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Legacy report on the 1997 Uniform Building Code™

DIVISION: 02—SITE CONSTRUCTION
Section: 02350—Piles and Caissons

DIXIE ANCHORING HELICAL FOUNDATION SYSTEM

MACLEAN DIXIE, LLC
3098 PELHAM PARKWAY
PELHAM, ALABAMA 35214

1.0 SUBJECT

Dixie Anchoring Helical Foundation System.

2.0 DESCRIPTION

2.1 General:

The Dixie Anchoring helical foundation system is used to underpin foundations of existing structures, to form deep foundations for new structures, to retrofit or remediate deficient foundations of existing structures, and to provide bearing for new foundations. The foundation anchors are used with foundation attachment brackets, designed and manufactured by others, to connect the foundation of the structure to the installed helical foundation anchor.

2.2 System Components:

2.2.1 Helical Steel Piles (Foundation Anchors): The foundation anchor lead sections consist of one or more helical-shaped circular steel plates welded to a central steel hub. The depth of the foundation anchors in the soil is typically extended by adding one or more steel hub extension shafts mechanically coupled together to form one long, continuous steel pile. Extensions can be with or without attached helical-shaped steel plates. After fabrication, the helical steel piles have a Class B1, hot-dipped, galvanized coating, complying with ASTM A 153, as applied.

Each helical steel plate is 3/8 inch (10 mm) or 1/2 inch (13 mm) thick and has an outer diameter ranging from 6 to 15 inches (152 to 381 mm), and an inner annulus either 1 1/4, 1 1/2 or 1 3/4 inches (31.7, 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 hub of lead sections and extension sections is round cornered square (RCS), solid steel bars. RCS bars are either 1 1/4, 1 1/2 or 1 3/4 inches (31.7, 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 hub 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 foundation anchor lead sections and some extension shafts, helical plates are welded to their respective hubs. Nominal spacing between helical plates is not less than 2.36 times the diameter of the lower helix. Figure 1 illustrates the foundation anchor lead sections and extension shafts.

2.2.2 Foundation Attachments (Brackets): The foundation attachments (brackets) are used to address foundation settlement. The brackets are supplied by others and their design is not considered in this report. Figure 2 provides a typical illustration of the foundation attachments.

2.3 Material Specifications:

2.3.1 Helical Plates: Hot-wrought carbon steel for the helical plates conforms to ASTM A 36, with a minimum yield strength of 36,000 psi (248 MPa) and a minimum tensile strength of 58,000 psi (400 MPa).

2.3.2 Pile Hubs (Lead Sections and Extensions): The 1 1/4-, 1 1/2- and 1 3/4-inch (31.7, 38, and 44.5 mm) square RCS hubs are formed from hot-wrought carbon steel conforming to ASTM A 576, Grade C-1045, having minimum yield and tensile strengths of 45 and 82 ksi (310 and 565 MPa), respectively. The hubs are also available in steel conforming to ASTM A 576, Grade 1530M, having minimum yield and tensile strengths of 60 ksi and 110 ksi (414 MPa and 758 MPa), respectively.

2.3.3 Bolts: Coupling bolts are 5/8 inch (15.9 mm), 3/4 inch (19.1 mm) or 7/8 inch (22 mm) in diameter and shall comply with ASTM A 325 Type 1, and shall have a Class C hot-dipped zinc coating that complies with ASTM A 153. The corresponding nut shall conform to either ASTM A 194 Grade 2H or ASTM A 563 Grade DH. Nuts shall have a Class C hot-dipped zinc coating that complies with ASTM A 153.

2.4 Design:

2.4.1 General: Structural calculations must be submitted to the building official for each project, and must be based on accepted engineering principles. The design of the steel components must be in accordance with the Allowable Stress

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Design (ASD) Specification in Chapter 22, Division III, of the code. The ASD design strengths of the steel components are described in Tables 1, 2 and 3. The overall capacity of the Dixie Anchoring Helical Foundation System depends upon the analysis of the interaction of the helical plates and the soil, and may be less than the ASD design strengths noted in this report. Combined flexural and compressive stresses, and column buckling of the foundation anchors due to compression loads, must be included in the analysis. 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 the following:

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.

**2.4.2 Connection to Building Structure:** Connection of the building structure to the helical steel piles must be designed. 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. Bolted connections shall be designed to resist applicable loads in accordance with the code or appropriate evaluation report. In addition, the effects of reduced lateral sliding resistance due to uplift from wind or seismic loads shall be considered for each project.

## 2.5 Installation:

**2.5.1 General:** The Dixie Anchoring Helical Foundation System is installed by Dixie Anchoring Systems certified installers, trained to install the Dixie Anchoring Helical Foundation System.

**2.5.1.1 Helical Steel Piles:** The foundation anchors are installed using rotary motors having forward and reverse capabilities. The torque rating (torsional force) for each of the included three steel pile shaft sizes are 3.4 kip-feet (4.61 kN-m) for 1<sup>1</sup>/<sub>4</sub>-inch (31.8 mm) RCS shafts, 6.0 kip-feet (8.13 kN-m) for 1<sup>1</sup>/<sub>2</sub>-inch (38 mm) RCS shafts and 10.0 kip-feet (13.56 kN-m) for 1<sup>3</sup>/<sub>4</sub>-inch (45 mm) RCS shafts. The foundation anchors must be positioned and angled as specified in the approved plans. Foundation anchors attached to structures are installed either vertically plumb or at a slight inward slope projecting under the foundations. The foundation anchors must be installed in a continuous manner, with the rate of shaft rotation in the range of 5 to 20 revolutions per minute. Extensions are selected based on the number and length, installation torque and site conditions as specified in the approved plans and are connected to the foundation anchor lead sections with the coupling bolts. Coupling bolts must be tightened firmly with a wrench. The foundation anchors are installed to the minimum depth shown on plans, but with the top helix not less than 5 feet (1525 mm) below the bottom of the foundation.

**2.5.1.2 Foundation Attachments:** Foundation brackets are installed by qualified and trained subcontracting dealers/installers as specified in the approved plans. The foundation must be excavated to create "L" shaped cavities with nominal 30 inches (762 mm) per side square openings to a depth of at least 18 inches (457 mm) below the foundation bottom surface. The exposed foundation surfaces must be prepared and smoothly dressed to receive the foundation attachment ("lifting bracket") without obstruction on the bearing or facing surfaces. The attachment must be pinned firmly to the foundation by driven or threaded fasteners. This connection may occur during or after foundation anchor installation. The foundation anchor lead

sections and shaft extensions must be driven into soil as set forth in Section 2.5.1.1 of this report. Upon obtaining satisfactory installation, the excess shaft extension above the foundation may be cut, normally about 8 to 10 inches (203 to 254 mm) above the footing (or turn down) base. Attachment of the foundation attachment (bracket) to the foundation anchor shall be in accordance with the approved plans.

## 2.6 Special Inspection:

Special inspection in accordance with Section 1701 of the UBC 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 UBC 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 foundation anchor and bracket configuration compliance with construction documents and this evaluation report.
2. Installation of first helical foundation anchor—Verify that location, installation torque, and depth of helical foundation anchors 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.

## 2.7 Identification:

Foundation Anchors have "D" stamped on the hub. The foundation anchors are also identified by a tag or label bearing the Dixie Anchoring Systems name and address, the catalog number, the product description, the evaluation report number (PFC-5551), and the name of the inspection agency (SGS U.S. Testing Company, Inc.).

## 3.0 EVIDENCE SUBMITTED

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

## 4.0 FINDINGS

**That the Dixie Anchoring Helical Foundation System described in this report complies with the 1997 Uniform Building Code™, subject to the following conditions:**

- 4.1 The foundation anchors are manufactured, identified and installed in accordance with this report.**
- 4.2 Special inspection is provided in accordance with Section 2.6 of this report.**
- 4.3 Engineering calculations and drawings, in accordance with recognized engineering principles and design parameters, are provided to the building official.**

- 4.4 A soil investigation for each project site must be provided to the building official for approval in accordance with Section 2.4.1 of this report.
- 4.5 The foundation anchors are designed to the satisfaction of the building official.
- 4.6 The foundation anchors are manufactured at the Dixie Electrical Manufacturing Co. facility located in

Birmingham, Alabama, under a quality control program with inspections by SGS U.S. Testing Company, Inc.

This report is subject to re-examination in two years.

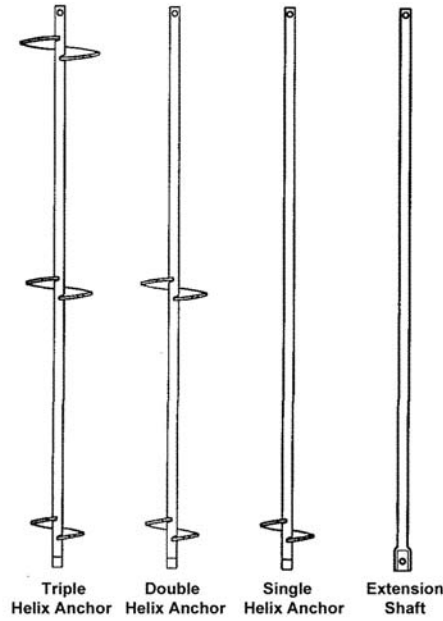


FIGURE 1—FOUNDATION ANCHOR LEAD SECTIONS AND EXTENSION SHAFT

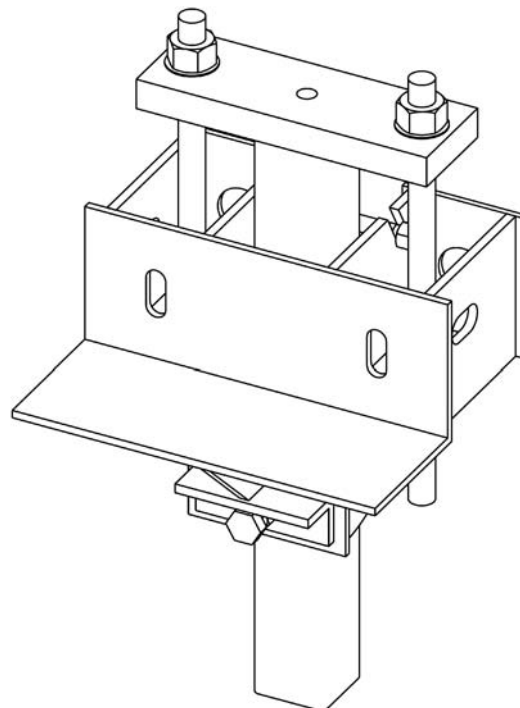


FIGURE 2—FOUNDATION ATTACHMENTS (“LIFTING BRACKETS”)

TABLE 1—FOUNDATION ANCHOR MECHANICAL STRENGTH RATINGS: STANDARD, SINGLE HELIX, AND MULTI-HELIX EXTENSIONS<sup>1</sup>

CATALOG NUMBER	SHAFT LENGTH (inches)	SHAFT WIDTH (inches)	HELIX DIAMETER <sup>2</sup> (inches)		HELIX THICKNESS <sup>2</sup> (inch)	ALLOWABLE AXIAL LOAD (pounds) <sup>3</sup>
			1st	2nd		
N-6401-0016	42	1.25	NA	NA	NA	34,000
N-6401-0017	60	1.25	NA	NA	NA	34,000
N-6401-0018	84	1.25	NA	NA	NA	34,000
N-6401-0019	120	1.25	NA	NA	NA	34,000
N-6401-0004	42	1.50	NA	NA	NA	56,250
N-6401-0005	60	1.50	NA	NA	NA	56,250
N-6401-0006	84	1.50	NA	NA	NA	56,250
N-6401-0007	120	1.50	NA	NA	NA	56,250
N-6401-0024	60	1.50	10	NA	0.375	26,900
N-6401-0025	60	1.50	12	NA	0.375	26,900
N-6401-0026	84	1.50	14	NA	0.375	26,900
N-6401-0008	42	1.75	NA	NA	NA	76,560
N-6401-0009	60	1.75	NA	NA	NA	76,560
N-6401-0010	84	1.75	NA	NA	NA	76,560
N-6401-0011	120	1.75	NA	NA	NA	76,560
N-6401-0020	60	1.75	12	NA	0.375	30,650
N-6401-0021	60	1.75	14	NA	0.375	30,650
N-6401-0027	84	1.75	14	14	0.375	61,300

For **SI**: 1 inch = 25.4 mm, 1 pound = 0.00448 kN.

<sup>1</sup>Bolts connect extensions to helix anchors or other extensions.

<sup>2</sup>NA = Not applicable.

<sup>3</sup>Loads apply to anchor or extension capacity only. System capacity may be limited by other factors, such as soil interaction capacity, bracket capacity, or foundation capacity. The allowable axial load reflects the lesser of tension or compression capacity.

TABLE 2—FOUNDATION ANCHOR MECHANICAL STRENGTH RATINGS: SINGLE HELIX ANCHORS<sup>1</sup>

CATALOG NUMBER	SHAFT LENGTH (inches)	SHAFT WIDTH (inches)	HELIX DIAMETER (inches)	HELIX THICKNESS (inch)	ALLOWABLE AXIAL LOAD (pounds) <sup>2</sup>
N-6202-0001	9 <sup>1</sup> / <sub>2</sub>	1.25	6	0.375	20,167
N-6202-0002	9 <sup>1</sup> / <sub>2</sub>	1.25	8	0.375	20,167
N-6202-0003	9 <sup>1</sup> / <sub>2</sub>	1.25	10	0.375	17,500
N-6202-0004	9 <sup>1</sup> / <sub>2</sub>	1.25	12	0.375	17,500
N-6202-0005	9 <sup>1</sup> / <sub>2</sub>	1.25	14	0.375	17,500
N-6202-0006	84	1.25	8	0.375	20,167
N-6202-0007	84	1.25	10	0.375	17,500
N-6202-0008	84	1.25	12	0.375	17,500
N-6202-0009	84	1.25	14	0.375	17,500
N-6202-0010	84	1.25	15	0.375	17,500
N-6203-0018	9 <sup>1</sup> / <sub>2</sub>	1.50	6	0.375	26,900
N-6203-0019	9 <sup>1</sup> / <sub>2</sub>	1.50	8	0.375	26,900
N-6203-0020	9 <sup>1</sup> / <sub>2</sub>	1.50	10	0.375	26,900
N-6203-0021	9 <sup>1</sup> / <sub>2</sub>	1.50	12	0.375	26,900
N-6203-0022	9 <sup>1</sup> / <sub>2</sub>	1.50	14	0.375	26,900
N-6203-0001	60	1.50	8	0.375	26,900
N-6203-0002	60	1.50	10	0.375	26,900
N-6203-0003	60	1.50	12	0.375	26,900
N-6203-0004	60	1.50	14	0.375	26,900
N-6203-0009	84	1.50	8	0.375	26,900
N-6203-0010	84	1.50	10	0.375	26,900
N-6203-0012	84	1.50	14	0.375	26,900
N-6203-0032	60	1.50	8	0.500	51,110
N-6203-0033	60	1.50	10	0.500	51,110
N-6203-0013	60	1.50	12	0.500	51,110
N-6203-0014	60	1.50	14	0.500	43,000
N-6203-0007	84	1.50	8	0.500	51,110
N-6203-0008	84	1.50	10	0.500	51,110
N-6203-0011	84	1.50	12	0.500	51,110
N-6203-0034	84	1.50	14	0.500	43,000

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

<sup>1</sup>Bolts connect extensions to helix anchors or other extensions.

<sup>2</sup>Loads apply to anchor or extension capacity only. System capacity may be limited by other factors such as soil interaction capacity, bracket capacity, or foundation capacity. The allowable axial load reflects the lesser of the tension or compression capacity.

**TABLE 3—FOUNDATION ANCHOR MECHANICAL STRENGTH RATINGS:  
DOUBLE HELIX, TRIPLE HELIX AND QUADRUPLE HELIX ANCHORS<sup>1</sup>**

CATALOG NUMBER	SHAFT LENGTH (inches)	SHAFT WIDTH (inches)	HELIX DIAMETER <sup>2</sup> (inches)				HELIX THICKNESS (inch)	ALLOWABLE AXIAL LOAD (pounds) <sup>3</sup>
<b>Double Helix Anchors</b>								
			<b>1<sup>st</sup></b>	<b>2<sup>nd</sup></b>	<b>3<sup>rd</sup></b>	<b>4<sup>th</sup></b>		
N-6202-0011	84	1.25	8	10	NA	NA	0.375	34,000
N-6203-0005	60	1.50	6	6	NA	NA	0.375	53,800
N-6203-0006	60	1.50	6	8	NA	NA	0.375	53,800
N-6203-0025	60	1.50	8	10	NA	NA	0.375	53,800
N-6203-0026	60	1.50	10	12	NA	NA	0.375	53,800
N-6203-0027	84	1.50	6	8	NA	NA	0.375	53,800
N-6203-0028	84	1.50	8	10	NA	NA	0.375	53,800
N-6203-0029	84	1.50	10	12	NA	NA	0.375	53,800
N-6203-0017	120	1.50	8	10	NA	NA	0.375	53,800
N-6203-0023	60	1.50	8	10	NA	NA	0.500	56,250
N-6203-0024	60	1.50	10	12	NA	NA	0.500	56,250
N-6206-0002	60	1.75	8	10	NA	NA	0.375	61,300
N-6206-0003	60	1.75	10	12	NA	NA	0.375	61,300
<b>Triple Helix Anchors</b>								
			<b>1<sup>st</sup></b>	<b>2<sup>nd</sup></b>	<b>3<sup>rd</sup></b>	<b>4<sup>th</sup></b>		
N-6202-0012	84	1.25	8	10	12	NA	0.375	34,000
N-6203-0030	84	1.50	8	10	12	NA	0.375	56,250
N-6203-0031	84	1.50	10	12	14	NA	0.375	56,250
N-6206-0004	84	1.75	8	10	12	NA	0.375	76,560
N-6206-0005	84	1.75	10	12	14	NA	0.375	76,560
<b>Quadruple Helix Anchors</b>								
			<b>1<sup>st</sup></b>	<b>2<sup>nd</sup></b>	<b>3<sup>rd</sup></b>	<b>4<sup>th</sup></b>		
N-6203-0015	120	1.50	8	10	12	14	0.500	56,250
N-6203-0016	120	1.50	10	12	14	14	0.500	56,250
N-6206-0006	120	1.75	8	10	12	14	0.375	76,560
N-6206-0007	120	1.75	10	12	14	14	0.375	76,560

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

<sup>1</sup>Bolts connect extensions to helix anchors or other extensions.

<sup>2</sup>NA = Not applicable.

<sup>3</sup>Loads apply to anchor or extension capacity only. System capacity may be limited by other factors such as soil interaction capacity, bracket capacity, or foundation capacity. The allowable axial load reflects the lesser of the tension or compression capacity.