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Legacy report on the 1997 Uniform Building Code™

DIVISION: 02—SITE CONSTRUCTION
Section: 02465—Bored Piles

HELICAL PIER® FOUNDATION SYSTEMS

HUBBELL CORPORATION/A. B. CHANCE CO.
210 NORTH ALLEN STREET
CENTRALIA, MISSOURI 65240

1.0 SUBJECT

HELICAL PIER® Foundation Systems.

2.0 DESCRIPTION

2.1 General:

The Hubbell Corporation/A. B. Chance Co. HELICAL PIER® Foundation System is used to underpin foundations of existing structures, and is used for deep foundations of new structures. The system consists of foundation repair brackets and foundation anchors. The foundation brackets are used to connect the foundation of the structure to the foundation anchor.

2.1.1 HELICAL PIER® Foundation Anchor Components:

The steel anchor components consist of one or more circular steel helix plates welded to a central steel shaft. The depth of the embedment of foundation anchors into the soil can be extended by adding one or more steel shaft extensions, coupled together to form one long continuous pier. Extensions can be with or without steel helix plates attached.

Each steel helix plate is 3/8 inch (10 mm) thick and has an outer diameter of from 6 to 14 inches (152 to 356 mm), and an inner annulus either 1 1/2 or 1 3/4 inches (38 or 44.5 mm) square. Each plate is formed with all radial sections normal to the central longitudinal axis, ± 3 degrees. The helix pitch is 3 inches (76 mm).

The central steel shaft of lead sections and extension sections is a round cornered square (RCS) solid steel bar. RCS bars are either 1 1/2 or 1 3/4 inches (38 or 44.5 mm) square.

Each lead section of a foundation anchor has provisions at the top for a connection to an extension, and has an earth-penetrating pilot at the bottom. Each extension has provisions for a coupler at one end and a connection at the other. The coupler is an integrally forged socket that slips over an RCS shaft of the same size. Each socket has a transverse hole so that lead sections and extensions can be connected using a bolt and nut.

For all foundation anchor leads and extensions, helix plates are welded to their respective shafts. Nominal spacing

between helix plates is not less than three times the diameter of the lower helix. For example, a foundation anchor lead with an 8-, 10- and 12-inch-diameter (203, 254 and 305 mm) helix has a nominal 24-inch space between the 8- and 10-inch (203 and 254 mm) helix and a 30-inch (762 mm) space between the 10- and 12-inch (254 and 305 mm) helix. Figure 1 illustrates the foundation anchors.

2.1.2 Foundation Brackets: The foundation repair brackets used to address foundation settlement are Parts Nos. C150-0121, C150-0298, C150-0299 and C150-0147. The brackets consist of upper and lower steel bracket bodies interconnected using two bolts. The bolts, described as "lifting" bolts, are 7/8 inch (22 mm) in diameter for the Nos. C150-0121, C150-0298 and C150-0299 brackets and 1 inch (25 mm) in diameter for the No. C150-0147 bracket. The lower bracket body consists of steel sections shaped and welded together to form a seat for the foundation of the structure. The lower bracket body also has slots for attachment of the bracket to the concrete foundation. The upper bracket body is T-shaped, with the stem of the "T" being a steel pipe in which the shaft of the foundation anchor is inserted. Brackets No. C150-0121 and No. C150-0298 are used with foundation anchors having 1 1/2-inch (38 mm) square shafts. Bracket Nos. C150-0299 and C150-0147 are used with foundation anchors having 1 3/4-inch (44.5 mm) square shafts. Figure 2 illustrates the brackets.

Brackets No. C150-0121 and C150-0298 are used to address settlement of residential dwellings and light commercial buildings. Brackets No. C150-0299 and C150-0147 are used to address settlement of large dwellings and commercial buildings.

The light-duty underpinning bracket No. C150-0239 is used to address settlement of porches, patios and light concrete slabs. This bracket consists of a steel bracket body with a seat for the concrete slab and an anchor terminator containing a 1-inch-diameter (25 mm) lifting bolt. The anchor terminator is a round steel pipe with a drilled and tapped steel cap on top, into which the foundation anchor shaft is inserted. Figures 7 and 8 illustrate the bracket.

Slab repair bracket No. T150-0085 is used to address settlement of existing concrete slabs on grade. This bracket consists of a steel channel, an anchor terminator and a 1-inch-diameter (25 mm) bolt. The anchor terminator is a square steel tube with a drilled and tapped steel cap on top, into which the foundation anchor shaft is inserted. Figures 3 and 5 illustrate the bracket.

New-construction foundation bracket No. C150-0132 is used to support gravity loads. The bracket is used with steel-reinforced, poured-in-place concrete foundations. The bracket

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consists of a $\frac{1}{2}$ -inch-thick (13 mm) rectangular steel plate welded to $2\frac{1}{2}$ -inch-diameter (63.5 mm) steel tubing. Figures 4 and 6 illustrate the bracket.

2.2 Material Specifications:

2.2.1 Helix Plates: Material specifications for the helix plates are noted in Tables 1 and 2. The plates have a Class B-1, hot-dipped galvanized coating complying with ASTM A 153.

2.2.2 Anchor Shafts (Lead Sections and Extensions): The $\frac{1}{2}$ - and $1\frac{3}{4}$ -inch (38 and 44.5 mm) square RCS shafts conform either to ASTM A 29 and AISI 1044, having minimum yield and tensile strengths of 70 and 100 ksi (483 and 689 MPa), respectively, or to AISI 1530, having minimum yield and tensile strengths of 95 and 120 ksi (655 and 827 MPa), respectively. Anchor shafts have a Class B-1, hot-dipped galvanized coating complying with ASTM A 153.

2.2.3 Foundation Brackets:

2.2.3.1 Bracket Body: The brackets are formed from $\frac{1}{4}$ -, $\frac{5}{16}$ -, $\frac{3}{8}$ - or $\frac{1}{2}$ -inch-thick (6.4, 7.9, 10 or 13 mm) steel that meets or exceeds the requirements of ASTM A 36, and have a hot-dipped galvanized coating conforming to Class B-1 of ASTM A 153.

2.2.3.2 Pipe Assembly: The pipe in the upper bracket body of the C150-0121, C150-0298 and C150-0299 foundation repair brackets is cold-formed, welded, and seamless carbon steel structural tubing. Complying with ASTM A 500 Grade B, the steel tube has minimum yield and tensile strengths of 42 and 58 ksi (290 and 400 MPa), respectively. The pipe in the upper bracket body of the C150-0147 foundation repair bracket is hot-rolled, electrical-resistance-welded, round steel tubing. Complying with ASTM A 512 or A 513 Grade 1020, the steel tube has minimum yield and tensile strengths of 50 and 62 ksi (345 and 427 MPa), respectively. All pipe assemblies have a Class B-1, hot-dipped, galvanized coating complying with ASTM A 153.

2.2.4 Bolts:

2.2.4.1 Steel Foundation Anchor: The sizes and types of bolts connecting the steel foundation anchor extensions to lead sections or another extension are described in Table 2. All bolts are hot-dipped galvanized steel.

2.2.4.2 Foundation Brackets:

2.2.4.2.1 Lifting Bolts: The lifting bolts for the No. C150-0121, C150-0298 and C150-0299 foundation brackets have a $\frac{7}{8}$ -inch (22 mm) diameter and comply with SAE J429 Grade 5. The lifting bolt for the No. C150-0147 foundation bracket has a diameter of 1 inch (25 mm) and complies with SAE J429 Grade 5.

2.2.4.2.2 Cross Bolts: Cross bolts for the No. C150-0121, C150-0298 and C150-0299 foundation brackets have a diameter of $\frac{5}{8}$ inch (16 mm) and comply with SAE J429 Grade 5. The cross bolt for the No. C150-0147 foundation bracket has a $\frac{7}{8}$ -inch (22 mm) diameter and complies with SAE J429 Grade 5.

2.2.4.2.3 Concrete Anchor Bolts: Anchor bolts shall be $\frac{5}{8}$ inch (15.9 mm) in diameter for all foundation brackets. Concrete anchor bolts are designed for each project.

2.2.4.2.4 Light-duty Underpinning Bracket: The bolt for the light-duty underpinning bracket is a 1-inch-diameter (25 mm) bolt complying with SAE J429 Grade 5.

2.2.4.2.5 Slab Repair Bracket: The bolt for the slab repair bracket is a 1-inch-diameter (25 mm) bolt complying with SAE J429 Grade 5.

2.2.4.5 New-construction Foundation Bracket: The bolt used to connect the new-construction foundation bracket to the foundation anchor is a $\frac{3}{4}$ -inch-diameter (19.1 mm) bolt complying with SAE J429 Grade 5 for $1\frac{1}{2}$ -inch (38 mm) RCS

shafts, and a $\frac{7}{8}$ -inch-diameter (22 mm) bolt complying with ASTM A 193 Grade B7 for $1\frac{3}{4}$ -inch (44.5 mm) RCS shafts.

2.3 Design:

2.3.1 General: Structural calculations must be submitted to the building official for each building, and must be based on accepted engineering principles. The design method is the Load and Resistance Factor Design Specification in Chapter 22, Division II, of the code. The design strengths of individual lead sections and extension sections are noted in Tables 1 and 2. Factored nominal loads must not exceed the design strengths. The nominal loads must be factored in accordance with Section A4 of the specification. The actual capacity of the HELICAL PIER® Foundation System depends upon the analysis of the interaction of the helix plates and the soil, and may be less than the maximum design strengths noted in this report. Column buckling of foundation anchors due to compression loads, and combined flexural and compressive stresses of foundation anchors used with foundation repair brackets, shall be included in the analysis if this is deemed necessary by the building official or structural designer. Construction in Seismic Zones 3 and 4 requires compliance with Section 1809.5.1 of the code. A soil investigation report is necessary and must include consideration of:

1. Soil properties, including those affecting design.
2. Allowable soil bearing pressure.
3. Suitability for use in seismically active areas.
4. Information on ground-water table, frost depth and corrosion.

2.3.2 Connection to Building Structure: Downward-acting design strengths associated with each foundation repair bracket are as follows: C150-0121 – 20 kips (89 kN); C150-0298, C150-0299 and C150-0147 – 40 kips (178 kN); C150-0239 - 5 kips (22.2 kN); C150-0132 – 15 kips (66.7 kN). The downward-acting design strength is 5 kips (22.2 kN) for the T150-0085 slab repair bracket.

Factored design loads must not exceed the design strengths for the brackets. The concrete foundation and slab must be designed and justified to the satisfaction of the building official for concentrated loads due to the foundation and slab repair brackets. Bearing areas not exceeding 28, 34.5, 11.4, and 28 square inches (18,064, 22,258, 7,355, 18,064 and 18,064 mm²) shall be used to calculate the concrete bearing stress at the seat of the C150-0121, C150-0147, C150-0239, C150-0298 and C150-0299 foundation brackets, respectively. In addition, if deemed necessary by the building official, the effects of reduced lateral sliding resistance due to uplift from wind or seismic loads shall be considered for each project utilizing the C150-0121, C150-0147, C150-0298 and C150-0299 foundation repair brackets.

2.3.3 Protection of Pier and Bracket Materials: Protection of the pier and bracket materials must comply with Section 1807.9 of the UBC.

2.4 Installation:

2.4.1 General: The HELICAL PIER® Foundation System is installed by A. B. Chance Co. certified installers, trained to install the A. B. Chance Co. HELICAL PIER® Foundation System.

2.4.1.1 Foundation Anchors: The foundation anchors are installed using rotary motors having forward and reverse capabilities. The foundation anchors must be positioned and angled as specified in the approved plans. Foundation anchors to be attached to the structure with the C150-0121, C150-0147, C150-0298 and C150-0299 foundation repair brackets are installed at an angle of 3 to 5 degrees from vertical. Foundation anchors attached to structures by means of the No. C150-0239 light-duty underpinning bracket, the No. T150-0085 slab repair bracket or the No. C150-0132 new-

construction foundation bracket, are installed vertically plumb. The foundation anchors are installed in a smooth, continuous manner, with the rate of rotation being within the range of 5 to 20 revolutions per minute. Extensions are connected to the foundation anchor using the bolts specified in Table 2. Coupling bolts must be tightened firmly with a wrench. The foundation anchors are installed to the minimum depth shown on the plans, but with the top helix not less than 5 feet (1524 mm) below the bottom of the foundation.

2.4.1.2 C150-0121, C150-0147, C150-0298 and C150-0299

Foundation Repair Brackets: The T-shaped upper bracket body is slid over the end of the extension of the installed foundation anchor. The lower bracket body is attached to the concrete foundation by means of a concrete anchor complying with the code or a current evaluation report. The lower bracket body is attached to the upper bracket body using the lifting bolts. A jack placed on top of the T-shaped section of the bracket, with a jacking tool on top of the jack and connected to the lifting bolts, is used to lift the lower bracket body as it pushes down on the upper bracket body. The nuts on the bolts are tightened and the jack is removed.

2.4.1.3 Slab Repair Bracket: The slab repair bracket is installed on top of a foundation anchor that has been installed through a 6-inch-diameter (152 mm) hole core-drilled through the concrete slab. The top of the foundation anchor shall be 1 inch (25 mm) below the slab. Prior to installing the foundation anchor, a 1-foot-deep (304.8 mm) pocket is excavated in the subgrade beneath the hole in the slab. The slab repair bracket tube is placed over the foundation anchor shaft. The slab repair bracket channel is placed on top of the bracket tube. The leveling bolt is threaded into the channel and tube, positioning the bracket so that each end of the channel is in contact with at least 4 square inches (2580 mm²) of the slab. The maximum torque on the bolt is 150 ft.-lbs. (203 N · m). See Figure 5 for typical installation details.

2.4.1.4 New-construction Foundation Bracket: The end of the shaft of the installed foundation anchor is cut off, or the pier is installed until the shaft top is a minimum of 3 inches (76 mm) above the foundation subgrade or at a level where the bracket will support an upper layer of steel reinforcing bars in the concrete foundation. The new-construction foundation bracket is placed over, and seated on the top of, the foundation anchor shaft. The steel reinforcing bars of the foundation are placed in direct contact with the top of the bracket. If required, the bracket is connected to the foundation anchor shaft with a ³/₄-inch-diameter (19 mm) bolt installed through a ¹³/₁₆-inch-diameter (20.6 mm) hole predrilled in 1¹/₂-inch (38 mm) RCS foundation anchor shafts, or a ⁷/₈-inch-diameter (22 mm) bolt installed through a 1-inch-diameter (25 mm) hole predrilled in 1³/₄-inch (44.5 mm) RCS foundation anchor shafts. See Figure 6.

2.4.1.5 Light-duty Underpinning Bracket: The end of the shaft of the installed foundation anchor is cut off or the foundation anchor is installed until the shaft top is a minimum of 1 inch (25 mm) below the bottom of the slab. The bolt guide is placed on top of the foundation anchor shaft and the pipe of the bracket is slipped over the shaft. The bracket is attached to the concrete slab by means of concrete anchors installed in accordance with the evaluation report on the anchor. The lifting bolt is threaded into the pipe cap so that its base engages the bolt guide inside the pipe. The maximum torque on the bolt is 200 ft.-lbs. (27.1 N · m). See Figure 8 for installation details.

2.4.2 Special Inspection: Special inspection in accordance with Section 1701 of the code shall be provided for the installation of the foundation anchors and foundation brackets. Items to be confirmed by the special inspector shall include, but not be limited to, the manufacturer's certification of installers, the installation torque and depth of the

foundation anchors and compliance of the installation with the approved construction documents and this evaluation report. In lieu of continuous special inspection, periodic special inspection in accordance with Section 1701.6.2 of the code is permitted provided that installers are certified by the manufacturer and structural observations in accordance with Section 1702 are provided.

Periodic inspections shall be performed in accordance with the following schedule, subject to the building official's approval:

1. Before the start of work—Verify manufacturer, verify installer's certification by the manufacturer, and confirm pier and bracket configuration compliance with construction documents and this evaluation report.
2. Installation of first helical steel pier—Verify that location, installation torque, and depth of helical steel piers comply with construction documents. Verify that installers keep an installation log.
3. First connection to building structure—Verify that installation of foundation repair brackets or new construction brackets complies with construction documents and this evaluation report.
4. End of work—Verify that installation log complies with requirements specified in the construction documents; verify that installation of all structural connections complies with construction documents and this evaluation report.

2.5 Identification:

Foundation anchors have the word "CHANCE" stamped on the top of the helix. The foundation anchors are also identified by a tag or label bearing the name and address of A. B. Chance Co., the catalog number, the product description, the evaluation report number (ER-5110), and the name of the inspection agency (RADCO). The brackets are identified by labels bearing the catalog number and product description. In addition, the letter "C" is stamped on the No. C150-0121, No. C150-0298, No. C150-0299 and No. C150-0147 brackets.

3.0 EVIDENCE SUBMITTED

Material specifications, installation instructions, load tests and a quality control manual.

4.0 FINDINGS

That the HELICAL PIER® Foundation Systems described in this report comply with the 1997 *Uniform Building Code*™, subject to the following conditions:

- 4.1 **The foundation anchors are manufactured at the A. B. Chance Co. facility located at 210 North Allen Street, in Centralia, Missouri, under a quality control program with inspections by RADCO (AA-650).**
- 4.2 **The foundation anchors are manufactured, identified and installed in accordance with this report.**
- 4.3 **Special inspection is provided in accordance with Section 2.4.2 of this report.**
- 4.4 **Engineering calculations and drawings, in accordance with recognized engineering principles and design parameters, are provided to the building official.**
- 4.5 **A soil investigation must be provided for each project site in accordance with Section 2.3.1 of this report.**
- 4.6 **The applied factored loads must not exceed the design strength loads in Section 2.3 of this report.**

This report is subject to re-examination in one year.

TABLE 1—DESCRIPTION AND DESIGN STRENGTHS OF LEAD SECTIONS

ITEM NUMBER	CATALOG NUMBER	DIMENSIONS ¹						MAXIMUM DESIGN STRENGTH (kips)	HELIX PLATE MATERIAL SPECIFICATION	SHAFT TYPE
		A (feet)	B (inches)	C (inches)	D (inches)	E (inches)	F (inch)			
1	C150-0002	5	1 ¹ / ₂	8	—	—	5/16	20	ASTM A 572 or A 935 Grade 50 $F_y = 50$ ksi $F_u = 65$ ksi	RCS ² Solid Steel Bar
2	C150-0001	7	1 ¹ / ₂	8	—	—	5/16	20		
3	C150-0058	5	1 ¹ / ₂	10	—	—	5/16	20		
4	C150-0003	7	1 ¹ / ₂	10	—	—	5/16	20		
5	C150-0242	5	1 ¹ / ₂	12	—	—	5/16	20		
6	C150-0004	7	1 ¹ / ₂	12	—	—	5/16	20		
7	C150-0243	5	1 ¹ / ₂	14	—	—	5/16	16		
8	C150-0005	7	1 ¹ / ₂	14	—	—	5/16	16	ASTM A 656 or A 936 Grade 80 $F_y = 80$ ksi $F_u = 65$ ksi	
9	C150-0086	3	1 ¹ / ₂	6	6	—	1/4	27.5		
10	C150-0244	3	1 ¹ / ₂	6	8	—	1/4	27.5		
11	C150-0030	7	1 ¹ / ₂	6	8	—	1/4	27.5		
12	C150-0160	3	1 ¹ / ₂	8	10	—	1/4	27.5		
13	C150-0006	7	1 ¹ / ₂	8	10	—	1/4	27.5		
14	C150-0031	10 ¹ / ₂	1 ¹ / ₂	8	10	—	1/4	27.5		
15	C150-0161	3 ¹ / ₂	1 ¹ / ₂	10	12	—	1/4	27.5		
16	C150-0051	7	1 ¹ / ₂	10	12	—	1/4	27.5		
17	C150-0007	5 ¹ / ₂	1 ¹ / ₂	8	10	12	1/4	27.5		
18	C150-0168	2 ¹ / ₂	1 ¹ / ₂	8	10	—	1/4	35	ASTM A 572 or A 935 Grade 50 $F_y = 50$ ksi $F_u = 65$ ksi	
19	C150-0169	5	1 ¹ / ₂	8	10	12	1/4	35		
20	C150-0163	7	1 ¹ / ₂	10	12	14	1/4	35		
21	C150-0010	5 ¹ / ₂	1 ³ / ₄	8	—	—	5/16	25		
22	C150-0011	5 ¹ / ₂	1 ³ / ₄	10	—	—	5/16	25		
23	C150-0012	5 ¹ / ₂	1 ³ / ₄	8	10	—	5/16	50		
24	C150-0180	5 ¹ / ₂	1 ³ / ₄	8	10	12	5/16	50		

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 kip = 4.448 kN, 1 ksi = 6.895 MPa.

¹For description of dimensions, see Figure 1.

²RCS = Round cornered square.

TABLE 2—DESCRIPTION AND DESIGN STRENGTH OF EXTENSIONS

ITEM NUMBER	CATALOG NUMBER	DIMENSIONS ¹				MAXIMUM DESIGN STRENGTH (kips)	COUPLING BOLTS ²			HELIX PLATE MATERIAL SPECIFICATION
		A (feet)	B (inches)	C (inches)	F (inch)		Quantity	Size	Type	
1	C150-0047	3 ¹ / ₂	1 ¹ / ₂	—	—	27.5	1	3 ³ / ₄ inch	ASTM A 320 Grade L7	12-inch helix: ASTM A 572 or A 935 Grade 50 $F_y = 50$ ksi $F_u = 65$ ksi 14-inch helix: ASTM A 656 and A 936 Grade 80 $F_y = 80$ ksi $F_u = 90$ ksi
2	C150-0008	5	1 ¹ / ₂	—	—					
3	C150-0009	7	1 ¹ / ₂	—	—					
4	C150-0048	10	1 ¹ / ₂	—	—					
5 ³	C150-0159	5	1 ¹ / ₂	12	1 ¹ / ₄					
6 ⁴	C150-0166	3 ¹ / ₂	1 ¹ / ₂	14	1 ¹ / ₄					
7 ⁴	C150-0167	5	1 ¹ / ₂	14	1 ¹ / ₄					
8	C150-0144	3 ¹ / ₂	1 ¹ / ₂	—	—	35	1	3 ³ / ₄ inch		
9	C150-0145	5	1 ¹ / ₂	—	—					
10	C150-0146	7	1 ¹ / ₂	—	—					
11	C150-0175	10 ¹ / ₂	1 ¹ / ₂	—	—					
12 ⁴	C150-0176	4	1 ¹ / ₂	14	1 ¹ / ₄					
13	C150-0183	3 ¹ / ₂	1 ³ / ₄	—	—	50	1	7 ⁷ / ₈ inch		
14	C150-0013	5	1 ³ / ₄	—	—					
15	C150-0014	7	1 ³ / ₄	—	—					
16	C150-0184	10 ¹ / ₂	1 ³ / ₄	—	—					
17 ⁴	C150-0185	4	1 ³ / ₄	14	5 ⁵ / ₁₆					

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 kip = 4.448 kN, 1 ksi = 6.895 MPa.

¹For description of dimensions A through F, see Figure 1.

²Bolts connect extensions to lead sections or extensions.

³Design strength of helix is 20 kips.

⁴Design strength of helix is 16 kips.

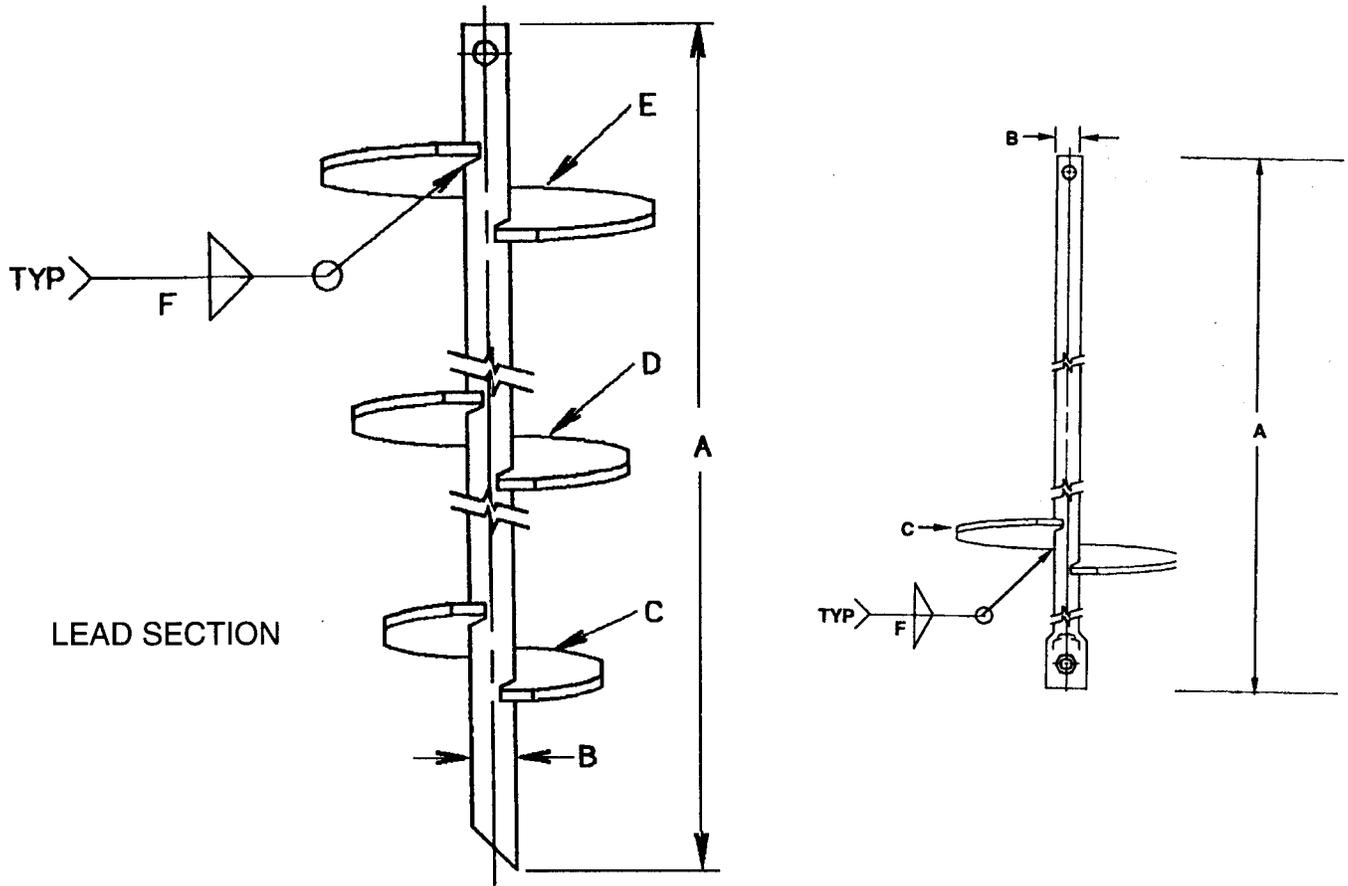
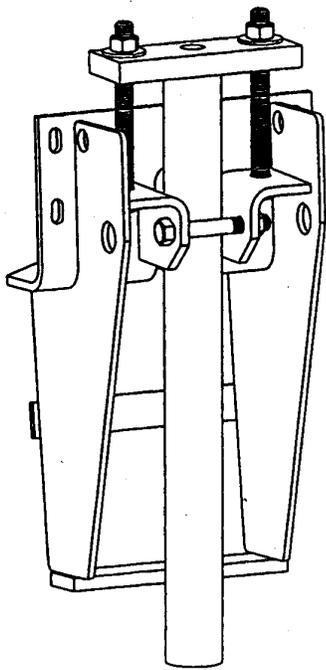
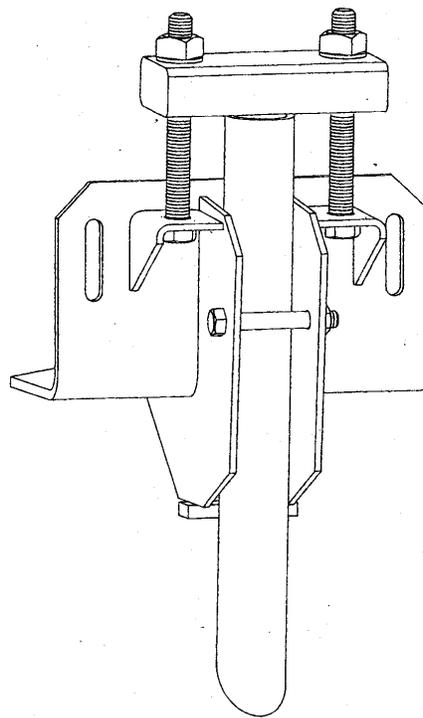


FIGURE 1—HELICAL STEEL PIER



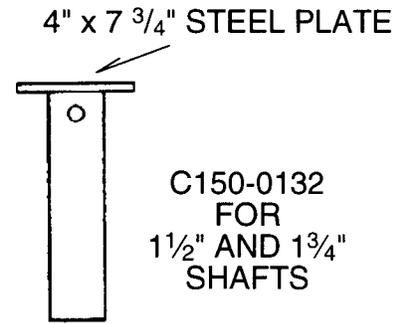
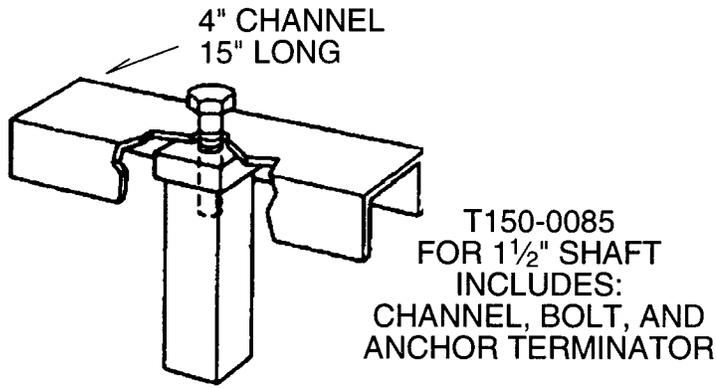
C150-0147 FOR
1 3/4" SHAFT



C150-0121, C50-0298
AND C150-0299

For SI: 1 inch = 25.4 mm.

FIGURE 2—FOUNDATION REPAIR BRACKETS



For SI: 1 inch = 25.4 mm.

For SI: 1 inch = 25.4 mm.

FIGURE 3—SLAB REPAIR BRACKET

FIGURE 4—NEW-CONSTRUCTION FOUNDATION BRACKET

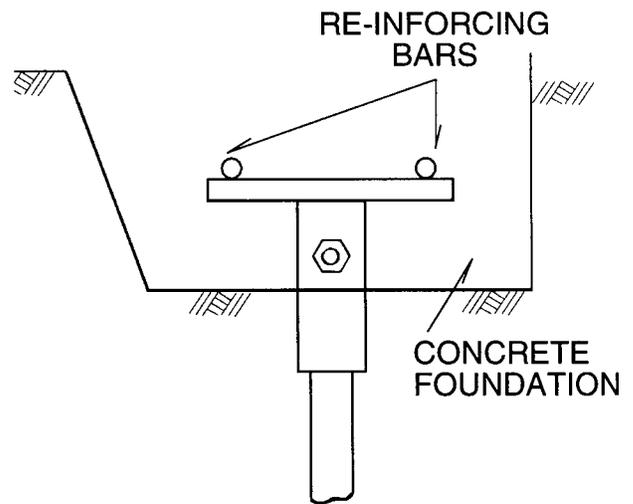
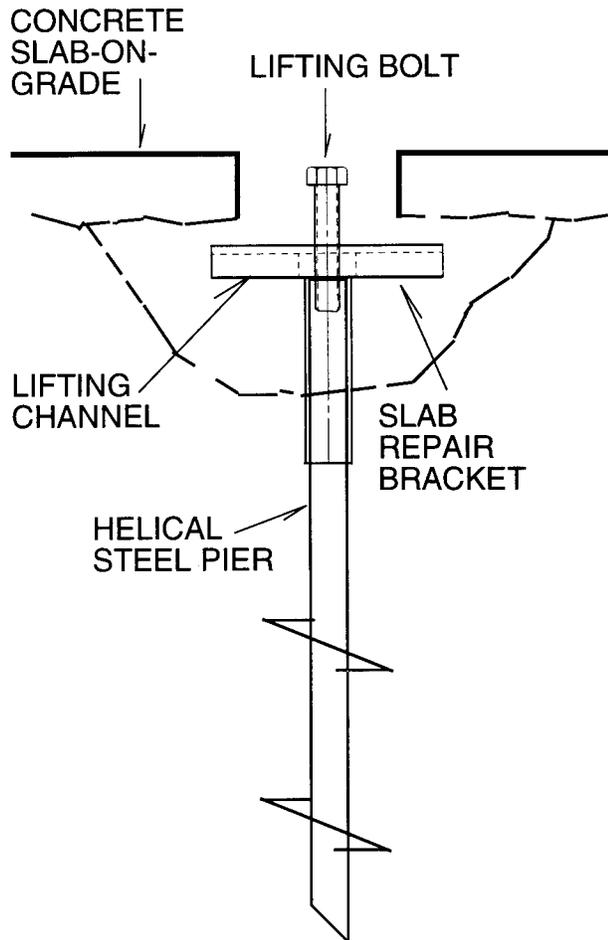
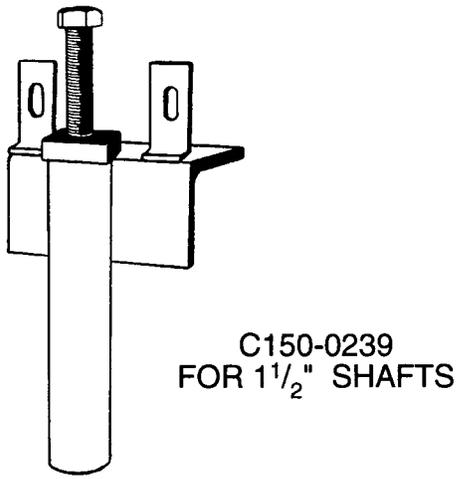


FIGURE 5—TYPICAL INSTALLATION OF SLAB REPAIR BRACKET

FIGURE 6—TYPICAL INSTALLATION OF NEW-CONSTRUCTION FOUNDATION BRACKET



For SI: 1 inch = 25.4 mm.

FIGURE 7—LIGHT-DUTY BRACKET

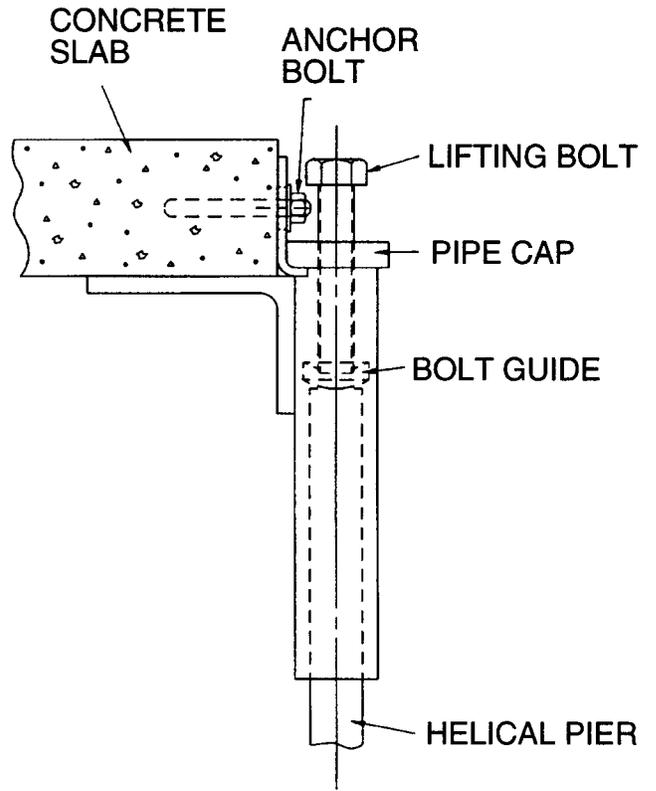


FIGURE 8—TYPICAL INSTALLATION OF LIGHT-DUTY UNDERPINNING BRACKET