ICC-ES Evaluation Report

ESR-3559

Reissued August 2024

This report also contains:

- CBC Supplement

Subject to renewal August 2026

- LABC Supplement

DIVISION: 31 00 00—EARTHWORK Section: 31 63 00—Bored Piles	REPORT HOLDER: EARTH CONTACT PRODUCTS, LLC.	EVALUATION SUBJECT: EARTH CONTACT PRODUCTS (ECP) HELICAL FOUNDATION SYSTEMS	

1.0 EVALUATION SCOPE

Compliance with the following codes:

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

For evaluation for compliance with codes adopted by *Los Angeles Department of Building and Safety* (LADBS), see ESR-3559 LABC and LARC Supplement.

Properties evaluated:

- Structural
- Geotechnical

2.0 USES

2.1 IBC:

Under the IBC, ECP 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 and tension loads from the supported structures to suitable soil bearing strata. Underpinning of existing foundations is generally achieved by attaching the helical piles to the retrofit brackets (Type A side-load brackets), which support compression loads only. Deep foundations for new construction are generally obtained by attaching the helical piles to new construction brackets (Type B direct-load brackets) that are embedded in concrete pile caps or grade beams, which support both tension and compression loads.

2.2 IRC:

Under the IRC, ECP 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 ECP helical foundation systems consist of a helical pile and a bracket that allows for attachment to the supported structures. Each helical pile, consisting of a lead section and one or more extension sections, is screwed into the ground by application of torsion to a depth that conforms to project requirements for avoidance of unsatisfactory subsurface conditions and ensures a suitable soil or bedrock bearing stratum has been reached. The bracket is then installed to connect the pile to the concrete foundation of the supported structure.

3.2 System Components:

The ECP helical foundation systems include either one of the following: a Model TA-150, a Model TA-175, a Model TA-288, or a Model TA-350 helical pile (shaft with helices) and either a Type A side-load bracket (underpinning bracket) or a Type B direct-load bracket (new construction bracket), for attachment to concrete foundations. Refer to tables below for bracket and pile model combinations.

Type A Side Load Bracket Model	Pile Model
TAB-MUB	TA-150 TA-288
TAB-175-LUB	TA-175
TAB-288-LUB	TA-288
Model-300	TA-288
TAB-350-LUB	TA-350

Type B Direct Load Bracket Model	Pile Model
TAB-150-NC	TA-150
TAB-175-NC	TA-175
TAB-288-NC	TA-288
TAB-350-NC	TA-350

3.2.1 Helical Pile Lead Sections and Extension Sections: The ECP Model TA-150, Model TA-175, Model TA-288, and Model TA-350 helical pile lead sections consist of multiple helical-shaped circular steel plates (helices) factory-welded to a central steel shaft. 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 integral, forged steel couplings, to form one continuous steel pile. The extensions do not include helical bearing plates.

The TA-150 central steel shafts of the lead section and extension sections are 1$^{1}/_{2}$-inch (38.1 mm), solid, round-cornered, square (RCS) steel bars. The TA-175 central steel shafts of the lead section and extension sections are 1$^{3}/_{4}$-inch (44.5 mm), solid, round-cornered, square (RCS) steel bars. The TA-288 central steel shafts of the lead section and extension sections are round, 2$^{7}/_{8}$-inch-outside-diameter (73 mm), nominally 0.262-inch-wall-thickness (6.7 mm), hollow structural steel sections (HSSs). The TA-350 central steel shafts of the lead section and extension sections are round, 3$^{1}/_{2}$-inch-outside-diameter (88.9 mm), nominally 0.300-inch-wall-thickness (7.6 mm), hollow structural steel sections (HSSs). Figures 1A(a), 1B, 2A and 2B provide details for lead section, coupler and extension section of TA-150, TA-175, TA-288, and TA-350.

As an alternate, the ECP Model TA-288 steel shaft may be extended with the use of a field-welded coupler. See Section 3.2.3 and Figure 1A(b).

3.2.2 Helix Plates: Each circular, helical, steel bearing plate (helix) is split from the center to the outside edge with spiral edge geometry. Each helix is formed to a clockwise downward spiral with all radial sections normal to the shaft's central longitudinal axis ±1° and with a 3-inch (76 mm) nominal pitch. The pitch is the distance between the leading and trailing edges. The helices are shop fillet-welded to the pile shaft. For ECP helical piles, each helix plate is 0.375 inch (9.5 mm) thick and has an outer diameter of 8, 10, 12, or 14 inches (203, 254, 305, or 356 mm). Figure 3 provides helix details for TA-150, TA-175, TA-288 and TA-350 pile shafts.

3.2.3 Couplings: At one end of each extension section, an upset socket is made from RCS steel bar, round HSS, square tube HSS, for either TA-150, TA-175, TA-288, or TA-350, which allows the upper end of the lead shaft or the other end (the end without the upset socket) of an extension section to be snug-fitted into the upset socket. Holes (one pair of diagrammatically opposite holes at either TA-150 or TA-175 shaft, and three pairs of diagrammatically opposite holes at either TA-288 or TA-350 shaft) are factory-drilled at each end of an extension section and at the upper end of the lead section, so as to allow the multiple shaft sections (between the lead and the extension section or between two extension sections) to be through-bolted together during the installation. For TA-150 helical piles, each coupling connection includes one $^{3}/_{4}$-inch-diameter (19.0 mm), 3-inch-long (76.2 mm), standard hex-head structural bolt, and one matching hex nut. For TA-175 helical piles, each coupling connection includes one $^{7}/_{8}$-inch-diameter (22.2 mm), 3¾-inch-long (95.3 mm), standard hex-head structural bolt, and one matching hex nut. For TA-288 helical piles, each coupling connection includes three $^{3}/_{4}$-inch-diameter (19.0 mm), $4^{1}/_{2}$-inch-long (114.3 mm), standard hex-head structural bolts, and three matching hex nuts. For TA-350 helical piles, each coupling connection includes three $^{3}/_{4}$-inch-diameter (19.0 mm), $5^{1}/_{8}$-inch-long (130.2 mm), standard hex-head structural bolts, and three matching hex nuts. Figures 1A, 1B, 2A and 2B provide coupling details for TA-150, TA-175, TA-288, and TA-350.

As an alternate, TA-288 shafts may be extended with a field-welded steel coupler. The steel coupler is a round, $3^{1}/_{2}$-inch-outside-diameter (88.9 mm), nominally 0.300-inch-wall-thickness (7.6 mm), hollow structural steel section (HSS) with a ¼ inch fillet weld between the shaft to the coupler, each end of the coupler. Figure 1A(b) provides welded coupling details for TA-288.

3.2.4 Brackets: The ECP side-load brackets are for attaching to helical piles that support axial compression loads only, which introduce both structure eccentricity (eccentricity between applied loading and reactions acting on the foundation structure) and bracket eccentricity (eccentricity between applied loading and reactions acting on the bracket assembly). ECP direct-load brackets are for attaching to helical piles that support axial compression or axial tension loads. The different brackets are described in Sections 3.2.4.1 through 3.2.4.9.

3.2.4.1 ECP TAB-MUB Bracket Assembly: The ECP TAB-MUB bracket assembly is designed for use with ECP Model TA-150 helical piles or ECP Model TA-288 helical piles. The bracket assembly is used to transfer axial compressive loading only from existing concrete foundations to the helical piles. The bracket assembly consists of a bracket subassembly; two face plates; one T-tube cap plate subassembly; two $^{3}/_{4}$-inch-diameter (19.1 mm), 12-inch-long (304.8 mm), all-threaded rods, with four matching $^{3}/_{4}$-inch (19.1 mm) heavy duty hex nuts; and four $^{1}/_{2}$-inch-diameter (12.7 mm), hex nuts. The four $^{1}/_{2}$-inch-diameter (12.7 mm), hex nuts are used to attach the two face plates to the mounting studs of the bracket subassembly, with two nuts attaching each face plate to the two $^{1}/_{2}$-inch-diameter (12.7 mm) steel all-threaded bars that are factory-welded to the bracket subassembly, so as to ensure the pile shaft is in proper alignment and position with the bracket assembly. The two $^{3}/_{4}$-inch all-threaded rods and four matching nuts are used to connect the T-tube cap plate subassembly to the bracket subassembly. The installing contractor must supply two post-installed, concrete anchor bolts complying with Section 3.2.4.1.5, which are used to attach the bracket subassembly to the concrete foundations. Figures 4 and 8 provide details for TAB-MUB bracket assembly.

3.2.4.1.1 Bracket Subassembly: Each bracket subassembly is constructed from one $^{3}/_{8}$-inch-thick (9.4 mm) steel vertical mounting plate; one $^{1}/_{2}$-inch (12.7 mm) steel horizontal bearing plate (seat plate); two $^{3}/_{8}$-inch-thick (9.4 mm) steel vertical side plates (side shoes); two HSS $1^{1}/_{4}$x$1^{1}/_{4}$x$^{3}/_{16}$ x $6^{1}/_{2}$-inch long tubular sleeves (side tubes); and four $^{1}/_{2}$-inch-diameter (12.7 mm) steel all-threaded bars (mounting studs) that are factory-welded together to form a bracket subassembly. The vertical mounting plate has four, $^{11}/_{16}$-inch-diameter (17.5 mm), factory-made circular holes, for installation of concrete anchors into concrete foundation.

3.2.4.1.2 The 150-MUB T-tube Cap Plate Subassembly: The 150-MUB T-tube Cap Plate Subassembly is used with TA-150 helical piles. Each T-Tube cap subassembly consists of a steel cap plate and a steel collar that are factory-welded together. The steel cap plate measures $1^{1}/_{2}$-inch-thick (38.1 mm), 4-inch wide (101.6 mm), and $7^{7}/_{8}$-inch-long (200.0 mm). The steel collar is 2-inch nominal diameter (50.8 mm) schedule 40 steel pipe, measuring $2^{3}/_{8}$-inch-outside-diameter (60.3 mm), 20-inch-long (508 mm), and a nominal wall thickness of 0.154 inch (3.9 mm). The cap plate has two $^{7}/_{8}$-inch-diameter (22.2 mm) circular holes made at the factory, which are used for attaching two $^{3}/_{4}$-inch-diameter (19.0 mm) all-threaded rods to the T-Tube cap subassembly. The steel collar is located at the center of the cap plate, and provides a sleeve around the TA-150 pile shaft so as to ensure the pile shaft alignment with the bracket assembly.

3.2.4.1.3 The 288-MUB T-tube Cap Plate Subassembly: The 288-MUB T-tube Cap Plate Subassembly is used with TA-288 helical piles. Each T-Tube cap subassembly consists of a steel cap plate and a steel collar that are factory-welded together. The steel cap plate measures $1^{1}/_{2}$-inch-thick (38.1 mm), 4-inch wide (101.6 mm), and $7^{7}/_{8}$-inch-long (200.0 mm). The steel collar is a steel round HSS, measuring 2.0-inch-outside-diameter (50.8 mm), 24-inch-long (609.6 mm), and a nominal wall thickness of 0.188 inch (4.8 mm). The cap plate has two $^{7}/_{8}$-inch-diameter (22.2 mm) circular holes made at the factory, which are used for attaching two $^{3}/_{4}$-inch-diameter (19.0 mm) all-threaded rods to the T-Tube cap subassembly. The steel collar is located at the center of the cap plate, and it fits into the inside of the TA-288 pile shaft so as to ensure the pile shaft alignment with the bracket assembly.

3.2.4.1.4 Face Plates: Each face plate measures $^{1}/_{2}$-inch-thick (12.7 mm), 2-inch wide (50.8 mm), and $6^{3}/_{8}$-inch-long (161.9 mm). The face plate has two $^{9}/_{16}$-inch by $^{3}/_{4}$-inch (14.3 by 19.0 mm) slotted holes made at the factory, which are used for attaching two $^{1}/_{2}$-inch-diameter (12.7 mm) mounting studs.

3.2.4.1.5 Concrete Anchors: Each TAB-MUB bracket must be installed with two $^{1}/_{2}$-inch-diameter (12.7 mm), 6-inch (152.4 mm) long, Hilti Kwik HUS-EZ (KH-EZ ½”X6”), carbon steel concrete anchors in accordance with ICC-ES ESR-3027. The two concrete anchors must be installed at the top or bottom row of holes in the steel vertical mounting plate.

3.2.4.2 ECP TAB-175-LUB Bracket Assembly: The ECP TAB-175-LUB bracket assembly is designed for use with the ECP Model TA-175 helical piles and is used to transfer axial compressive loading only from existing concrete foundations to the helical piles. The bracket assembly consists of a bracket subassembly; three face plate subassemblies; one T-tube cap plate subassembly; two $^{7}/_{8}$-inch-diameter (22.2 mm), 17$^{7}/_{8}$-inch-long (454.0 mm), all-threaded rods, with four matching $^{7}/_{8}$-inch (22.2 mm) hex nuts; and six $^{1}/_{2}$-inch-diameter (12.7 mm), hex nuts. The six $^{1}/_{2}$-inch-diameter (12.7 mm), hex nuts are used to attach the three face plate subassemblies to the mounting studs of the bracket subassembly, with two nuts attaching each face plate subassembly to the two $^{1}/_{2}$-inch-diameter (12.7 mm) steel all-threaded bars that are factory-welded to the bracket subassembly, so as to ensure the pile shaft is in proper alignment and position with the bracket assembly. The two $^{7}/_{8}$-inch all-threaded rods and four matching nuts are used to connect the T-tube cap plate subassembly to the bracket subassembly. The installing contractor must supply two post-installed, concrete anchor bolts complying with Section 3.2.4.2.4, which are used to attach the bracket subassembly to the concrete foundations. Figures 5 and 9 provide details for TAB-175-LUB bracket assembly.

3.2.4.2.1 Bracket Subassembly: Each bracket subassembly is constructed from one $^{1}/_{2}$-inch-thick (12.7 mm) steel vertical mounting plate; one $^{5}/_{8}$-inch (15.9 mm) steel horizontal bearing plate (seat plate); two $^{1}/_{2}$-inch-thick (12.7 mm) steel vertical side plates (side shoes); two HSS 1.5x1.5x$^{3}/_{16}$ x 6$^{1}/_{2}$-inch long tubular sleeves (side tubes); one $^{3}/_{8}$-inch-thick (9.5 mm) steel angle; and six $^{1}/_{2}$-inch-diameter (12.7 mm) steel all-threaded bars (mounting studs) that are factory-welded together to form a bracket subassembly. The vertical mounting plate has four, $^{11}/_{16}$-inch-diameter (17.5 mm), factory-made circular holes, for installation of concrete anchors into concrete foundation.

3.2.4.2.2 T-tube Cap Plate Subassembly: Each T-tube cap plate subassembly consists of a steel cap plate and a steel collar that are factory-welded together. The steel cap plate measures 1$^{1}/_{2}$-inch-thick (38.1 mm), 4-inch-wide (101.6 mm), and 9-inch-long (228.6 mm). The steel collar is a round, hollow structural steel section, HSS 2.50 x 0.203, measuring 28 inches long (711.2 mm), and having a 2.5 inch (63.5 mm) outside diameter and a 0.203 inch (5.16 mm) nominal wall thickness. The cap plate has two 1-inch-diameter (25.4 mm) circular holes made at the factory, which are used for attaching two $^{7}/_{8}$-inch-diameter (22.2 mm) all-threaded rods to the T-tube cap plate subassembly. The steel collar is located at the center of the cap plate, and it fits into the inside of a pile shaft so as to ensure the pile shaft alignment with the bracket assembly.

3.2.4.2.3 Face Plate Subassembly: Each face plate subassembly consists of a steel face plate and two steel square bars that are factory-welded together. The steel face plate measures $^{1}/_{2}$-inch-thick (12.7 mm), 2-inch wide (50.8 mm), and 7$^{7}/_{8}$-inch-long (200.0 mm). The steel square bar measures $^{3}/_{4}$-inch (19.0 mm) in all three orthogonal directions. The face plate has two, $^{5}/_{8}$-inch by $^{3}/_{4}$-inch (15.9 by 19.0 mm) slotted holes made at the factory, which are used for attaching two $^{1}/_{2}$-inch-diameter (12.7 mm) mounting studs.

3.2.4.2.4 Concrete Anchors: Each TAB-175-LUB bracket must be installed with two $^{1}/_{2}$-inch-diameter (12.7 mm), 3$^{1}/_{4}$-inch (82.6 mm) effective minimum embedment, Hilti KwikBolt 3 (KB3), carbon steel concrete anchors (ICC-ES ESR-2302) along with matching hex nuts and matching flat washers or equivalent as determined by the structural design professional, with hot-dip galvanized coating complying with ASTM A153. The two concrete anchors must be installed at the top or bottom row of holes in the steel vertical mounting plate.

3.2.4.3 ECP TAB-288-LUB Bracket Assembly: The ECP TAB-288-LUB bracket assembly is designed for use with the ECP Model TA-288 helical piles and is used to transfer axial compressive loading only from existing concrete foundations to the helical piles. The bracket assembly consists of a bracket subassembly; three face plate subassemblies; one T-tube cap plate subassembly; two $^{7}/_{8}$-inch-diameter (22.2 mm), 17$^{7}/_{8}$-inch-long (454.0 mm), all-threaded rods, with four matching $^{7}/_{8}$-inch (22.2 mm) hex nuts; and six $^{1}/_{2}$-inch-diameter (12.7 mm), hex nuts. The six $^{1}/_{2}$-inch-diameter (12.7 mm), hex nuts are used to attach the three face plate subassemblies to the mounting studs of the bracket subassembly, with two nuts attaching each face plate subassembly to the two $^{1}/_{2}$-inch-diameter (12.7 mm) steel all-threaded bars that are factory-welded to the bracket subassembly, so as to ensure the pile shaft is in proper alignment and position with the bracket assembly. The two $^{7}/_{8}$-inch all-threaded rods and four matching nuts are used to connect the T-tube cap plate subassembly to the bracket subassembly. The installing contractor must supply two post-installed, concrete anchor bolts complying with Section 3.2.4.2.4, which are used to attach the bracket subassembly to the concrete foundations. Figures 5 and 9 provide details for TAB-288-LUB bracket assembly.

3.2.4.3.1 Bracket Subassembly: Each bracket subassembly is constructed from one $^{1}/_{2}$-inch-thick (12.7 mm) steel vertical mounting plate; one $^{5}/_{8}$-inch (15.9 mm) steel horizontal bearing plate (seat plate); two $^{1}/_{2}$-inch-thick (12.7 mm) steel vertical side plates (side shoes); two HSS 1.5x1.5x$^{3}/_{16}$ x 6$^{1}/_{2}$-inch long tubular sleeves (side tubes); one $^{3}/_{8}$-inch-thick (9.5 mm) steel angle; and six $^{1}/_{2}$-inch-diameter (12.7 mm) steel all-threaded bars (mounting studs) that are factory-welded together to form a bracket subassembly. The vertical mounting plate has four, $^{11}/_{16}$-inch-diameter (17.5 mm), factory-made circular holes, for installation of concrete anchors into concrete foundation.

3.2.4.3.2 T-tube Cap Plate Subassembly: Each T-tube cap plate subassembly consists of a steel cap plate and a steel collar that are factory-welded together. The steel cap plate measures 1$^{1}/_{2}$-inch-thick (38.1 mm), 4-inch wide (101.6 mm), and 9-inch-long (228.6 mm). The steel collar is a round, hollow structural steel section, HSS 2.0x0.188, measuring 24 inch long (609.6 mm), and having a 2.0 inch (50.8 mm) outside diameter and a 0.188 inch nominal wall thickness. The cap plate has two 1-inch-diameter (25.4 mm) circular holes made at the factory, which are used for attaching two $^{7}/_{8}$-inch-diameter (22.2 mm) all-threaded rods to the T-tube cap plate subassembly. The steel collar is located at the center of the cap plate, and it fits into the inside of a pile shaft so as to ensure the pile shaft alignment with the bracket assembly.

3.2.4.3.3 Face Plate Subassembly: Each face plate subassembly consists of a steel face plate and two steel square bars that are factory-welded together. The steel face plate measures $^{1}/_{2}$-inch-thick (12.7 mm), 2-inch wide (50.8 mm), and 7$^{7}/_{8}$-inch-long (200.0 mm). The steel square bar measures $^{3}/_{4}$-inch (19.0 mm) in all three orthogonal directions. The face plate has two, $^{5}/_{8}$-inch by $^{3}/_{4}$-inch (15.9 by 19.0 mm) slotted holes made at the factory, which are used for attaching two $^{1}/_{2}$-inch-diameter (12.7 mm) mounting studs.

3.2.4.3.4 Concrete Anchors: See Section 3.2.4.2.4.

3.2.4.4 ECP Model-300 Bracket Assembly: The ECP Model-300 bracket assembly is designed for use with the ECP Model TA-288 helical shaft and is used to transfer compressive loading from existing concrete foundations to the TA-288 helical piles. The bracket assembly consists of a bracket subassembly; three face plates; one T-Tube cap subassembly; two $^{3}/_{4}$-inch-diameter (19.0 mm), 17$^{7}/_{8}$-inch-long (454.0 mm), all-threaded rods, with four matching $^{3}/_{4}$-inch (19.0 mm) hex nuts; and six $^{1}/_{2}$-inch-diameter (12.7 mm), hex nuts. The six $^{1}/_{2}$-inch-diameter (12.7 mm), hex nuts are used to attach the three face plates to the bracket subassembly, with two nuts attaching each face plate to the two $^{1}/_{2}$-inch-diameter (12.7 mm) steel all-threaded bars that are factory-welded to the bracket subassembly, so as to ensure the pile shaft is in proper alignment and position with the bracket assembly. The two $^{3}/_{4}$-inch all-threaded rods and four matching nuts are used to connect the T-tube cap plate subassembly to the bracket subassembly. The installing contractor must supply two post-installed, concrete anchor bolts complying with Section 3.2.4.4.4, which are used to attach the bracket subassembly to the concrete foundations. Figures 6 and 10 provide details for Model-300 bracket assembly.

3.2.4.4.1 Bracket Subassembly: Each bracket subassembly is constructed from one $^{3}/_{8}$-inch-thick (9.5 mm) steel vertical mounting plate; one $^{1}/_{2}$-inch (12.7 mm) steel horizontal bearing plate (seat plate); two $^{3}/_{8}$-inch-thick (9.5 mm) steel vertical side plates (side shoes); two HSS 1.25x1.25x$^{3}/_{16}$ x 9-inch long tubular sleeves (side tubes); and six $^{1}/_{2}$-inch-diameter (12.7 mm) steel all-threaded bars (mounting studs) that are factory-welded together to form a bracket subassembly. The vertical mounting plate has, four, $^{11}/_{16}$-inch-diameter (17.5 mm), factory-made, circular holes, for installation of concrete anchors into concrete foundation.

3.2.4.4.2 T-Tube Cap Subassembly: Each T-Tube cap subassembly consists of a steel cap plate and a steel collar that are factory-welded together. The steel cap plate measures 1$^{1}/_{2}$-inch-thick (38.1 mm), 4-inch wide (101.6 mm), and 7$^{7}/_{8}$-inch-long (200.0 mm). The steel collar is a steel round HSS, measuring 2.0-inch-outside-diameter (50.8 mm), 24-inch-long (609.6 mm), and a nominal wall thickness of 0.188 inch (4.8 mm). The cap plate has two $^{7}/_{8}$-inch-diameter (22.2 mm) circular holes made at the factory, which are used for attaching two $^{3}/_{4}$-inch-diameter (19.0 mm) all-threaded rods to the T-Tube cap subassembly. The steel collar is located at the center of the cap plate, and it fits into the inside of a pile shaft so as to ensure the pile shaft alignment with the bracket assembly.

3.2.4.4.3 Face Plate: Each steel face plate measures $^{3}/_{8}$-inch-thick (9.5 mm), 2-inch wide (50.8 mm), and 6$^{3}/_{8}$-inch-long (161.9 mm). The face plate has two slotted holes, with each slot consists of a straight cut hole of $^{5}/_{8}$-inch wide by $^{15}/_{16}$-inch long (15.9 by 406.4 mm) and a semi-circular hole of $^{5}/_{8}$-inch diameter (15.9 mm), which are used for attaching two $^{1}/_{2}$-inch-diameter (12.7 mm) mounting studs.

3.2.4.4.4 Concrete Anchors: See Section 3.2.4.2.4.

3.2.4.5 ECP TAB-350-LUB Bracket Assembly: The ECP TAB-350-LUB bracket assembly is designed for use with the ECP Model TA-350 helical piles and is used to transfer axial compressive loading only from existing concrete foundations to the helical piles. The bracket assembly consists of a bracket subassembly;

three face plate subassemblies; one T-tube cap plate subassembly; two $^{7}/_{8}$-inch-diameter (22.2 mm), $17^{7}/_{8}$-inch-long (454.0 mm), all-threaded rods, with four matching $^{7}/_{8}$-inch (22.2 mm) hex nuts; and six $^{1}/_{2}$-inch-diameter (12.7 mm), hex nuts. The six $^{1}/_{2}$-inch-diameter (12.7 mm), hex nuts are used to attach the three face plate subassemblies to the mounting studs of the bracket subassembly, with two nuts attaching each face plate subassembly to the two $^{1}/_{2}$-inch-diameter (12.7 mm) steel all-threaded bars that are factory-welded to the bracket subassembly, so as to ensure the pile shaft is in proper alignment and position with the bracket assembly. The two $^{7}/_{8}$-inch all-threaded rods and four matching nuts are used to connect the T-tube cap plate subassembly to the bracket subassembly. The installing contractor must supply two post-installed, concrete anchor bolts complying with Section 3.2.4.5.4, which are used to attach the bracket subassembly to the concrete foundations. Figures 5 and 9 provide details for TAB-350-LUB bracket assembly.

3.2.4.5.1 Bracket Subassembly: Each bracket subassembly is constructed from one $^{1}/_{2}$-inch-thick (12.7 mm) steel vertical mounting plate; one $^{5}/_{8}$-inch (15.9 mm) steel horizontal bearing plate (seat plate); two $^{1}/_{2}$-inch-thick (12.7 mm) steel vertical side plates (side shoes); two HSS 1.5x1.5x$^{3}/_{16}$ x $6^{1}/_{2}$-inch long tubular sleeves (side tubes); one $^{3}/_{8}$-inch-thick (9.5 mm) steel angle; and six $^{1}/_{2}$-inch-diameter (12.7 mm) steel all-threaded bars (mounting studs) that are factory-welded together to form a bracket subassembly. The vertical mounting plate has four, $^{11}/_{16}$-inch-diameter (17.5 mm), factory-made circular holes, for installation of concrete anchors into concrete foundation.

3.2.4.5.2 T-tube Cap Plate Subassembly: Each T-tube cap plate subassembly consists of a steel cap plate and a steel collar that are factory-welded together. The steel cap plate measures $1^{1}/_{2}$-inch-thick (38.1 mm), 4-incn wide (101.6 mm), and 9-inch-long (228.6 mm). The steel collar is a round, hollow structural steel section, HSS 2.50 x 0.203, measuring 27.75 inches long (704.9 mm), and having a 2.5 inch (63.5 mm) outside diameter and a 0.203 inch (5.16 mm) nominal wall thickness. The cap plate has two 1-inch-diameter (25.4 mm) circular holes made at the factory, which are used for attaching two $^{7}/_{8}$-inch-diameter (22.2 mm) all-threaded rods to the T-tube cap plate subassembly. The steel collar is located at the center of the cap plate, and it fits into the inside of a pile shaft so as to ensure the pile shaft alignment with the bracket assembly.

3.2.4.5.3 Face Plate Subassembly: Each face plate subassembly consists of a steel face plate and two steel square bars that are factory-welded together. The steel face plate measures $^{1}/_{2}$-inch-thick (12.7 mm), 2-inch wide (50.8 mm), and $7^{7}/_{8}$-inch-long (200.0 mm). The steel square bar measures $^{3}/_{4}$-inch (19.0 mm) in all three orthogonal directions. The face plate has two, $^{5}/_{8}$-inch by $^{3}/_{4}$-inch (15.9 by 19.0 mm) slotted holes made at the factory, which are used for attaching two $^{1}/_{2}$-inch-diameter (12.7 mm) mounting studs.

3.2.4.5.4 Concrete Anchors: See Section 3.2.4.2.4.

3.2.4.6 ECP New Construction Bracket TAB-150-NC Assembly: The ECP TAB-150-NC is designed for use with the ECP Model TA-150 helical shaft and for embedment in cast-in-place concrete foundations for resisting axial compression and axial tension loads. Each TAB-150-T assembly consists of one cap/bearing plate and one steel pipe sleeve that are factory-welded together to form the bracket. The steel cap plate is $^{1}/_{2}$ inch (12.7 mm) thick and 6 inches (152 mm) square. The sleeve is a steel round HSS2.375x0.154, measuring $2^{3}/_{8}$-inch-outside-diameter (60.3 mm), $5^{3}/_{4}$-inch-long (146.0 mm), and a nominal wall thickness of 0.154 inch (3.9 mm), with a pair of $^{13}/_{16}$-inch-diameter (20.6 mm) holes manufactured in opposite walls of the sleeve, allowing the bracket sleeve and the top of the shaft section (which has one pair of holes as described in Section 3.2.3) to be through-bolted together during the field installation. One $^{3}/_{4}$-inch-diameter (19.0 mm), $3^{1}/_{2}$-inch-long (88.9 mm), standard hex-head hex structural bolt (with threads excluded from the shear planes) along with one matching $^{3}/_{4}$-inch (19.0 mm) hex nut, supplied by the report holder, must be installed to resist the axial tension load. Figure 7 and Table 6A provide details for TAB-150-T bracket assembly.

3.2.4.7 ECP New Construction Bracket TAB-175-NC Assembly: The ECP TA-175-NC is designed for use with the ECP Model TA-175 helical shaft and for embedment in cast-in-place concrete foundations for resisting axial compression and axial tension loads. Each TAB-175-NC assembly consists of one cap/bearing plate and one steel pipe sleeve that are factory-welded together to form the bracket. The steel cap plate is $^{3}/_{4}$ -inch (19.1 mm) thick and 8 inches (203.2 mm) square. The sleeve is a steel tube HSS 2.50 x 2.50 x 0.25, measuring $2^{1}/_{2}$-inch-outside-diameter (63.5 mm), $6^{1}/_{2}$-inch-long (165.1 mm), and a nominal wall thickness of 0.250 inch (6.4 mm), with a pair of $^{15}/_{16}$-inch-diameter (23.8 mm) holes manufactured in opposite walls of the sleeve, allowing the bracket sleeve and the top of the shaft section (which has one pair of holes as described in Section 3.2.3) to be through-bolted together during the field installation. One $^{7}/_{8}$-inch-diameter (22.2 mm), $3^{3}/_{4}$-inch-long (95.3 mm), standard hex-head hex structural bolt (with threads excluded from the shear planes) along with one matching $^{7}/_{8}$-inch (22.2 mm) hex nut, supplied by the report holder, must be installed to resist the axial tension load. Figure 7 and Table 6A provide details for TAB-175-NC bracket assembly.

3.2.4.8 ECP New Construction Bracket TAB-288-NC Assembly: The ECP TAB-288-NC is designed for use with the ECP Model TAB-288 helical shaft and for embedment in cast-in-place concrete foundations for resisting axial compression and axial tension loads. Each TAB-288-NC assembly consists of one cap/bearing plate and one steel pipe sleeve that are factory-welded together to form the bracket. The steel cap plate is $^{3}/_{4}$-inch (19.1 mm) thick and 8 inches (203.2 mm) square. The sleeve is a steel round HSS 3.5 x 0.216, measuring $3^{1}/_{2}$-inch-outside-diameter (88.9 mm), $7^{3}/_{4}$-inch-long (196.9 mm), and a nominal wall thickness of 0.216-inch (5.5 mm), with two pairs of $^{7}/_{8}$-inch-diameter (22.2 mm) holes manufactured in opposite walls of the sleeve, allowing the bracket sleeve and the top of the shaft section (which has 3 pairs of holes as described in Section 3.2.3) to be through-bolted together during the field installation. Two $^{3}/_{4}$-inch-diameter (19.0 mm), $4^{3}/_{8}$-inch-long (111.1 mm), standard hex-head hex structural bolt (with threads excluded from the shear planes) along with two matching $^{3}/_{4}$-inch (19.0 mm) hex nuts, supplied by the report holder, must be installed to resist the axial tension load. Figure 7 and Table 6A provide details for TAB-288-NC bracket assembly.

3.2.4.9 ECP New Construction Bracket TAB-350-NC Assembly: The ECP TAB-350-NC is designed for use with the ECP Model TAB-350 helical shaft and for embedment in cast-in-place concrete foundations for resisting axial compression and axial tension loads. Each TAB-350-NC assembly consists of one cap/bearing plate and one steel pipe sleeve that are factory-welded together to form the bracket. The steel cap plate is $^{3}/_{4}$-inch (19.1 mm) thick and 8 inches (203.2 mm) square. The sleeve is a steel round HSS 4.5 x 0.34, measuring $4^{1}/_{2}$-inch-outside-diameter (114.3 mm), $7^{3}/_{4}$-inch-long (196.9 mm), and a nominal wall thickness of 0.34-inch (8.6 mm), with two pairs of $^{7}/_{8}$-inch-diameter (22.2 mm) holes manufactured in opposite walls of the sleeve, allowing the bracket sleeve and the top of the shaft section (which has 3 pairs of holes as described in Section 3.2.3) to be through-bolted together during the field installation. Two $^{3}/_{4}$-inch-diameter (19.0 mm), $5^{1}/_{8}$-inch-long (130.2 mm), standard hex-head hex structural bolt (with threads excluded from the shear planes) along with two matching $^{3}/_{4}$-inch (19.0 mm) hex nuts, supplied by the report holder, must be installed to resist the axial tension load. Figure 7 and Table 6A provide details for TAB-350-NC bracket assembly.

3.3 Material Specifications:

3.3.1 Helical Pile Lead Sections and Extension Sections:

3.3.1.1 Models TA-150 and TA-175: The shaft lead and extension sections are solid, hot-wrought, RCS, carbon steel bars, conforming to a proprietary specification, and having a minimum yield strength of 90 ksi (620 MPa) and a minimum tensile strength of 120 ksi (827 MPa). The pile shafts and helix plates (where provided) are hot-dipped galvanized as welded assemblies in accordance with ASTM A123, Grade 100.

3.3.1.2 Models TA-288 and TA-350: The shaft lead and extension sections are carbon steel round structural tubes, conforming to ASTM A500, Grade C, except having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 62 ksi (425 MPa). The pile shafts and helix plates (where provided) are hot-dipped galvanized as welded assemblies in accordance with ASTM A123, Grade 75 for the Model TA-288 and ASTM A123, Grade 100 for the Model TA-350.

3.3.2 Helix Plates:

3.3.2.1 Helix Plates for Model TA-150: The helix plates that have an outer diameter of 8, 10, 12, or 14 inches (203, 254, 305 or 356 mm) are High-Strength Low-Alloy steels, conforming to ASTM A572, Grade 50, and having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 65 ksi (448 MPa). The helix plates and the shafts to which they are factory-welded are hot-dipped galvanized as welded assemblies in accordance with ASTM A123, Grade 100.

3.3.2.2 Helix Plates for Models TA-175, TA-288, and TA-350: See Section 3.3.2.1.

3.3.3 Shaft Coupling:

3.3.3.1 Upset Socket: The upset socket is an integral part (integrally forged) of the extension shaft, and it is of the same material as the extension section itself.

3.3.3.2 Coupling Sleeve: The coupling sleeve is a round HSS sleeve conforming to ASTM A500, Grade C, having a minimum yield strength of 50 ksi (344 MPa) and a minimum tensile strength of 62 ksi (425 MPa).

3.3.3.3 Bolts and Nuts: The bolts used in couplings for helical pile shafts conform to SAE J429, Grade 8, with threads excluded from the shear planes. The matching hex nuts conform to SAE J995, Grade 8. The bolts and nuts are hot-dipped galvanized in accordance with ASTM A153.

3.3.4 ECP MUB Bracket Assemblies (TAB-288-MUB):

3.3.4.1 Bracket Subassembly: The steel vertical mounting plate, horizontal bearing plate and vertical side plates conform to ASTM A572, Grade 50, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 65 ksi (448 MPa). The side tubes conform to ASTM A500, Grade C, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 62 ksi (425 MPa). The mounting studs are $^{1}/_{2}$-13 UNC 2A threaded rods, conforming to ASTM 193, Grade B7, having a minimum yield strength of 105 ksi (720 MPa) and a minimum tensile strength of 125 ksi (860 MPa). The welded assembly is hot-dipped galvanized in accordance with ASTM A123, Grade 100, except the mounting studs are zinc coated in accordance with ASTM B633, with a Coating Classification of Fe/Zn 5 and a Surface Condition code of SC1.

3.3.4.2 T-tube Cap Plate Subassembly: The steel cap plate conforms to ASTM A572 Grade 50, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 65 ksi (448 MPa). The steel collar conforms to ASTM A500, Grade C, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 62 ksi (427 MPa). The welded assembly is hot-dipped galvanized in accordance with ASTM A123, Grade 100.

3.3.4.3 Face Plate: The steel face plate conforms to ASTM A572, Grade 50, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 65 ksi (448 MPa). The plate is hot-dipped galvanized in accordance with ASTM A123, Grade 100.

3.3.4.4 Structural Fasteners for TAB-MUB Bracket Assemblies: The threaded rods, used in connecting the T-tube cap plate subassembly to the bracket subassembly, are $^{3}/_{4}$-10 UNC 2A threaded rods, conforming to ASTM A193, Grade B7, having a minimum yield strength of 105 ksi (720 MPa) and a minimum tensile strength of 125 ksi (860 MPa). The matching nuts are $^{3}/_{4}$-10 UNC 2B hex nuts, conforming to SAE J995, Grade 2. The steel nuts used to connect face plate assemblies to the mounting studs of the bracket subassembly are $^{1}/_{2}$-13 UNC 2B hex nut, conforming to A563, Grade A. The threaded rods and matching nuts and the nuts for connecting to the mounting studs are zinc-coated in accordance with ASTM B633, with a Coating Classification of Fe/Zn 5 and a Surface Condition code of SC1.

3.3.5 ECP LUB Bracket Assemblies (TAB-175-LUB, TAB-288-LUB and TAB-350-LUB):

3.3.5.1 Bracket Subassembly: The steel vertical mounting plate, horizontal bearing plate and vertical side plates conform to ASTM A572, Grade 50, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 65 ksi (448 MPa). The side tubes conform to ASTM A500, Grade C, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 62 ksi (425 MPa). The steel angle conforms to ASTM A36, having a minimum yield strength of 36 ksi (250 MPa) and a minimum tensile strength of 58 ksi (400 MPa). The mounting studs are $^{1}/_{2}$-13 UNC 2A threaded rods, conforming to ASTM 193, Grade B7, having a minimum yield strength of 105 ksi (720 MPa) and a minimum tensile strength of 125 ksi (860 MPa). The welded assembly is hot-dipped galvanized in accordance with ASTM A123, Grade 100, except the mounting studs are zinc coated in accordance with ASTM B633, with a Coating Classification of Fe/Zn 5 and a Surface Condition code of SC1.

3.3.5.2 T-tube Cap Plate Subassembly: The steel cap plate conforms to ASTM A36, having a minimum yield strength of 36 ksi (248 MPa) and a minimum tensile strength of 58 ksi (400 MPa). The steel collar conforms 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 welded assembly is hot-dipped galvanized in accordance with ASTM A123, Grade 100.

3.3.5.3 Face Plate Subassembly: The steel face plate conforms to ASTM A572, Grade 50, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 65 ksi (448 MPa). The steel square bars conform to ASTM A36, having a minimum yield strength of 36 ksi (250 MPa) and a minimum tensile strength of 58 ksi (400 MPa). The welded assembly is hot-dipped galvanized in accordance with in accordance with ASTM A123, Grade 100.

3.3.5.4 Structural Fasteners for LUB Bracket Assemblies (TAB-175-LUB, TAB-288-LUB and TAB-350-LUB): The threaded rods, used in connecting the T-tube cap plate subassembly to the bracket subassembly, are $^{7}/_{8}$-9 UNC 2A threaded rods, conforming to ASTM A193, Grade B7, having a minimum yield strength of 105 ksi (720 MPa) and a minimum tensile strength of 125 ksi (860 MPa). The matching nuts are $^{7}/_{8}$-9 UNC 2B hex nuts, conforming to SAE J995, Grade 2. The steel nuts used to connect face plate assemblies to the mounting studs of the bracket subassembly are $^{1}/_{2}$-13 UNC 2B hex nut, conforming to A563, Grade A. The threaded rods and matching nuts and the nuts for connecting to the mounting studs are zinc-coated in accordance with ASTM B633, with a Coating Classification of Fe/Zn 5 and a Surface Condition code of SC1.

3.3.6 ECP Model-300 Bracket Assembly:

3.3.6.1 Bracket Subassembly: The steel vertical mounting plate, horizontal bearing plate and vertical side plates conform to ASTM A572, Grade 50, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 65 ksi (448 MPa). The side tubes conform to ASTM A500, Grade C, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 62 ksi (425 MPa). The mounting studs are $^1/_2$-13 UNC 2A threaded rods, conforming to ASTM 193, Grade B7, having a minimum yield strength of 105 ksi (720 MPa) and a minimum tensile strength of 125 ksi (860 MPa). The welded assembly is hot-dipped galvanized in accordance with ASTM A123, Grade 100, except the mounting studs are zinc coated in accordance with ASTM B633, with a Coating Classification of Fe/Zn 5 and a Surface Condition code of SC1.

3.3.6.2 T-Tube Cap Subassembly: The steel cap plate conforms to ASTM A36, having a minimum yield strength of 36 ksi (248 MPa) and a minimum tensile strength of 58 ksi (400 MPa). The steel collar conforms 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 welded assembly is hot-dipped galvanized in accordance with ASTM A123, Grade 100.

3.3.6.3 Face Plate: The steel face plate conforms to ASTM A572, Grade 50, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 65 ksi (448 MPa). The face plate is hot-dipped galvanized in accordance with ASTM A123, Grade 100.

3.3.6.4 Structural Fasteners for Model-300 Bracket Assembly: The threaded rods, used in connecting the T-tube cap plate subassembly to the bracket subassembly, are $^3/_4$-10 UNC 2A threaded rods, conforming to ASTM A193, Grade B7, having a minimum yield strength of 105 ksi (720 MPa) and a minimum tensile strength of 125 ksi (860 MPa). The matching nuts are $^3/_4$-10 UNC 2B hex nuts, conforming to SAE J995, Grade 2. The steel nuts used to connect face plate assemblies to the mounting studs of the bracket subassembly are $^1/_2$-13 UNC 2B hex nut, conforming to ASTM A563, Grade A. The threaded rods and matching nuts and the nuts for connecting to the mounting studs are zinc-coated in accordance with ASTM B633, with a Coating Classification of Fe/Zn 5 and a Surface Condition code of SC1**.**

3.3.7 ECP New Construction Brackets (TAB-150-NC, TAB-175-NC, TAB-288-NC and TAB-350-NC):

3.3.7.1 Bracket: The cap plate conforms to ASTM A572, Grade 50, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 65 ksi (448 MPa). The round HSS sleeve conforms to ASTM A500, Grade C, having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of 62 ksi (425 MPa). The brackets are hot-dipped galvanized in accordance with ASTM A123, Grade 100.

3.3.7.2 Structural Fasteners for New Construction Brackets: The bolts used in connecting shaft to the bracket for resisting axial tension conform to SAE J429, Grade 8, with threads excluded from the shear planes. The matching hex nuts conform to SAE J995, Grade 8. The bolts and nuts are hot-dipped galvanized in accordance with ASTM A153.

3.3.7.3 Concrete for New Construction Brackets: The minimum specified concrete strength at 28-days, and the concrete cover dimensions, must comply with Table 6B.

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 approved by the code official for each project, and must be based on accepted engineering principles in accordance with 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 the Load and Resistance Factor Design (LRFD) described in IBC Section 202 and AISC 360 Section B3. The design method for the concrete components is the Strength Design (also called LRFD) described in IBC Section 202 and ACI 318. The design method for soils is the ASD prescribed in IBC Sections 202 and 1802.1 (Section 1801.2 of the 2015, 2012, and 2009 IBC).

The structural analysis must consider all applicable internal forces (axial forces, shears, bending moments and torsional moments, if applicable) due to applied loads, eccentricity between applied loads and reactions acting on the pile-supported structure, the forces/moments exerted on the concrete foundations by the ECP connection brackets, and the design span(s) between helical foundations.

ECP side-load brackets entail eccentric connection to the pile-supported structure. The effects of this eccentricity can be divided into two components: bracket eccentricity and structural eccentricity. The structural eccentricity relates to the offset distance between the applied loads and the reactions, including reactions from the brackets acting on the pile-supported structure. The bracket eccentricity is resisted by the pile shaft, the bracket, the connection between the shaft and the bracket, and the connection between the bracket and the pile-supported structure. The effects of the bracket eccentricity have been evaluated in this report. The effects of the structural eccentricity, including the reactions (forces and moments) exerted by the bracket to the pile-supported structures, vary with application, and must be included in the structural analysis by a registered design professional. The result of this 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 determined based on the most stringent requirements of the following: engineering analysis; tested conditions and specified minimum pile embedment described in this report; the site-specific geotechnical investigation report; and site-specific load tests, as applicable.

The allowable strengths (capacities) of the ECP helical foundation components (bracket, shaft, helix, and soil) are included in this evaluation report. The bracket capacities are listed in Tables 5 and 6; shaft capacities are listed in Tables 3, 4 and 7; helix capacities are listed in Table 8; and soil capacities are described in Tables 1 and 2 and Section 4.1.5, below.

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 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 written report of the geotechnical investigation must be submitted to the code official as part of the required 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 report and the soil capacity of the helical pile must be established in accordance with Equation 3 in Section 4.1.5 of this report using a safety factor of 2.5. The site-specific geotechnical investigation report must include, but not be limited to, the following information:

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 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.
7. Recommendations for design criteria, including but not limited to: mitigations of effects of differential settlement and varying soil strength; and effects of adjacent loads.
8. Field inspection and reporting procedures (to include procedures for verification of the installed bearing capacity when required).
9. Load test requirements.
10. Any questionable soil characteristics and special design provisions, as necessary.

4.1.2 Bracket Capacity (P1): Only localized limit states related to interaction between a bracket and its supported concrete foundation have been evaluated in this evaluation report. All other limit states related to supported concrete foundations, such as beam (one-way) shear, and flexural (bending) related limit states, have not 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 all applicable limit states and the direction and eccentricity of applied loads, including reactions provided by the brackets, acting on the concrete foundation. Under Seismic Design Categories D, E and F, the bracket must be designed in accordance with IBC Section 1810.3.11.2. Refer to Table 5 for side load bracket allowable compression capacities and Table 6 for new construction bracket allowable axial tension and axial compression capacities.

4.1.3 Shaft Capacity (P2): The top of shafts must be braced as prescribed 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 that is 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 soil must be defined as any soil with a Standard Penetration Test blow count of five or greater. Soft soil 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.

All helical pile systems addressed in this evaluation report, including Model TA-150 shaft used with Model TA-150-T new construction bracket; Model TA-175 shaft used with either Model TAB-175-LUB retrofit bracket or Model TAB-175-NC new construction bracket; Model TA-288 shaft used with TAB-288-LUB retrofit bracket, Model-300 retrofit bracket, or TAB-288-NC new construction bracket; and Model TA-350 shaft used with either TAB-350-LUB retrofit bracket or Model TA-350-NC new construction bracket, must be installed under a fully braced condition, which requires the top of the shaft be braced as stipulated in this section; shaft must not stand in air, water or fluid soils; and the shaft must be embedded into a minimum of 5 feet (1524 mm) firm soil or a minimum of 10 feet (3048 mm) soft soil.

Shaft capacities of the helical foundation systems in air, water or fluid soils must be determined by a registered design professional considering shaft support conditions and shaft unbraced length.

The following are the allowable stress design (ASD) shaft capacities:

- Allowable compression capacity: Reference Table 3 for Model TA-175 shaft used with TAB-175-LUB retrofit bracket, Model TA-288 shaft used with TAB-288-LUB retrofit bracket or with Model-300 retrofit bracket, and Model TA-350 shaft used with TAB-350-LUB retrofit bracket; Table 4 for Model TA-150 shaft used with Model TA-150-T new construction bracket, Model TA-175 shaft used with Model TAB-175-NC new construction bracket, Model TA-288 shaft used with Model TAB-288-NC new construction bracket, and Model TA-350 shaft used with Model TAB-350-NC new construction bracket.
- Allowable tension capacity: Reference Table 7A
- Allowable lateral shear capacity: Reference Table 7A
- Allowable bending capacity: Reference Table 7A
- Shaft torsion rating: Reference Tables 1A, 1B, 2A and 2B, for TA-150, TA-175, TA-288, and TA-350, respectively

4.1.4 Helix Plate Capacity (P3): The helix compression and tension load capacities (P3) are listed in Table 8. For helical piles with more than one helix, the allowable helix capacity, P3, for the helical foundation system, may be taken as the sum of the least allowable capacity of each individual helix.

4.1.5 Soil Capacity (P4): The design axial compressive and tensile load capacities of helical piles based on soil resistance (P4) 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 that predicted by Method 1 or 2, described above.

With the individual helix bearing method, the total nominal axial load capacity of the helical pile is determined as the sum of the individual areas of the helical bearing plates times the ultimate bearing capacities of the soil or rock comprising the respective bearing strata for the plates, as follows:

Q_{tot} = $\Sigma(A_h q_u)$ (Equation 1)

where:

Q_{tot} = predicted nominal axial tensile or compressive capacity of the helical pile, lbf (N).

A_h = area of an individual helix bearing plate, in.^{2} (mm^2).

q_u = ultimate unit bearing capacity of the soil or rock comprising the bearing stratum for the individual helix bearing plate, psi (MPa).

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 surface area of the shaft above the uppermost helical bearing plate times the ultimate skin friction.

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

The torque correlation method must be used to determine the ultimate capacity (Q_{ult}) of the pile (Equation 2). A safety factor of at least 2 must be applied to the ultimate capacity to determine the allowable soil capacity (Q_{all}) of the pile (Equation 3).

Q_{ult} = K_t T (Equation 2)

Q_{all} = Q_{ult} / FS (Equation 3)

FS $\geq$ 2.0 or 2.5 under the IRC

where:

Q_{ult} = Ultimate axial tensile or compressive capacity (lbf or N) of the helical pile, which must be limited to the following maximum values: 57.6 kips (256.2 kN) for TA-150 helical piles in compression; 50.7 kips (225.5 kN) for TA-150 helical piles in tension; 84.6 kips (376.2 kN) for TA-175 helical piles in compression; 79.8 kips (355.0 kN) for TA-175 helical piles in tension; 74.9 kips (333.0 kN) for TA-288 helical piles in compression with forged couplers; 58.8 kips (261.5 kN) for TA-288 helical piles in tension with forged couplers; 72.2 kips (321.2 kN) for TA-288 helical piles in compression with welded couplers; 70.9 kips (315.4 kN) for TA-288 helical piles in tension with welded couplers 107.5 kips (478 kN) for TA-350 piles in compression; 92.1 kips (409.8 kN) for TA-350 helical piles in tension.

Q_{all} = Allowable axial tensile or compressive capacity (lbf or N), which must be limited to the following maximum values: 28.8 kips (128.1 kN) for TA-150 helical piles in compression; 25.4 kips (113.0 kN) for TA-150 helical piles in tension; 42.3 kips (188.1 kN) for TA-175 helical piles in compression; 39.9 kips (177.5 kN) for TA-175 helical piles in tension; 37.4 kips (166.5 kN) for TA-288 helical piles in compression; 29.4 kips (130.8 kN) for TA-288 helical piles in tension; 53.7 kips (239 kN) for TA-350 piles in compression; 46.1 kips (204.9 kN) for TA-350 helical piles in tension.

K_t = Torque correlation factor of 10 ft^{-1} (32.8 m^{-1}) for the shaft Model TA-150 (1.5-inch round corner square shaft), torque correlation factor of 10 ft^{-1} (32.8 m^{-1}) for the shaft Model TA-175 (1.75-inch round corner square shaft), torque correlation factor of 9 ft^{-1} (29.5 m^{-1}) for shaft model TA-288 (2.875-inch outside diameter round shaft); and torque correlation factor of 7 ft^{-1} (22.9 m^{-1}) for shaft model TA-350 (3.50-inch outside diameter round shaft).

T = Effective torsional resistance or final installation torque, which is defined as the installation torque measured when the pile reaches its final tip embedment or the average of the last three installation torque measurements, whichever is less. Such measurements must be made at 1-foot (305 mm) increments of tip embedment as the lead helix moves from a position, which is 2 feet (710 mm) prior to the final tip embedment, to the final tip embedment, in lbf-ft or N-m.

The lateral capacity of the piles referenced in Table 7B of this report is based on field testing of the 1.75-inch RCS and 3.5-inch-outside-diameter shafts with a single 8-inch-diameter helical plate installed in a clay over claystone soil having an average standard penetration blow count of 15, at a minimum embedment as indicated in Table 7B. For soil condition other than clay over claystone, the lateral capacity of the pile must be designed by a registered design professional.

4.1.6 Foundation System: The overall allowable capacity of the ECP helical foundation system (in tension and compression) depends upon the analysis of interaction of brackets, shafts, helical plates, and soils, and must be based on the least of the following conditions 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.
- P2: Allowable capacities of the shaft and shaft couplings. See Section 4.1.3 of this report.
- P3: Sum of the allowable axial capacity of helical bearing plates affixed to the pile shaft. See Section 4.1.4 of this report.
- P1: Allowable axial load capacity of the bracket. See Section 4.1.2 of this report.

4.1.7 Settlement Analysis: The pile head vertical movement at allowable load of an ECP helical pile may be estimated as the sum of the following: the movement at helix plates due to soil deformation and helix plate deflection, and the shaft elastic shortening or lengthening including slip in shaft couplers. The corresponding equation is described below:

$\Delta_{total} = \Delta_{helix} + \Delta_{shaft}$ (Equation 4)

where:

Δ_{total} = Total pile head vertical movement, in. (mm).

Δ_{helix} = Movement of helix plates within soil, in. (mm).

Δ_{shaft} = Shaft elastic shortening/lengthening, in. (mm).

The reliability of foundation system capacity and settlement predictions may be improved by performing full-scale field tests at the construction site using piles of same configuration as the intended production piles.

4.1.7.1 Shaft Elastic Shortening and Lengthening: Elastic shortening or lengthening of an ECP TA-150, TA-175, TA-288 or TA-350 shaft may be a significant contributor to overall pile head movement under load for long piles. For loads up to and including the allowable load limits found in the tables of this report, the length change that does not include slip in couplers can be estimated as :

$\Delta_{shaft} = P\,L/(A\,E)$ (Equation 5)

where:

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

P = applied axial load, lbf (N).

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

A = cross-sectional area of the shaft, see Tables 9 through 12, $in.^2$ (mm^2).

E = Young's modulus of the shaft, may be taken as 29,000 ksi (200 000 MPa).

The effective length of the shaft, L, may be approximated as the average of the distances from the point of load application to each helix plate.

For the TA-288 piles with forged couplers, the slip in couplers is 0.205 inch (5.21 mm) per coupler.

For the TA-288 piles with welded couplers, the slip in couplers is 0.132 inch (3.35 mm) per coupler.

For the TA-350 piles, the slip in coupler is 0.132 inch (3.35 mm) per coupler.

For the TA-150 piles, the slip in couplers is 0.201 inch (5.10 mm) per coupler.

For the TA-175 piles, the slip in couplers is 0.193 inch (4.90 mm) per coupler.

4.1.7.2 Helix Movement: The evaluation of helix movement due to helix deformation, soil deformation, and the helix-soil interaction, is beyond the scope of this evaluation report.

4.2 Installation:

4.2.1 General:

1. The ECP helical foundation systems must be installed in accordance with this section (Section 4.2), IBC Section 1810.4.11, site-specific approved construction documents (engineering drawings and specifications), and the manufacturer's written installation instructions. In case of conflict, the most stringent requirement governs.
2. The ECP helical foundation systems must be installed by ECP trained and certified installers.
3. A hydraulic gear motor is required to install the ECP helical piles to the desired torque and depth. The installation torque rating of the hydraulic gear motor must be at least 25 percent higher than the maximum installation torque noted in Tables 1A, 1B, 2A and 2B, for TA-150, TA-175, TA-288, and TA-350. Rotation must range between 5 and 25 revolutions per minute.
4. The installation torque applied to the ECP helical piles must be monitored continuously during installation. The maximum installation toques, noted in Tables 1A, 1B, 2A and 2B, must not be exceeded during pile installation.
5. The hydraulic installation motor must be installed to portable equipment or to a suitable machine capable of providing the proper installation angle, reaction against installation torque, and the downward force (crowd). If using portable equipment, the torque reaction bar must be properly secured against movements in all directions.
6. The foundation piles must be aligned both vertically and horizontally as specified in the approved plans. The new construction helical pile system (TA-150 shaft installed with TAB-150-NC bracket, TA-175 shaft installed with TAB-175-NC bracket, and TA-350 shaft installed with TAB-350-NC bracket) must be installed vertically plumb into the ground with a maximum allowable angle of inclination of 0° ± 1°. The retrofit helical pile systems (TA-175, TA-288 and TA-350 shafts with retrofit brackets) must be installed such that the angles of inclination from vertical does not exceed 4° ± 1° for TA-288 shaft installed with TAB-288-LUB bracket;0° ± 1° for TA-288 shaft installed with Model-300 bracket; and 2° ± 1° for TA-175 shaft installed with TAB-175-LUB bracket and TA-350 shaft installed with TAB-350-LUB bracket.
7. The helical piles must be installed in a smooth and continuous manner using sufficient downward pressure for uniform advancement. Installation speeds must be limited to less than 25 revolutions per minute (rpm).
8. The foundation piles must be installed to the specified installation torque and minimum pile tip embedment specified in the approved construction documents.
9. For tension applications, the pile must be installed such that the minimum depth from the ground surface to the uppermost helix is 12D, where D is the diameter of the largest helix. In cases where the installation depth is less than 12D, the minimum embedment depth must be determined by a registered design professional based on site-specific soil conditions, which must be subject to the approval of the code official. For tension application where the helical pile is installed at an embedment depth less than 12D, the torque-correlation soil capacity, P4, is outside the scope of this report.
10. The helical piles must be located in accordance with the approved plans and specifications.

4.2.2 Installation Procedures for ECP Models TA-175, TA-288, and TA-350 Helical Piles with Retrofit Brackets (TAB-175-LUB, TAB-288-LUB, TAB-350-LUB and Model-300 Brackets):

1. An area at each location adjacent to the building foundation must be excavated to expose the footing or grade beam. The excavation must be approximately a depth of 14 inches (356 mm) and a width of 10 inches (254 mm) below the bottom of the foundation.
2. Soil attached to the bottom of the footing or grade beam must be removed. The footing or grade beam may be prepared by chipping away irregularities from the bottom and side faces. Notching the footing or grade beam is recommended to allow the bracket to mount directly and adjacent to the load-bearing wall/column, but must be performed with the approval of the registered design professional and the code official. The vertical and horizontal surfaces of the footing or grade beam must be flat and smooth before the bracket is mounted.

3. Reinforcing steel within the foundation must not be cut without the approval of the registered design professional and the code official.
4. The bearing surface of the concrete must be smooth, and free of all soil, debris, and loose concrete, so as to provide a firm bearing surface for the repair bracket. A level must be used to verify that the portion of the footing upon which the bracket will bear is level in directions that are perpendicular and parallel to the foundation.
5. The pile lead section must be inserted into the excavation and must be positioned with shaft adjacent to the foundation.
6. Attach torque motor attachment/gear motor to the pile lead section. Align the pile lead section with an inclination to vertical as follows: 4° ± 1° for piles installed with TAB-288-LUB bracket; 0° ± 1° for piles installed with Model-300 bracket; and 2° ± 1° for piles installed with either TAB-175-LUB or TAB-350-LUB brackets.
7. Start gear motor rotation in a clockwise motion, and maintain the pile shaft inclination angles as prescribed in step 6, above.
8. If extension sections are to be used, the torque motor attachment/gear motor must be removed, and the shaft extensions must be added in proper sequence in accordance with the approved foundation plans. Couplings between pile sections must be connected by bolts and nuts supplied by the pile manufacturer, and as described in this report. All coupling nuts must be tightened so the bolts achieve a snug-tight condition as defined in Section J3 of AISC 360.
9. After the extension shaft is connected to the lead shaft, the torque motor attachment/gear motor must be re-attached, and the helical pile is advanced in a similar manner as the advancement of the lead shaft.
10. Continue steps 7 through 9 until the termination criteria (such as torque and depth) prescribed in the construction documents are met and the top of the shaft is at the required elevation, which is the top of the bracket plus the amount of expected lift plus $^1/_2$ inch (12.7 mm).
11. After the helical pile has been installed, any excess length above the required elevation must be cut off to allow for mounting to the bracket. Cutting must comply with manufacturer’s installation instruction and applicable code including AISC 360, and to ensure the top of shaft is true level, and to ensure a uniform contact between pile shaft and the bracket cap subassembly.
12. The bracket must be held in the approximate installation location and the T-Tube cap subassembly must be connected to both sides of the bracket using the threaded rods and nuts provided with the bracket. The face plates or face plate subassemblies must be connected to the mounting studs of the bracket subassembly using the supplied nuts. All nuts must be tightened to snug-tight condition as defined in Section J3 of AISC 360.
13. An appropriate lift assembly must be installed on top of the bracket and a hydraulic ram must be placed between the lift assembly and the T-tube cap subassembly.
14. The bracket must be placed under the footing and the hydraulic ram must be activated by a hand pump such that the bearing plate of the bracket is in full contact with previously prepared bottom surface of the footing. Inspection must confirm that the vertical mounting plate and the horizontal bearing plate of the bracket evenly bear across the entire bottom of the footing and against the vertical face of the footing.
15. Lifting of the structure can be done by activating the hydraulic rams associated with lifting assemblies. Any lifting of the structure must be verified by qualified personnel (a registered design professional) to ensure that no part of the foundation, structure, or helical pile is overstressed and is subjected to approval of the code official.
16. Once the foundation has been raised or stabilized, as a minimum, all nuts must be tightened to a snug-tight condition to secure the T-Tube cap subassembly and the face plates to the bracket and pile shaft. The bracket to the foundation or grade beam must be connected by means of the concrete anchor bolts described in Section 3.0 of this report. The installation of concrete anchors must be strictly in accordance the ICC-ES evaluation report noted in Section 3.0 of this report.
17. The hydraulic rams must then be removed.
18. The excavation must be backfilled with properly compacted soil. Excess soil and debris must be removed.
19. The full installation instructions are contained in the installation instructions available from the report holder (ECP, LLC).

4.2.3 Installation Procedures for ECP Models TA-150, TA-175, and TA-350 Helical Piles with New Construction Brackets (TAB-150-NC, TAB-175-NC and TAB-350-NC):

1. The lead helical section must be installed and successive extensions must be added as needed until the termination criteria (such as torque and depth) prescribed in the construction documents are met and the top of the shaft is at or above the required elevation. If necessary, the pile can be cut off in accordance with the manufacturer's instructions at the required elevation.
2. The new construction bracket must be placed over the top of the helical pile shaft and must be seated firmly.
3. The embedment depth, concrete cover and edge distance must be as prescribed in Tables 6A and 6B.
4. If the pile is to be used to resist tension forces, the embedment of the new construction bracket into the footing or grade beam as required for resisting tension loads must be determined by a registered design professional, and the bracket must be through-bolted to the helical pile shaft with the bolt and matching nut as specified in Sections 3.2.4.6, 3.2.4.7, 3.2.4.8, 3.2.4.9 and 3.3.7.2. The nut must be tightened so the bolt achieves snug-tight condition as defined in Section J3 of AISC 360.
5. The steel reinforcing bars must be placed and the concrete must be poured according to the approved construction documents.
6. All helical pile components must be galvanically isolated from the concrete reinforcing steel and other metal building components.

4.3 Special Inspections:

4.3.1 IBC:

Special inspections in accordance with Section 1705.9 of the 2021, 2018, 2015 and 2012 IBC (Section 1704.10 of the 2009 IBC) must be performed continuously during installation of the ECP helical foundation system (piles and brackets). Items to be recorded and 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 installers.
2. Product configuration and identification (including catalog numbers) for lead sections, extension sections, brackets/Face Plates/ T-Tube Cap plate assemblies, bolts/threaded rods, and nuts as specified in the construction documents and this evaluation report.
3. Installation equipment used.
4. Written installation procedures.
5. Verification that the actual, as-constructed pile tip embedment's and effective torsional resistances are within the limits specified in the construction document and this evaluation report.
6. Inclination and horizontal position/location of helical piles.
7. Tightness of all bolts/threaded rods.
8. Verification that the new construction pile cap plate is in full contact with the top of pile shaft.
9. Verification of bracket bearing plate and mounting plate, as applicable, in full contact with the concrete foundation and absence of cracks in the foundation in the vicinity of the bracket.
10. Compliance of the installation with the approved construction documents and this evaluation report.
11. Where on-site welding is required, special inspection in accordance with Section 1705.2 of the 2021, 2018, 2015 and 2012 IBC (Section 1704.3 of the 2009) must be conducted.
12. Both minimum tip embedment and minimum effective torsional resistance termination criteria must be met before installation ceases, unless one of the following issues arises:

a. Continuing the installation would pose a safety concern.

b. Continuing the installation would cause the maximum installation torque rating of the pile listed in Table 1 or 2 of this report to be exceeded.

c. Continuing the installation would cause the maximum tip embedment limit (if any) to be exceeded.

4.3.2 IRC:

Continuous special inspection of helical pile system and devices installed under the provisions of the IRC defined in this report is not required.

5.0 CONDITIONS OF USE:

The ECP Models TA-150, TA-175, TA-288, and TA-350 Helical Foundation Systems described in this report comply with, or are suitable alternatives to what is specified in, the codes indicated in Section 1.0 of this report, subject to the following conditions:

5.1 The ECP helical foundation systems are manufactured, identified, and installed in accordance with this report, the approved construction documents (engineering drawings and specifications), and the manufacturer's written installation instructions, which must be available at the jobsite at all times during installation. In case of conflict, the most stringent requirement governs.

5.2 The ECP helical foundation systems have been evaluated for support of structures assigned to Seismic Design Categories A, B and C in accordance with the IBC and IRC.

5.3 The TAB-288-NC and TAB-350-NC helical foundation systems may be used to support structures assigned to Seismic Design Category D, E or F in accordance with the IBC; and SDCs D_0 through D_2 and E in accordance with the IRC. Anchorage must be addressed by the registered design professional for each site in accordance with Section 5.3 of this report and subject to approval by the code official.

5.4 The use of other ECP helical foundations systems not indicated in Section 5.3 to support structures assigned to Seismic Design Category D, E or F in accordance with the IBC; and SDCs D_0 through D_2; and E in accordance with the IRC 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.

5.5 When installed in Seismic Design Category D, E or F in accordance with the IBC; and SDCs D_0 through D_2 and E in accordance with the IRC, the following conditions must be considered:

a. The strength of the top bracket connection to the shaft and to the foundation of the structure shall comply with IBC Section 1810.3.11.2 and must not exceed the published capacities noted in Section 4.1.2 of this report.

b. The shaft seismic flexural length must be determined by registered design professional in accordance with applicable code sections of the IBC. The shaft seismic flexural length is defined as the length of the shaft equal to 120 percent of the shaft flexural length.

c. The shaft couplers shall be limited to the shaft capacity reported in Section 4.1.3 of this report and must comply with the requirements in IBC Section 1810.3.6.1.

d. The analysis of the seismic forces imparted on the bracket, bracket connection to foundation and pile must be prepared by a registered design professional taking into account soil characteristics such as liquefiable zone, length of pile in air or length of fluid conditions per the appropriate code.

5.6 Installations of the helical foundation systems are limited to regions of concrete members where analysis indicates no cracking will occur at service load levels.

5.7 All brackets (TAB-175-LUB, TAB-288-LUB, TAB-350-LUB, Model-300, TA-150-NC, TAB-175-NC, TAB-288-NC and TAB-350-NC) must be used only with pile systems that are installed under a fully supported condition as described in Section 4.1.3 of this report.

5.8 Use of ECP 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 a landfill, or (6) soil containing mine waste, is beyond the scope of this evaluation report.

5.9 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.

5.10 The new construction helical pile system (TA-150 shaft installed with TAB-150-NC bracket, TA-175 shaft installed with TAB-175-NC bracket, TA-288 shaft installed with TAB-288-NC bracket and TA-350 shaft with TAB-350-NC bracket) must be installed vertically plumb into the ground with a maximum allowable angle of inclination of 0° ± 1°. The tops of pile caps must be embedded into the concrete footing with a minimum 4-inch (101.6 mm) vertical embedment and a minimum 4-inch (101.6 mm) side embedment beyond the perimeter of the steel cap plates. To comply with requirements found in IBC Section 1810.3.1.3, the superstructure shall be designed to resist the effects of helical pile eccentricity. Adequate concrete cover and reinforcement specified by the project engineer must be provided to meet the requirements of Chapter 17 of ACI 318-19 under the 2021 IBC (Chapter 17 of ACI 318-14 under the 2018 and 2015 IBC, Appendix D of ACI 318-11 under the 2012 IBC, and Appendix D of ACI 318-08 under the 2009 IBC) for new construction bracket to resist axial tension or axial compression loading.

5.11 The retrofit helical pile systems (TA-175, TA-288 and TA-350 shafts with retrofit brackets) must be installed such that the angles of inclination from vertical does not exceed 4° ± 1° for TA-288 shaft installed with TAB-288-LUB bracket; 0° ± 1° for TA-288 shaft installed with Model-300 bracket; and 2° ± 1° for TA-175 shafts installed with TAB-175-LUB bracket and TA-350 shafts installed with TAB-350-LUB bracket.

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

5.13 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, are prepared by a registered design professional, and approved by the code official.

5.14 The adequacy of the concrete structures that are connected to the ECP brackets must be verified by a registered design professional, in accordance with applicable code provisions such as Chapter 13 of ACI 318 under the 2021, 2018 and 2015 IBC (Chapter 15 of ACI 318 under the 2012 and 2009 IBC) and Chapter 18 of the IBC. Verification is subject to the approval of the code official.

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

5.16 The load combinations prescribed in 2021 IBC Section 1605.1 (2018, 2015, 2012 and 2009 IBC Section 1605.3.1) must be used to determine the applied loads. When using the alternative basic load combinations prescribed in the 2021 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 (Chapters 19 through 23, as applicable) or the referenced standards are prohibited.

5.17 The minimum helical pile center-to-center spacing is three times the diameter of the largest helical bearing plate. 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. Load reductions are subject to the approval of the code official.

5.18 See Section 4.2.1, item 8, for the minimum pile tip embedment requirement.

5.19 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.

5.20 Post-installed concrete anchors, including requirements for installation and inspection, must comply with the applicable ICC-ES evaluation reports noted in Sections 3.2.4.1.4, 3.2.4.2.4, 3.2.4.3.4, 3.2.4.4.4 and 3.2.4.4.5 of this report. The anchors must be installed into normal-weight concrete.

5.21 Requirements set forth in the footnotes of Tables 1 through 8 must be satisfied.

5.22 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 a registered design professional for each site, and the work of the design professional is subject to approval by the code official.

5.23 The ECP helical foundation systems are manufactured in Olathe, Kansas; 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 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-3559) along with the name, registered trademark, or registered logo of the report holder 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, the ECP Models TA-150, TA-175, TA-288, and TA-350 Helical Foundation System components described in this report including lead and extension shafts, brackets and connection hardware are identified by product package labels that include the product part number and each bracket is identified by a product purchase order stamped onto the side of the bracket. Each TA-150, TA-175, TA-288 and TA-350 lead shaft and extension shaft is identified by a product identification number “XXXXYZ” (where “XXXX” denotes the numerical purchase order code, “Y” is the material size/grade code, and “Z” is the production location code) stamped into the shaft.

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

EARTH CONTACT PRODUCTS, LLC
15620 SOUTH KEELER TERRACE
OLATHE, KANSAS 66062
(913) 393-0007
www.earthcontactproducts.com
eng@getecp.com

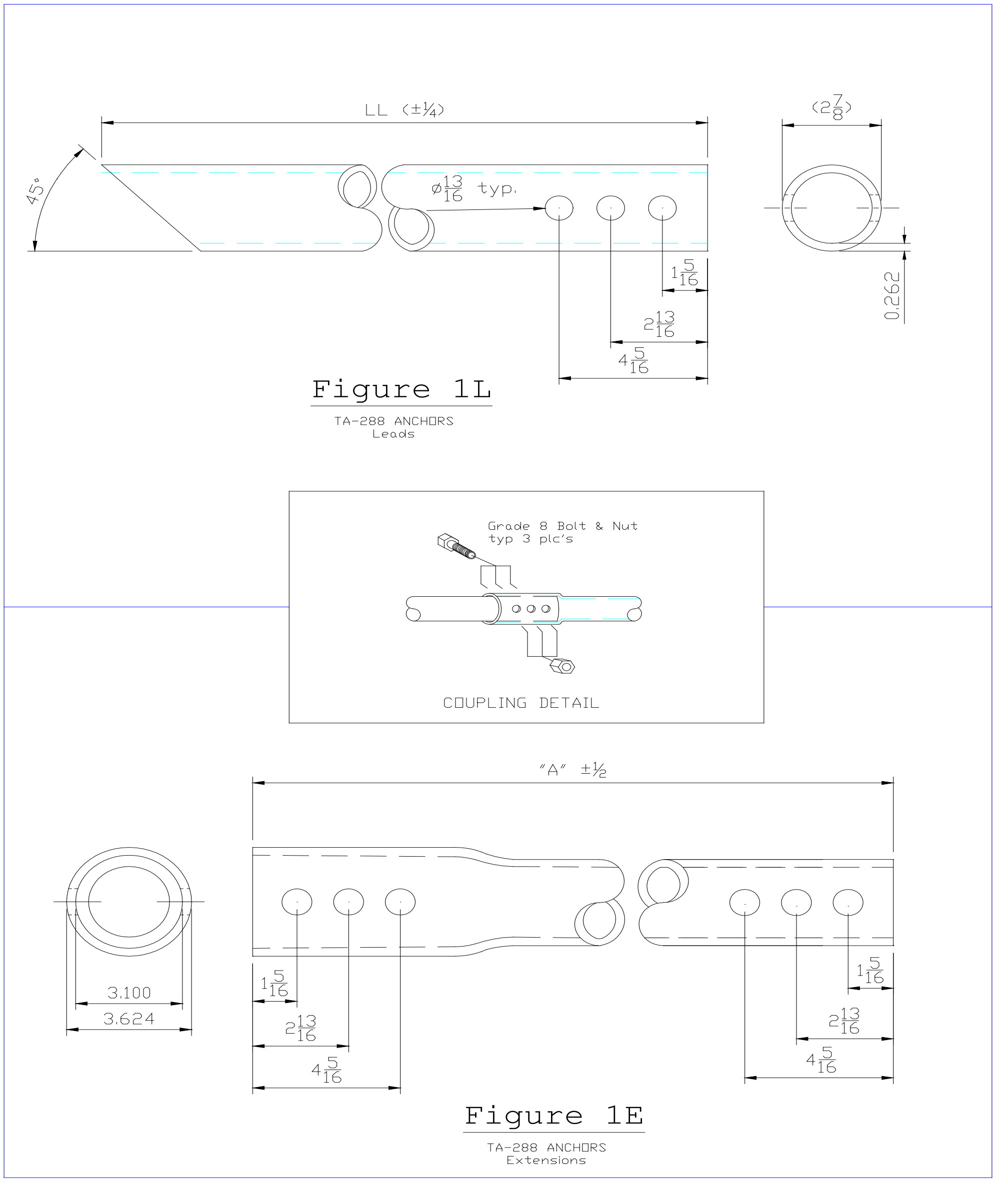


FIGURE 1A(a)—TA-288 LEAD SECTION, FORGED COUPLER AND EXTENSION SECTION

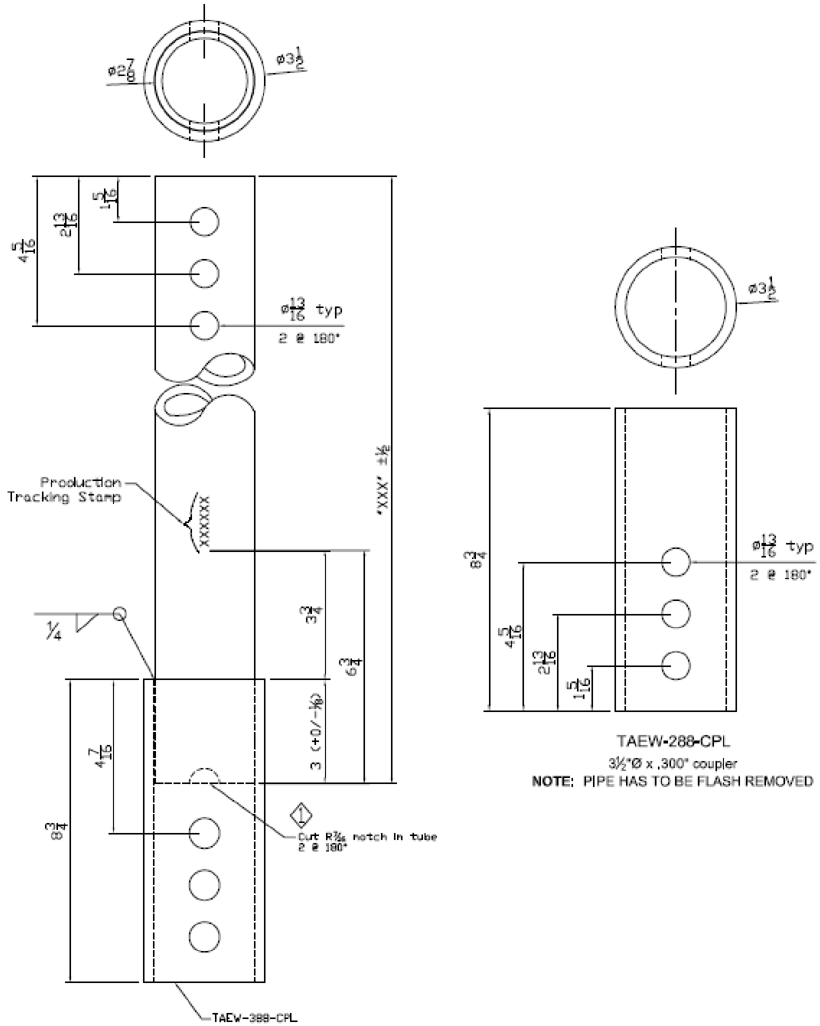
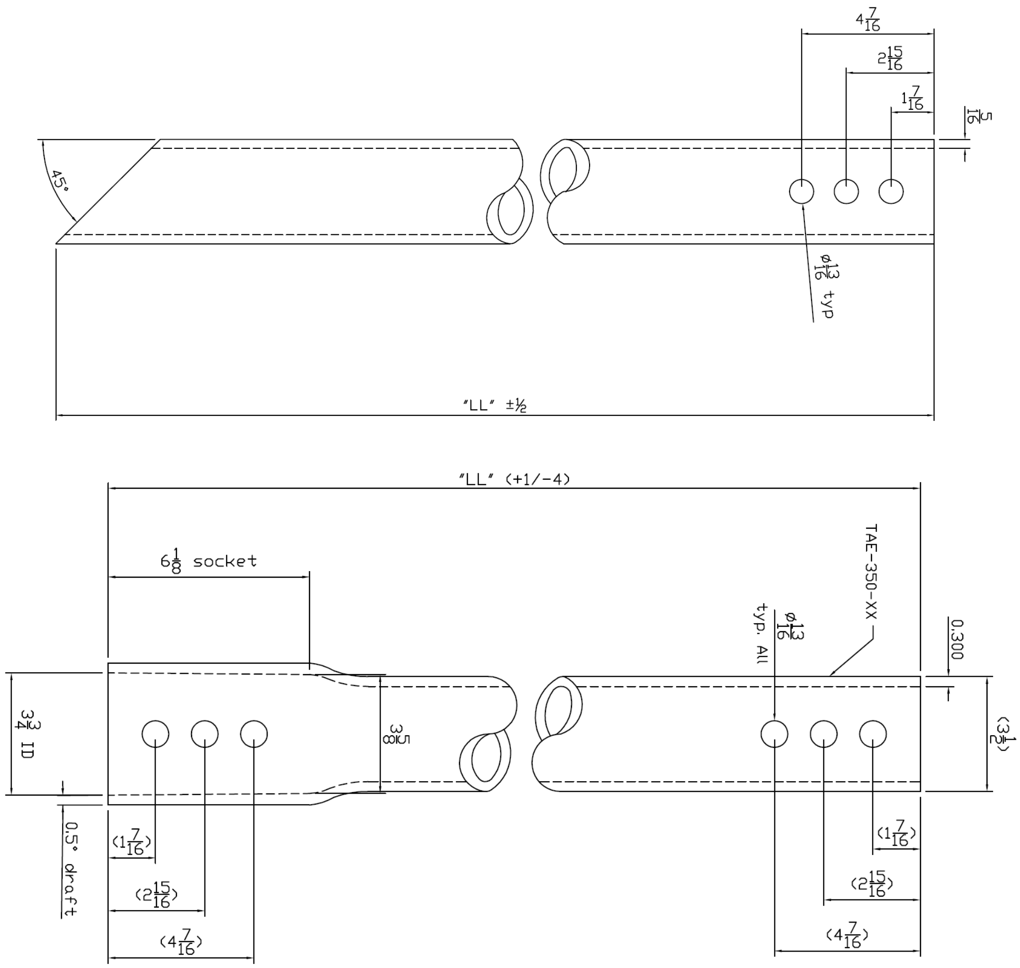


FIGURE 1A(b) – TA-288 LEAD SECTION, WELDED COUPLER AND EXTENSION SECTION (ALTERNATE)



Part No.	"LL" (in.)
TAE-350-036	36
TAE-350-060	60
TAE-350-084	84
TAE-350-120	120

FIGURE 1B—TA-350 LEAD SECTION AND EXTENSION SECTION (COUPLER SECTION DETAIL AS SHOWN IN FIGURE 1A(a))

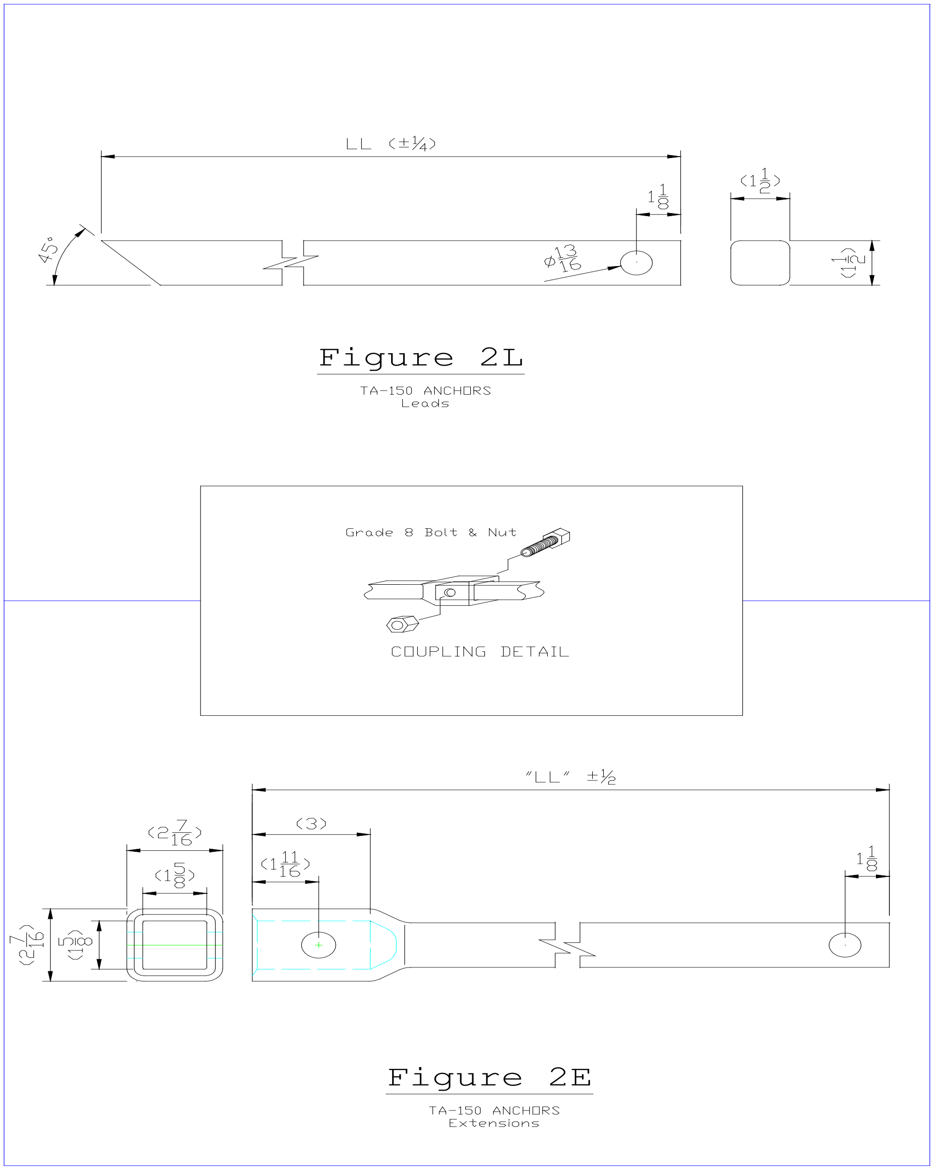
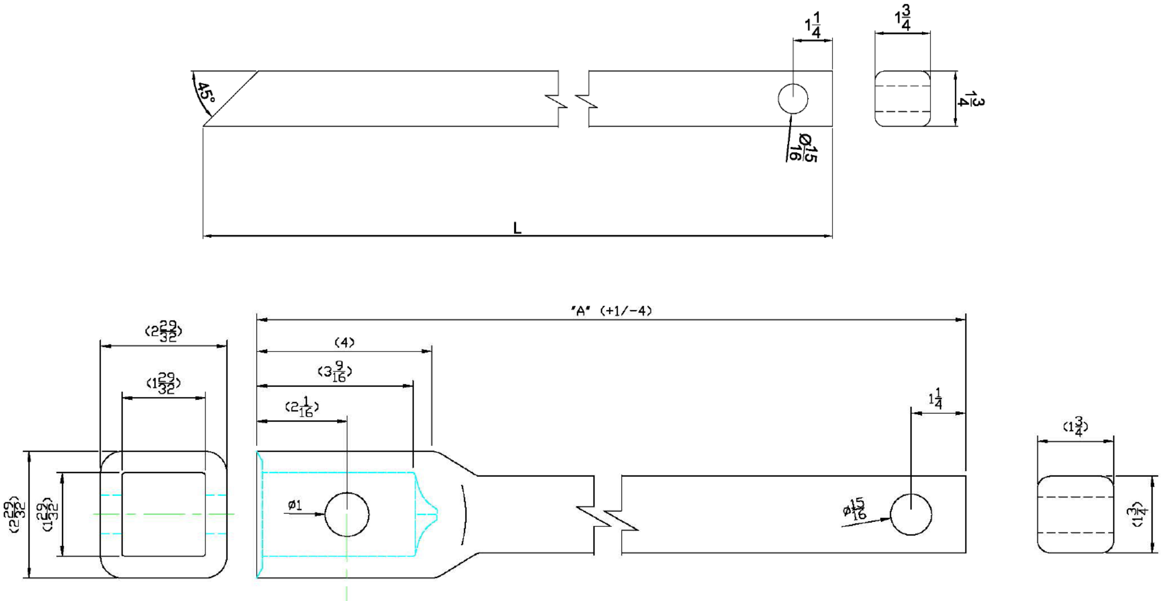


FIGURE 2A—TA-150 LEAD SECTION, COUPLER AND EXTENSION SECTION



Part No.	"A" (in.)
TAE-175-036	36
TAE-175-060	60
TAE-175-084	84
TAE-175-120	120

NOTE:
1. All Dimensions ±1/16 U.N.O.

FIGURE 2B—TA-175 LEAD AND EXTENSION SECTION (COUPLER SECTION DETAIL AS SHOWN IN FIGURE 2A)

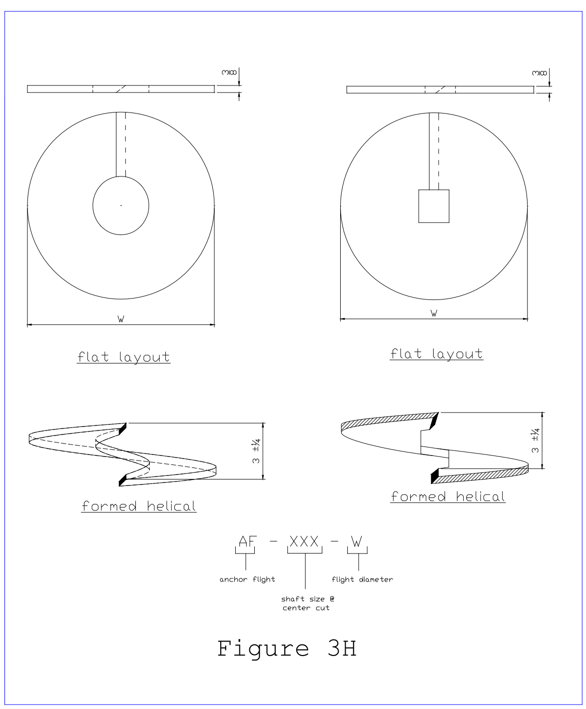
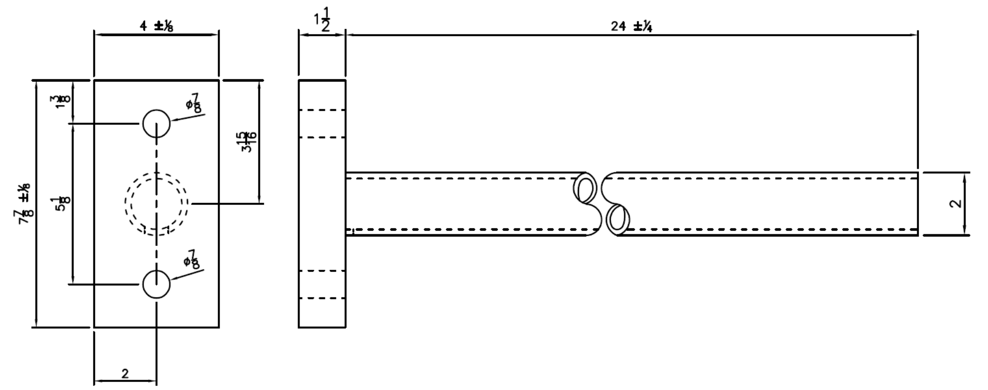
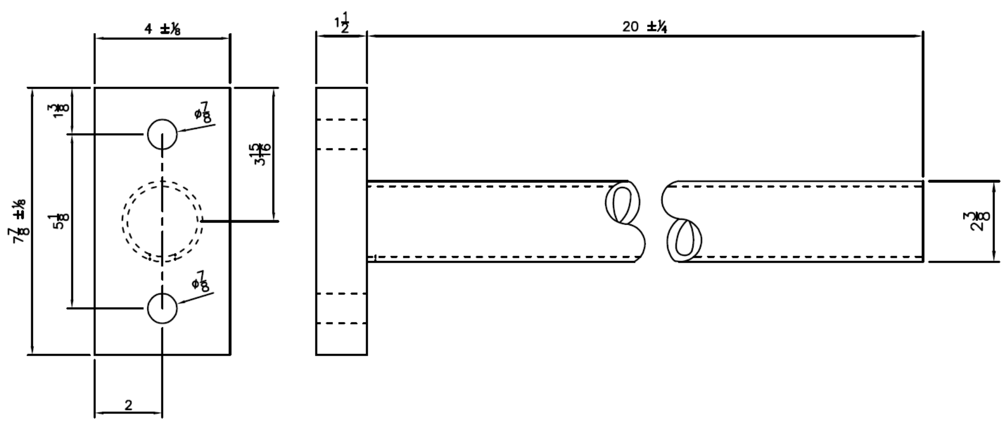


FIGURE 3—HELIX FOR TA-150, TA-175, TA-288 AND TA-350 PILE SHAFTS



T-Tube Subassembly for the TA-288 Pile



T-Tube Subassembly for the TA-150 Pile

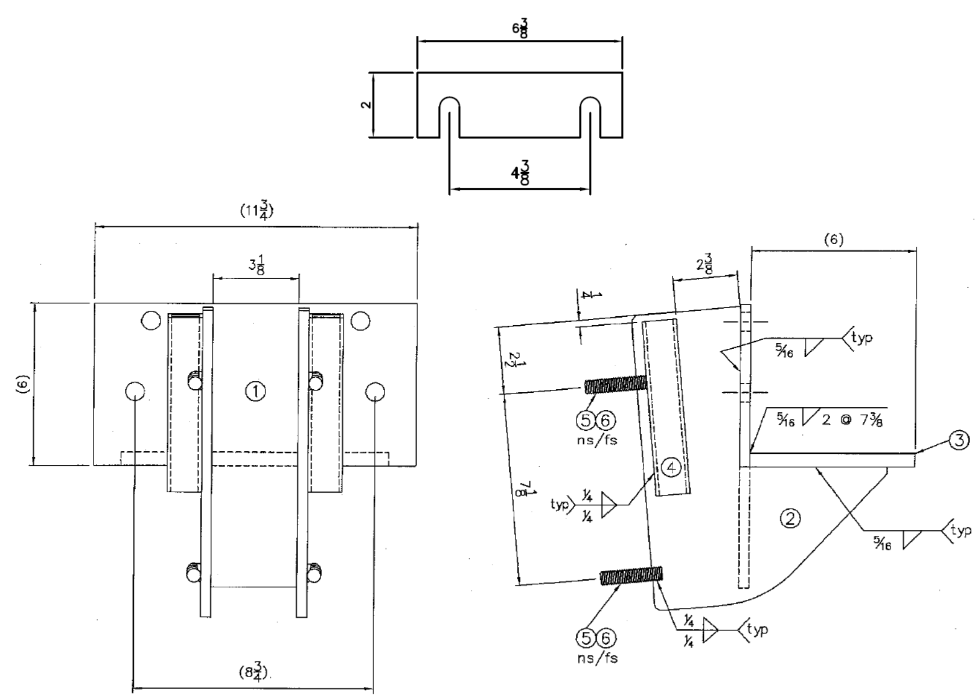
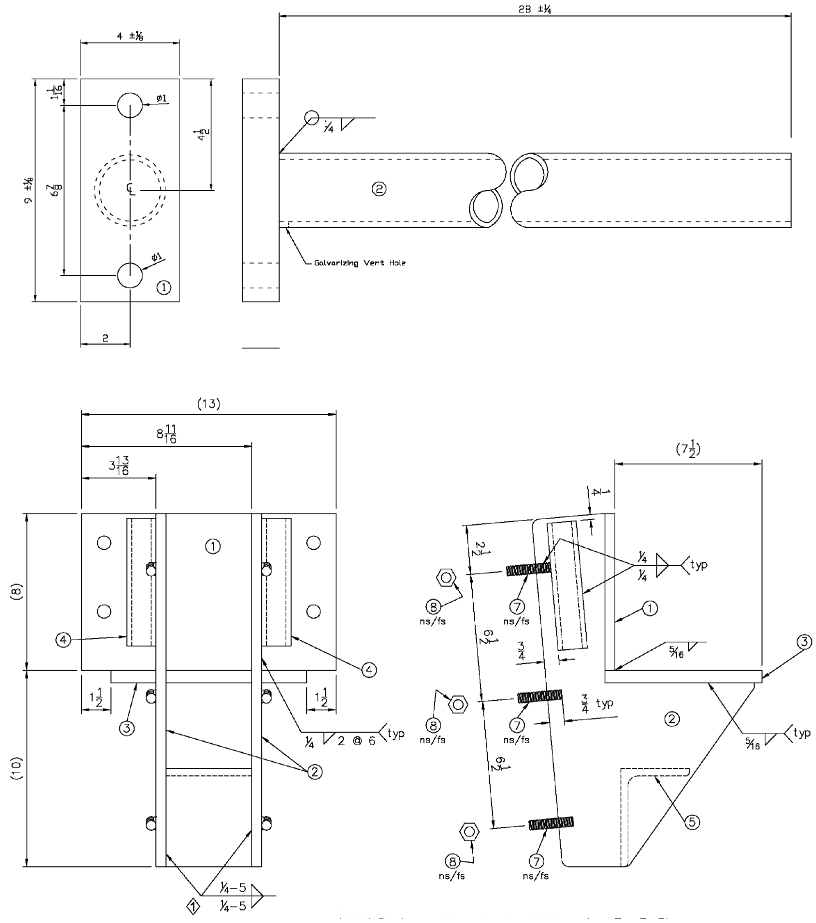
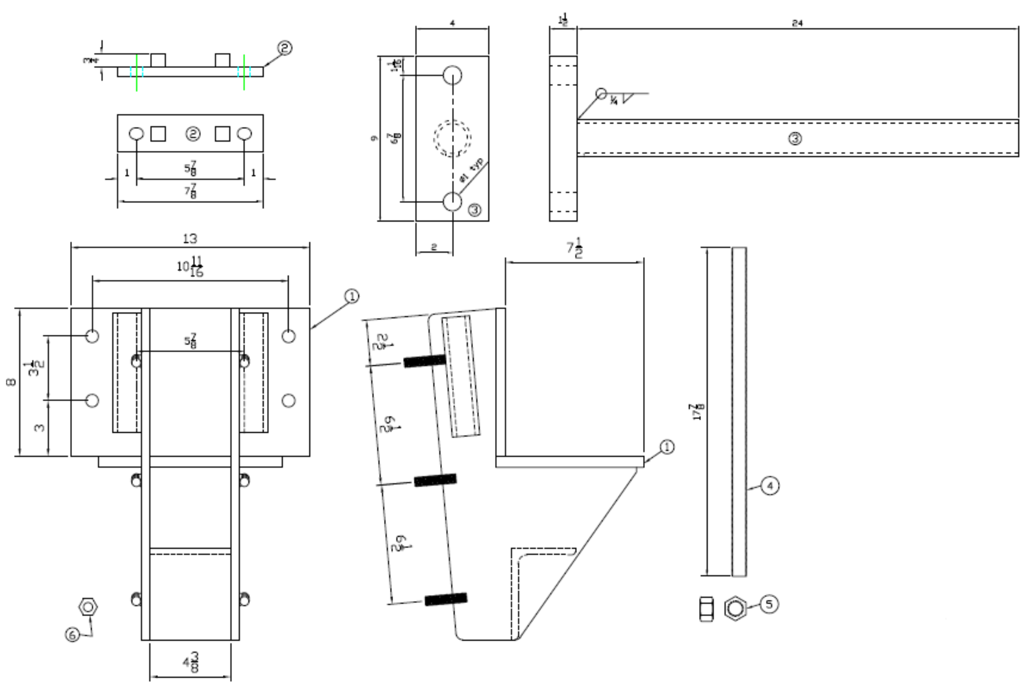


FIGURE 4—TAB-MUB BRACKETS

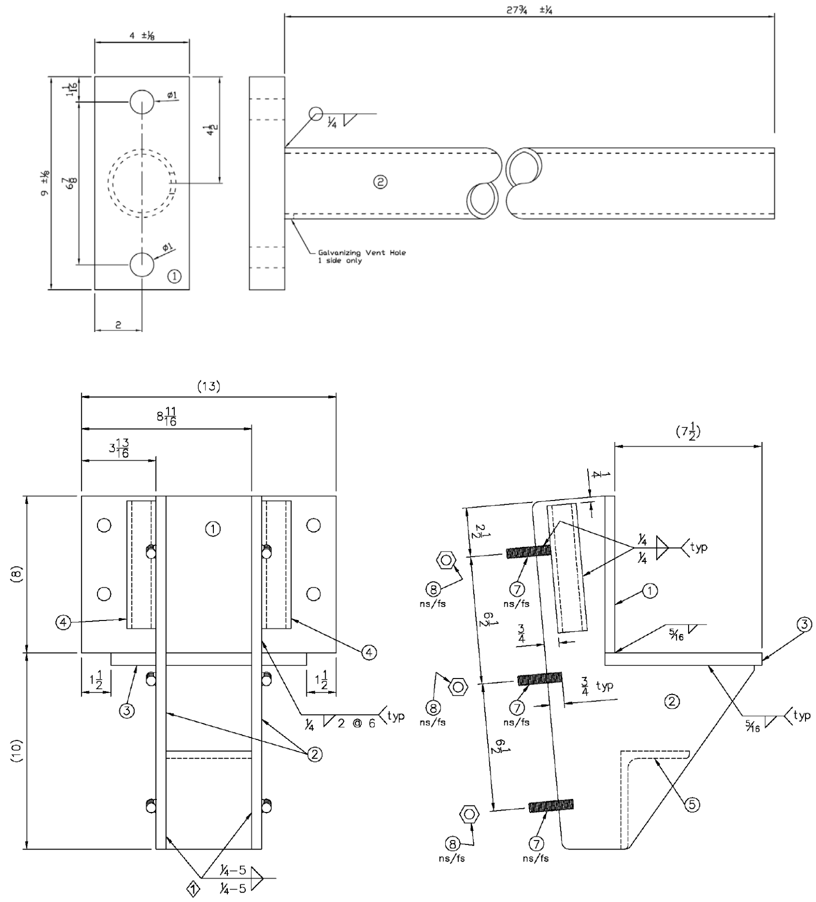


TAB-175-LUB



TAB-288-LUB

FIGURE 5—LUB BRACKETS (TAB-175-LUB, TAB-288-LUB, AND TAB-350-LUB)



TAB-350-LUB

FIGURE 5—LUB BRACKETS (TAB-175-LUB, TAB-288-LUB AND TAB-350-LUB) - CONTINUED

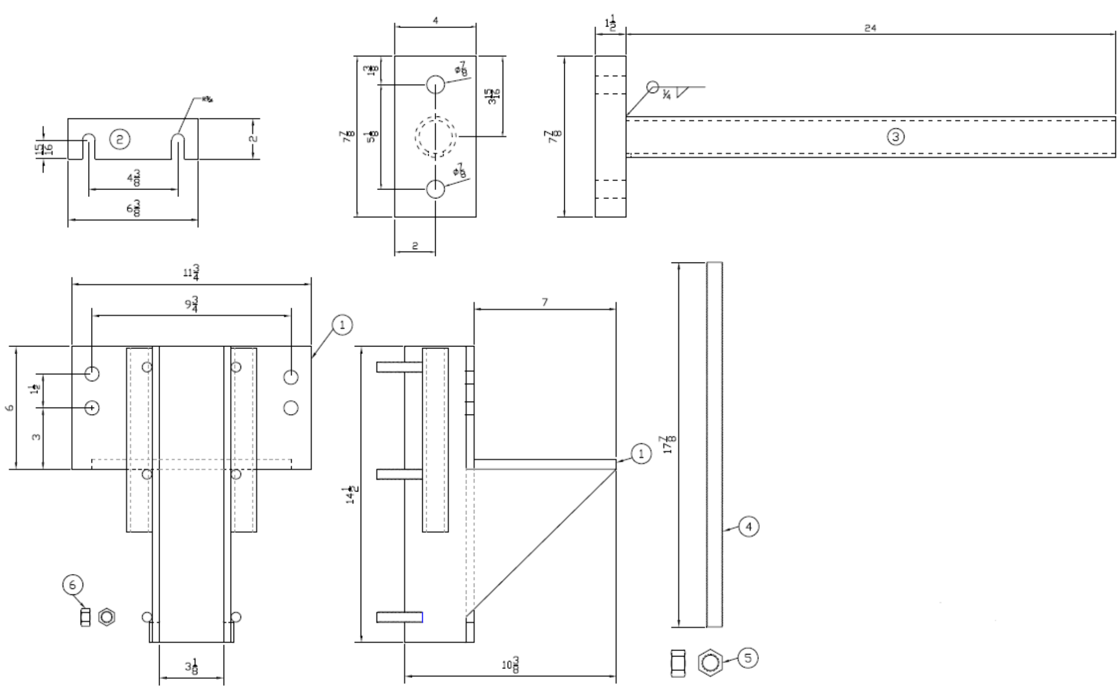
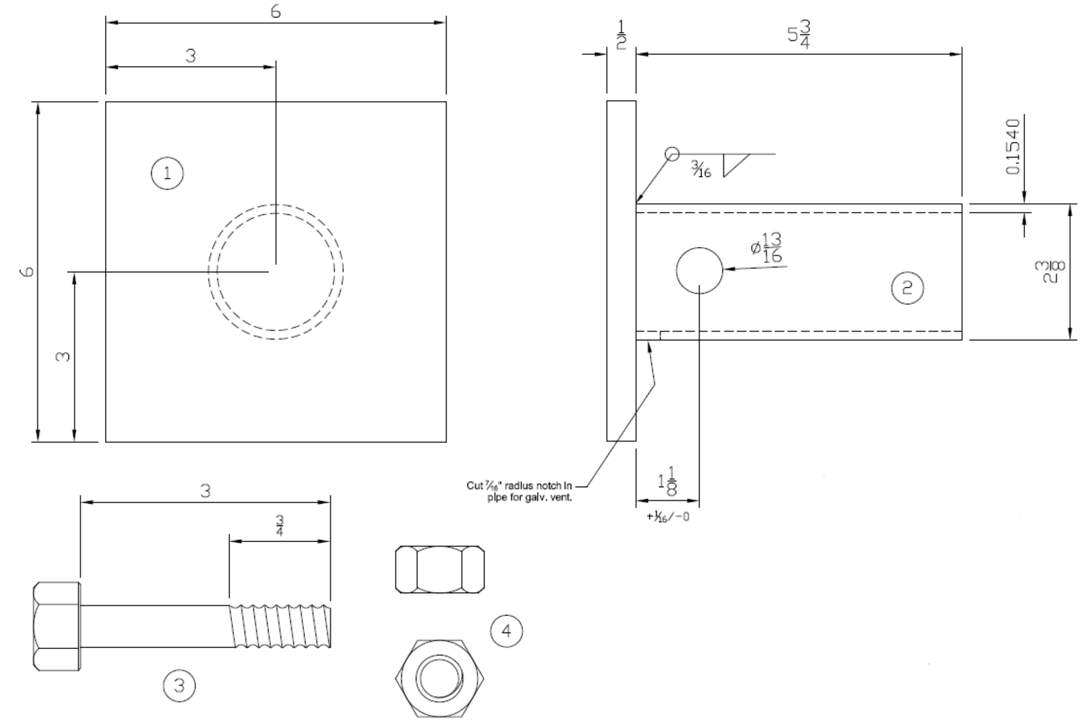
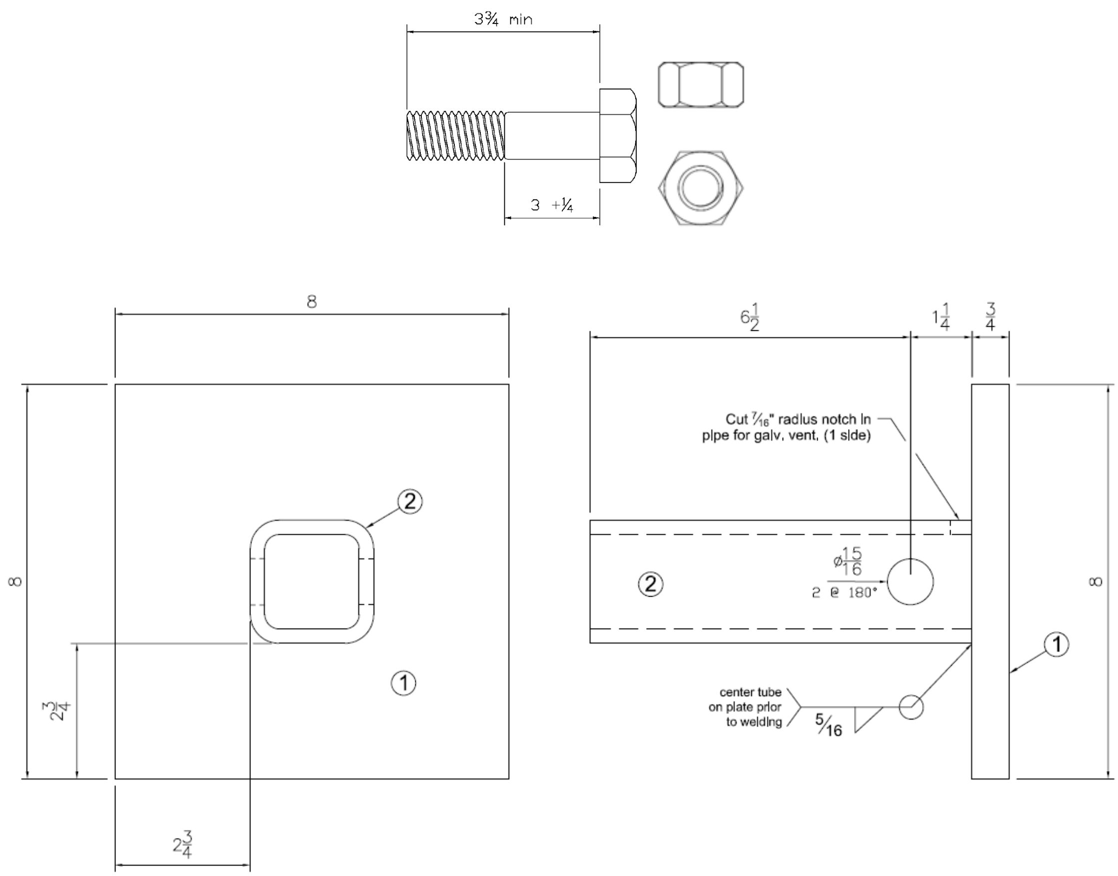


FIGURE 6—MODEL-300 BRACKET

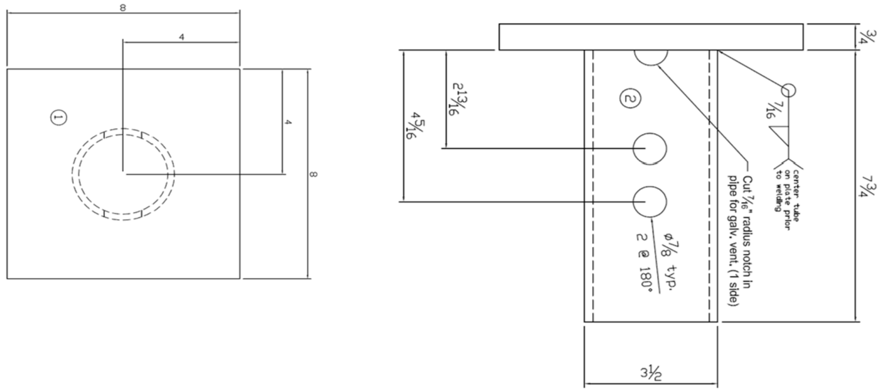


A) TAB-150-NC

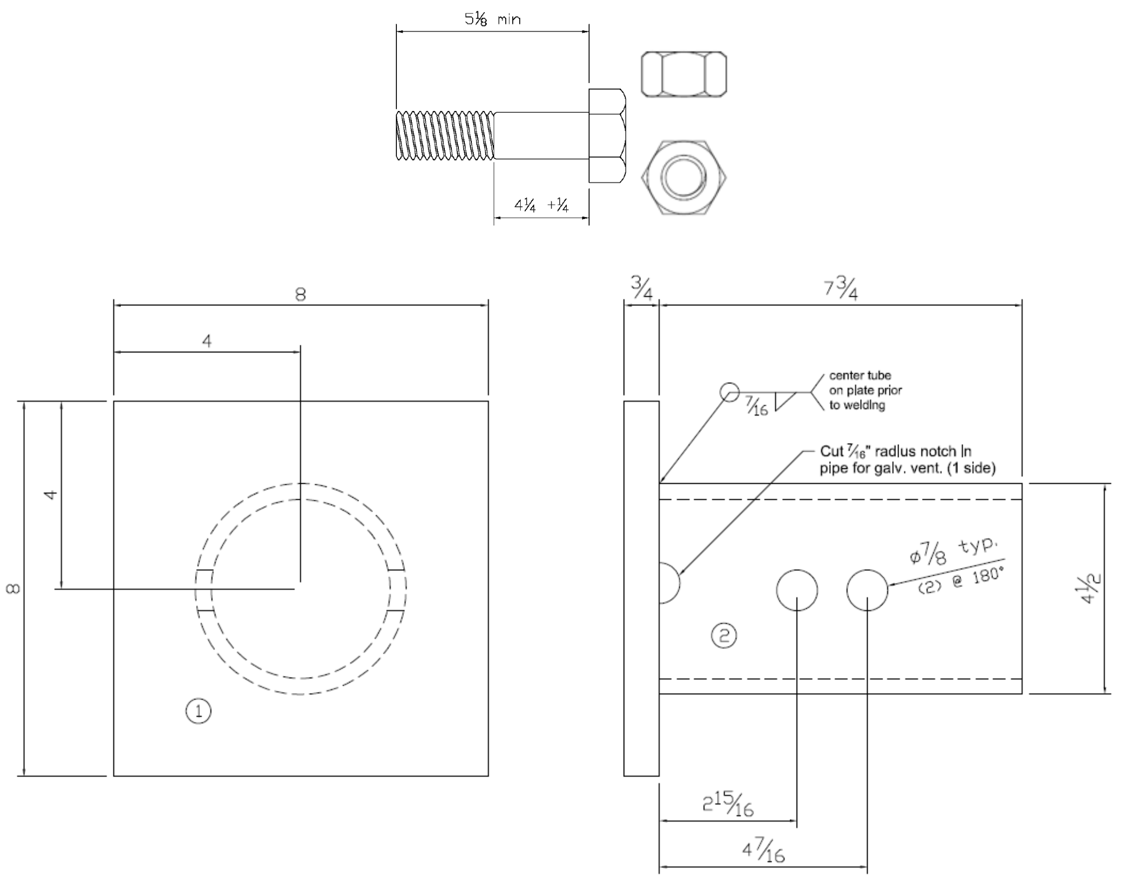


B) TAB-175-NC

FIGURE 7—NEW CONSTRUCTION BRACKETS (TAB-150-NC, TAB-175-NC, TAB-288-NC AND TAB-350-NC)



C) TAB-288-NC



D) TAB-350-NC

FIGURE 7—NEW CONSTRUCTION BRACKETS (TAB-150-NC, TAB-175-NC, TAB-288-NC AND TAB-350-NC) – CONTINUED

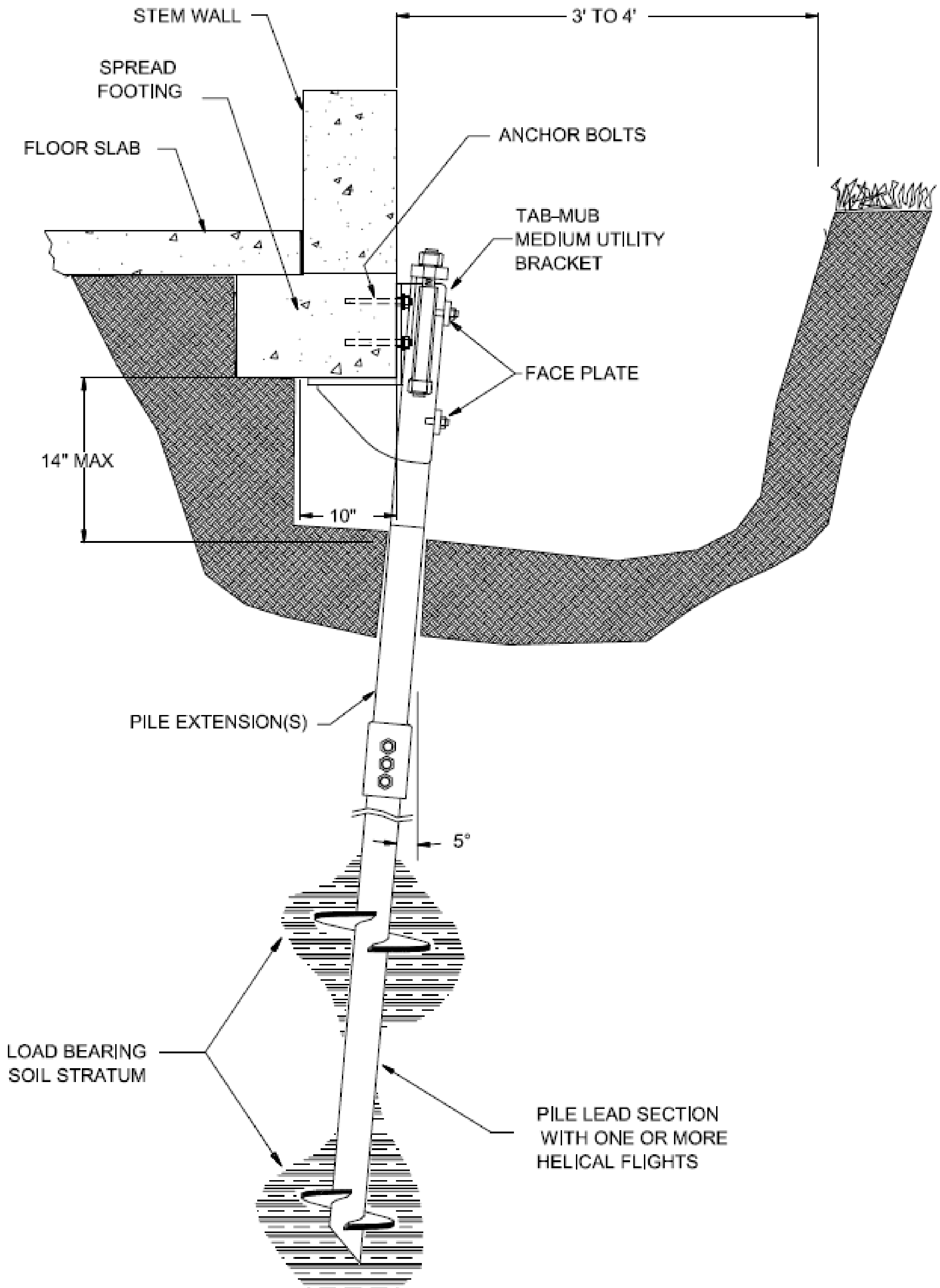


FIGURE 8—TAB-MUB BRACKET INSTALLED WITH TA-288 PILE AND WITH TA-150 PILE

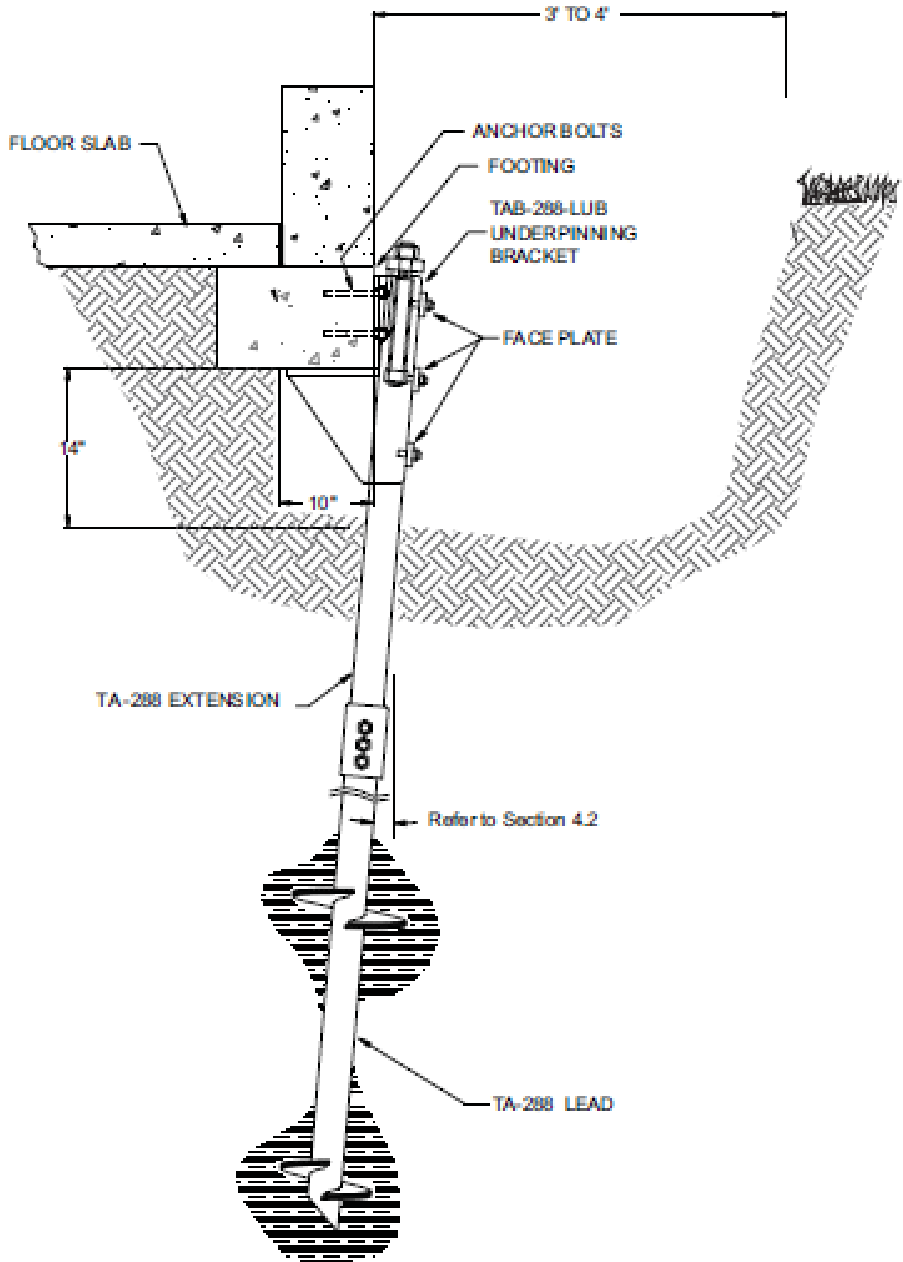


FIGURE 9—TAB-288-LUB BRACKET INSTALLED WITH TA-288 PILE (SIMILAR FOR TAB-175-LUB BRACKET INSTALLED WITH TA-175 PILE AND FOR TAB-350-LUB BRACKET INSTALLED WITH TA-350 PILE)

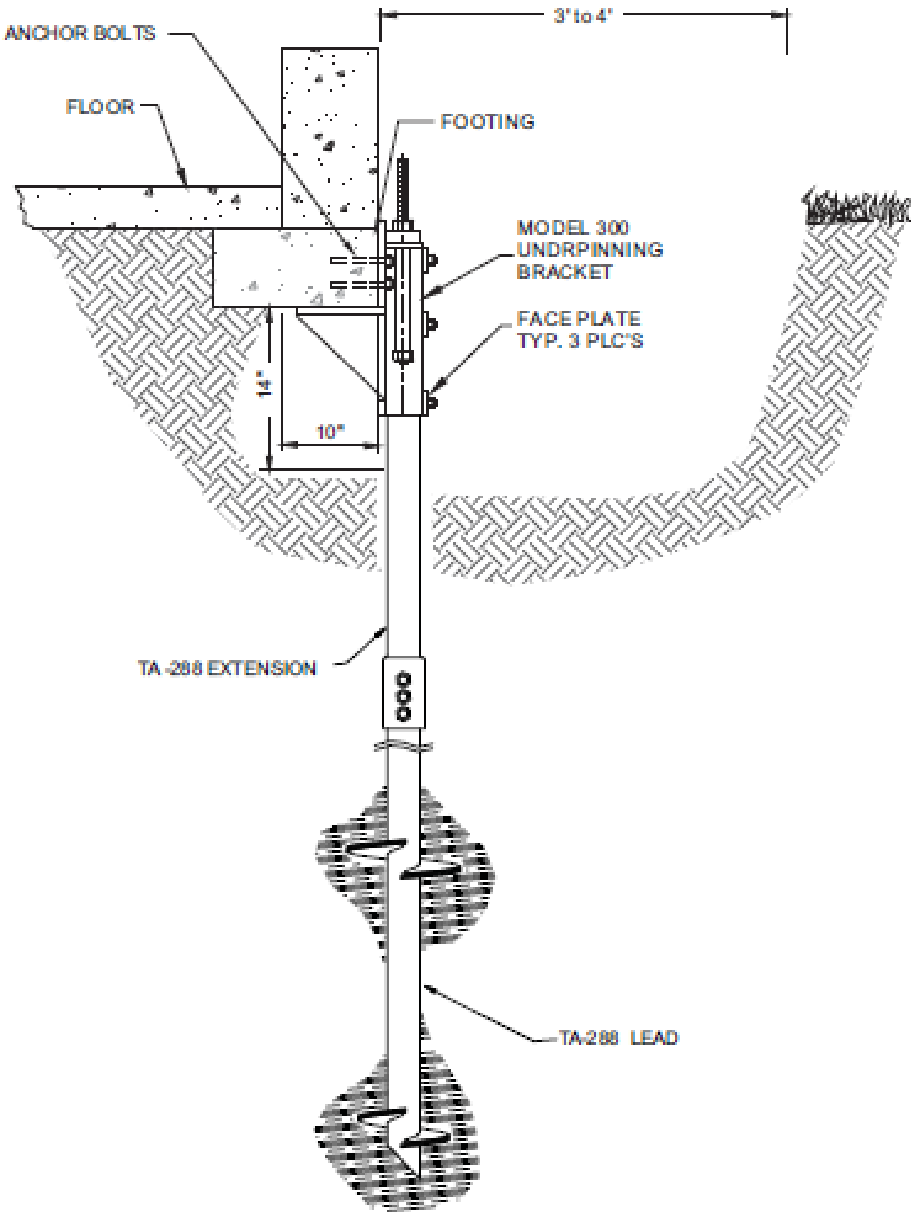
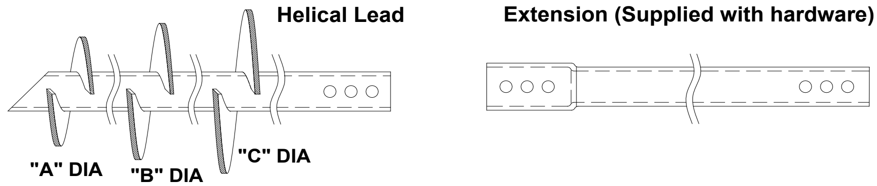


FIGURE 10—MODEL-300 BRACKET INSTALLED WITH TA-288 PILE

TABLE 1A—TA-288 DIMENSIONS AND ASD TENSION AND COMPRESSION CAPACITIES[3]



Product Designation	Shaft Length "L" (in)	Helix Diameter (in)			(P2) Shaft Comp. (kips)	(P2) Shaft Ten. (kips)	(P3) Helix (kips)	K_t (ft^{-1})	Torsion Rating[1,4] (lbf-ft)	(P4) Maximum Allowable Torque Correlated Soil Capacity[2,4] (kips)	
		A	B	C						Com.	Ten.
TAH-288-60-08	60	8	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-60-10	60	10	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-60-12	60	12	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-60-14	60	14	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-60-08-10	60	8	10	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-60-10-12	60	10	12	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-60-12-14	60	12	14	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-60-08-10-12	60	8	10	12	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-60-10-12-14	60	10	12	14	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-84-08	84	8	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-84-10	84	10	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-84-12	84	12	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-84-14	84	14	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-84-08-10	84	8	10	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-84-10-12	84	10	12	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-84-12-14	84	12	14	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-84-08-10-12	84	8	10	12	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-84-10-12-14	84	10	12	14	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-120-08	120	8	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-120-10	120	10	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-120-12	120	12	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAH-288-120-14	120	14	--	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-120-08-10	120	8	10	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-120-10-12	120	10	12	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-120-12-14	120	12	14	--	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-120-08-10-12	120	8	10	12	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)
TAF-288-120-10-12-14	120	10	12	14	Table 3	Table 7A	Table 8	9	8400 (8024)	37.4 (36.1)	29.4 (35.5)

For **SI:** I inch = 25.4 mm, 1 kip = 1000 lbf = 4.448 kN, 1lbf-ft = 1.356 N-m.

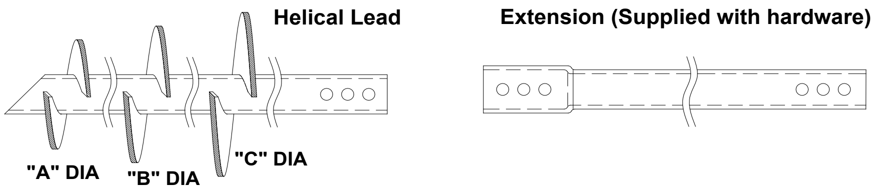
[1]Shaft torsion rating is the maximum installation torque that can be applied to the shaft during the helical pile installation.

[2]Torque correlated soil capacity (P4) is based on torque correlation per Section 4.1.5, with piles installed at the shaft torsion rating.

[3]For piles with extension(s), shaft coupling(s) must be installed in accordance with Sections 3.2.3 and 4.2 of this report.

[4]Values in parentheses are for shafts with welded couplers.

TABLE 1B—TA-350 DIMENSIONS AND ASD TENSION AND COMPRESSION CAPACITIES[3]



Product Designation	Shaft Length "L" (in)	Helix Diameter (in)			(P2) Shaft Comp. (kips)	(P2) Shaft Ten. (kips)	(P3) Helix (kips)	K_t (ft^{-1})	Torsion Rating[1] (lbf-ft)	(P4) Maximum Allowable Torque Correlated Soil Capacity[2] (kips)	
		A	B	C						Com.	Ten.
TAH-350-60-08	60	8	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-60-10	60	10	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-60-12	60	12	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-60-14	60	14	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-60-08-10	60	8	10		Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-60-10-12	60	10	12	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-60-12-14	60	12	14	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-60-08-10-12	60	8	10	12	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-60-10-12-14	60	10	12	14	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-84-08	84	8	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-84-10	84	10	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-84-12	84	12	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-84-14	84	14	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-84-08-10	84	8	10	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-84-10-12	84	10	12	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-84-12-14	84	12	14	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-84-08-10-12	84	8	10	12	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-84-10-12-14	84	10	12	14	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-120-08	120	8	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-120-10	120	10	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-120-12	120	12	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAH-350-120-14	120	14	--	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-120-08-10	120	8	10	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-120-10-12	120	10	12	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-120-12-14	120	12	14	--	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-120-08-10-12	120	8	10	12	Table 3	Table 7A	Table 8	7	14800	53.7	46.1
TAF-350-120-10-12-14	120	10	12	14	Table 3	Table 7A	Table 8	7	14800	53.7	46.1

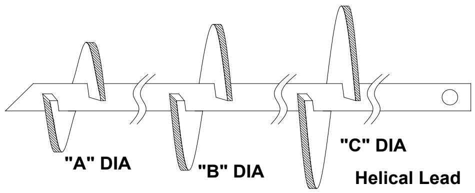
For **SI:** l inch = 25.4 mm, 1 kip = 1000 lbf = 4.448 kN, 1lbf-ft = 1.356 N-m.

[1]Shaft torsion rating is the maximum installation torque that can be applied to the shaft during the helical pile installation.

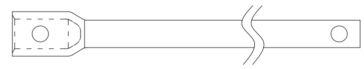
[2]Torque correlated soil capacity (P4) is based on torque correlation per Section 4.1.5, with piles installed at the shaft torsion rating.

[3]For piles with extension(s), shaft coupling(s) must be installed in accordance with Sections 3.2.3 and 4.2 of this report.

TABLE 2A—TA-150 DIMENSIONS AND ASD TENSION AND COMPRESSION CAPACITIES(3)



Helical Lead


Extension (Supplied with hardware)

Product Designation	Shaft Length "L" (in)	Helix Diameter (in)			(P2) Shaft Comp. (kips)	(P2) Shaft Ten. (kips)	(P3) Helix (kips)	K_t (ft^{-1})	Torsion Rating[1] (lbf-ft)	(P4) Maximum Allowable Torque Correlated Soil Capacity[2] (kips)	
		A	B	C						Com.	Ten.
TAH-150-60-08	60	8	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-60-10	60	10	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-60-12	60	12	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-60-14	60	14			Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-60-08-10	60	8	10	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-60-10-12	60	10	12	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-60-12-14	60	12	14	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-60-08-10-12	60	8	10	12	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-60-10-12-14	60	10	12	14	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-84-08	84	8	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-84-10	84	10	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-84-12	84	12	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-84-14	84	14	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-84-08-10	84	8	10	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-84-10-12	84	10	12	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-84-12-14	84	12	14	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-84-08-10-12	84	8	10	12	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-84-10-12-14	84	10	12	14	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-120-08	120	8	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-120-10	120	10	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-120-12	120	12	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAH-150-120-14	120	14	--	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-120-08-10	120	8	10	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-120-10-12	120	10	12	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-120-12-14	120	12	14	--	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-120-08-10-12	120	8	10	12	Table 4	Table 7A	Table 8	10	5500	28.8	25.4
TAF-150-120-10-12-14	120	10	12	14	Table 4	Table 7A		10	5500	28.8	25.4

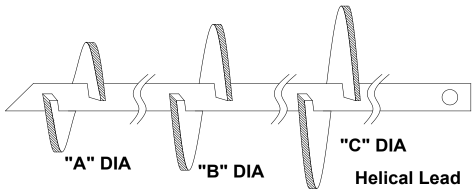
For **SI:** I inch = 25.4 mm, 1 kip = 1000 lbf = 4.448 kN, 1lbf-ft = 1.356 N-m.

[1]Shaft torsion rating is the maximum installation torque that can be applied to the shaft during the helical pile installation.

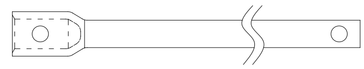
[2]Torque correlated soil capacity (P4) is based on torque correlation per Section 4.1.5, with piles installed at the shaft torsion rating.

[3]For piles with extension(s), shaft coupling(s) must be installed in accordance with Sections 3.2.3 and 4.2 of this report.

TABLE 2B—TA-175 DIMENSIONS AND ASD TENSION AND COMPRESSION CAPACITIES[3]



Helical Lead


Extension (Supplied with hardware)

Product Designation	Shaft Length "L" (in)	Helix Diameter (in)			(P2) Shaft Comp. (kips)	(P2) Shaft Ten. (kips)	(P3) Helix (kips)	K_t (ft^{-1})	Torsion Rating[1] (lbf-ft)	(P4) Maximum Allowable Torque Correlated Soil Capacity[2] (kips)	
		A	B	C						Com.	Ten.
TAH-175-60-08	60	8	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-60-10	60	10	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-60-12	60	12	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-60-14	60	14			Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-60-08-10	60	8	10	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-60-10-12	60	10	12	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-60-12-14	60	12	14	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-60-08-10-12	60	8	10	12	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-60-10-12-14	60	10	12	14	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-84-08	84	8	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-84-10	84	10	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-84-12	84	12	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-84-14	84	14	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-84-08-10	84	8	10	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-84-10-12	84	10	12	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-84-12-14	84	12	14	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-84-08-10-12	84	8	10	12	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-84-10-12-14	84	10	12	14	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-120-08	120	8	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-120-10	120	10	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-120-12	120	12	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAH-175-120-14	120	14	--	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-120-08-10	120	8	10	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-120-10-12	120	10	12	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-120-12-14	120	12	14	--	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-120-08-10-12	120	8	10	12	Table 4	Table 7A	Table 8	10	10750	42.3	39.9
TAF-175-120-10-12-14	120	10	12	14	Table 4	Table 7A	Table 8	10	10750	42.3	39.9

For **SI:** I inch = 25.4 mm, 1 kip = 1000 lbf = 4.448 kN, 1lbf-ft = 1.356 N-m.
[1]Shaft torsion rating is the maximum installation torque that can be applied to the shaft during the helical pile installation.
[2]Torque correlated soil capacity (P4) is based on torque correlation per Section 4.1.5, with piles installed at the shaft torsion rating.
[3]For piles with extension(s), shaft coupling(s) must be installed in accordance with Sections 3.2.3 and 4.2 of this report.

TABLE 3—TA-288 and TA-350 SHAFT ASD COMPRESSION CAPACITIES [1, 2, 3]

	TOTAL	TA-288					TA-350				
Shaft Capacities (kips)	**L_u =**	**0 ft**	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**0 ft**	**5 ft**	**10 ft**	**15 ft**	**20 ft**
	No Coupler[4]	58.6	24.5	12.9	7.1	4.5	82.4	39.6	23.2	13.8	8.8
	1 Forged Coupler[4]	58.6	16.1	10.2	6.2	4.1	82.4	27.8	18.5	12.0	8.0
	1 Welded Coupler[5]	58.6	19.3	11.4	6.6	4.3	-	-	-	-	-
	2 Forged Couplers	58.6	6.7	5.4	4.0	3.0	82.4	16.4	12.7	9.2	6.7
	2 Welded Couplers[5]	58.6	15.5	9.9	6.1	4.0	-	-	-	-	-

For **SI:** 1 ft = 0.305 m; 1 kip = 4.448 kN.

[1]L_u = Total unbraced pile length per IBC Section 1810.2.1, where L_u=0 represents a fully braced condition in that the total pile length is fully embedded and the supported structure is braced in accordance with IBC Section 1810.2.2.
[2]The capacities shown in the Table are installed with a maximum 1 degree of inclination.
[3]Capacities include allowance for corrosion over a 50-year service life.
[4]Total number of couplers with the total pile section length.
[5]Compression capacities are for the TA-288 shaft with welded couplers as an alternate to the forged couplers in accordance with Section 3.2.1.

TABLE 4—TA-150 and TA-175 SHAFT ASD COMPRESSION CAPACITIES [1, 2, 3]

	TOTAL	TA-150			TA-175		
Shaft Capacities (kips)	**L_u =**	**0 ft**	**5 ft**	**10 ft**	**0 ft**	**5 ft**	**10 ft**
	No Coupler[4]	60.0	16.9	4.6	161.2	36.7	10.4
	1 Coupler[4]	60.0	9.1	3.6	161.2	16.2	7.1
	2 Couplers[4]	60.0	4.5	2.5	161.2	7.5	4.7

For **SI:** 1 ft = 0.305 m; 1 kip = 4.448 kN.

[1]L_u = Total unbraced pile length per IBC Section 1810.2.1, where L_u=0 represents a fully braced condition in that the total pile length is fully embedded and the supported structure is braced in accordance with IBC Section 1810.2.2.
[2]The capacities shown in the Table are installed with a maximum 1 degree of inclination.
[3]Capacities include allowance for corrosion over a 50-year service life.
[4]Total number of couplers with the total pile section length.

TABLE 5—RETROFIT BRACKET ASD COMPRESSION CAPACITIES[1,2,3] (kips)

Bracket Description	Shaft Description	ASD Compression Capacity
TAB-MUB	TA-150	14.8
	TA-288	20.7
TAB-175-LUB	TA-175	19.9
TAB-288-LUB	TA-288	22.6
Model-300	TA-288	22.2
TAB-350-LUB	TA-350	28.8

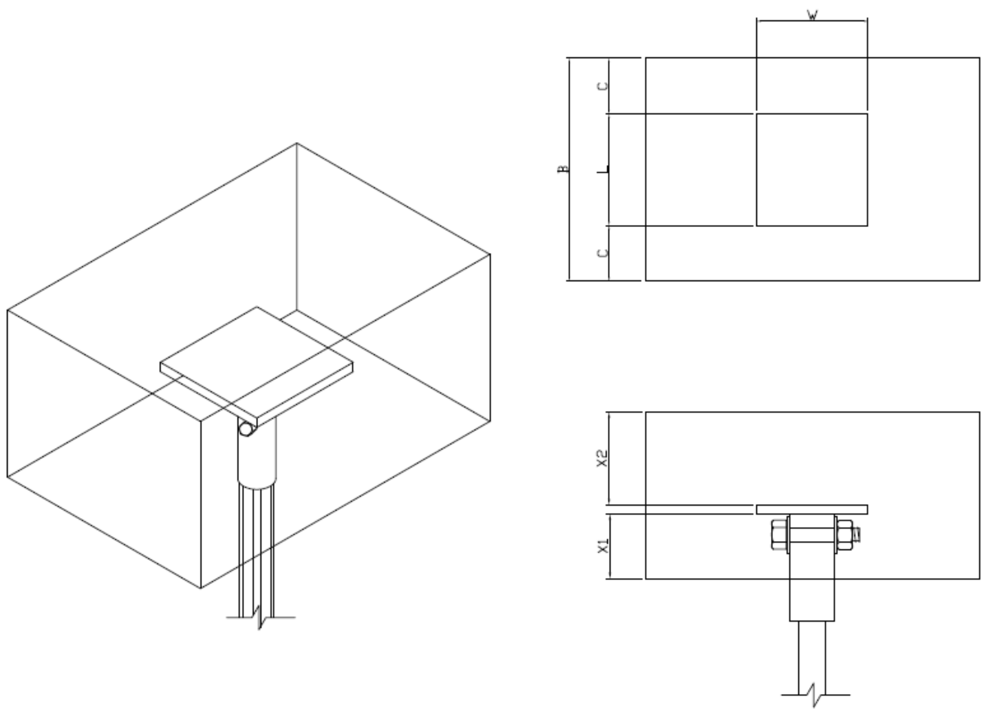
For **SI:** I inch = 25.4 mm, 1 kip = 1000 lbf = 4.448 kN.

[1]Bracket capacity is based on full scale load tests per AC358 with an installed 5'-0" unbraced pile length per IBC Section 1810.2.1, having a maximum of one coupling.

[2]Where the helical pile system is required to resist lateral forces; the lateral load capacity of the retrofit brackets must be determined by registered design professional in accordance with Chapter 18 of the IBC.

[3]The minimum specified compressive strength of the concrete foundation is 2,850 psi (19,650 kPa).

TABLE 6A—NEW CONSTRUCTION BRACKET ASD LOAD CAPACITIES[1]



Product Name	Axial Compression		Axial Tension		Lateral	
	Min. Concrete Cover[2]	Full Concrete Cover[3]	Min. Concrete Cover[2]	Full Concrete Cover[3]	Min. Concrete Cover[2]	Full Concrete Cover[3]
	(kips)	(kips)	(kips)	(kips)	(kips)	(kips)
TAB-150-NC	8.14	17.4	1.42	6.45	-	-
TAB-175-NC	10.72	59.0	2.01	29.42	-	-
TAB-288-NC	10.72	58.6	2.01 (1.51)[4]	26.43 (19.82)[4]	1.6 (1.1)[4]	8.64 (6.17)[4]
TAB-350-NC	10.72	82.4	2.01 (1.51)[4]	27.61 (20.71)[4]	1.4 (1.0)[4]	8.08 (5.77)[4]

For **SI:** 1 kip = 4.448 kN.

[1]Capacities include allowance for corrosion over a 50-year service life.
[2]Refer to Table 6B for the code-prescribed minimum concrete cover dimensions.
[3]Refer to Table 6B for the required full concrete cover dimensions such that concrete related limit states do not govern the bracket capacity.
[4] Values in parenthesis are for Seismic Design Categories D, E and F.

TABLE 6B—NEW CONSTRUCTION BRACKETS - CONCRETE STRENGTH AND COVERS[1]

Product Name	Concrete Specified Compressive Strength[4]	Minimum Requirements for Concrete Covers for Axial Compression, Axial Tension and Lateral				Minimum Requirements for Full Concrete Covers[3]							
		Overall Horizontal Dimension	Edge Distance	Concrete Covers[2]		For Axial Compression				For Axial Tension			
		B[5]	C[5]	X1	X2	B[5]	C[5]	X1	X2	B[5]	C[5]	X1[6]	X2
	(psi)	(in.)	(in.)	(in.)	(in.)	(in.)	(in.)	(in.)	(in.)	(in.)	(in.)	(in.)	(in.)
TAB-150-NC	2500	14	4	3	4	27.00	9.50	3	9.50	23.00	7.50	7.50	4
TAB-175-NC	2500	16	4	3	4	33.50	12.75	3	12.75	28.30	10.15	10.15	4
TAB-288-NC	2500	16	4	3	4	33.4	12.7	3	12.68	28.00	10.00	9.59	4
TAB-350-NC	2500	16	4	4	4	39.2	15.6	3	15.62	28.00	10.0	9.82	4

For **SI:** 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

[1]See the figure included in Table 6A for concrete cover designations.
[2]Minimum concrete covers are prescribed in IBC Section 1810.3.11.
[3]Full concrete covers are determined to ensure that concrete related limit states do not govern the bracket capacities.
[4]Concrete strength is the specified compressive strength at 28 days, see Section 3.3.7.3.
[5]Dimensions B and C apply to both bracket width and length directions.
[6]For dimension X1 determination, in accordance with Section 14.5.1.7 of ACI 318-19 under the 2021 IBC (Section 14.5.1.7 of ACI 318-14 under the 2018 and 2015 IBC, Section 22.4.7 of ACI 318-11 under the 2012 IBC, and Section 22.4.7 of ACI 318-08 under the 2009 IBC), concrete is assumed cast against soil, and a 2-inch extra concrete thickness is include in X1.

TABLE 7A—SHAFT ALLOWABLE CAPACITY (EXCEPT AXIAL COMPRESSION)[1,2]

SHAFT MODEL	COMPRESSION	TENSION	LATERAL SHEAR	BENDING MOMENT	TORQUE RATING
	(kips)	(kips)	(kips)	(kip-ft)	(lb-ft)
TA-150	Table 4	24.8	15.1	2.8	Table 2
TA-175	Table 4	20.1	41.7	4.7	Table 2
TA-288	Table 3	33.9	14.0	3.83	Table 1
TA-288 (With Welded Coupler)	Table 3	36.4	14.3	3.87	Table 1
TA-350	Table 3	45.1	21.1	6.8	Table 1

For **SI:** 1 kip = 4.448 kN, 1lbf-ft = 1.356 N-m, 1kip-ft = 1.356 kN-m.

[1]Capacities include allowance for corrosion over a 50-year service life.
[2]Capacities are based on the lower capacity of the two components that are shaft and coupling.

TABLE 7B—LATERAL LOAD

PILE TYPE	ALLOWABLE LATERAL CAPACITY	MINIMUM INSTALLATION DEPTH
	(lbs)	(ft)
TA-175	774	15
TA-288 (With Welded Coupler)	1964	16
TA-350	1864	15

For **SI:** 1 foot = 0.305 m, 1 lbf = 4.45 N

[1]Installation must be in accordance with Section 4.1.5 of this report. Installation is limited for use with new construction brackets. Minimum concrete edge distance to bracket plate is 4 inches.

TABLE 8—HELIX ALLOWABLE CAPACITY FOR AXIAL TENSION AND AXIAL COMPRESSION [(1)]

PILE MODEL	HELIX DIAMETER (in.)	ALLOWABLE CAPACITY (kips)
TA-150	8	27.3
	10	33.0
	12	30.1
	14	N/A
TA-175	8	46.0
	10	46.5
	12	41.2
	14	40.3
TA-288	8	45.6
	10	63.5
	12	60.1
	14	N/A
TA-350	8	39.4
	10	85.5
	12	48.4
	14	39.4

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

[1]Capacities include allowance for corrosion over a 50-year service life.

TABLE 9—MECHANICAL PROPERTIES OF TA-288 SHAFT[1]

Mechanical Properties	After Corrosion Loss
Steel Minimum Yield Strength, Fy	50 ksi
Steel Minimum Ultimate Strength, Fu	62 ksi
Modulus of Elasticity, E	29,000 ksi
Nominal Wall Thickness	0.244 in.
Design Wall Thickness	0.237in.
Outside Diameter, OD	2.868 in.
Inside Diameter, ID	2.395 in.
Cross Sectional Area, A	1.960 in^2
Moment of Inertia, I	1.710 in^4
Radius of Gyration, r	0.930 in.
Elastic Section Modulus, S	1.190 in^3
Plastic Section Modulus, Z	1.54 in^3

For **SI:** I inch = 25.4 mm, 1 ksi = 6.895 MPa, 1lbf-ft = 1.356 N-m, 1 lbf = 4.448 N.

[1] Mechanical properties are based on 50-year corrosion loss in accordance with Section 3.9 of AC358.

TABLE 10—MECHANICAL PROPERTIES OF TA-150 SHAFT[1]

Mechanical Properties	After Corrosion Loss
Steel Minimum Yield Strength, Fy	90 ksi
Steel Minimum Ultimate Strength, Fu	120 ksi
Modulus of Elasticity, E	29,000 ksi
Shaft Depth	1.487 in.
Corner Radius	0.369 in.
Depth At a Diagonal	1.798 in.
Cross Sectional Area, A	2.095 in^2
Moment of Inertia, I	0.356 in^4
Radius of Gyration, r	0.412 in.
Elastic Section Modulus, S	0.396 in^3
Plastic Section Modulus, Z	0.628 in^3

For **SI:** I inch = 25.4 mm, 1 ksi = 6.895 MPa, 1lbf-ft = 1.356 N-m, 1 lbf = 4.448 N.

[1] Mechanical properties are based on 50-year corrosion loss in accordance with Section 3.9 of AC358

TABLE 11—MECHANICAL PROPERTIES OF TA-175 SHAFT[1]

Mechanical Properties	After Corrosion Loss
Steel Minimum Yield Strength, Fy	90 ksi
Steel Minimum Ultimate Strength, Fu	123 ksi
Modulus of Elasticity, E	29,000 ksi
Shaft Depth	1.745 in.
Corner Radius	0.247 in.
Depth At a Diagonal	2.263 in.
Cross Sectional Area, A	2.992 in^2
Moment of Inertia, I	0.737 in^4
Radius of Gyration, r	0.496 in.
Elastic Section Modulus, S	0.652 in^3
Plastic Section Modulus, Z	1.128 in^3

For **SI:** I inch = 25.4 mm, 1 ksi = 6.895 MPa, 1lbf-ft = 1.356 N-m, 1 lbf = 4.448 N.
[1] Mechanical properties are based on 50-year corrosion loss in accordance with Section 3.9 of AC358.

TABLE 12—MECHANICAL PROPERTIES OF TA-350 SHAFT[1]

Mechanical Properties	After Corrosion Loss
Steel Minimum Yield Strength, Fy	50 ksi
Steel Minimum Ultimate Strength, Fu	62 ksi
Modulus of Elasticity, E	29,000 ksi
Nominal Wall Thickness	0.279 in.
Design Wall Thickness	0.272 in.
Outside Diameter, OD	3.493 in.
Inside Diameter, ID	2.949 in.
Cross Sectional Area, A	2.75 in^2
Moment of Inertia, I	3.59 in^4
Radius of Gyration, r	1.14 in.
Elastic Section Modulus, S	2.06 in^3
Plastic Section Modulus, Z	2.27 in^3

For **SI:** I inch = 25.4 mm, 1 ksi = 6.895 MPa, 1lbf-ft = 1.356 N-m, 1 lbf = 4.448 N.
[1] Mechanical properties are based on 50-year corrosion loss in accordance with Section 3.9 of AC358.

ICC-ES Evaluation Report

ESR-3559 LABC and LARC Supplement

Reissued August 2024

This report is subject to renewal August 2026.

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

REPORT HOLDER:

EARTH CONTACT PRODUCTS, LLC

EVALUATION SUBJECT:

EARTH CONTACT PRODUCTS (ECP) HELICAL FOUNDATION SYSTEMS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that ECP Helical Foundation Systems, described in ICC-ES evaluation report ESR-3559, have also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2023 *City of Los Angeles Building Code* (LABC)
- 2023 *City of Los Angeles Residential Code* (LARC)
  *For evaluation for compliance with the anticipated requirements of the 2023 LABC and LARC

2.0 CONCLUSIONS

The ECP Helical Foundation Systems, described in Sections 2.0 through 7.0 of the evaluation report ESR-3559, comply with the LABC Chapter 1810, and the LARC, and are subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The ECP Helical Foundation Systems described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-3559.
- The design, installation, conditions of use and identification of the ECP Helical Foundation Systems are in accordance with the 2021 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-3559.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, and Sections 1803 and 1810.3.1.5, as applicable.
- The ECP Helical Foundation Systems may be used in new construction and to resist horizontal loads as an exception to LABC Section 1810.3.1.5, provided the following conditions are met:
  - The ECP Helical Foundation Systems must comply with the provisions in ESR-3559 that apply to installation in Seismic Design Categories D, E and F.
  - A soil investigation report as required by LABC Section 1803.1 shall be submitted to the Los Angeles Department of Building and Safety Grading Division for review and approval for each site where helical piles are being installed.
  - For installation of helical piles under LABC covered structures, axial and lateral (where used) capacities of helical piles shall be determined in accordance with LABC Section 1810.3.3 by at least two project specific preproduction tests for each soil profile, size and depth of helical pile. At least two percent of all production piles shall be proof tested to the design strength, determined by using load combinations in LABC Section 1605.2.

- For installation of helical piles under LARC covered structures, axial and lateral (where used) capacities of helical piles shall be determined in accordance with LABC Section 1810.3.3 by at least one project specific preproduction test for each soil profile, size and depth of helical pile. At least two percent of all production piles shall be proof tested to the design strength, determined by using load combinations in LABC Section 1605.2.
- Helical piles installation shall be performed under the inspection and approval of the soils engineer and the continuous inspection and approval of the deputy grading inspector. The information recorded shall include installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data as required by soils engineer.
- Helical piles shall satisfy corrosion resistance requirements of AC358. In addition, all helical piles materials that are subject to corrosion shall include at least 1/16-inch corrosion allowance.
- The allowable axial design load must comply with LABC Section 1810.3.3.1.9.
- The allowable lateral load must comply with ESR-3559. The seismic demand force must not exceed the allowable lateral load reported in ESR-3559

- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.

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

ICC-ES Evaluation Report

ESR-3559 CBC and CRC Supplement

Reissued August 2024

This report is subject to renewal August 2026.

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

REPORT HOLDER:

EARTH CONTACT PRODUCTS, LLC.

EVALUATION SUBJECT:

EARTH CONTACT PRODUCTS (ECP) HELICAL FOUNDATION SYSTEMS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that ECP Helical Foundation Systems, described in ICC-ES evaluation report ESR-3559, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2022 and 2019 *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 Division of State Architect (DSA), see Sections 2.1.1 and 2.1.2 below.

- 2022 and 2019 *California Residential Code* (CRC)

2.0 CONCLUSIONS

2.1 CBC:

The ECP Helical Foundation Systems, described in Sections 2.0 through 7.0 of the evaluation report ESR-3559, comply with CBC Chapter 18, provided the design and installation are in accordance with the 2021 and 2018 *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 ECP Helical Foundation Systems, described in Sections 2.0 through 7.0 of the evaluation report ESR-3559, complies with CRC Chapter 4, provided the design and installation are in accordance with the 2021 and 2018 *International Residential Code®* (IRC) provisions noted in the evaluation report.

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