Listing and Technical Evaluation Report™

A Duly Authenticated Report from an Approved Agency

Report No: 2404-11

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Drillcrete® Concrete Screws for Use in Concrete

Trade Secret Report Holder:

Robertson, Inc.

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CSI Designations:

DIVISION: 03 00 00 - CONCRETE

Section: 03 16 00 - Concrete Anchors

DIVISION: 05 00 00 - METALS

Section: 05 05 19 - Post-Installed Concrete Anchors

1 Innovative Products Evaluated[1]

1.1 Drillcrete Concrete Screws:

1.1.1 $^{3}/_{16}$" Drillcrete Concrete Screw

1.1.2 $^{1}/_{4}$" Drillcrete Concrete Screw

2 Product Description and Materials

2.1 The innovative products evaluated in this report are shown in **Figure 1**.

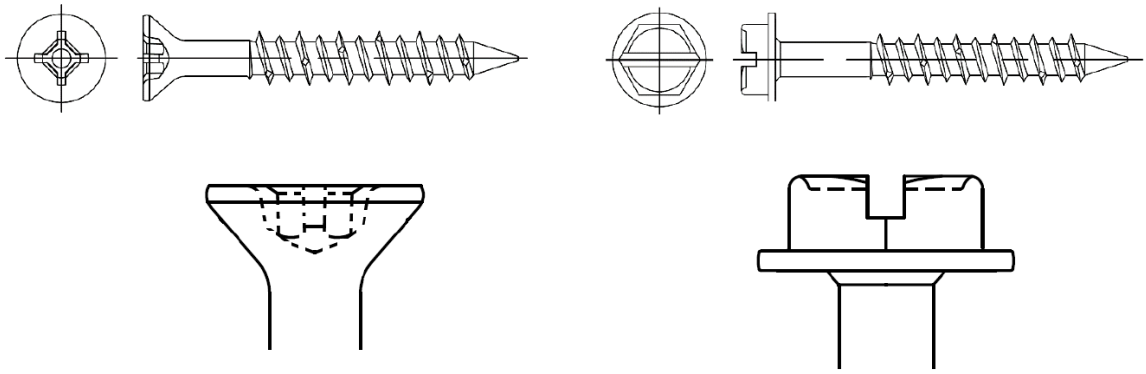

Figure 1. Drillcrete Concrete Screws – Flat Head and Hex Head

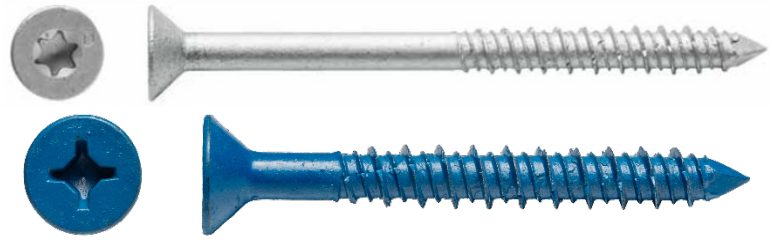

Figure 2. Drillcrete Concrete Screws Flat Head – Brushed Nickel Finish and Blue Fluorocarbon Finish

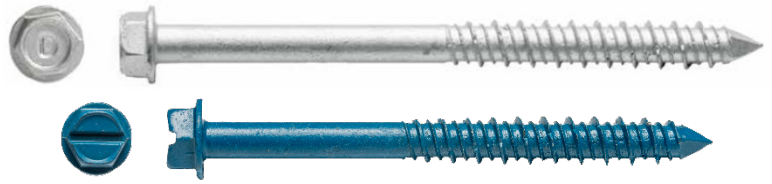

Figure 3. Drillcrete Concrete Screws Hex Head – Brushed Nickel Finish and Blue Fluorocarbon Finish

2.2 Drillcrete Concrete Screws are post-installed screw anchors for use as anchorage in concrete (wood-to-concrete and steel-to-concrete applications) in accordance with IBC Section 1901.3. Drillcrete Concrete Screws are used to resist static, wind, seismic tension, and shear loads in uncracked normal weight or lightweight concrete having a specified compressive strength, f_c, of 2,500-psi to 8,500-psi (17.2 MPa to 58.6 MPa).

2.2.1 Drillcrete Concrete Screws are manufactured from heat-treated, carbon steel and are subsequently coated with a corrosion-resistant brushed nickel finish or a blue fluorocarbon coating.

2.2.2 Drillcrete Concrete Screws are available with a flat countersinking (bugle) head with a Philips or Star-drive recess or a hex-washer head. Drillcrete Concrete Screws are available in lengths ranging from $1^1/_4$" to $3^1/_4$".

2.2.3 The threaded region of Drillcrete Concrete Screws have high-low alternating threads.

2.2.3.1 The length of the anchor is identified with a marking on the head in accordance with ACI 355.2, Table 6.3.4. The length identification codes are provided in **Table 1**.

Table 1. Length Identification Codes

Marking on Head	#	A	B	C	D	E
Anchor Length (in.)	$1 < L < 1^1/_2$	$1^1/_2 < L < 2$	$2 < L < 2^1/_2$	$2^1/_2 < L < 3$	$3 < L < 3^1/_2$	$3^1/_2 < L < 4$
SI: 1 in. = 25.4 mm						

2.3 Drillcrete Concrete Screws are an alternative to cast-in-place anchors described in IBC Section 1901.3 and may be used where an engineered design is submitted, as specified in IRC Section R301.1.3.

2.4 As needed, review material properties for design in **Section 6** and the regulatory evaluation in **Section 8**.

3 Definitions[2]

3.1 New Materials[3] are defined as building materials, equipment, appliances, systems, or methods of construction, not provided for by prescriptive and/or legislatively adopted regulations, known as alternative materials.[4] The design strength and permissible stresses shall be established by tests[5] and/or engineering analysis.[6]

3.2 Duly authenticated reports[7] and research reports[8] are test reports and related engineering evaluations that are written by an approved agency[9] and/or an approved source.[10]

3.2.1 This report utilizes intellectual property and/or trade secrets to create public domain material properties for commercial end-use.

3.2.1.1 This report protects confidential Intellectual Property and trade secrets under the regulation, 18.US.Code.90, also known as Defend Trade Secrets Act of 2016 (DTSA).[11]

3.3 An approved agency is *"approved"* when it is ANAB ISO/IEC 17065 accredited. DrJ Engineering, LLC (DrJ) is accredited and listed in the ANAB directory.

3.4 An approved source is *"approved"* when a professional engineer (i.e., Registered Design Professional, hereinafter RDP) is properly licensed to transact engineering commerce. The regulatory authority governing approved sources is the state legislature via its professional engineering regulations.[12]

3.5 Testing and/or inspections conducted for this duly authenticated report were performed by an ISO/IEC 17025 accredited testing laboratory, an ISO/IEC 17020 accredited inspection body, and/or a licensed RDP.

3.5.1 The Center for Building Innovation (CBI) is ANAB[13] ISO/IEC 17025 and ISO/IEC 17020 accredited.

3.6 The regulatory authority shall enforce[14] the specific provisions of each legislatively adopted regulation. If there is a non-conformance, the specific regulatory section and language of the non-conformance shall be provided in writing[15] stating the nonconformance and the path to its cure.

3.7 The regulatory authority shall accept duly authenticated reports from an approved agency and/or an approved source with respect to the quality and manner of use of new materials or assemblies as provided for in regulations regarding the use of alternative materials, designs, or methods of construction.[16]

3.8 ANAB is an International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA) signatory. Therefore, recognition of certificates and validation statements issued by conformity assessment bodies accredited by all other signatories of the IAF MLA with the appropriate scope shall be approved.[17] Thus, all ANAB ISO/IEC 17065 duly authenticated reports are approval equivalent,[18] and can be used in any country that is an MLA signatory found at this link: https://iaf.nu/en/recognised-abs/

3.9 Approval equity is a fundamental commercial and legal principle.[19]

4 Applicable Local, State, and Federal Approvals; Standards; Regulations[20]

4.1 *Local, State, and Federal*

4.1.1 Approved in all local jurisdictions pursuant to ISO/IEC 17065 duly authenticated report use, which includes, but is not limited to, the following featured local jurisdictions: Austin, Baltimore, Broward County, Chicago, Clark County, Dade County, Dallas, Detroit, Denver, DuPage County, Fort Worth, Houston, Kansas City, King County, Knoxville, Las Vegas, Los Angeles City, Los Angeles County, Miami, Nashville, New York City, Omaha, Philadelphia, Phoenix, Portland, San Antonio, San Diego, San Jose, San Francisco, Seattle, Sioux Falls, South Holland, St. Louis County, Texas Department of Insurance, and Wichita.[21]

4.1.2 Approved in all state jurisdictions pursuant to ISO/IEC 17065 duly authenticated report use, which includes, but is not limited to, the following featured states: California, Florida, New Jersey, Oregon, New York, Texas, Washington, and Wisconsin.[22]

4.1.3 Approved by the Code of Federal Regulations Manufactured Home Construction: Pursuant to Title 24, Subtitle B, Chapter XX, Part 3282.14[23] and Part 3280[24] pursuant to the use of ISO/IEC 17065 duly authenticated reports.

4.1.4 Approved means complying with the requirements of local, state, or federal legislation.

4.2 *Regulations*

4.2.1 *IBC – 18, 21, 24: International Building Code®*

4.2.2 *IRC – 18, 21, 24: International Residential Code®*

4.3 *Standards*

4.3.1 *ACI 318: Building Code Requirements for Structural Concrete*

4.3.2 *ACI 355.2: Qualification of Post-Installed Mechanical Anchors in Concrete*

5 Listed[25]

5.1 Equipment, materials, products, or services included in a List published by a nationally recognized testing laboratory (e.g., CBI), an approved agency (e.g., CBI and DrJ), and/or and approved source (e.g., DrJ), or other organization(s) concerned with product evaluation (e.g., DrJ), that maintains periodic inspection (e.g., CBI) of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

6 Tabulated Properties Generated from Nationally Recognized Standards

6.1 *General*

6.1.1 Drillcrete Concrete Screws installed with a $1^1/_2$" effective embedment, may be permitted to be used in single anchor applications or group anchorages when designed in accordance with ACI 318 Chapter 17 and the applicable sections of **Section 6**.

6.1.2 Design strength of Drillcrete Concrete Screws complying with IBC Section 1604.2 and IRC Section R301.1.3 shall be determined in accordance with ACI 318 Chapter 17 and this report.

6.1.3 Where applicable, strength design shall comply with ACI 318 Section 17.5.1.2.

6.1.4 Strength reduction factors, Φ, as provided in ACI 318 Section 17.5.3, shall be used for load combinations calculated in accordance with IBC Section 1605.1 and ACI 318 Section 5.3, where applicable.

6.1.5 The value of f'_c used in the calculations shall be limited to a maximum of 8,000-psi (55.2 MPa) in accordance with ACI 318 Section 17.3.1.

6.2 *Tension Strength Design*

6.2.1 *Requirements for Static Steel Strength in Tension, N_{sa}:*

6.2.1.1 Nominal state steel strength of a single anchor in tension is calculated in accordance with ACI 318 Section 17.6.1.2 and is provided in **Table 2**.

6.2.1.2 Strength reduction factors, Φ, corresponding to brittle steel elements as defined in ACI 318 and provided in **Table 2**, shall be applied.

6.2.2 *Requirements for Static Concrete Breakout Strength in Tension N_{cb} or N_{cbg}:*

6.2.2.1 Nominal concrete breakout strengths of a single anchor or group of anchors in tension, N_{cb} or N_{cbg}, shall be calculated in accordance with ACI 318 Section 17.6.2, with modifications as described in this section.

6.2.2.2 Nominal concrete breakout strength in tension in regions of concrete where analysis indicates no cracking at service loads in accordance with ACI 318 Section 17.6.2.5.1, shall be calculated using values of k_{uncr} as provided in **Table 2** with $\Psi_{c,N}$ = 1.0.

6.2.3 *Requirements for Static Pullout Strength in Tension, N_{pn}:*

6.2.3.1 Nominal pullout strength of a single anchor in accordance with ACI 318 Section 17.6.3.1 and ACI 318 Section 17.6.3.2.1 in uncracked concrete, $N_{p,uncr}$ is provided in **Table 2**.

6.2.3.2 In lieu of ACI 318 Section 17.6.3., $\Psi_{c,P}$ = 1.0 for all design cases.

6.2.3.3 Nominal pullout strength can be adjusted by calculation in accordance with **Equation 1**:

Equation 1

$$N_{p,f_c'} = N_{p,uncr}\left(\frac{f_c'}{2{,}500}\right)^n \qquad \text{[lb, psi]}$$

$$N_{p,f_c'} = N_{p,uncr}\left(\frac{f_c'}{17.2}\right)^n \qquad \text{[N, MPa]}$$

where:

f_c' is the specified compressive strength, and

n is the factor defining the influence of concrete strength on the pullout strength.

For all diameters, n shall be 0.5.

Table 2. Tension Strength Design Information for Drillcrete Concrete Screws[1]

Parameter			Nominal Anchor Diameter	
			$^3/_{16}$	$^1/_4$
Anchor Category		-	1	1
Nominal Embedment Depth	h_{nom}	in (mm)	1.97 (50)	2.03 (52)
Critical Edge Distance	c_{ac}	in (mm)	2.25 (57)	2.50 (64)
Minimum Edge Distance	c_{min}	in (mm)	2.00 (51)	2.50 (64)
Minimum Spacing	s_{min}	in (mm)	3.00 (76)	4.00 (102)
Steel Strength in Tension per ACI 318 Section 17.6.1				
Minimum Specified Yield Strength	f_{ya}	psi (N/mm²)	100,000 (689)	
Minimum Specified Tensile Strength	f_{uta}	psi (N/mm²)	125,000 (862)	
Effective Tensile Stress Area	A_{se}	in² (mm²)	0.0138 (9)	0.0238 (15)
Steel Strength in Tension	N_{sa}	lb (kN)	1,725 (7.68)	2,975 (13.24)
Strength Reduction Factor – Steel Failure[2]	Φ_{sa}	-	0.65	
Concrete Breakout Strength in Tension per ACI 318 Section 17.6.2				
Effective Embedment Depth	h_{ef}	in (mm)	1.50 (38)	
Effectives Factor – Uncracked Concrete	k_{uncr}	-	24	
Strength Reduction Factor – Concrete Breakout Failure[2]	Φ_{cb}	-	0.65	
Modification Factor for Concrete[3]	$\Psi_{c,N}$	-	1.00	

Table 2. Tension Strength Design Information for Drillcrete Concrete Screws[1]

Parameter			Nominal Anchor Diameter	
			$^3/_{16}$	$^1/_4$
Pull-Out Strength in Tension per ACI 318 Section 17.6.3				
Pull-out Resistance Uncracked Concrete (f_c'=2,500-psi)	$N_{p,uncr}$	lb (kN)	500 (2.22)	N/A
Strength Reduction Factor – Pullout Failure[2]	Φ_p	-	0.65	
Axial Stiffness				
Axial Stiffness in Service Load Range in Uncracked Concrete	β	lb/in (N/mm)	70,256 (12,295)	106,696 (18,672)

1. The information presented in this table shall be used in conjunction with the design requirements in ACI 318 Chapter 17.
2. The strength reduction factor applies when the load combinations from IBC or ACI 318 are used and the requirements of ACI 318 Section 17.5.3 be met.
3. For all design cases use $\Psi_{c,N}$ = 1.0. The effectiveness factor for uncracked concrete (k_{uncr}) shall be used.
4. N/A denotes that pullout resistance does not govern and does not need to be considered.

6.3 *Shear Strength Design*

6.3.1 *Requirements for Static Steel Shear Strength, V_{sa}:*

6.3.1.1 Nominal steel shear strength, V_{sa}, of a single anchor in accordance with ACI 318 Section 17.7.1.2, is provided in **Table 3** and shall be used in lieu of the values derived by calculation from ACI 318 Equation 17.7.1.2b.

6.3.1.2 The strength reduction factor, φ, corresponding to brittle steel elements as defined in ACI 318 and provided in **Table 3**, shall be applied.

6.3.2 *Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}:*

6.3.2.1 Nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} and V_{cbg}, shall be calculated in accordance with ACI 318 Section 17.7.2.

6.3.2.2 The basic concrete breakout strength of a single anchor in shear, V_b, shall be calculated in accordance with ACI 318 Section 17.7.2.2.1 using the value of l_e and d_a given in **Table 3**. The value of l_e used in ACI 318 Section 17.7.2.2.1a shall be taken as no greater than the lesser of h_{ef} or $8d_a$.

6.3.3 *Requirements for Static Concrete Pryout Strength in Shear, V_{cp} or V_{cpg}:*

6.3.3.1 Static nominal concrete pryout strength of a single anchor or group of anchors, V_{cp} and V_{cpg}, shall be calculated in accordance with ACI 318 Section 17.7.3, modified by using the value of k_{cp} provided in **Table 3**, and the value of N_{cb} or N_{cbg} as calculated in **Section 6.2.2**.

Table 3. Shear Strength Design Information for Drillcrete Concrete Screws[1]

Parameter			Nominal Anchor Diameter	
			3/16	1/4
Anchor Category		-	1	1
Nominal Embedment Depth	h_{nom}	in (mm)	1.97 (50)	2.03 (52)
Critical Edge Distance	c_{ac}	in (mm)	2.25 (57)	2.50 (64)
Minimum Edge Distance	c_{min}	in (mm)	2.00 (51)	2.50 (64)
Minimum Spacing	s_{min}	in (mm)	3.00 (76)	4.00 (102)
Steel Strength in Shear per ACI 318 Section 17.7.1				
Minimum Specified Yield Strength	f_{ya}	psi (N/mm²)	100,000 (689)	
Minimum Specified Tensile Strength	f_{uta}	psi (N/mm²)	125,000 (862)	
Effective Shear Stress Area	A_{se}	in² (mm²)	0.0138 (9)	0.0238 (15)
Steel Strength in Shear - Static	V_{sa}	lb (kN)	775 (3.4)	1,405 (6.3)
Strength Reduction Factor – Steel Failure[2]	Φ_{sa}	-	0.60	
Concrete Breakout Strength in Shear per ACI 318 Section 17.7.2				
Nominal Diameter	d_a	in (mm)	3/16 (4.8)	1/4 (6.4)
Load Bearing Length of Anchor in Shear (h_{ef} or $8d_0$, whichever is less)	l_e	-	1.50 (38)	
Strength Reduction Factor – Concrete Breakout Failure[2]	Φ_{cb}	-	0.70	
Concrete Pryout Strength in Shear per ACI 318 Section 17.7.3				
Coefficient for Pryout Strength	k_{cp}	lb (kN)	1.00	
Strength Reduction Factor – Concrete Pryout Failure[2]	Φ_{cp}	-	0.70	

1. The information presented in this table shall be used in conjunction with the design requirements in ACI 318 Chapter 17.
2. The strength reduction factor applies when the load combinations from IBC or ACI 318 are used, and the requirements of ACI 318 Section 17.5.3 be met.

6.4 *Requirements for Interaction of Tensile and Shear Forces:*

6.4.1 For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 Section 17.8, as applicable.

6.5 *Requirements for Critical Edge Distance c_{ac}:*

6.5.1 In applications where $c < c_{ac}$, and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318 Section 17.6.2, shall be further multiplied by the factor $\Psi_{cp,N}$ given in **Equation 2**:

Equation 2

$$\Psi_{cp,N} = \frac{c}{c_{ac}}$$

where:

$\Psi_{cp,N}$ need not to be taken as less than 1.5 h_{ef}/c_{ac}

6.5.2 For all other cases, $\Psi_{(cp,N)} = 1.0$.

6.5.3 In lieu of ACI 318 Section 17.9.5, the values for the critical edge distance, c_{ac}, shall be taken from **Table 2**.

6.6 *Requirements for Minimum Member Thickness, Minimum Anchor Spacing, and Minimum Edge Distance:*

6.6.1 In lieu of ACI 318 Section 17.9.2, minimum spacing, s_{min}, and minimum edge distance, c_{min}, shall comply with **Table 2** and **Table 3**.

6.6.2 In lieu of ACI 318 Section 17.9.4, minimum member thickness, h_{min}, shall comply with **Table 5**.

6.7 *Lightweight Concrete:*

6.7.1 For use of anchors in lightweight concrete, the modification factor, λ_a equal to 0.8λ, is applied to all values of $\sqrt{f_c'}$ affecting N_n, and V_n.

6.7.2 Determination of λ is provided in **Table 4**:

Table 4. Values of λ for Lightweight Concrete Based on Equilibrium Density or Composition of Aggregates

Concrete		λ
Equilibrium Density, w_c (lb/ft³)	≤ 100	0.75
	100 < w_c ≤ 135	0.0075w_c ≤ 1.0
	> 135	1.0
All-Lightweight	Fine: ASTM C330 Coarse: ASTM C330	0.75
Lightweight, Fine Blend	Fine: Combination of ASTM C330 and C33 Coarse: ASTM C330	0.75 to 0.85[1]
Sand-Lightweight	Fine: ASTM C33 Coarse: ASTM C330	0.85
Sand-Lightweight, Coarse Blend	Fine: ASTM C330 Coarse: Combination of ASTM C330 and C33	0.85 to 1.0[2]

1. Linear interpolation from 0.75 to 0.85 is permitted based on the absolute volume of normal weight fine aggregate as a fraction of the total absolute volume of fine aggregate.
2. Linear interpolation from 0.85 to 1.0 is permitted based on the absolute volume of normal weight coarse aggregate as a fraction of the total absolute volume of aggregate.

6.8 *Allowable Stress Design (ASD, Structural):*

6.8.1 Design values for use with allowable stress design (working stress design) load combinations in accordance with IBC Section 1605.1 shall be determined using **Equation 3** and **Equation 4** as follows:

Equation 3

$$T_{allowable,ASD} = \frac{\varphi N_n}{\alpha}$$

Equation 4

$$V_{allowable,ASD} = \frac{\varphi V_n}{\alpha}$$

where:

$T_{allowable,ASD}$ is the allowable tension load [lb or N]

$V_{allowable,ASD}$ is the allowable shear load [lb or N]

φN_n is the lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 Chapter 17 and IBC Section 1905.7[26] and the applicable sections in **Section 6**

φV_n is the lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 Chapter 17 and IBC Section 1905.7[27] and the applicable sections in **Section 6**

α is the conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α shall include all applicable factors to account for non-ductile failure modes and required overstrength.

6.8.2 Limits on edge distance, anchor spacing, and member thickness, as provided in **Section 6.6**, shall be applied.

6.9 *Interaction of Tensile and Shear Forces*

6.9.1 Interaction shall be calculated and consistent with ACI 318 Section 17.8 as follows:

6.9.1.1 If $T_{applied} \leq 0.2\ T_{allowable}$, then the full allowable strength in shear, $V_{allowable}$, shall be permitted.

6.9.1.2 If $V_{applied} \leq 0.2\ V_{allowable}$, then the full allowable strength in tension, $T_{allowable}$ shall be permitted.

6.9.1.3 For all other cases, see **Equation 5**:

Equation 5

$$\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2$$

6.10 *Corrosion Resistance*

6.10.1 Drillcrete Concrete Screws, coated with the blue fluorocarbon coating or the corrosion-resistant brushed nickel finish, may be used where screws are required to exhibit corrosion resistance when exposed to adverse environmental conditions, which are subject to the limitations of this report.

6.10.1.1 Drillcrete Concrete Screws have been evaluated for use in wood treated with ACQ-D preservatives and may be used as an alternative to hot-dip galvanized fasteners in wood treated with preservatives or less corrosive effects meeting ASTM A153, Class D (IBC Section 2304.10.6 and IRC Section R304.3[28]).

6.11 Alternative techniques shall be permitted in accordance with accepted engineering practice and experience. These provisions for the use of alternative materials, designs, and methods of construction are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed herein. This includes, but is not limited to, the following areas of engineering: mechanics of materials, structures, building science, and fire science.

7 Certified Performance[29]

7.1 All construction methods shall conform to accepted engineering practices to ensure durable, livable, and safe construction and shall demonstrate acceptable workmanship reflecting journeyman quality of work of the various trades.[30]

7.2 The strength and rigidity of the component parts and/or the integrated structure shall be determined by engineering analysis or by suitable load tests to simulate the actual loads and conditions of application that occur.[31]

8 Regulatory Evaluation and Accepted Engineering Practice

8.1 Drillcrete Concrete Screws comply with the following legislatively adopted regulations and/or accepted engineering practice for the following reasons:

8.1.1 Drillcrete Concrete Screws were evaluated in accordance with ACI 355.2 as specified in ACI 318 Section 17.1.2(f), per IBC Section 1901.3.

8.2 Any building code, regulation and/or accepted engineering evaluations (e.g., research reports, duly authenticated reports, etc.) that are conducted for this Listing were performed by DrJ, which is an ISO/IEC 17065 accredited certification body and a professional engineering company operated by RDP or approved sources. DrJ is qualified[32] to practice product and regulatory compliance services within its scope of accreditation and engineering expertise,[33] respectively.

8.3 Engineering evaluations are conducted with DrJ's ANAB accredited ICS code scope of expertise, which is also its areas of professional engineering competence.

9 Installation

9.1 Installation shall comply with the approved construction documents, the manufacturer installation instructions, this report, and the applicable building code.

9.2 In the event of a conflict between the manufacturer installation instructions and this report, contact the manufacturer for counsel on the proper installation method.

9.3 *Installation Procedure*

9.3.1 The parameters listed in **Table 5** shall be used in conjunction with the design methodology in ACI 318 Chapter 17.

Table 5. Installation Parameters for Drillcrete Concrete Screws

Anchor Parameter		Nominal Anchor Diameter	
		3/16	1/4
Nominal Outside Diameter (in)	d_a	3/16	1/4
Drill Bit Specification (in)	d_{bit}	5/32	3/16
Philips- or Torx-driven		#2 Philips or T-25	#3 Philips or T-30
Hex-driven		1/4" Hex	5/16" Hex
Maximum Installation Torque	$T_{inst,max}$	Not Applicable	
Nominal Embedment Depth (in) [1]	h_{nom}	1.97	2.03
Effective Embedment Depth (in) [1]	h_{ef}	1.50	
Minimum Hole Depth (in) [1]	h_{hole}	2.22	2.28
Minimum Concrete Thickness [1] (in)	h_{min}	4.00	
Critical Edge Distance (in)	c_{ac}	2.25	2.50
Minimum Edge Distance (in)	c_{min}	2.00	2.50
Minimum Spacing (in)	s_{min}	3.00	4.00

SI: 1 in. = 25.4 mm

1. See **Figure 4** for Diagram of Anchor Parameters.

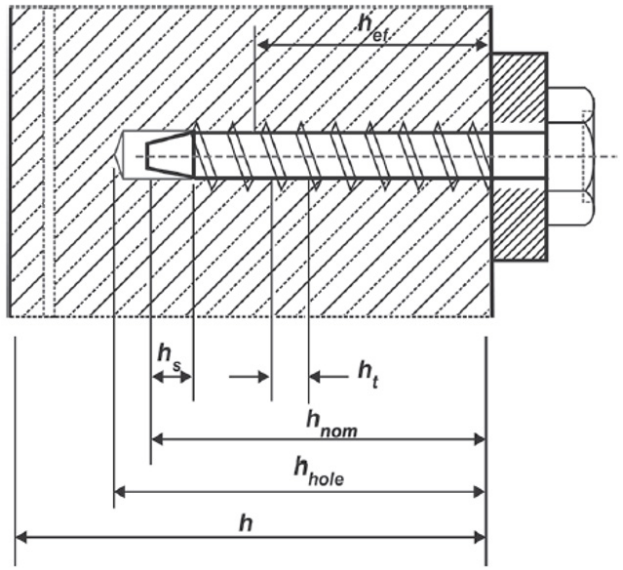

Figure 4. Diagram of Installation Parameters for Drillcrete Concrete Screws

9.3.2 Select the drill bit according to the size of the Drillcrete Concrete Screws being used, detailed drill bit size is provided in **Table 2**.

9.3.3 Drill hole a minimum of 1/4" deeper than the anchor engagement (penetration) with a hammer drill, with the hammering function on.

9.3.4 Clear the bored hole from dust or debris generated from the drilling process.

9.3.4.1 A blow out bulb or compressed air may be used to perform this function.

9.3.5 Drive the anchor using a drill with the appropriate attachment (nut driver, Star Drive, Philips bit) until the concrete screw is fully seated.

9.3.5.1 Do not overdrive or over torque.

9.3.5.1.1 Overdriving may result in anchor failure.

9.3.5.1.2 Driving at high speeds may also result in anchor failure.

9.3.5.2 Being fully seated is achieved when the anchor bearing surface is flush with the substrate being attached.

9.3.5.3 If a hammer drill is used to perform this task, the hammering function shall be off.

9.3.5.4 For faster and easier installation, use Robertson Installation Concrete Drill and Drive Tool Kit. See **Figure 5**.

Figure 5. Contents of Robertson Drillcrete Tool Kit for Drillcrete Concrete Screws

10 Substantiating Data

10.1 Testing has been performed under the supervision of a professional engineer and/or under the requirements of ISO/IEC 17025 as follows:

10.1.1 Testing in accordance with ACI 355.2

10.2 Information contained herein may include the result of testing and/or data analysis by sources that are approved agencies, approved sources, and/or an RDP. Accuracy of external test data and resulting analysis is relied upon.

10.3 Where applicable, testing and/or engineering analysis are based upon provisions that have been codified into law through state or local adoption of regulations and standards. The developers of these regulations and standards are responsible for the reliability of published content. DrJ's engineering practice may use a regulation-adopted provision as the control. A regulation-endorsed control versus a simulation of the conditions of application to occur establishes a new material as being equivalent to the regulatory provision in terms of quality, strength, effectiveness, fire resistance, durability, and safety.

10.4 The accuracy of the provisions provided herein may be reliant upon the published properties of raw materials, which are defined by the grade mark, grade stamp, mill certificate, or duly authenticated reports from approved agencies and/or approved sources provided by the supplier. These are presumed to be minimum properties and relied upon to be accurate. The reliability of DrJ's engineering practice, as contained in this duly authenticated report, may be dependent upon published design properties by others.

10.5 *Testing and Engineering Analysis*

10.5.1 The strength, rigidity, and/or general performance of component parts and/or the integrated structure are determined by suitable tests that simulate the actual conditions of application that occur and/or by accepted engineering practice and experience.[34]

10.6 Where additional condition of use and/or regulatory compliance information is required, please search for Drillcrete Concrete Screws on the DrJ Certification website.

11 Findings

11.1 As outlined in **Section 6**, Drillcrete Concrete Screws have performance characteristics that were tested and/or meet applicable regulations. In addition, they are suitable for use pursuant to its specified purpose.

11.2 When used and installed in accordance with this duly authenticated report and the manufacturer installation instructions, Drillcrete Concrete Screws shall be approved for the following applications:

11.2.1 Use in single or group anchorage when designed in accordance with ACI 318 to resist static, wind, seismic tension, and shear loads in uncracked, normal weight or lightweight concrete having a specified compressive strength between 2,500-psi to 8,500-psi.

11.2.2 Use as anchorage to concrete in accordance with IBC Section 1901.3.

11.2.3 Use where an engineered design is submitted in accordance with IRC Section R301.1.3.

11.2.4 Drillcrete Concrete Screws have been evaluated for reliability against brittle failure and found to be not significantly sensitive to stress-induced hydrogen embrittlement.

11.3 Unless exempt by state statute, when Drillcrete Concrete Screws are to be used as a structural and/or building envelope component in the design of a specific building, the design shall be performed by an RDP.

11.4 Any application specific issues not addressed herein can be engineered by an RDP. Assistance with engineering is available from Robertson, Inc.

11.5 IBC Section 104.2.3[35] (IRC Section R104.2.2[36] and IFC Section 104.2.3[37] are similar) in pertinent part state:

> **104.2.3 Alternative Materials, Design and Methods of Construction and Equipment.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative is not specifically prohibited by this code and has been approved.

11.6 **Approved:**[38] Building regulations require that the building official shall accept duly authenticated reports.[39]

11.6.1 An approved agency is *"approved"* when it is ANAB ISO/IEC 17065 accredited.

11.6.2 An approved source is *"approved"* when an RDP is properly licensed to transact engineering commerce.

11.6.3 Federal law, Title 18 US Code Section 242, requires that, where the alternative product, material, service, design, assembly, and/or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved. Denial without written reason deprives a protected right to free and fair competition in the marketplace.

11.7 DrJ is a licensed engineering company, employs licensed RDPs and is an ANAB Accredited Product Certification Body – Accreditation #1131.

11.8 Through the IAF Multilateral Arrangement (MLA), this duly authenticated report can be used to obtain product approval in any jurisdiction or country because all ANAB ISO/IEC 17065 duly authenticated reports are equivalent.[40]

12 Conditions of Use

12.1 As defined in **Section 6**, where material and/or engineering mechanics properties are created for load resisting design purposes, the resistance to the applied load shall not exceed the ability of the defined properties to resist those loads using the principles of accepted engineering practice.

12.2 As listed herein, Drillcrete Concrete Screws shall be subject to the following conditions:

12.2.1 Concrete shall be normal weight or lightweight and shall comply with IBC Section 1903 and IBC Section 1905.

12.2.1.1 Drillcrete Concrete Screws shall be installed in uncracked concrete that has achieved its minimum design strength.

12.2.1.2 Concrete shall be normal weight or lightweight with a specified compressive strength of 2,500-psi to 8,500-psi.

12.2.1.2.1 For calculation purposes, the compressive strength used shall not exceed 8,000-psi per ACI 318 Section 17.3.1.

12.2.2 Strength design shall comply with ACI 318 Section 17.5.1.2, except as required in ACI 318 Section 17.10.

12.2.2.1 Strength reduction factors as given in ACI 318 Section 17.5.3, and noted in **Table 2** and **Table 3**, shall be used for load combinations calculated in accordance with IBC Section 1605.1 and ACI 318 Section 5.3, as applicable.

12.2.3 Strength design values shall be established in accordance with **Section 6.2** through **Section 6.7**.

12.2.4 Allowable stress design values shall be established in accordance with **Section 6.8** and **Section 6.9**.

12.2.5 Anchor spacing, edge distance, and minimum member thickness shall comply with **Table 2**, **Table 3**, and **Table 5**.

12.2.6 Use of Drillcrete Concrete Screws to resist seismic forces in structures assigned Seismic Design Category C, D, E, or F, is outside of the scope of this report.

12.2.6.1 Drillcrete Concrete Screws may be used to resist short-term loading due to wind or seismic forces (Seismic Design Category A or B).

12.2.7 Where not otherwise prohibited in the code, Drillcrete Concrete Screws may be use in fire-resistance construction provided that at least one of the following conditions are satisfied:

12.2.7.1 Drillcrete Concrete Screws are used to resist wind or seismic forces only.

12.2.7.2 Drillcrete Concrete Screws supporting a fire-resistance-rated envelope or a fire-resistance rated membrane are protected by approved fire-resistance rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.

12.2.7.3 Drillcrete Concrete Screws are used to support non-structural elements.

12.2.8 Use of Drillcrete Concrete Screws shall be limited to dry, interior locations.

12.2.9 Use of Drillcrete Concrete Screws is not permitted to support fire-resistance rated construction.

12.2.10 Where not prohibited by the applicable building code, Drillcrete Concrete Screws are permitted for use with fire-resistance rated construction, provided that at least one of the following conditions be satisfied:

12.2.10.1 Anchors are used to resist wind or seismic forces only.

12.2.10.2 Anchors that support gravity load-bearing structural elements are:

12.2.10.2.1 Within a fire-resistance rated envelope or a fire-resistance rated membrane

12.2.10.2.2 Protected by an approved fire-resistance rated material

12.2.10.2.3 Evaluated for resistance to fire exposure in accordance with recognized standards

12.2.11 Performance of anchors subjected to fatigue or shock loading is out of the scope of this report.

12.3 When required by adopted legislation and enforced by the building official, also known as the Authority Having Jurisdiction (AHJ) in which the project is to be constructed:

12.3.1 Any calculations incorporated into the construction documents shall conform to accepted engineering practice and, when prepared by an approved source, shall be approved when signed and sealed.

12.3.2 This report and the installation instructions shall be submitted at the time of permit application.

12.3.3 These innovative products have an internal quality control program and a third-party quality assurance program.

12.3.4 At a minimum, these innovative products shall be installed per **Section 9**.

12.3.5 The review of this report by the AHJ shall comply with IBC Section 104.2.3.2 and IBC Section 105.3.1.

12.3.6 These innovative products have an internal quality control program and a third party quality assurance program in accordance with IBC Section 104.7.2, IBC Section 110.4, IBC Section 1703, IRC Section R104.7.2, and IRC Section R109.2.

12.3.7 The application of these innovative products in the context of this report is dependent upon the accuracy of the construction documents, implementation of installation instructions, inspection as required by IBC Section 110.3, IRC Section R109.2, and any other regulatory requirements that may apply.

12.4 The approval of this report by the AHJ shall comply with IBC Section 1707.1, where legislation states in part, *"the building official shall make, or cause to be made, the necessary tests and investigations; or the building official shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new materials or assemblies as provided for in Section 104.2.3"*, all of IBC Section 104, and IBC Section 105.3.

12.5 Design loads shall be determined in accordance with the regulations adopted by the jurisdiction in which the project is to be constructed and/or by the building designer (i.e., owner or RDP).

12.6 The actual design, suitability, and use of this report for any particular building, is the responsibility of the owner or the authorized agent of the owner.

13 Identification

13.1 Drillcrete Concrete Screws ($^{3}/_{16}$" Drillcrete Concrete Screw and $^{1}/_{4}$" Drillcrete Concrete Screw), as listed in **Section 1.1**, are identified by a label on the board or packaging material bearing the manufacturer name, product name, this report number, and other information to confirm code compliance.

13.2 Additional technical information can be found at www.robertsonscrew.com.

14 Review Schedule

14.1 This report is subject to periodic review and revision. For the latest version, visit www.drjcertification.org.

14.2 For information on the status of this report, please contact DrJ Certification.

Notes

1 For more information, visit drjcertification.org or call us at 608-310-6748.

2 Capitalized terms and responsibilities are defined pursuant to the applicable building code, applicable reference standards, the latest edition of TPI 1, the NDS, AISI S202, US professional engineering law, Canadian building code, Canada professional engineering law, Qualtim External Appendix A: Definitions/Commentary, Qualtim External Appendix B: Project/Deliverables, Qualtim External Appendix C: Intellectual Property and Trade Secrets, definitions created within Design Drawings and/or definitions within Reference Sheets. Beyond this, terms not defined shall have ordinarily accepted meanings as the context implies. Words used in the present tense include the future; words stated in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural, the singular.

3 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1702

4 Alternative Materials, Design and Methods of Construction and Equipment: The provisions of any regulation code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by a regulation. Please review https://www.justice.gov/atr/mission and https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.2.3

5 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1706.2:~:text=the%20design%20strengths%20and%20permissible%20stresses%20shall%20be%20established%20by%20tests

6 The design strengths and permissible stresses of any structural material shall conform to the specifications and methods of design of accepted engineering practice. https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1706.1:~:text=Conformance%20to%20Standards-,The%20design%20strengths%20and%20permissible%20stresses,-of%20any%20structural

7 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1:~:text=the%20building%20official%20shall%20make%2C%20or%20cause%20to%20be%20made%2C%20the%20necessary%20tests%20and%20investigations%3B%20or%20the%20building%20official%20shall%20accept%20duly%20authenticated%20reports%20from%20approved%20agencies%20in%20respect%20to%20the%20quality%20and%20manner%20of%20use%20of%20new%20materials%20or%20assemblies%20as%20provided%20for%20in%20Section%20104.2.3.

8 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1703.4.2

9 https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#approved_agency

10 https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#approved_source

11 https://www.law.cornell.edu/uscode/text/18/1832 (b) Any organization that commits any offense described in subsection (a) shall be fined not more than the greater of $5,000,000 or 3 times the value of the stolen trade secret to the organization, including expenses for research and design and other costs of reproducing the trade secret that the organization has thereby avoided. The federal government and each state have a public records act. To follow DTSA and comply state public records and trade secret legislation requires approval through ANAB ISO/IEC 17065 accredited certification bodies or approved sources. For more information, please review this website: Intellectual Property and Trade Secrets.

12 https://www.nspe.org/resources/issues-and-advocacy/professional-policies-and-position-statements/regulation-professional AND https://apassociation.org/list-of-engineering-boards-in-each-state-archive/

13 https://www.cbitest.com/accreditation/

14 https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.1:~:text=directed%20to%20enforce%20the%20provisions%20of%20this%20code

15 https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.2.3 AND https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#105.3.1

16 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1

17 https://iaf.nu/en/about-iaf-mla/#:~:text=Once%20an%20accreditation%20body%20is%20a%20signatory%20of%20the%20IAF%20MLA%2C%20it%20is%20required%20to%20recognise%20certificates%20and%20validation%20and%20verification%20statements%20issued%20by%20conformity%20assessment%20bodies%20accredited%20by%20all%20other%20signatories%20of%20the%20IAF%20MLA%2C%20with%20the%20appropriate%20scope

18 True for all ANAB accredited product evaluation agencies and all International Trade Agreements.

19 https://www.justice.gov/crt/deprivation-rights-under-color-law AND https://www.justice.gov/atr/mission

20 Unless otherwise noted, the links referenced herein use un-amended versions of the 2024 International Code Council (ICC) 2024 International Code Council (ICC) model codes as foundation references. Mississippi versions of the IBC 2024 and the IRC 2024 are un-amended. This material, product, design, service and/or method of construction also complies with the 2000-2012 versions of the referenced codes and the standards referenced therein. As pertinent to this technical and code compliance evaluation, CBI and/or DrJ staff have reviewed any state or local regulatory amendments to assure this report is in compliance.

21 See Adoptions by Publisher for the latest adoption of a non-amended or amended model code by the local jurisdiction. https://up.codes/codes/general

22 See Adoptions by Publisher for the latest adoption of a non-amended or amended model code by state. https://up.codes/codes/general

23 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3282/subpart-A/section-3282.14

24 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280

25 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#p-3280.2(Listed%20or%20certified); https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#listed AND https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#labeled

26 2021 IBC Section 1905.1.8

27 2021 IBC Section 1905.1.8

28 2021 IRC Section R317.3

29 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1703.4

30 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=All%20construction%20methods%20shall%20be%20in%20conformance%20with%20accepted%20engineering%20practices%20to%20insure%20durable%2C%20livable%2C%20and%20safe%20housing%20and%20shall%20demonstrate%20acceptable%20workmanship%20reflecting%20journeyman%20quality%20of%20work%20of%20the%20various%20trades

[31] https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=The%20strength%20and%20rigidity%20of%20the%20component%20parts%20and/or%20the%20integrated%20structure%20shall%20be%20determined%20by%20engineering%20analysis%20or%20by%20suitable%20load%20tests%20to%20simulate%20the%20actual%20loads%20and%20conditions%20of%20application%20that%20occur

[32] Qualification is performed by a legislatively defined Accreditation Body. ANSI National Accreditation Board (ANAB) is the largest independent accreditation body in North America and provides services in more than 75 countries. DrJ is an ANAB accredited product certification body.

[33] https://anabpd.ansi.org/Accreditation/product-certification/AllDirectoryDetails?prgID=1&orgID=2125&statusID=4#:~:text=Bill%20Payment%20Date-,Accredited%20Scopes,-13%20ENVIRONMENT.%20HEALTH

[34] See Code of Federal Regulations (CFR) Title 24 Subtitle B Chapter XX Part 3280 for definition: https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280

[35] 2021 IBC Section 104.11

[36] 2021 IRC Section R104.11

[37] 2018: https://up.codes/viewer/wyoming/ifc-2018/chapter/1/scope-and-administration#104.9 AND 2021: https://up.codes/viewer/wyoming/ibc-2021/chapter/1/scope-and-administration#104.11

[38] Approved is an adjective that modifies the noun after it. For example, Approved Agency means that the Agency is accepted officially as being suitable in a particular situation. This example conforms to IBC/IRC/IFC Section 201.4 (https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#201.4) where the building code authorizes sentences to have an ordinarily accepted meaning such as the context implies.

[39] https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1

[40] Multilateral approval is true for all ANAB accredited product evaluation agencies and all International Trade Agreements.