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EVALUATION REPORT

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ER-5110

Issued June 1, 1996

Filing Category: DESIGN—Miscellaneous (038)

HELICAL PIER™ FOUNDATION SYSTEM

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

I. **Subject:** Helical Pier™ Foundation System.

II. **Description:** A. **General:** The A. B. Chance Co. Helical Pier Foundation System is used for foundation underpinning. The system is used to retrofit foundations of existing structures or to provide bearing for new foundations. The system consists of foundation brackets and helical steel piers. The foundation brackets are used to connect the foundation of the structure to the helical steel pier.

1. **Helical Steel Piers:** The steel piers consist of one or more helically shaped circular steel plates welded to a central steel shaft. The depth of the helical piers in the soil can be extended by adding one or more shaft extensions coupled together to form one long continuous pier. Extensions can be with or without attached helically shaped steel plates.

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

The central steel shaft of piers and extensions is round cornered square (RCS) solid steel bars. RCS bars are either $1\frac{1}{2}$ or $1\frac{3}{4}$ inches (38 or 44.5 mm) square.

Each lead section of a helical steel pier 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 with a bolt and nut.

For all helical pier leads and extensions, helical plates are welded to their respective shafts. Nominal spacing between helical plates is not less than three times the diameter of the lower helix. For example, a helical pier lead with an 8-, 10- and 12-inch-diameter (203, 254 and 305 mm) helix has a nominal 24-inch (610 mm) 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. Refer to Figure 1 and Tables 1 and 2 for sizes of shafts, helix diameters, number of helices, bolts, welds and allowable loads of lead sections and extensions.

2. **Foundation Brackets:** Foundation repair brackets used to address foundation settlement are designated as part Nos. C150-0121 and C150-0147. The brackets consist of upper and lower steel bracket bodies interconnected with two bolts. The bolts, described as "lifting" bolts, are $\frac{7}{8}$ inch (22 mm) and 1 inch (25 mm) in diameter for the Nos. C150-0121 and C150-0147 brackets, respectively. 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 holes 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 helical steel pier is inserted. Bracket Nos. C150-0121 and C150-0147 are used with helical steel piers having $1\frac{1}{2}$ - and $1\frac{3}{4}$ -inch (38 and 44.5 mm) square shafts, respectively. See Figure 2.

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 with 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 shaft of the helical pier foundation shaft is inserted. See Figures 7 and 8.

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 shaft of the helical pier shaft is inserted. See Figures 3 and 5.

New-construction foundation bracket No. C150-0132 is used to support gravity loads. The bracket is used with steel-reinforced, poured-in-place concrete footings. The bracket consists of a $1\frac{1}{2}$ -inch-thick (13 mm) rectangular steel plate welded to $2\frac{1}{2}$ -inch-diameter (63.5 mm) steel tubing. See Figures 4 and 6 for additional details.

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

3. **Foundation Brackets:** a. **Bracket Body:** The brackets are formed from $\frac{1}{4}$ -, $\frac{3}{8}$ - or $\frac{1}{2}$ -inch-thick (6.4, 10 or 13 mm) steel complying with ASTM A 36, and have a hot-dipped galvanized coating conforming to Class B-1 of ASTM A 153.

b. **Pipe Assembly:** The pipe of the upper bracket body of the Nos. C150-0121 and C150-0147 foundation repair brackets is hot-rolled, electrical resistance, welded, round steel tubing complying with ASTM A 512 or ASTM A 513 Grade 1020, having minimum yield and tensile strengths of 50 and 62 ksi (345 and 427 kPa), respectively.

4. **Bolts:** a. **Helical Steel Pier:** The sizes and types of bolts connecting the steel pier extensions to lead sections or another extension are described in Table 2.

b. **Foundation Brackets:** (1) **Lifting Bolts:** The lifting bolts for the Nos. C150-0121 and C150-0147 foundation brackets comply with SAE J429, Grade 2 or Grade 5, and have a diameter of $\frac{7}{8}$ inch and 1 inch (22 and 25 mm), respectively.

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This report is based upon independent tests or other technical data submitted by the applicant. The ICBO Evaluation Service, Inc., technical staff has reviewed the test results and/or other data, but does not possess test facilities to make an independent verification. There is no warranty by ICBO Evaluation Service, Inc., express or implied, as to any "Finding" or other matter in the report or as to any product covered by the report. This disclaimer includes, but is not limited to, merchantability.

(2) **Cross Bolts:** Cross bolts for the Nos. C150-0121 and C150-0147 foundation brackets comply with SAE J429 Grade 5 and have $\frac{5}{8}$ - and $\frac{7}{8}$ -inch (16 and 22 mm) diameters, respectively.

(3) **Concrete Anchor Bolts:** Anchor bolts are $\frac{5}{8}$ inch (16 mm) in diameter and are designed for each project.

c. **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.

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

e. **New-construction Foundation Bracket:** The bolt used to connect the new-construction foundation bracket to helical pier shafts 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.

C. Design: 1. General: Structural calculations must be submitted to the building official for each building, and must be based on accepted engineering principles. Factored design loads on helical piers shall not exceed the allowable loads shown in Tables 1 and 2 of this report. The design loads may be increased by the load factors of Section A 4 of Division VIII of the code. The total allowable load of helical piers is the summation of allowable loads of the lead section and extensions from Tables 1 and 2, provided the total allowable load does not exceed 40,000 or 58,000 pounds (178 or 258 kN) for helical piers with $1\frac{1}{2}$ -inch (38 mm) and $1\frac{3}{4}$ -inch (44.5 mm) RCS shafts, respectively. Combined flexural and compressive stresses, and column buckling of the piers due to compression loads, must be included in the analysis. In addition, Section 1809.5.1 of the Uniform Building Code (U.B.C.) needs to be addressed in Seismic Zones 3 and 4.

A soil investigation report is necessary that includes:

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

2. Connection to Building Structure: Allowable downward-acting loads are 20,000, 40,000, 5,000 and 15,000 pounds (89, 178, 22.2 and 66.7 kN) for the Nos. C150-0121, C150-0147, C150-0239 and C150-0132 foundation brackets, respectively. The allowable downward-acting load is 5,000 pounds (22.2 kN) for the No. T150-0085 slab repair bracket.

Factored design loads must not exceed the allowable loads 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 19, 34.5 and 11.4 square inches (483, 876 and 289 mm²) shall be used to calculate the concrete bearing stress at the seat of the C150-0121, C150-0147 and C150-0239 foundation brackets, respectively. In addition, the effects of reduced lateral sliding resistance due to uplift from wind or seismic loads need to be addressed for each project utilizing the Nos. C150-0121 and C150-0147 foundation repair anchors.

3. Protection of Pier and Bracket Materials: Protection of the pier and bracket materials must comply with Section 1807.9 of the U.B.C.

D. Installation: 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.

a. **Helical Steel Piers:** The helical piers are installed with rotary motors having forward and reverse capabilities. The piers must conform to approved plans and be positioned and angled as specified. Helical piers to be attached to the structure with the Nos. C150-0121 and C150-0147 foundation repair brackets are installed at an angle of 3 to 5 degrees from vertical. Helical piers attached to structures with 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 plumb. The helical piers are installed in a smooth, continuous manner, with the rate of pier rotation in the range of 5 to 20 revolutions per minute. Extensions are connected to the helical pier with the bolts specified in Table 2. Bolts are tightened to approximately 40 ft-lb (54 N-m) of torque.

The piers are installed to the minimum depth shown on plans, but with the top helix not less than 5 feet (1524 mm) below the bottom of the foundation.

b. **Numbers C150-0121 and C150-0147 Foundation Repair Brackets:** The T-shaped upper bracket body is slid over the end of the extension of the installed helical steel pier. The lower bracket body is attached to the concrete foundation with concrete anchors installed in accordance with the evaluation report on the anchors. The lower bracket body is attached to the upper bracket body with 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.

c. **Slab Repair Bracket:** The slab repair bracket is installed on top of a helical pier that has been installed through a 6-inch-diameter (152 mm) hole core-drilled through the concrete slab. The top of the helical pier shall be 1 inch (25 mm) below the slab. Prior to installing the helical pier, a 1-foot-deep pocket in the subgrade is excavated beneath the hole in the slab. The tube of the slab repair bracket is placed over the pier 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-lb (203 N-m). See Figure 5 for typical installation details.

d. **New-construction Foundation Bracket:** The end of the shaft of the installed helical pier 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 footing. The new-construction foundation bracket is placed over and seated on the top of the pier shaft. The steel reinforcing bars of the foundation are placed in direct contact with the top of the bracket. The bracket is connected to the pier shaft with a $\frac{3}{4}$ -inch-diameter (19 mm) bolt installed through a $\frac{13}{16}$ -inch-diameter (20.6 mm) hole predrilled in $1\frac{1}{2}$ -inch (35 mm) RCS pier shafts, or a $\frac{7}{8}$ -inch-diameter (22 mm) bolt installed through a 1-inch-diameter (25 mm) hole predrilled in $1\frac{3}{4}$ -inch (44.5 mm) RCS pier shafts. See Figure 6.

e. **Light-duty Underpinning Bracket:** The end of the shaft of the installed helical pier is cut off or the pier 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 pier shaft and the pipe of the bracket is slipped over the shaft. The bracket is attached to the concrete slab with concrete anchors installed in accordance with the evaluation report on the anchors. 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-lb (271 N-m). See Figure 8 for installation details.

2. Special Inspection: Special inspection is required for installation of the helical piers and foundation brackets. Items to be inspected are verification of catalog numbers, types and configurations of helical pier lead sections, extensions, brackets, bolt type and torque, installation procedure and depth, inclination and position of helical pier, shaft of pier extension in full contact with T-shaped bracket, concrete anchor bolt size, type and installation procedure, full-surface contact of foundation brackets with concrete, and tightness of all bolts.

E. Identification: Helical piers have the word "CHANCE" stamped on the top of the helix. The helical piers 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 (5110), and the name of the quality control agency (RADCO). The brackets are identified by labels bearing the catalog number and product description. In addition, the letter "C" is stamped on the Nos. C150-0121 and C150-0147 brackets.

III. Evidence Submitted: Material specifications, installation instructions, load tests and quality control manual.

Findings

IV. Findings: That the Helical Pier Foundation System described in this report complies with the 1994 Uniform Building Code™, subject to the following conditions:

1. The helical piers are manufactured at the A. B. Chance Co. facility located in Centralia, Missouri, with quality control inspections by RADCO (NER-QA204).
2. The helical piers are manufactured, identified and installed in accordance with this report.
3. Special inspection is provided in accordance with Section II D 2 of this report.
4. Engineering calculations and drawings, in accordance with rec-

ognized engineering principles and design parameters, are to be provided to the building official.

5. A soils investigation must be provided for each project site in accordance with Section II C 1 of this report.
6. Design loads factored in accordance with Section II C of this report must not exceed the allowable loads of Section II C.

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

TABLE 1—DESCRIPTION AND ALLOWABLE LOADS OF LEAD SECTIONS

CATALOG NUMBER	DIMENSIONS ¹						ALLOWABLE TENSION OR COMPRESSION (pounds)	HELICAL PLATE MATERIAL SPECIFICATION	SHAFT TYPE
	A (feet)	B (inches)	C (inches)	D (inches)	E (inches)	F (inches)			
C150-0001	7	1 ¹ / ₂	8	—	—	5 ¹ / ₁₆	20,000	ASTM A 607, A 570 and A 572 Grade 50 F _y = 50 ksi F _t = 65 ksi	RCS ² solid steel bar
C150-0002	5	1 ¹ / ₂	8	—	—	5 ¹ / ₁₆	20,000		
C150-0003	7	1 ¹ / ₂	10	—	—	5 ¹ / ₁₆	20,000		
C150-0004	7	1 ¹ / ₂	12	—	—	5 ¹ / ₁₆	20,000		
C150-0005	7	1 ¹ / ₂	14	—	—	5 ¹ / ₁₆	16,000		
C150-0030	7	1 ¹ / ₂	6	8	—	1 ¹ / ₄	20,000		
C150-0006	7	1 ¹ / ₂	8	10	—	1 ¹ / ₄	20,000		
C150-0031	10	1 ¹ / ₂	8	10	—	1 ¹ / ₄	20,000		
C150-0007	7	1 ¹ / ₂	8	10	12	1 ¹ / ₄	20,000		
C150-0168	2 ¹ / ₂	1 ¹ / ₂	8	10	—	1 ¹ / ₄	20,000		
C150-0169	5	1 ¹ / ₂	8	10	12	1 ¹ / ₄	20,000		
C150-0170	10	1 ¹ / ₂	14	14	14	1 ¹ / ₄	20,000		
C150-0010	5 ¹ / ₂	1 ³ / ₄	8	—	—	5 ¹ / ₁₆	25,000		
C150-0011	5 ¹ / ₂	1 ³ / ₄	10	—	—	5 ¹ / ₁₆	25,000		
C150-0012	5 ¹ / ₂	1 ³ / ₄	8	10	—	5 ¹ / ₁₆	40,000		

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 lbf = 4.448 N, 1 ksi = 6.895 MPa.

¹For description of dimensions, see Figure 1.

²RCS = Round cornered square.

TABLE 2—DESCRIPTION AND ALLOWABLE LOADS OF EXTENSIONS

CATALOG NUMBER	DIMENSIONS ¹						ALLOWABLE TENSION OR COMPRESSION (pounds)	BOLTS ²			HELICAL PLATE MATERIAL SPECIFICATION
	A (feet)	B (inches)	C (inches)	D (inches)	E (inches)	F (inches)		Qty.	Size	Type	
C150-0047	3 ¹ / ₂	1 ¹ / ₂	—	—	—	—	20,000	1	3 ³ / ₄	ASTM A 320 Grade L7	ASTM A 715 Grade 80 F _y = 80 ksi F _t = 90 ksi
C150-0008	5	1 ¹ / ₂	—	—	—	—					
C150-0009	7	1 ¹ / ₂	—	—	—	—					
C150-0048	10	1 ¹ / ₂	—	—	—	—					
C150-0144	3 ¹ / ₂	1 ¹ / ₂	—	—	—	—					
C150-0145	5	1 ¹ / ₂	—	—	—	—					
C150-0146	7	1 ¹ / ₂	—	—	—	—					
C150-0175	10	1 ¹ / ₂	—	—	—	—	20,000 ³				
C150-0176	4	1 ¹ / ₂	14	—	—	1 ¹ / ₄					
C150-0177	6 ¹ / ₂	1 ¹ / ₂	14	14	—	1 ¹ / ₄	20,000				
C150-0178	10	1 ¹ / ₂	14	14	14	1 ¹ / ₄					
C150-0013	5	1 ³ / ₄	—	—	—	—	40,000	1	7 ⁷ / ₈	ASTM A 193 Grade B7	
C150-0014	6 ¹ / ₂	1 ³ / ₄	—	—	—	—					

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 lbf = 4.448 N, 1 ksi = 6.895 MPa.

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

²Bolts connect extensions to lead sections or extensions.

³Allowable load applied to helix is 16,000 pounds.

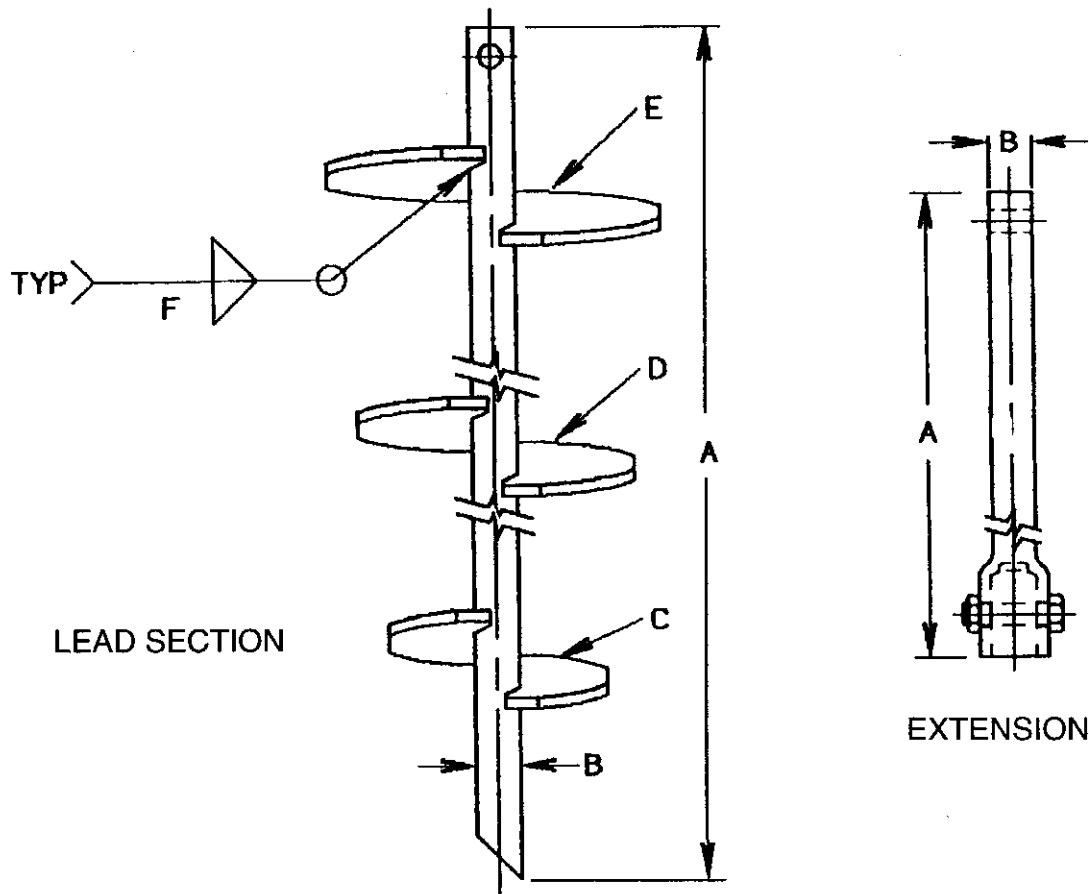
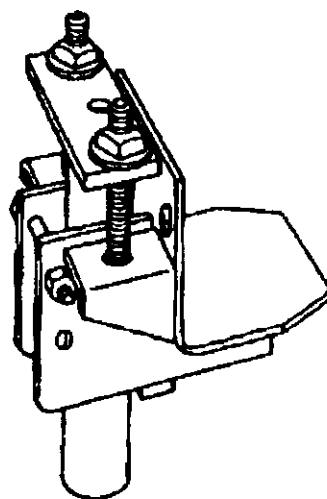


FIGURE 1—HELICAL STEEL PIER

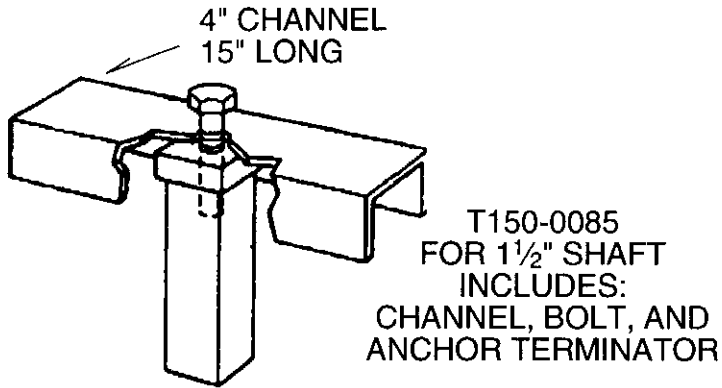


C150-0121
FOR 1½"
SHAFT

C150-0147
FOR 1¾"
SHAFT

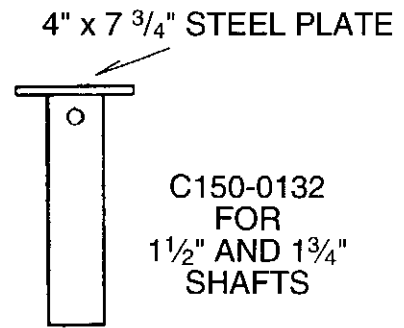
For SI: 1 inch = 25.4 mm.

FIGURE 2—FOUNDATION REPAIR BRACKET



For SI: 1 inch = 25.4 mm.

FIGURE 3—SLAB REPAIR BRACKET



For SI: 1 inch = 25.4 mm.

FIGURE 4—NEW-CONSTRUCTION FOUNDATION BRACKET

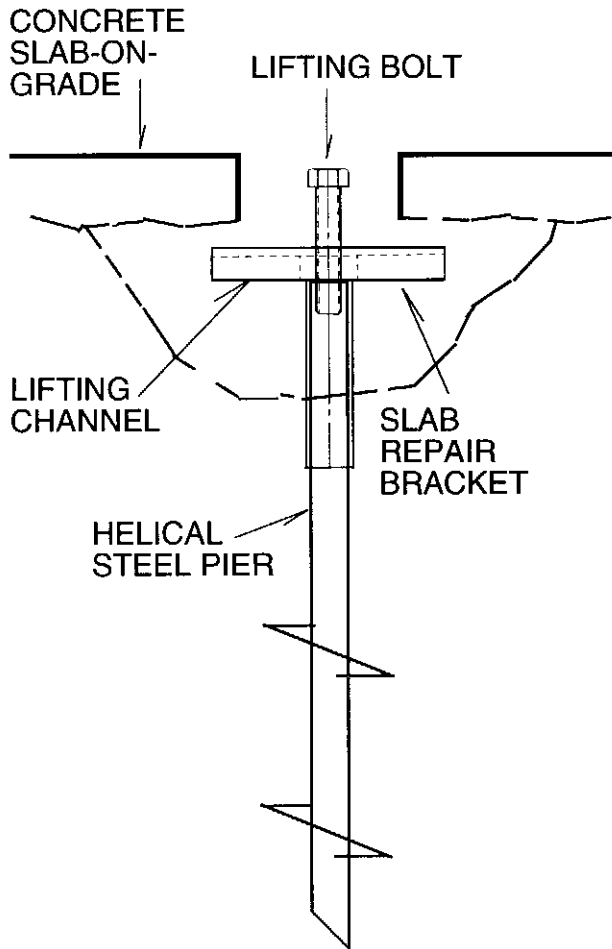


FIGURE 5—TYPICAL INSTALLATION OF SLAB REPAIR BRACKET

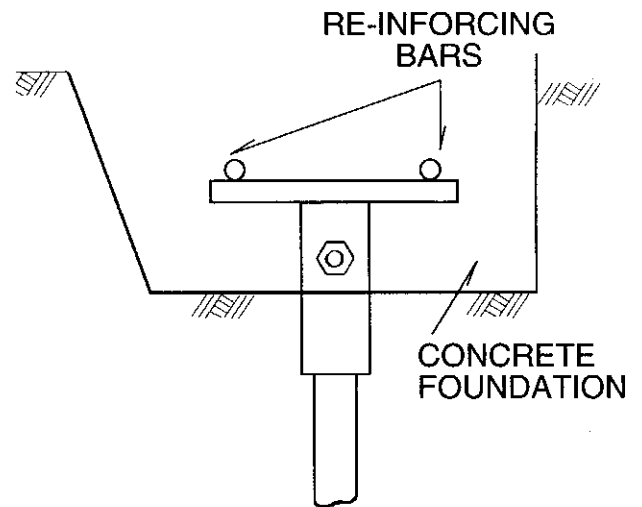
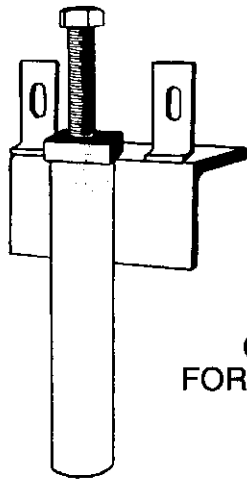


FIGURE 6—TYPICAL INSTALLATION OF NEW-CONSTRUCTION FOUNDATION BRACKET



C150-0239
FOR 1 1/2" SHAFTS

For SI: 1 inch = 25.4 mm.

FIGURE 7—LIGHT-DUTY BRACKET

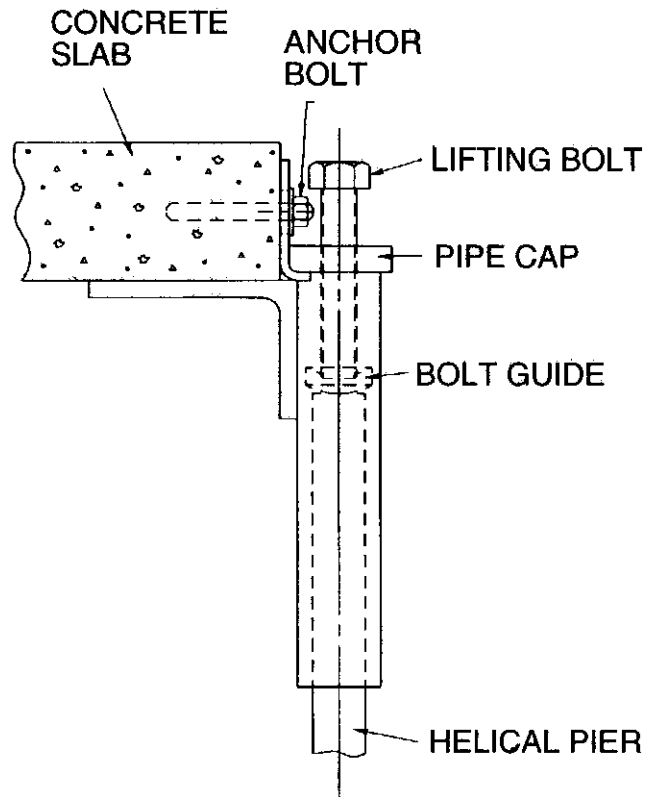


FIGURE 8—TYPICAL INSTALLATION OF LIGHT-DUTY
UNDERPINNING BRACKET



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EVALUATION REPORT SUPPLEMENT 1

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ER-5110

June 1, 1996

Filing Category: DESIGN—Miscellaneous (038)

HELICAL PIER FOUNDATION SYSTEM

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

I. SUBJECT:

Helical Pier Foundation System (issued December, 1996):

Clarify Section II C 1 regarding the maximum allowable load for the helical pier foundation systems.

II. DESCRIPTION:

A. **General:** 1 and 2: No changes.

B. **Material Specifications:** 1 through 4: No changes.

C. **Design:** 1. **General:** Structural calculations must be submitted to the building official for each building, and must be based on accepted engineering principles. The maximum allowable loads for the helical pier systems are 20,000 and 40,000 pounds (178 and 250 kN) for helical piers with 1¹/₂-inch (38 mm) and 1³/₄-inch (44.5 mm) RCS shafts, respectively, with allowable loads of individual lead sections and extensions noted in Tables 1 and 2. Factored design loads must not exceed the allowable loads. The design loads must be factored in accordance with Chapter 22, Section A4, of Division VIII of the code. The actual capacity of the helical pier system may be less than the maximum allowable loads noted in this report, dependent upon the analysis of the helical plates and soil interac-

tion. Combined flexural and compressive stresses, and column buckling of the piers due to compression loads, must be included in the analysis. In addition, Section 1809.5.1 of the Uniform Building Code (UBC) needs to be addressed in Seismic Zones 3 and 4.

A soil investigation report is necessary that includes:

- a. Soil properties, including those affecting design.
 - b. Allowable soil bearing pressure.
 - c. Suitability for use in seismically active areas.
 - d. Information on ground-water table, frost depth and corrosion.
2. **Connection to Building Structure:** No changes.
3. **Protection of Pier and Bracket Materials:** No changes.
- D. **Installation:** 1 and 2: No changes.
- E. **Identification:** No changes.

III. EVIDENCE SUBMITTED:

No changes.

IV. FINDINGS:

That the changes noted herein comply with the 1994 *Uniform Building Code*™ that, unless specifically noted in this evaluation report supplement, the master report remains valid and unchanged.

This report is subject to re-examination concurrently with the master report dated June 1, 1996.

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