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BOCA EVALUATION SERVICES, INC.

BOCA ES™

RESEARCH REPORT NO. 94-27

A Participating Member of the NES, Inc.

DIVISION 2 - SITEWORK

SECTION 02350 - PILES AND CAISSONS

A.B. CHANCE COMPANY HELICAL PIER™ FOUNDATION SYSTEM

A.B. CHANCE COMPANY
210 NORTH ALLEN STREET
CENTRALIA, MO 65240-1395

1.0 DESCRIPTION OF EVALUATION

This report evaluates the structural capacity of a helical pier foundation system through the review of test reports, structural calculations and a quality control manual.

2.0 DESCRIPTION AND USE OF PRODUCT

2.1 GENERAL DESCRIPTION

The A.B. Chance Company Helical Pier™ Foundation System is intended for use as foundation underpinning in undisturbed soils. The system consists of a lead section with helical plates, shaft extensions, and a foundation support bracket. The lead section is placed in the soil with mechanical rotation. Depending on the application, the depth of the lead section of the helical piers in the soil is extended to the required depth by adding one or more shaft extensions coupled to the lead section. The foundation repair bracket is used to support a building footing and is attached to an A.B. Chance helical pier.

2.2 SYSTEM COMPONENTS

2.2.1 Lead Section

The lead section of the helical foundation system, as shown in Figure 1, consists of circular steel plates welded to a central steel shaft.

The shaft of the lead section is round cornered square (RCS) solid steel bars. The RCS bar is 1½ inch square and is formed of ASTM A29 steel. Material specifications for the steel shaft are as presented in Table 1 of this report.

The minimum diameter of the helical steel plate is 6 inches, and the maximum is 14 inches. The center of the plate is punched out to accept the pier shaft. Each helical plate is formed so that all radial sections of the plate are normal to the central longitudinal axis ±3 degrees. The pitch of the helix is 3 inches. The helical plates are ⅜ inch thick. The material specifications for the helical plates are noted in Tables 1 and 2 of this report.

The size of the helical plates remains the same, or increases as they are placed up the shaft of the lead section, as shown in Figure 1 and Table 1. The size of the plates used depends on the required bearing capacity of the pier and the soils into which the pier is to be installed. The spacing between any two helical plates on the central shaft is nominally three times the diameter of the lower helix.

Each lead section of helical steel pier has a coupler means on the top end and an earth penetrating pilot on the bottom. The connection means consists of a hole drilled perpendicular to the central axis near the end of the shaft, to accommodate a bolted connection to extensions or support brackets.

Once the plates are welded to the central shaft and the coupler and pilot ends formed, the entire assembly is hot dipped galvanized in accordance with ASTM A153. The maximum design strengths of the helical pier foundation systems, based on the lead section used and Load Resistant Factored Design (LRFD), are given in Table 1.

2.2.2 Extensions

Extensions consist of the same size steel shaft described above for the lead section, with or without 14 inch helical plates. The dimensions and material specifications for the steel shaft and the helical plates are as described above, and each extension assembly is also hot dipped galvanized in accordance with ASTM A153. The extensions are shown in Figures 2 and 3. Technical data for the extension shaft and the coupling connection is given in Table 2.

Each extension has a coupler means on one end and a connection means on the other. The coupler at the end of the central shaft is an integrally forged socket that slips over the connection means at the end of the preceding lead section or extension. Each socket has a transverse hole in the socket to facilitate connection of lead sections and extensions with a bolt and nut. The connection and coupling means of the coupler connection are shown on the extension in Figures 2 and 3.

2.2.3 Foundation Bracket

The foundation bracket consists of upper and lower steel bracket bodies which are interconnected with two lifting bolts, as shown in Figure 4. Table 3 gives design data for the foundation bracket.

The brackets are formed of ¼ and ⅜ inch thick ASTM A36 steel. The stem of the T-shaped upper bracket is 18 inches long hot rolled electrical resistance welded round steel tubing which complies with ASTM A512 or ASTM A513 Grade 1020, with a minimum yield and tensile strength of 50 and 62 ksi, respectively. Both the upper and lower brackets have an ASTM A153, Grade B-1 hot dipped galvanized coating.

The lifting bolts are ⅞ inch in diameter, comply with SAE J429, Grade 2, and have a minimum yield strength of 36 ksi and a minimum tensile strength of 60 ksi. Cross bolts are also required to support the eccentric load of the foundation on the helical pier extension. These cross bolts are ⅝ inch in diameter, comply with SAE J429, Grade 5, and have a minimum yield and tensile strength of 92 and 120 ksi, respectively.

2.3 INSTALLATION

2.3.1 Helical Pier

The A.B. Chance Helical Pier shall be installed in undisturbed soil with rotary motors that are capable of rotating clockwise or counterclockwise. The torque applied during the installation of the final length of the helical pier shall be recorded. Ultimate bearing capacity of the soil for the installed pier is determined by multiplying the final installation torque of the pier by the load factor for the lead section, as given in Table 1.

The piers are rated by the maximum torque permitted to be used to complete their installation. Torque ratings for the lead sections and extensions are given in Tables 1 and 2. The minimum required torque rating for each extension shall be equal to or greater than the torque rating of the lead section it is used with.

2.3.2 Foundation Bracket

The T-shaped upper bracket body is slid over the end of the topmost extension of the installed helical steel pier. The lower bracket is attached to the foundation with anchors bolts, as specified in the approved construction documents required in Section 5.0 of this report. The lower bracket body is attached to the upper bracket body with the lifting bolts. A jacking tool with cross plate is connected to the top of the lifting bolts, and a jack is placed between the cross plate and the top of the T-bracket, as shown in Figure 5. In this manner the jack is used to lift the lower bracket body as it pushes down on the T-shaped section of the upper bracket body, and indirectly loads the extension of the helical pier. Once the lower bracket has been lifted to the desired height, the nuts on the lifting bolts are tightened, and the jack removed.

3.0 CODE ANALYSIS OF SUBMITTED INFORMATION

The following data was submitted by the proponent for the demonstration of compliance with the respective code sections listed above each item of information. The basis is the *BOCA National Building Code/1996.*

3.1 BEARING CAPACITY OF THE HELICAL PIER FOUNDATION SYSTEM

Code Section 106.4 Alternative Materials and Equipment: This code section permits the use of materials and methods of construction not provided for in the code, if they are demonstrated to be equivalent to that prescribed in the code in quality, strength, effectiveness, fireresistance, durability and safety.

Code Section 1807.1 Design Loads: This code section specifies that footings and foundations shall be designed to resist the most unfavorable effects due to combinations of loads, as specified in Section 1613.0.

Code Section 1817.1 Load Tests: This code section states that the allowable axial load on piles shall be determined by an approved formula, load test or method of analysis.

INFORMATION SUBMITTED:

The method of determining the bearing capacity of the helical anchors, as given in Table 1 of this report, has been evaluated based on the following test reports and calculations.

3.1.1 LBA, Inc., Report on a Load Test of a Chance Helical Pier, dated November 3, 1992, stamped by Carl Bobish, P.E. Four A.B. Chance helical piers with 1½ inch square shafts and 10 inch helical plates were tested for compression load in accordance with ASTM D1143. The piers withstood a maximum load 20 ft^{-1} times the installation torque of 1500 ft-lbs. Type of soil and location of ground water table relative to the bearing plates of the piers was not determined.

3.1.2 CTL/Thompson, Inc., Axial Compressive Load Test, dated February 5, 1993, stamped by Robert U. Branson, P.E. An A.B. Chance helical pier with 1½ inch square shaft and an 8 inch helical plate was tested for compression in accordance with ASTM D1143. The shaft was located in clay soil with intermittent sandstone that progressed from stiff sandy clay at the surface to hard claystone bedrock at a depth of 30 feet. The water table was located at a depth of 14 feet at the time of testing. The pier had been placed to a depth of 26 feet and withstood a maximum compressive load 15 ft^{-1} times the installation torque of 4000 ft-lbs.

3.1.3 Chen Northern, Inc., Observation of Helical Anchor Pile Load Test at West High School, 9th Avenue and Galapago Street, Denver, CO., dated May 28, 1992, stamped by Michael Riggins, P.E. One A.B. Chance helical pier with a square shaft of 1½ inch and an 8 inch and 10 inch helical plate was tested for compression load. The pier was extended to clay soil at a depth of 21 feet. The pier withstood a maximum compressive load 14.6 ft^{-1} times the installation torque of 3000 ft-lb. The location of the groundwater table relative to the bearing plates of the footing was not determined.

3.1.4 BBC & M Engineering, Inc, Load Testing Results, Thompson and Avery Road Sites, dated August 31, 1992, signed by Robert Thompson, P.E. Four A.B. Chance piers were tested for compression. The piers had a shaft size of 1½ inch. The installation torque of the piers at the Avery Road site was 1500-2000 ft-lbs. and the installation torque at the Thompson Road site was 2500 ft-lbs. Two of the piers had 8 inch helical plates, and two of the piers had 10 inch plates. The piers were placed in sand. One 8 inch pier was placed to a depth below the water table, while the other three were placed in unsaturated soils. The piers withstood maximum compressive loads between 11 ft^{-1} and 18 ft^{-1} times their installation torques.

3.1.5 Report of Full-Scale Load Tests on Helical Anchors, dated June 23, 1995, by Engineering Surveys and Services. Full-Scale Load Tests were performed on single helix pier anchors with 12 inch and 14 inch plates, and double helix pier anchors with a 6/8 inch plate combination. The anchors were tested in clay and sand soils, with installation torques of 1900 to 4500 ft-lbs. The single helix 14 inch anchors in sandy soils withstood loads 6.0 ft^{-1} to 8.2 ft^{-1} times the installation torque of 3300 to 4500 ft-lbs. All other anchors withstood loads 10.9 ft^{-1} to 14.9 ft^{-1} times their installation torques of 1900 to 4000 ft-lbs. The water table was not encountered during any of the testing described in this report.

3.1.6 Pressure Distribution Beneath a Bearing Plate Resulting from a Compressive Load Being Applied to a Helical Pier Foundation in Soil, signed and dated October 11, 1995, by Gary Seider, P.E.

3.1.7 Compression Load Tests on A.B. Chance - Helical Pier Foundation System Components, Radco Test Report No. RAD-1663, dated January, 1996, by Radco, signed by Ray Tucker, P.E. Three samples each of 1½ inch RCS shafts with one 12 or 14 inch helical plate were tested for resistance to compressive load, with the load distributed along the bottom of the helical plate, approximately half the plate radius away from the shaft. The 12 inch anchors were tested to 40 kips ultimate load, and the 14 inch anchors were tested to 32 kips.

3.1.8 Report on Full-Scale Tensile Load Tests on Helical Anchors, dated July 11, 1996, by Engineering Surveys and Services, signed by Bruce Dawson, P.E. Two 8/10 and two 6/8 double helical anchors were installed to installation torques of 5500-7500 ft-kips, loaded to 10 times the installation torque, then unloaded, removed from the soil and inspected. No crack welds were observed on any of the plates. Maximum distortion of the edge of the helical plates was 0.5 inch, and occurred on the trailing edge of one of the 8 inch helical plates in a 8/10 double anchor. No distortion was observed on the helical plates of the 6/8 double anchors.

3.2 UPLIFT CAPACITY RESISTANCE

Code Section 1817.7 Uplift Capacity: This code section states that the uplift capacity of a pile shall be determined in accordance with ASTM D3689, or an approved method of analysis based upon a minimum safety factor of 3.

INFORMATION SUBMITTED:

3.2.1 S.P. Clemence, P.E., Professor and Chairman, Civil Engineering Department, Syracuse University, *Uplift Capacity of Helical Anchors in Soil*, presented at the International Conference on Soil Mechanics and Foundation Engineering, August, 1989. The load tests of ninety-one helical pier anchors with a variety of plate sizes, number of plates and shaft size were analyzed to determine the relationship between installation torque and uplift capacity. The report concluded that a correlation did exist between installation torque and uplift capacity.

3.2.2 Letter of September 27, 1995, signed by Dr. S.P. Clemence, P.E., discussing the uplift capacity of helical piers in various types of soils based on the finding sited in *Uplift Capacity of Helical Anchors in Soil*, and comparing the test method used for that report to ASTM D3689-90 and ASTM D1143.

3.2.3 S.P. Clemence, P.E., Professor, Syracuse University, L.K. Crouch, Assistant Professor, Department of Civil Engineering, Tennessee Technological University, and R.W. Stephenson, Professor, Department of Civil Engineering, University of Missouri-Rolla, *Prediction of Uplift Capacity for Helical Anchors in Sand.* Nine anchors with 1¾ inch shafts and 12 inch helical plates were tested for uplift after installation in 20 feet of medium to fine sand. Three of the anchors had a single helix plate, three had two helix plates, and three had three helix plates. Each of the pier groups tested withstood a maximum uplift load greater than 18 ft^{-1} times the installation torque of the pier group.

3.3 DESIGN STRENGTH OF ANCHOR COMPONENTS

Code Section 2203.1 General - Structural Steel Construction: This code section specifies the appropriate design manuals to be used for the design of structural steel. One of those manuals specified is the AISC *Load and Resistance Factor Design Specification for Structural Steel Buildings* (LRFD) - 86.

3.3.1 Coupling Bolt Calculations, prepared and signed by Gary Seider, P.E., dated December 20, 1994 and March 1, 1995. Mr. Seider prepared calculations in accordance with AISC LRFD, which determined that the design strength of the coupling connection described in Section 2.2.2 of this report, with a ¾ inch diameter bolt, is 41.2 kips.

3.3.2 Stress Analysis - Foundation Repair Brackets, prepared and signed by Gary Seider, P.E. These calculations, done in accordance with AISC LRFD, determined that the design strength of the Foundation Repair Bracket C150-0121, shown in Figure 4 and described in Section 2.2.3 of this report, has a design strength of 24.1 kips.

3.3.3 Compression Load Tests on A.B. Chance - Helical Pier Foundation System Components, Radco Test Report No. RAD-1663, dated January, 1996 by Radco, signed by Ray Tucker, P.E. Three samples of the foundation bracket were tested for load in a manner representative of intended use. The test specimens withstood an ultimate load of 40 kips each.

3.3.4 Study of Loading Tests Results of the Chance Underpinning System Tested in Centralia, Missouri, by Lymon Reese and Associates, dated December, 1993. Tests were performed on the T-bracket, and a installed helical pier with the top 88 inches of surrounding earth removed, to determine the distribution of axial and moment loads in the bracket and pier shaft. The study showed that the maximum moment in the pier shaft due to the eccentricity of the load from the foundation occurs at the bottom of the T-bracket, and gradually reduces to -.25 times the axial load at a depth of 60 to 80 inches from the top of the shaft. The study also showed that the axial load in the shaft is relatively constant along its length until the bearing plates are reached.

3.4 QUALITY CONTROL

Code Section 1705.3.1 Inspection of Steel Fabricators: This code section requires inspection of steel fabricators.

Code Section 1705.3.3.2 Welding: This code section requires that welding of steel be inspected in accordance with AWS D1.1, by weld inspectors who are AWS certified.

INFORMATION SUBMITTED:

3.4.1 Quality Control Manual and Inspection Procedures for A.B. Chance Company, by RADCO, dated August 1994.

3.4.2 Copies of the AWS certification for weld inspectors employed by A.B. Chance.

4.0 INSTRUCTIONS TO THE CODE OFFICIAL

A.B. Chance Helical Piers have been evaluated for compliance with the 1996 editions of the *BOCA National Codes*. This report is limited to the application and products as stated herein. This evaluation is based solely upon information provided to BOCA Evaluation Services, Inc. by A.B. Chance Company and has not been independently verified. BOCA-ES intends that the report be used by the code official to determine that A.B. Chance Helical Piers comply with the code requirements specifically addressed in Section 3.0 of this report, provided that this product is installed in accordance with the following limitations:

Limitations

4.1 This report is subject to annual certification. Reports that are not certified shall not be used or referred to. In order to determine the status of certification of this report, see the current BOCA Evaluation Services, Inc. *National Product Evaluation Quarterly*.

4.2 A.B. Chance Helical Piers shall be limited to applications where the required bearing and uplift capacity of the anchor does not exceed that determined through application of Table 1 of this report, and the recommendations of the construction documents required in Section 5.0 of this report.

4.3 The A.B. Chance Helical Pier shall be installed in accordance with this research report and the manufacturer's recommendations, by installers certified by A.B. Chance. The installation shall comply to the approved construction documents, and the following:

4.3.1 The anchor shall be positioned and angled as specified in the approved construction documents.

4.3.2 The rotation rate of the helical piers during installation shall be between 5 to 20 revolutions a minute.

4.3.3 If used, extensions shall be connected to the helical pier with the bolts specified in Table 2. The bolts shall be tightened to 40 ft-lbs. of torque.

4.3.4 The piers shall be installed to the minimum depth shown on the approved construction documents, with a minimum depth to the top helix of 5 feet.

4.3.5 Each extension used with the lead sections shall have a minimum torque rating, as shown in Table 2, equal to or greater than the torque rating of the lead section, as given in Table 1.

4.4 Special Inspections of the installation of A.B. Chance Helical Piers shall be provided in accordance with Section 1705.9 of the *BOCA National Building Code/1996*. Items to be confirmed by the Special Inspector shall include, but not be limited to, evidence of certification of installers by manufacturer, verification of adequacy of soil for installation, the installation torque of the pier, correct jacking of the foundation onto the pier and compliance of the installation with the approved construction documents and this report.

4.5 The factored design load on the A.B. Chance Helical Pier shall not be greater than the lowest value determined from the following:

4.5.1 The design soil bearing capacity of the anchor, determined by multiplying the installation torque, in ft-lbs, used to install the final length of the pier by the load factor given in Table 1 of this report, and a strength reduction factor, $\phi = 0.70$.

4.5.2 The maximum design strength, P_D, given for the lead section in Table 1 of this report.

4.6 The capacity of the anchor in all but soft soils shall be determined in the manner described in Limitation of Use 4.5. Determination of capacity in soft soils, including loose cohesionless soils, soft organic soils or soft clays, is beyond the scope of this report. Verification that the proposed pier location or locations do not include "soft soils" shall be included in the soils investigation report required in Section 5.3 of this report.

4.7 Factored design loads on the foundation bracket, based on LRFD, shall not exceed 24.1 kips. Other brackets, or other means of securing the A.B. Chance Helical Pier to the building or structure supported are beyond the scope of this report. All connections used in conjunction with the A.B. Chance Helical Pier shall be designed by a registered design professional, as required by Section 5.2 of this report.

4.8 The use of the A.B. Chance Helical Piers described in this report is limited to undisturbed soils that have been determined by the registered design professional responsible for the construction documents described in Section 5.3 of this report to be adequate to provide support of the helical pier against lateral buckling, and to meet the requirements of Section 1804.2 of the *BOCA National Building Code/1996* as satisfactory foundation material.

4.9 Evaluation of the durability of the galvanized coating in the soil it is to be placed in is outside the scope of this report.

5.0 INFORMATION REQUIRED ON CONSTRUCTION DOCUMENTS

To aid in the use of this report, the following represents the minimum level of information to be reflected on construction documents in order to determine compliance with this research report.

5.1 The language "See BOCA Evaluation Services, Inc., Research Report No. 94-27."

5.2 All permit applications for A.B. Chance Helical Piers shall be accompanied by structural calculations which are performed by a registered architect or engineer who is qualified to perform them in accordance with the registration laws of the state in which construction is to take place. Items addressed in the structural calculations shall include, but not be limited to, the following:

5.2.1 All brackets and connections used to secure the A.B. Chance Helical Pier to the building or structure.

5.2.2 Column buckling of the piers due to compression loads, based on the lateral load carrying capacity of the soil, as given in the soil investigation report required in Section 5.3 of this report.

5.2.3 The effects of seismic loads on the A.B. Chance Helical Pier, as required in Sections 1610.0 and 1802.1.1 of the *BOCA National Building Code/1996*.

5.2.4 The required spacing of the anchors.

5.2.5 A settlement analysis of the helical piers under design load shall be provided, as required by Section 1816.19 of the *BOCA National Building Code/1996*. The analysis shall demonstrate that the predicted settlement of the piers shall not cause harmful distortion of, or instability in, the structure supported, nor cause any stresses within the structure to exceed allowable values.

5.2.6 The angle at which the pier is to be placed.

5.3 A soils investigation report for the proposed construction site shall be provided by a registered design professional qualified to perform such work, with each permit application proposing the use of A.B. Chance Helical Piers. Information provided in the soils investigation reports shall include, but not be limited to, the following:

5.3.1 The type of soil at each strata along the length of the proposed pier installation.

5.3.2 The allowable soil bearing pressure.

5.3.3 Indication of the method used by the registered design professional to determine that the soil is adequate for the proposed installation.

5.3.4 Properties affecting the design of the system, including the lateral load carrying capacity of the soil at each strata.

5.3.5 The location of the ground water table.

5.3.6 The maximum anticipated depth of frost.

5.3.7 The presence or absence of corrosives in the soil and the appropriateness of the use of galvanized steel in the soil.

5.3.8 The presence of stone, rocks or other debris in each soil strata, and their effect on the suitability of the soil for use with the A.B. Chance Helical Pier system.

5.3.9 Recommendations to the registered design professional to preclude settlement due to ground water or overloading of the soil, wall damage due to frost heave or corrosion of the pier materials and the characteristics of the appropriate types of loading for the soil.

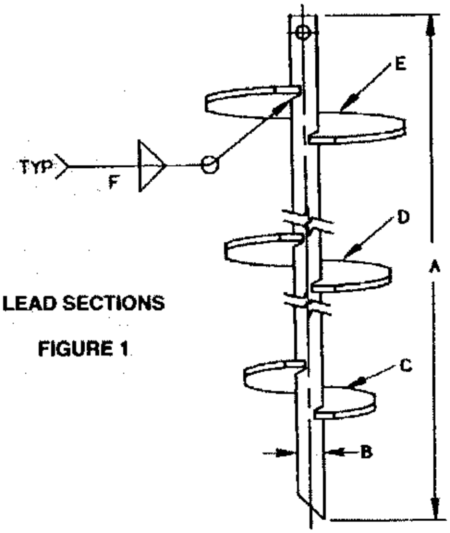
5.3.10 Suitability of the system in a seismic area for areas required to have seismic calculations in Section 5.2.3 of this report.

6.0 IDENTIFICATION

All A.B. Chance Helical Piers manufactured in accordance with this research report shall be marked at the plant with the identifying language, "See BOCA Evaluation Services, Inc. Research Report No. 94-27."

Reference to this research report is limited to the identification as described herein.

Chance Helical Pier® Foundation System Details



LEAD SECTIONS

FIGURE 1

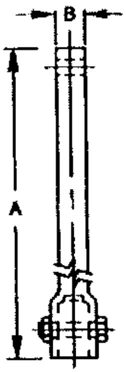
TABLE 1 — DESCRIPTION AND ULTIMATE BEARING CAPACITY OF LEAD SECTIONS

LEAD SECTION								LOAD FACTOR[1]		MAXIMUM DESIGN STRENGTH P_D[5] (kips)	HELICAL PLATE MATERIAL SPECIFICATION[2]	SHAFT TYPE & SPEC.
CAT. NO.	A	B	C	D	E	F	MAX. INSTALLATION TORQUE RATING FT.-LB.	COMPRESSION[4]	UPLIFT[4]			
C150-0001	7'	1-1/2"	8"	NP	NP	5/16"	(SS-5) 5,500	10	10	20	ASTM A 570 ASTM A 572 ASTM A 607 GRADE 50 F_Y = 50KSI MIN. F_T = 65KSI MIN.	RCS SOLID STEEL BAR ASTM A 29 F_Y = 70 ksi MIN. F_T = 100 ksi MIN.
C150-0002	5'	1-1/2"	8"	NP	NP	5/16"	(SS-5) 5,500	10	10	20		
C150-0003	7'	1-1/2"	10"	NP	NP	5/16"	(SS-5) 5,500	10	10	20		
C150-0004	7'	1-1/2"	12"	NP	NP	5/16"	(SS-5) 5,500	10	10	20		
C150-0005	7'	1-1/2"	14"	NP	NP	5/16"	(SS-5) 5,500	6[3]	6[3]	16		
C150-0030	7'	1-1/2"	6"	8"	NP	1/4"	(SS-5) 5,500	10	10	27.5		
C150-0006	7'	1-1/2"	8"	10"	NP	1/4"	(SS-5) 5,500	10	10	27.5		
C150-0031	10'	1-1/2"	8"	10"	NP	1/4"	(SS-5) 5,500	10	10	27.5		
C150-0007	7'	1-1/2"	8"	10"	12"	1/4"	(SS-5) 5,500	10	10	27.5		
C150-0168	2-1/2'	1-1/2"	8"	10"	NP	1/4"	(SS-7) 7,000	10	10	35.0		HSLA ASTM A 29 F_Y = 95 ksi MIN. F_T = 120 ksi MIN.
C150-0169	5'	1-1/2"	8"	10"	12"	1/4"	(SS-7) 7,000	10	10	35.0		
C150-0170	10'	1-1/2"	14"	14"	14"	1/4"	(SS-7) 7,000	6[3]	6[3]	35.0		

1. The ultimate bearing capacity of the soil supporting the anchor is determined by multiplying the maximum torque used to fully install the lead section and extensions by the load factor given in Table 1. The load factor is a function of the lead section only.
2. Grades and physical properties shown are minimum.
3. Load factor of 10 applicable in uniform homogenous deposits of clay or silty-clay soils, load factor of 6 applicable in sand or soil combinations which include sand.
4. Use of these load factors to determine capacity of the anchor shall be limited to those soils which are not considered soft or very soft soils, as determined by the registered design professional responsible for the preparation of the construction documents.
5. Based on LRFD, with $P_D = \phi P_U$.

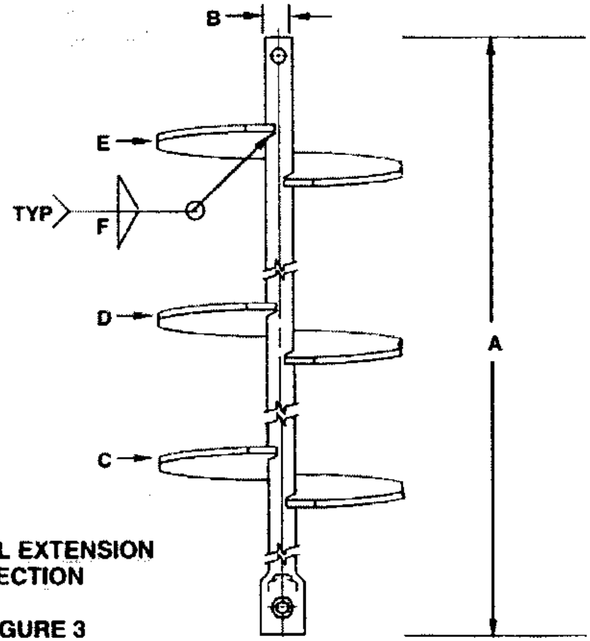
NP = Not Provided

Chance Helical Pier® Foundation System Details



EXTENSION SECTION

FIGURE 2

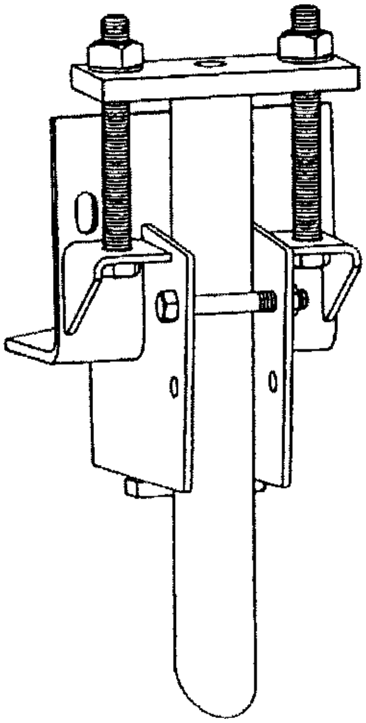


HELICAL EXTENSION SECTION

FIGURE 3

TABLE 2 — DESCRIPTION OF EXTENSIONS

EXTENSION								BOLTS			HELICAL PLATE MATERIAL SPECIFICATION	SHAFT MATERIAL SPECIFICATION
CAT. NO.	A	B	C	D	E	F	MAX. INSTALLATION TORQUE RATING FT.-LB.	QTY	SIZE	TYPE		
C150-0047	3-1/2'	1-1/2"					(SS-5) 5,500	1	3/4	ASTM A 320 GRADE L7		ASTM A 29 F_Y = 70 ksi MIN. F_T = 100 ksi MIN.
C150-0008	5'	1-1/2"					(SS-5) 5,500	1	3/4			
C150-0009	7'	1-1/2"					(SS-5) 5,500	1	3/4			
C150-0048	10'	1-1/2"					(SS-5) 5,500	1	3/4			
C150-0144	3-1/2'	1-1/2"					(SS-7) 7,000	1	3/4			HSLA ASTM A 29 F_Y = 95 MIN. F_T = 120 MIN.
C150-0145	5'	1-1/2"					(SS-7) 7,000	1	3/4			
C150-0146	7'	1-1/2"					(SS-7) 7,000	1	3/4			
C150-0175	10'	1-1/2"					(SS-7) 7,000	1	3/4			
C150-0176	4'	1-1/2"	14"			1/4"	(SS-7) 7,000	1	3/4		ASTM A 715, A 656 GRADE 80 F_Y = 80KSI min. F_T = 90KSI	
C150-0177	6-1/2'	1-1/2"	14"	14"		1/4"	(SS-7) 7,000	1	3/4			
C150-0178	10'	1-1/2"	14"	14"	14"	1/4"	(SS-7) 7,000	1	3/4			

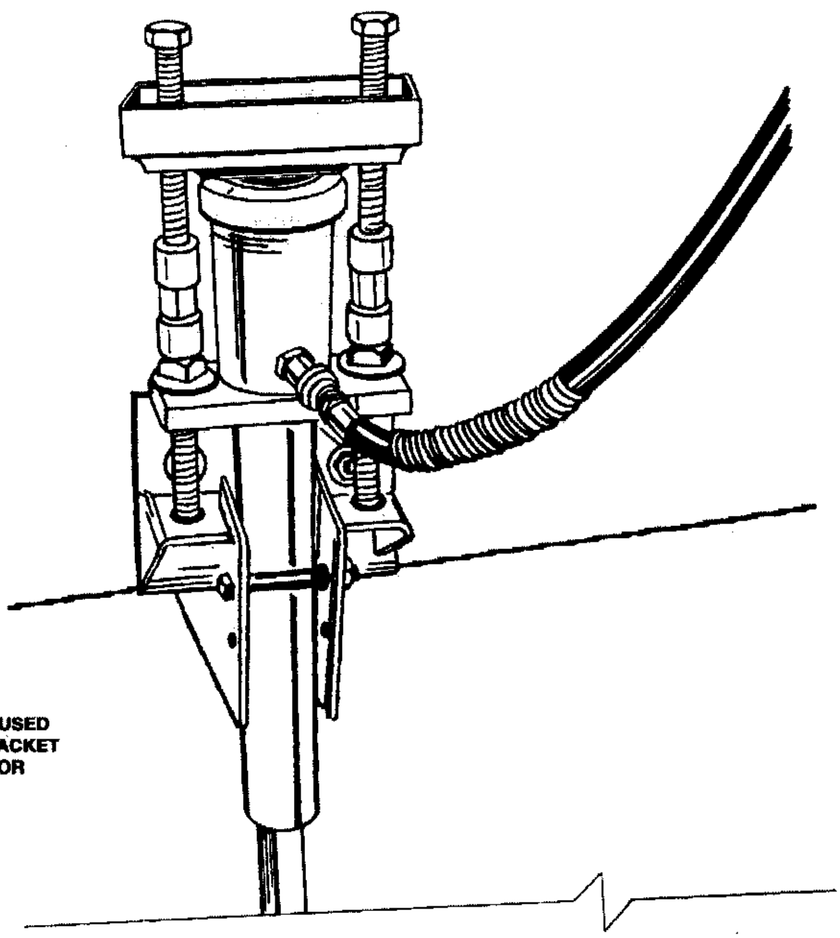


FOUNDATION BRACKET
FIGURE 4

TABLE 3 — ACCESSORY COMPONENTS

Component	Design Strength P_D[1] (kips)	Bolts Used
C150-0121 Foundation Bracket	20.0	(2) 7/8″ lifting bolts (1) 5/8″ cross bolt

1. Based on LRFD with $P_D = \phi P_U$



JACKING TOOL AND JACK USED TO PLACE FOUNDATION BRACKET ON HELICAL PIER ANCHOR

FIGURE 5