual bearing method 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 bearing stratum for helix plates. Under the 2021 IBC, the axial capacity is equal to the sum of the areas of the helical bearing plates times the ultimate bearing capacity of the soil or rock comprising the bearing stratum plus the shaft resistance. The shaft resistance is equal to the area of the shaft above the uppermost helical bearing plate times the ultimate skin friction.

The design allowable axial capacity 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.

Under the IRC, if the helical pile system is being installed to support structures governed by the IRC as defined in Section 2.2 of this report, and a site-specific geotechnical report is not available, a factor of safety (FOS) of 2.5 must be used with the torque correlation method in lieu of Method 1 or 2 to determine allowable soil capacity of the pile (Equation 3).

With the torque correlation method, the ultimate axial soil capacity (P_{ult}) of the pile and the allowable axial soil capacity (Pa) of the pile are predicted as follows:

P_{ult} = K_t x T (Equation 1)

Pa = 0.5 P_{ult} (Equation 2)

Pa = 0.4 P_{ult} (Equation 3)

where:

P_{ult} = Ultimate axial tensile or compressive capacity (lbf or N) of helical pile, which must be limited to the maximum ultimate values noted in Table 4.

P_a = Allowable axial tensile or compression capacity (lbf or N) of helical piles, which must be limited to the maximum allowable values noted in Table 4.

K_t = Torque correlation factor per Table 4.

T = Final installation torque defined as the last torque reading taken when terminating the helical pile installation; which must not exceed the maximum installation torque rating noted in Table 4 of this report.

The maximum ultimate and maximum allowable compression and tension capacities predicted by the torque-correlation method are less than or equal to those axial verification test results. The smaller of the torque-correlation predicted maximum axial capacities (ultimate and allowable) and the axial verification test results are provided in Table 4, on soil capacities.

The lateral capacity of the pile referenced in Table 5 of this report is based on field testing of the helical pile with a 10-inch-diameter (254 mm) single helix plate installed in a clay soil as defined in Table 5. For other soil conditions, the lateral capacity of the pile must be determined by a registered design professional on a project by project basis and subjected to approval of the code official.

4.2 Installation:

4.2.1 General: The PierTech helical foundation systems must be installed by PierTech trained and authorized installers. The PierTech helical foundation systems must be installed in accordance with this section (Section 4.2), IBC Section 1810.4.11, the site-specific approved construction documents (engineering plans and specifications), and the manufacturer's written installation instructions. In case of conflict, the most stringent requirement governs.

4.2.2 Helical Piles: The helical piles must be installed according to a preapproved plan of placement. Installation begins by attaching the helical pile lead section to the torque motor (drive head) using a drive tool and drive pin. Next, crowd must be applied to force the pilot point into the ground at the proper location, inclination and orientation, as described in the placement plan. Then the pile must be rotated into the ground in a smooth, clockwise, continuous manner while maintaining sufficient crowd to promote normal advancement (approximately 3 inches per revolution). Installation continues by adding extension sections as necessary. Refer to Sections 3.2.1 and 3.3.6 of this report and the approved construction documents for type, grade, size and number of bolts and nuts that are required to connect the shaft sections. Inclination and alignment shall be checked and adjusted periodically during installation. Connection bolts between shaft sections shall be snug-tightened as defined in Section J3 of AISC 360. Care shall be taken not to exceed the maximum installation torque rating, as shown in Table 4, of the helical piles during installation. Helical piles must be advanced until axial capacity is verified by achieving the required final installation torque as indicated by the torque correlation method described in Section 4.1.5, and the minimum depth, if any, as specified by the geotechnical report Section 4.1.1.

4.2.3 Type A Side Load Brackets: Type A brackets must be installed as specified in the approved plans. Installation of brackets requires an area adjacent to the building foundation to be excavated at each location thus exposing the footing, column pad, or grade beam. The area to be exposed should be an approximate width of 18 inches and should extend below the bottom of the footing or grade beam by approximately 12 inches. Any soil attached to the bottom of the footing, column pad, or grade beam should be removed prior to bracket installation. The footing or grade beam must be prepared by chipping away the irregularities from the side or bottom for a sure bracket attachment. Existing concrete footing or grade beam capacity must not be altered, such as notching of concrete or cutting of reinforcing steel, without the approval of the registered design professional and the code official. Prepping of the footing allows for the bracket to be mounted to a reasonably flat, smooth, and full bearing surface. Once the pile has been installed to the design load, the bracket shelf is rotated into place under the existing concrete footing, column pad, or grade beam. Any excess pile length will be cut off level, above the bracket several inches, to enable the mounting of the bracket. The T-bracket will be placed into the top helical pile and bracket assembly. The threaded rods, hex nuts and washers, supplied with the bracket, are added to hold the bracket in position. The hex nuts shall be snug tightened, as defined in Section J3 of AISC 360. A jacking block bracket, and lifting jack are installed to raise the foundation to the desired elevation. Any lifting of the existing structure must be verified by a registered design processional and is subjected to approval of the code official to ensure that the foundation, superstructure, and helical piles are not overstressed. Once the foundation has been raised to its desired elevation, the hex nuts over the T-bracket are tightened, and the jacking brackets and lifting jacks are removed. Cut off the excess thread rod, which was used for lifting, from above the bracket assembly. The field cutting and bolting must be in accordance with the most restrictive requirements as described in the evaluation report, the IBC, AISC 360, and the manufacturer's written instructions. The exaction must be backfilled in accordance with IBC Section 1804.

4.2.4 Type B Direct Load Brackets: Type B 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 bearing contact between the top of the pile shaft and the bracket. In the case of Type B bracket, two ¾-inch-diameter (19 mm) bolts and hex nuts as described in Section 3.3.6 of this report must be used for installing the bracket to the helical pile. The bolts must be snug-tightened, as defined in Section J3 of AISC 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 (Per IBC):

Special inspections in accordance with 2021, 2018, 2015, and 2012 IBC Section 1705.9 (2009 IBC Section 1704.10) must be performed continuously during installation of PierTech helical foundation systems (piles and brackets). Items to be recorded and confirmed by the special inspector must include, but are not be limited to, the following:

1. Verification of the product manufacturer, the manufacturer's certification of installers.
2. Product identification including lead sections, couplings, extension sections, brackets, bolts and nuts, as specified in the construction documents and this evaluation report.
3. Installation equipment used.
4. Written installation procedures.
5. Bolts, nuts and washers are specified in the approved construction documents and this evaluation report.
6. Field cutting, bolting and welding as specified in the approved construction documents and this evaluation report.
7. Tip elevations, the installation torque and final depth of the helical foundation systems.
8. Inclination and position/location of helical piles.
9. Tightness of all bolted connections.
10. Verification that direct load bracket cap plates are in full contact with the top of the pile shaft.
11. Compliance of the installation with the approved construction documents and this evaluation report, including conditions and limitations described in the footnotes to the tables in this report.

5.0 CONDITIONS OF USE

The PierTech helical foundation systems described in this report, comply with or are suitable alternative to what is specified in, the code listed in Section 1.0 of this report, subject to the following conditions:

5.1 The PierTech helical foundation systems are manufactured identified and installed in accordance with this report, the site-specific approved construction documents (engineering plans and specifications), IBC Section 1810.4.11, and the manufacturer's written installation instructions. In case of conflict, the most stringent requirement governs.

5.2 The PierTech helical foundation systems have been evaluated for support of structures assigned to Seismic Design Categories A, B and C in accordance with IBC and IRC. Helical foundation systems that support structures assigned to Seismic Design Category D, E or F under the IBC or D through D_2 and E under the IRC, are outside the scope of this report, and are subject to the approval of the code official based upon submission of a design in accordance with the code by a registered design professional.

5.3 Type A (Side Load) brackets are limited to compression loads only. Type B (Direct Load) brackets are limited to tension, compression and lateral loads.

5.4 Type A (Side Load) and Type B (Direct Load) brackets must be used only to support structures that are laterally braced as defined in IBC Section 1810.2.2. Shaft couplings must be located within firm or soft soil as defined in Section 4.1.3.

5.5 The installations of Type A (Side Load) and Type B (Direct Load) brackets are limited to regions of concrete members where analysis indicates no cracking at service load levels.

5.6 Use of the PierTech helical foundation systems in exposure conditions that are indicative of potential pile deterioration or corrosion situations as defined by the following: (1) soil resistivity less than 1,000 ohm-cm; (2) soil pH less than 5.5; (3) soils with high organic content; (4) soil sulfate concentrations greater than 1,000 ppm; (5) soils located in landfill, or (6) soil containing mine waste is beyond the scope of the evaluation report.

5.7 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.

5.8 The helical piles must be installed vertically into the ground with the maximum allowable angle of inclination of 1 degree.

5.9 To comply with the requirements found in IBC Section 1810.3.1.3, the superstructure must be designed to resist the effect of helical pile eccentricity.

5.10 Engineering calculations and drawings, in accordance with recognized engineering principles, as described in IBC Section 1604.4, and complying with Section 4.1 of this report, prepared by a registered design professional, are provided to, and are approved by the code official.

5.11 The adequacy of the concrete structures that are connected to the PierTech brackets must be verified by a registered design professional, in accordance with applicable code provisions, such as Chapter 13 of ACI 318 (Chapter 15 of ACI 318-11 and AC 318-08 as referenced in 2012 and 2009 IBC, respectively) and Chapter 18 of IBC, and subject to the approval of the code official.

5.12 A geotechnical investigation report for each project site in accordance with Section 4.1.1 of this report must be provided to the code official for approval.

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

5.14 The load combinations prescribed in 2021 IBC Section 1605.1 (2018, 2015, 2012, 2009, and 2006 IBC Section 1605.3.1) must be used to determine the applied loads. When using the alternative basic load combinations prescribed in IBC Section 1605.2 (2018, 2015, 2012, and 2009 IBC Section 1605.3.2), the allowable stress increases permitted by material chapters of the IBC or the referenced standards are prohibited.

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

5.16 For axially loaded helical piles, the minimum helical pile center-to-center spacing upon which this evaluation report is based is four times the average helical bearing plate diameters. For piles with closer spacing, the pile allowable load reductions due to pile group effects must be included in the geotechnical report, described in Section 4.1.1 of this report, and must be considered in the pile design by a registered design professional, and subject to the approval of the code official.

5.17 For laterally loaded helical piles, the minimum center-to-center spacing of helical piles must be at least eight times the pile shaft outside diameter; the clear spacing between helical plates must not be less than 3D, where D is the diameter of the largest helical plate, measured from the edge of the helical plate to the edge of the adjacent helical plate; and the spacing between helical plates must not be less than 4D, where the spacing is measured from the center to the center of the adjacent helical pile plates. For piles with closer spacing, the pile allowable load reductions due to pile group effects must be included in the geotechnical report, described in Section 4.1.1 of this report, and must be considered in the pile design by a registered design professional, and subject to the approval of the code official.

5.18 For tension applications, the helical pile must be installed such that the minimum depth from the ground surface to the helix is 12D, where D is the diameter of the helix plate. In cases where the installation depth is less than 12D, the torque-correlation soil capacity, P4, is outside the scope of this report and the minimum embedment depth shall be determined by a registered design professional based on site-specific soil conditions, which must be subject to the approval of the code official.

5.19 Requirements described in footnotes of tables in this report must be satisfied.

5.20 Evaluation of compliance with IBC Section 1810.3.11 for buildings assigned to Seismic Design Category (SDC) C through F, and with IBC Sections 1810.3.6 and 1810.3.6.1 for all buildings, is outside of the scope of this evaluation report. Such compliance must be addressed by a registered design professional for each site and is subject to approval by the code official.

5.21 Settlement of helical piles is beyond the scope of this evaluation report and must be determined by a registered design professional as required in IBC Section 1810.2.3 based upon shaft (including coupling) information prescribed in this evaluation report and in consultation with the pile manufacturer.

5.22 The PierTech helical foundation systems are manufactured in Canton, Ohio and Paragloud, Arkansas, under quality-control programs 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 June 2020 (editorially revised March 2021).

7.0 IDENTIFICATION

7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-3969) along with the name, registered trademark, or registered logo of the report holder [and/or listee] must be included in the product label. [Electronic labeling is the ICC-ES web address (www.icc-es.org); specific URL related to the report; or the ICC-ES machine-readable code placed on the aforementioned items.]

7.2 In addition, Product labeling shall include the name of the report holder or listee, and the ICC-ES mark of conformity. The listing or evaluation report number (ICC-ES ESR-3969) may be used in lieu of the mark of conformity. The Pier Tech Systems, LLC (PierTech) helical foundation systems (including lead shafts, extension shafts, brackets, and boxed hardware) are identified by a tag or label bearing the logo, name, and address of PierTech, the product number, and the evaluation report number (ESR-3969).

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

PIERTECH SYSTEMS, LLC
600 TRADE CENTER BOULEVARD
CHESTERFIELD, MISSOURI 63005
(636) 536-5007
http://www.piertech.com

TABLE 1—BRACKET CAPACITY (P1) FOR DIRECT LOAD BRACKETS

BRACKET TYPE	PRODUCT NUMBER	SHAFT DIAMETER (inches)	(P1) ALLOWABLE CAPACITY (kips)		
			Normal-Weight Concrete ($f'_c \geq$ 2,500 psi)		
			Compression	Tension	Shear
Type A (Side Load) Bracket	2.88-TLB	$2^7/_8$	27.9	N/A	N/A
Type B (Direct Load) Bracket [1,2]	2.88-NCB	$2^7/_8$	43.5[3]	33.9[4]	1.29[5]

For **SI:** 1 kip = 4.448 kN, 1 psi = 6.895 kPa.

[1]Only localized limit states of supporting concrete including bearing and 2-way punching shear have been evaluated. Refer to Sections 5.4 and 5.9 of this report for additional requirements.

[2]Allowable capacities include an allowance for corrosion over a 50-year service life in accordance with Section 3.9 of AC358 and presume the supported structure is braced in accordance with IBC Section 1810.2.2. The provided capacities are for concentrically loaded brackets.

[3]The allowable compressive load capacity is based on the 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 318-19 and ACI 318-14 Section 9.6.1.2 (ACI 318-11 and ACI 318-08 Section 10.5.1). The minimum distance between the top of the bracket plate to the top of the concrete footing is 11.3 inches. The end of helical pile shaft must be fully bearing on bracket plate. For Type B bracket, the concrete footing must have a minimum thickness of 15.8-inches and a minimum width of 28.6-inches. The minimum clear distance between the edge of the bracket's plate and the edge of concrete is 11.3 inches.

[4]The allowable tensile load capacity is based on the mechanical strength of the steel bracket, concrete punching shear capacity, and concrete bearing strength. Minimum reinforcement per ACI 318-19 and ACI 318-14 Section 9.6.1.2 (ACI 318-11 and ACI 318-08 Section 10.5.1) must be provided. The minimum distance between the bottom of the bracket plate and the bottom of the concrete footing is 11.7 inches. The pile shaft must be connected to the bracket's sleeve with two bolts. The minimum clear distance between the edge of the bracket's plate and the edge of concrete is 11.7 inches.

[5]The minimum clear distance between the edge of the bracket's plate and the edge of the concrete is 5 inches. The minimum embedment depth of the bracket in concrete is 3.5 inches. Reinforcement of at least No. 4 bar or greater must be included between the bracket and the concrete edge, and with the reinforcement enclosed within stirrups spaced at not more than 4 inches in accordance with Section 17.7.2.5.1 of ACI 318-19 (Section 17.5.2.7 of ACI 318-14 and Section D.6.2.7 of ACI 318-11 and -08).

TABLE 2(A)— 2 7/8-INCH SHAFT ALLOWABLE CAPACITY (P2)[1]

UNBRACED SHAFT LENGTH, kL (FT) [2]	(P2) ALLOWABLE CAPACITY						MAXIMUM INSTALLATION TORQUE (ft-lb)
	COMPRESSION[3]			Tension (kips)	Bending (kip-ft)	Lateral Shear (kips)	
	0 Coupler[4]	1 Coupler[4]	2 Couplers[4]				
0	50	50	50	52	3.55	13.16	8,840
5	23.9	12.9	6.7				
10	15.7	10.1	5.9				

For **SI:** 1 inch = 25.4 mm, 1 kip = 4.448 kN.

[1]Allowable capacities include allowance for corrosion over a 50-year service life in accordance with Section 3.9 of AC358 and presume the supported structure is braced in accordance with IBC Section 1810.2.2.
[2]k = Effective length factor for shaft compression buckling consideration.
L = Total pile unbraced length in accordance with IBC Section 1810.2.1, including the length in air, water or in fluid soil, and the embedment length into firm or soft soil (non-fluid soil). Refer to Section 4.1.3 of this report for the determination of unbraced length, L.
kL = Total effective unbraced length of the pile, where kL = 0 represents a fully braced condition.
[3]For other unbraced lengths, the shaft capacity of helical foundations must be determined by a registered design professional.
[4]Total number of couplers within the total pile length.

TABLE 2(B)—MECHANICAL PROPERTIES AFTER CORROSION LOSS[1] OF 2.875-INCH DIAMETER HELICAL SHAFT

MECHANICAL PROPERTIES	2.875-INCH (0.217-INCH WALL THICKNESS)
Steel Yield Strength, F_y (ksi)	60
Steel Ultimate Strength, F_u (ksi)	63
Modulus of Elasticity, E (ksi)	29,000
Nominal Wall Thickness (inch)	0.217
Design Wall Thickness (inch)	0.166
Outside Diameter (inch)	2.839
Inside Diameter (inch)	2.507
Cross Sectional Area ($inch^2$)	1.39
Moment of Inertia, I ($inch^4$)	1.25
Radius of Gyration, r (inch)	0.95
Section Modulus, S ($inch^3$)	0.88
Plastic Section Modulus, Z ($inch^3$)	1.19

For **SI:** 1 inch = 25.4 mm; 1 ksi = 6.89 MPa, 1 ft-lbf =1.36 N-m; 1 lbf =4.45 N.

[1]Dimensional properties are based on bare steel losing 0.036-inch steel thickness as indicated in Section 3.9 of AC358 for a 50-year service life.

TABLE 3—HELICAL BEARING PLATE CAPACITY (P3) – AXIAL COMPRESSION[1,2,3]

HELIX DIAM. (IN)	HELIX THICKNESS (IN)	HELIX PITCH (IN)	ALLOWABLE CAPACITY[3] (P3) (KIPS)
8	0.375	3.0	63.4
10	0.375	3.0	59.3
12	0.375	3.0	62.6
14	0.375	3.0	65.4

For **SI:** 1 inch = 25.4 mm, 1 kip = 4.448 kN.

[1]For helical piles with more than one helix, the allowable helix capacity, P3, for the helical foundation systems, may be taken as the sum of the least allowable capacity of each individual helix.
[2]As described in Section 3.2.1 of this report, all helical bearing plates are made from same material, and have the same edge geometry, thickness and pitch.
[3]Allowable capacities include an allowance for corrosion over a 50-year service life.

TABLE 4—SOIL CAPACITY (P4) – AXIAL CAPACITY FOR 2$^{7}/_{8}$-INCH HELICAL PILE [1]

GEOTECHNICAL RELATED PROPERTIES	LOAD DIRECTION	
	Compression	**Tension**
Mechanical Torsion Rating of shaft and helical plate (ft-lbs)[3]	8,840	8,840
Maximum Torque Per Soil Tests (ft-lbs)[4]	8,840	8,840
Maximum Installation Torque Rating (ft-lbs)[5]	8,840	8,840
Torque Correlation Factor, K_t (ft^{-1})	9	8
Maximum Ultimate Soil Capacity / Maximum Allowable Soil Capacity (P4) from Torque Correlations (kips)[2]	79.6/39.8	70.7/35.4

For **SI:** 1 foot = 0.305 m, 1 lbf = 4.448 N, 1 lbf-ft = 1.356 N-m.

[1] Soil capacity (P4) must be determined per Section 4.1.5 of this report.
[2] Maximum ultimate soil capacity is determined from $P_{ult} = K_t \times T$ based on the corresponding maximum installation torque rating for the specific pile model. Allowable soil capacity is determined from $Pa = P_{ult}/2.0$ based on the corresponding maximum installation torque rating for the specific pile model. See Section 4.1.5 for additional information.
[3] Mechanical torsion rating is the maximum torsional resistance of the steel shaft.
[4] Maximum Torque Per Soil Tests is the maximum torque achieved during field axial verification testing that was conducted to verify the pile axial capacity related to pile-soil interaction.
[5] Maximum Installation Torque rating is the lower of the "mechanical torsion rating" and the "maximum torque per soil tests".

TABLE 5—HELICAL PILE ALLOWABLE LATERAL SOIL CAPACITY[1,2,3]

PILE MODEL	ALLOWABLE LATERAL CAPACITY (lbs)	MINIMUM INSTALLATION DEPTH (ft)
Helical pile with 10-inch helical plate diameter	1,890	16

For **SI:** 1 lbs = 4.448 N, 1 ft = 304.8 mm

[1] Installation must be in accordance with Sections 4.1.5 and 4.2 of this report.
[2] Installation is limited to piles in clay with a minimum SPT of 20.
[3] For other soil conditions, the lateral capacity of the pile must be determined by a registered design professional.

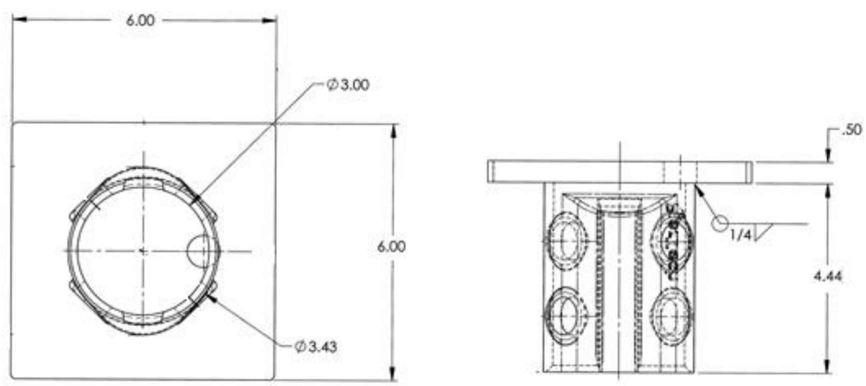


FIGURE 1—NEW CONSTRUCTION BRACKET (NCB)

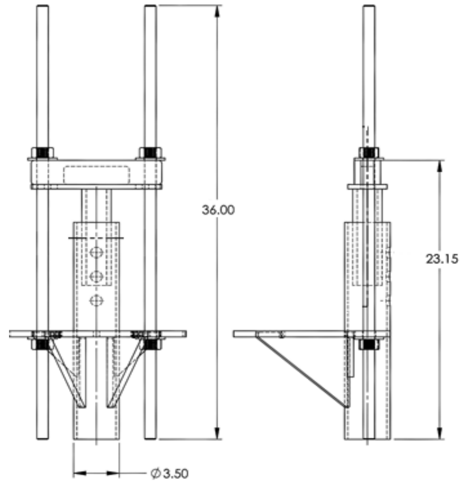


FIGURE 2—TRU-LIFT BRACKET (TLB)

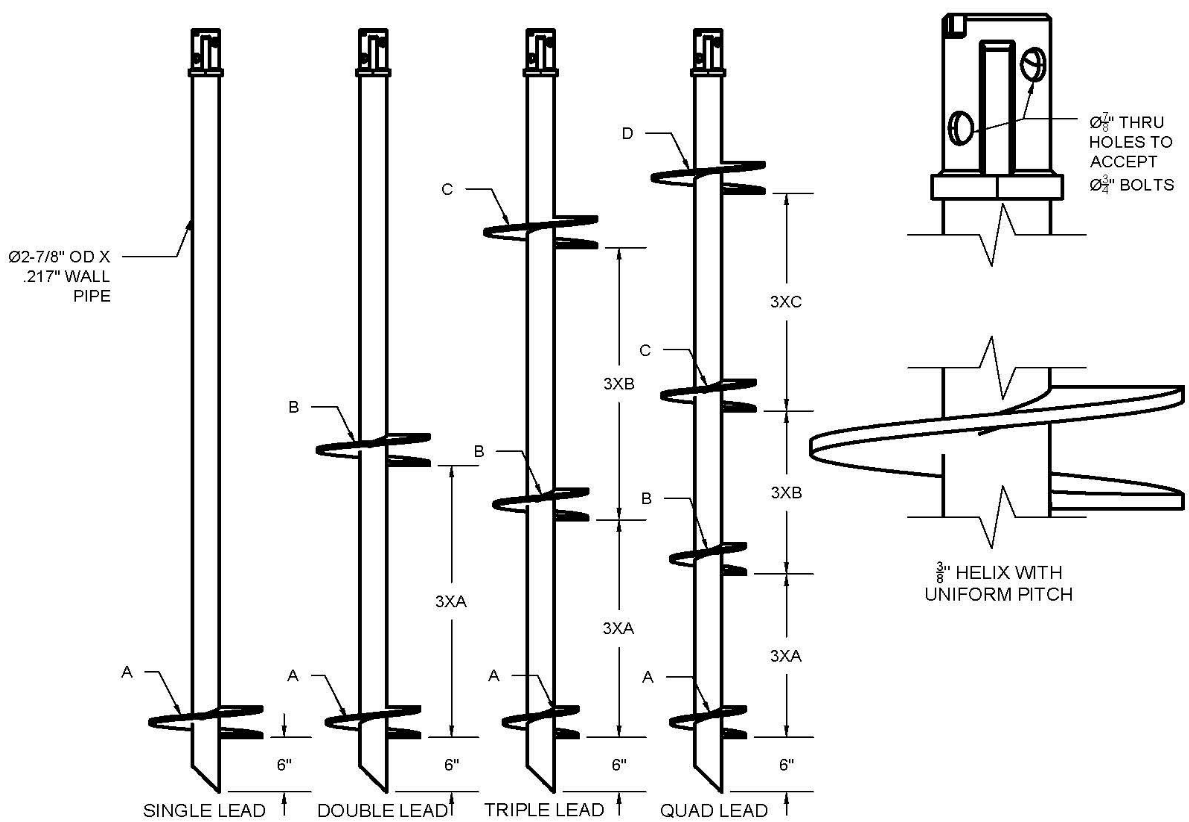


FIGURE 3—HELICAL LEAD SHAFTS

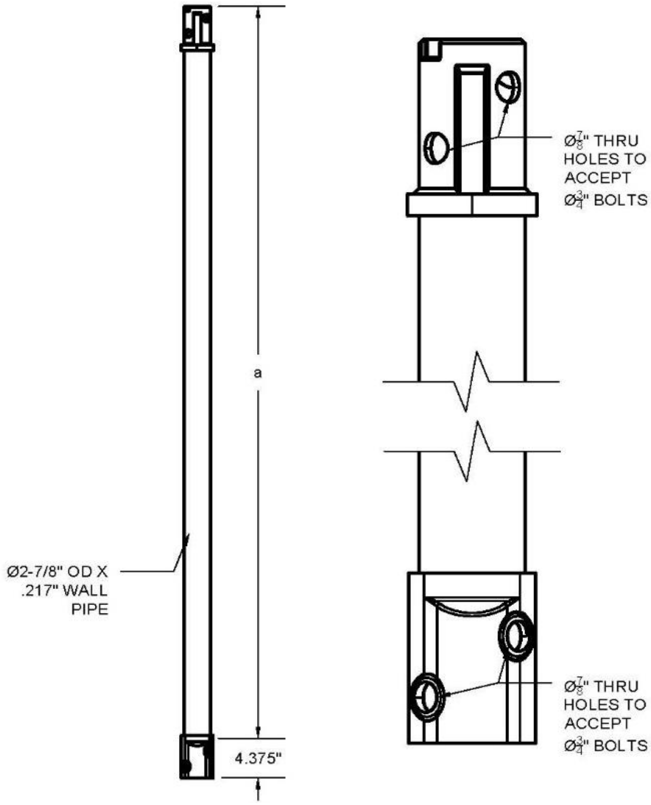
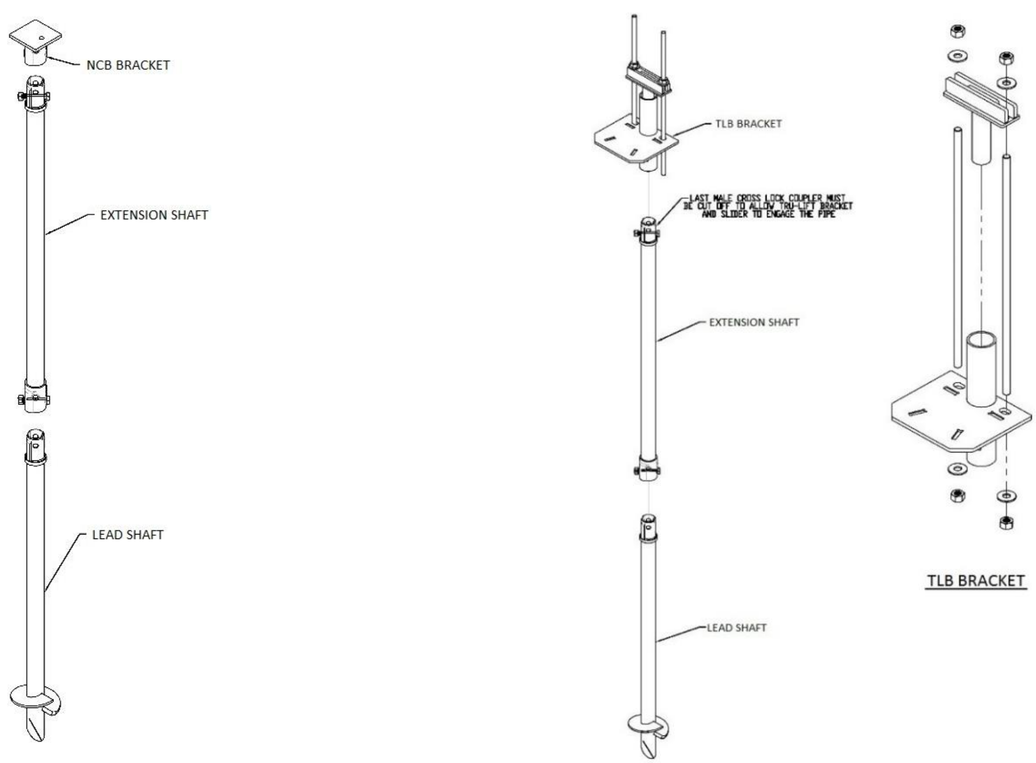


FIGURE 4—HELICAL EXTENSION SHAFTS



NEW CONSTRUCTION HELICAL PIER ASSEMBLY

REPAIR HELICAL PIER ASSEMBLY

FIGURE 5—HELICAL PIER ASSEMBLY

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

REPORT HOLDER:

PIERTECH SYSTEMS, LLC

EVALUATION SUBJECT:

PIERTECH HELICAL FOUNDATION SYSTEMS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the PierTech helical foundation systems, described in ICC-ES evaluation report ESR-3969, have also been evaluated for compliance with the code noted below.

Applicable code edition:

- 2022 *California Building Code* (CBC)

For evaluation of applicable Chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) AKA: California Department of Health Care Access and Information (HCAI) and the Division of State Architect (DSA), see Sections 2.1.1 and 2.1.2 below.

- 2022 *California Residential Code* (CRC)

2.0 CONCLUSIONS

2.1 CBC:

The PierTech helical foundation systems, described in Sections 2.0 through 7.0 of the evaluation report ESR-3969, comply with CBC Chapter 18, provided the design and installation are in accordance with the 2021 *International Building Code®* (IBC) provisions noted in the evaluation report and the additional requirements of CBC Chapters 16, 17 and 18, as applicable.

2.1.1 OSHPD: The applicable OSHPD Sections and Chapters of the CBC are beyond the scope of this supplement.

2.1.2 DSA: The applicable DSA Sections and Chapters of the CBC are beyond the scope of this supplement.

2.2 CRC:

The PierTech helical foundation systems, described in Sections 2.0 through 7.0 of the evaluation report ESR-3969, comply with CRC Chapter 3, provided the design and installation are in accordance with the 2021 *International Residential Code®* (IRC) provisions noted in the evaluation report.

This supplement expires concurrently with the evaluation report, reissued January 2024.

ICC-ES Evaluation Report

ESR-3969 FBC Supplement

Reissued January 2024

This report is subject to renewal January 2025.

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

REPORT HOLDER:

PIERTECH SYSTEMS, LLC

EVALUATION SUBJECT:

PIERTECH HELICAL FOUNDATION SYSTEMS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the PierTech helical foundation systems, described in ICC-ES evaluation report ESR-3969, has also been evaluated for compliance with the code noted below.

Applicable code edition:

- 2020 *Florida Building Code—Building*
- 2020 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The PierTech helical foundation systems, described in Sections 2.0 through 7.0 of ICC-ES evaluation report ESR-3969, comply with the *Florida Building Code—Building* or the *Florida Building Code—Residential*, as applicable, provided the design requirements are determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable. The installation requirements noted in ICC-ES evaluation report ESR-3969 for the 2018 *International Building Code*® meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable.

Use of the PierTech helical foundation systems for compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* or the *Florida Building Code—Residential* has not been evaluated and is outside the scope of this supplemental report.

For products falling under Florida Rule 61G20-3, 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 January 2024.