ICC-ES Evaluation Report

ESR-4421

Reissued August 2024

Subject to renewal July 2025

This report also contains:

- CBC Supplement

- FBC Supplement

- LABC Supplement

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DIVISION: 03 00 00—CONCRETE **Section: 03 16 00—Concrete Anchors** **DIVISION: 05 00 00—METALS** **Section: 05 05 19—Post-Installed Concrete Anchors**	**REPORT HOLDER:** **ROBERTSON, INC.**	**EVALUATION SUBJECT:** **DRILLCRETE CONCRETE SCREWS**	

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015, 2012, and 2009 *International Building Code®* (IBC)
- 2021, 2018, 2015, 2012, and 2009 *International Residential Code®* (IRC)

For evaluation for compliance with codes adopted by the *Los Angeles Department of Building and Safety (LADBS)*, see ESR-4421 LABC and LARC Supplement.

For evaluation for compliance with codes adopted by the California Office of Statewide Health Planning and Development (OSHPD) and Division of the State Architects (DSA), see ESR-4421 CBC and CRC Supplement.

Property evaluated:

- Structural

2.0 USES

The Drillcrete concrete screws are used as anchorage to resist static, wind and seismic (Seismic Design Categories A and B only) 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).

The Drillcrete concrete screws $^3/_{16}$- and ¼- inch (4.8 and 6.4 mm) diameters with 1½ -inch (38 mm) effective embedment are to be used in single anchor applications or in group anchorages when designed according to ACI 318 (-19 and -14) Chapter 17 or ACI 318 (-11 and -08) Appendix D and Sections 4.1 and 4.2 of this report, as applicable.

The Drillcrete concrete screws are an alternative to cast-in-place anchors described in Section 1901.3 of the 2021, 2018 and 2015 IBC, Sections 1908 and 1909 of the 2012 IBC and Sections 1911 and 1912 of the 2009 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 Drillcrete Concrete Screws:

The Drillcrete Concrete Screws are manufactured from carbon steel that is heat treated. The anchors are available with a blue coating and nominal diameters of $^3/_{16}$- and ¼-inch (4.8 and 6.4 mm) with various lengths. The anchor bodies have a high-low alternating thread form and are available with a hex washer head or a flat countersunk head with a cross recess.

The Drillcrete Concrete Screws with different head styles are illustrated in Figure 1.

3.2 Concrete:

Normal-weight and lightweight concrete must comply with Sections 1903 and 1905 of the IBC.

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with 2021 IBC, as well as Section R301.1.3 of the 2021 IRC, must be determined in accordance with ACI 318-19 Chapter 17 and this report.

Design strength of anchors complying with 2018 and 2015 IBC, as well as Section R301.1.3 of the 2018 and 2015 IRC must be determined in accordance with ACI 318-14 Chapter 17 and this report.

Design strength of anchors complying with the 2012 IBC and Section R301.1.3 of the 2012 IRC, must be determined in accordance with ACI 318-11 Appendix D and this report.

Design strength of anchors complying with the 2009 IBC and Section R301.1.3 of the 2009 IRC, must be determined in accordance with ACI 318-08 Appendix D and this report.

Design parameters and references to ACI 318 are based on the 2021 IBC (ACI 318-19), 2018 and 2015 IBC (ACI 318-14) and 2012 IBC (ACI 318-11) unless noted otherwise in Sections 4.1.2 through 4.1.11 of this report.

The strength design must comply with ACI 318-19 17.5.1.2, ACI 318-14 17.3.1 or ACI 318-11 D.4.1, except as required in ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Strength reduction factors, ϕ, as given in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 Section D.4.3, as applicable, and noted in Tables 3 and 4 must be used for load combinations calculated in accordance with Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015, 2012, and 2009 IBC and Section 5.3 of ACI 318 (-19 and -14) or Section 9.2 of ACI 318-11, as applicable. Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations set forth in ACI 318-11 Appendix C.

The value of f'_c used in the calculations must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal static steel strength of a single anchor in tension is calculated in accordance with ACI 318-19 17.6.1.2, ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable. The N_{sa} values of a single anchor are given in Table 3 of this report. Strength reduction factors, ϕ, corresponding to brittle steel elements as defined in ACI 318-19 and ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, and provided in Table 3, must be used.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal concrete breakout strengths of a single anchor or a group of anchors in tension, N_{cb} and N_{cbg}, respectively, must be calculated in accordance with ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with modifications as described in this section. The nominal concrete breakout strength in tension in regions of concrete where analysis indicates no cracking at service loads in accordance with ACI 318-19 17.6.2.5.1, ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, must be calculated using the values of k_{uncr} as given in Table 3 of this report with $\psi_{c,N}$ = 1.0.

4.1.4 Requirements for Static Pullout Strength in Tension, N_{pn}: The nominal pullout strength of a single anchor in accordance with ACI 318-19 17.6.3.1 and 17.6.3.2.1, ACI 318-14 17.4.3.1 and 17.4.3.2 or ACI 318-11 D.5.3.1 and D.5.3.2, respectively, as applicable, in uncracked concrete, $N_{p,uncr}$, is given in Table 3 of this report. In lieu of ACI 318-19 17.6.3.3, ACI 318-14 17.4.3.6 or ACI 318-11 D.5.3.6, as applicable, $\psi_{c,P}$ = 1.0 for all design cases. The nominal pullout strength can be adjusted by calculation according to Eq-1:

$$N_{p,f'_c} = N_{p,uncr}\left(\frac{f'_c}{2{,}500}\right)^n \text{ (lb,psi)} \qquad \text{(Eq-1)}$$

$$N_{p,f'_c} = N_{p,uncr}\left(\frac{f'_c}{17.2}\right)^n \text{ (N, MPa)}$$

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 is 0.5.

4.1.5 Requirements for Static Steel Shear Strength, V_{sa}: The nominal steel strength in shear, V_{sa}, of a single anchor in accordance with ACI 318-19 17.7.1.2, ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, is given in Table 4 of this report and must be used in lieu of the values derived by calculation from ACI 318-19 Eq. 17.7.1.2b, ACI 318-14 Eq. 17.5.1.2b or ACI 318-11 Eq. D-29, as applicable. The strength reduction factor, ϕ, corresponding to brittle steel elements as defined in ACI 318-19 and ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, and provided in Table 4, must be used.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: The nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, with modifications as described in this section. The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-19 17.7.2.2.1, ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the value of ℓ_e and d_a given in Table 4 of this report. The value of l_e used in ACI 318-19 Eq. 17.7.2.2.1a, ACI 318-14 Eq. 17.5.2.2a or ACI 318-11 Eq. D-33, as applicable, must be taken as no greater than the lesser of h_{ef} or $8d_a$.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear, V_{cp} or V_{cpg}: Static nominal concrete pryout strength of a single anchor or a group of anchors, V_{cp} and V_{cpg}, respectively, must be calculated in accordance with ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, modified by using the value of k_{cp} provided in Table 4 and the value of N_{cb} or N_{cbg} as calculated in Section 4.1.3 of this report.

4.1.8 Requirements for Interaction of Tensile and Shear forces: For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-19 17.8, ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.9 Requirements for Critical Edge Distance, c_{ac}: 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 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2,as applicable, must be further multiplied by the factor $\psi_{cp,N}$ given by Eq-2:

$$\psi_{cp,N} = \frac{c}{c_{ac}} \qquad \text{(Eq-2)}$$

where the factor $\psi_{cp,N}$ need not be taken as less than $1.5h_{ef}/c_{ac}$. For all other cases, $\Psi_{cp,N} = 1.0$. In lieu of ACI 318-19 17.9.5, ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, the values for the critical edge distance, c_{ac}, must be taken from Table 3.

4.1.10 Requirements for Minimum Member Thickness, Minimum Anchor Spacing, and Minimum Edge Distance: In lieu of ACI 318-19 17.9.2, ACI 318-14 17.7.1 and 17.7.3 or ACI 318-11 D.8.1 and D.8.3,respectively, as applicable, values of s_{min} and c_{min} must comply with Tables 3 and 4 of this report. In lieu of ACI 318-19 17.9.4, ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, minimum member thicknesses, h_{min}, must comply with Table 2 of this report.

4.1.11 Lightweight Concrete: For the 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.

For ACI 318-19 (2021 IBC), ACI 318-14 (2018 and 2015 IBC), ACI 318-11 (2012 IBC), and ACI 318-08 (2009 IBC), λ shall be determined in accordance with the corresponding version of ACI 318.

4.2 Allowable Stress Design (ASD, Structural):

4.2.1 General: Design values for use with allowable stress design (working stress design) load combinations in accordance with Section 1605.1 of the 2021 IBC or Section 1605.3 of the 2018, 2015, 2012 and 2009 IBC are required. These are calculated using Eq-3 and Eq-4 as follows:

$T_{allowable,\ ASD} = \phi N_n / \alpha$ (Eq-3)

and

$V_{allowable,\ ASD} = \phi V_n / \alpha$ (Eq-4)

where:

$T_{allowable,ASD}$ = Allowable tension load (lbf or N).

$V_{allowable,ASD}$ = Allowable shear load (lbf or N).

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 (-19 and -14) Chapter 17 or ACI 318 (-11 and -08) Appendix D and 2021, 2018, 2015 IBC Section 1905.1.8, 2009 IBC Section 1908.1.9 and Section 4.1 of this report, as applicable (lbf or kN). For the 2012 IBC, Section 1905.1.9 shall be omitted.

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 (-19 and -14) Chapter 17 or ACI 318 (-11 and -08) Appendix D and 2021, 2018, 2015 IBC Section 1905.1.8, 2009 IBC Section 1908.1.9 and Section 4.1 of this report, as applicable (lbf or kN). For the 2012 IBC, Section 1905.1.9 shall be omitted.

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α must include all applicable factors to account for nonductile failure modes and required overstrength.

Limits on edge distance, anchor spacing and member thickness as given in Section 4.1.10 of this report must apply. An example of allowable stress design tension values for illustrative purposes is shown on Figure 4 of this report.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318-19 17.8, ACI 318-14 17.6 or ACI 318-11 D.7 as follows:

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

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

For all other cases:

$$\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2 \quad \text{(Eq-5)}$$

4.3 Installation:

Installation parameters are provided in Table 1, Table 2 and in Figure 2. The manufacturer's printed installation instructions (MPII) are reproduced in Figure 3. Anchor locations must comply with this report and the plans and specifications approved by the code official. The Drillcrete concrete screws must be installed in accordance with the manufacturer's published installation instructions and this report. In case of conflict, this report governs. Holes must be predrilled in concrete with carbide-tipped drill bit conforming to ANSI B212.15-1994 and a rotary-hammer drill. The hole must be drilled $^1/_4$ inch (6.4 mm) deeper than the embedment depth and cleaned out of any dust or debris. The anchors must then be installed through the attachment into the hole, to the specified nominal embedment depth, with the Robertson installation tool kit.

4.4 Special Inspection:

Special inspection is required in accordance with Section 1705.1.1 and Table 1705.3 of the 2021, 2018, 2015 and 2012 IBC or Section 1704.15 and Table 1704.4 of the 2009 IBC, as applicable. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, anchor spacing, edge distances, concrete thickness, anchor embedment, drill bit type and size, hole cleaning procedures, installation torque, and adherence to the manufacturer's published installation instructions and the conditions of this report (in case of conflict, this report governs). The special inspector must be present as often as required in accordance with the "statement of special inspection." Under the IBC, additional requirements as set forth in Sections 1705, 1706 and 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE:

The Drillcrete concrete screws described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Anchor sizes, dimensions, and other installation parameters are as set forth in this report.

5.2 The anchors must be installed in accordance with Figure 3 and this report. In case of conflicts, this report governs.

5.3 The Drillcrete concrete screws 3/16- and ¼- inch (4.8 and 6.4 mm) diameters with 1½ -inch (38 mm) effective embedment may only be installed 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).

5.4 The values of f'c used for calculation purposes must not exceed 8,000 psi (55.2 MPa).

5.5 The concrete must have attained its minimum design strength prior to the installation of anchors.

5.6 Strength design values must be established in accordance with Section 4.1 of this report.

5.7 Allowable stress design values must be established in accordance with Section 4.2 of this report.

5.8 Anchor spacing, edge distance, and minimum member thickness must comply with Tables 2, 3, and 4 of this report.

5.9 Prior to installation, calculations and details justifying that the applied loads demonstrate compliance with this report must be submitted to the code official for approval. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.10 Since ICC-ES acceptance criteria for evaluating data to determine the performance of expansion anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

5.11 Use of Drillcrete concrete screws to resist seismic forces in structures assigned to Seismic Design Category C, D, E or F is beyond the scope of this report. Anchors may be used to resist short-term loading due to wind or seismic forces (Seismic Design Category A and B), subject to the conditions of this report.

5.12 Drillcrete concrete screws are not permitted to support fire resistance-rated construction. Where not otherwise prohibited in the code, the Drillcrete concrete screws are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support gravity load-bearing structural elements are within 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.
- Anchors are used to support nonstructural elements.

5.13 Anchors have been evaluated for reliability against brittle failure and found to be not significantly sensitive to stress-induced hydrogen embrittlement.

5.14 Use of anchors is limited to dry, interior locations.

5.15 Special inspections are provided in accordance with Section 4.4 of this report.

5.16 Anchors are manufactured under an approved quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated October 2017 (editorially revised December 2020), which incorporates requirements in ACI 355.2-19 and ACI 355.2-07; and quality-control documentation.

7.0 IDENTIFICATION

7.1 Drillcrete concrete screws, are packaged in cartons bearing labels that provide the manufacturer name and the name of the product (Drillcrete Concrete Screws); screw description (type, length, and shank diameter) and the evaluation report number (ESR-4421). The length identification code letter is stamped on the head of the anchor. See the length identification system indicated in Table 1 of this report.

7.2 The report holder's contact information is the following:

ROBERTSON, INC.
1185 CORPORATE DR. #1
BURLINGTON, ONTARIO L7L 5V5
CANADA
(905) 332-7666
www.robertsonscrew.com
info@robertsonscrew.com

TABLE 1—LENGTH IDENTIFICATION SYSTEM

LENGTH ID MARKING ON ANCHOR HEAD		#	A	B	C	D	E	F	G	H	I	J
Length of anchor (inches)	From	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Up to, but not including	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2

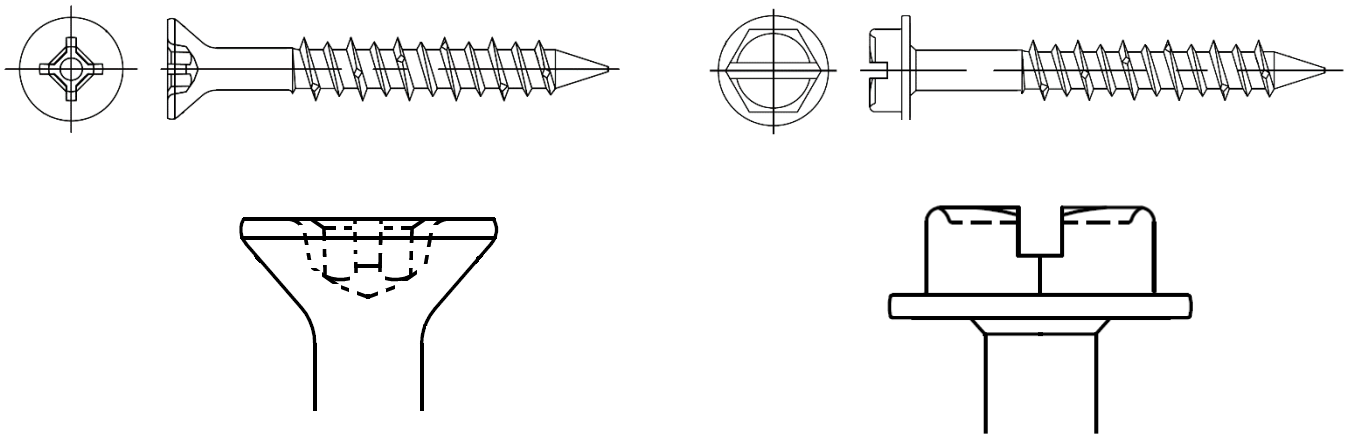
For **SI:** 1 inch = 25.4 mm.

TABLE 2—INSTALLATION INFORMATION FOR DRILLCRETE CONCRETE SCREWS [1]

ANCHOR INFORMATION	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER (inch)	
			3/16	1/4
Nominal Outside Anchor Diameter	d_a	in. (mm)	3/16 (4.8)	1/4 (6.4)
Drill Bit Specification	d_{bit}	in. (mm)	5/32 (4.0)	3/16 (4.8)
Maximum Installation Torque	$T_{inst,max}$	ft-lbf (N-m)	Not applicable[2]	
Nominal Embedment Depth	h_{nom}	in. (mm)	1.97 (50)	2.03 (52)
Effective Embedment Depth	h_{ef}	in. (mm)	1½ (38)	
Minimum Hole Depth	h_{hole}	in. (mm)	2.22 (56)	2.28 (58)
Minimum Concrete Thickness	h_{min}	in. (mm)	4 (102)	

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318 (-19 or -14) Chapter 17 or ACI 318 (-11 or -08) Appendix D, as applicable. See Figure 2 for location of dimensions.
[2]Installation must be performed with Robertson installation tool kit. See Figure 3 for additional information.



Flat Countersunk Head

Hex Washer Head

FIGURE 1—DRILLCRETE CONCRETE SCREWS AND HEAD STYLES

DRILLCRETE®
INSTALLED CONCRETE SCREW

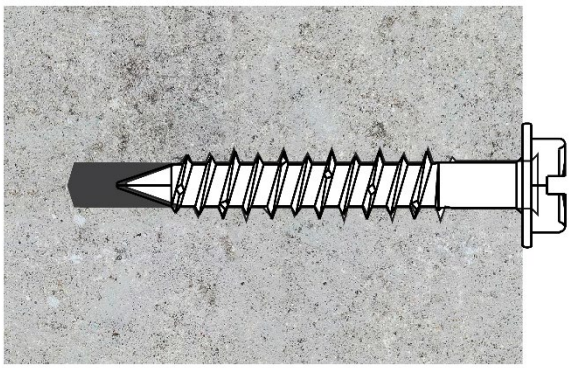
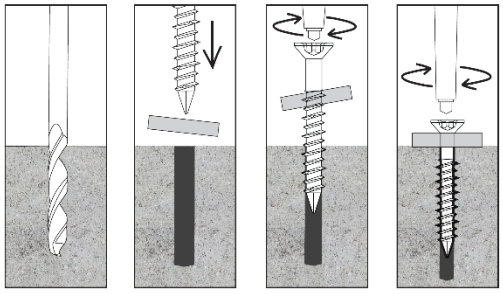


FIGURE 2—DRILLCRETE CONCRETE SCREWS (INSTALLED)

DRILLCRETE®
INSTALLATION INSTRUCTIONS



INSTALLATION INSTRUCTIONS

TO DRILL HOLE:
Place drill bit into drill adapter and insert adapter into drill chuck - drill hole 1/4" deeper than fastener's engagement.

TO INSTALL ANCHOR:
Insert proper nutsetter or bit holder into 1/4" end of drive tube. Slide 5/16" end of drive tube over drill bit and lock on drill adapter. Insert head of screw/anchor into appropiate nutsetter/bit holder and drive it into your pre-drilled hole.

CAUTION:
Always wear safety glasses when operating power tools.

DRILLCRETE®
TOOL KIT

ROBERTSON® INSTALLATION CONCRETE DRILL & DRIVE TOOL KIT

Drive Tube
Drill Adapter
1/4" Drive Nutsetter
5/16" Drive Nutsetter
Holder for Phillips Bits

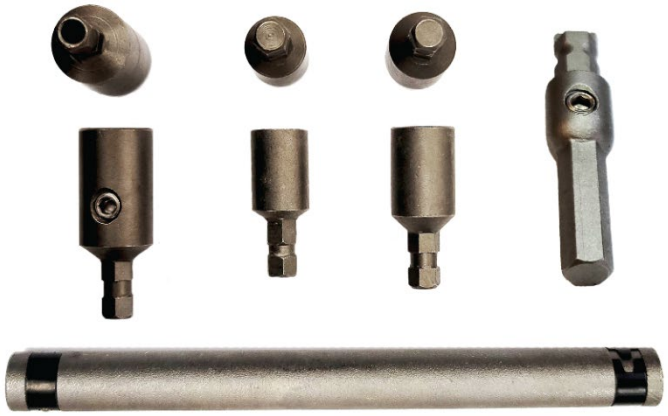


FIGURE 3—INSTALLATION INSTRUCTIONS (MPII) AND KIT FOR DRILLCRETE CONCRETE SCREWS

TABLE 3—TENSION STRENGTH DESIGN INFORMATION FOR DRILLCRETE CONCRETE SCREWS[1]

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER (inch)	
			$^3/_{16}$	$^1/_4$
Anchor Category	1, 2 or 3	-	1	1
Nominal Embedment Depth	h_{nom}	in. (mm)	1.97 (50)	2.03 (52)
Critical Edge Distance	c_{ac}	in. (mm)	2¼ (57)	2½ (64)
Minimum Edge Distance	c_{min}	in. (mm)	2 (50)	2½ (64)
Minimum Spacing	s_{min}	in. (mm)	3 (76)	4 (102)
Steel Strength in Tension (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1)				
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}	lbf (kN)	1,725 (7.68)	2,975 (13.24)
Strength Reduction Factor-Steel Failure[2]	ϕ_{sa}	-	0.65	
Concrete Breakout Strength in Tension (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)				
Effective Embedment Depth	h_{ef}	in. (mm)	1½ (38)	
Effectiveness Factor-Uncracked Concrete	k_{uncr}	-	24	
Strength Reduction Factor-Concrete Breakout Failure[2]	ϕ_{cb}	-	0.65	
Modification Factor for Concrete[3]	$\Psi_{c,N}$	-	1.0	
Pull-Out Strength in Tension (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 D.5.3)				
Pull-Out Resistance Uncracked Concrete (f'_c = 2,500 psi)	$N_{p,uncr}$	lbf (kN)	500 (2.22)	NA
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)

For **SI:** 1 inch = 25.4mm, 1lbf = 4.45N, 1 lb/in = 0.175 N/mm, 1 psi = 0.00689 MPa = 0.00689 N/mm², 1 in² = 645 mm², 1 lb/in = 0.175 N/mm.

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318-19 and ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable.
[2]The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
[3]For all design cases use $\Psi_{c,N}$ = 1.0. The effectiveness factor for uncracked concrete (k_{uncr}) must be used.
[4]NA denotes that pullout resistance does not govern and does not need to be considered.

TABLE 4—SHEAR STRENGTH DESIGN INFORMATION FOR DRILLCRETE CONCRETE SCREWS[1]

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER (inch)	
			$^3/_{16}$	$^1/_4$
Anchor Category	1, 2 or 3	-	1	1
Nominal Embedment Depth	h_{nom}	in. (mm)	1.97 (50)	2.03 (52)
Critical Edge Distance	c_{ac}	in. (mm)	2¼ (57)	2½ (64)
Minimum Edge Distance	c_{min}	in. (mm)	2 (50)	2½ (64)
Minimum Spacing	s_{min}	in. (mm)	3 (76)	4 (102)
Effective Embedment Depth	h_{ef}	in. (mm)	1½ (38)	
Steel Strength in Shear (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.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 Shear Stress Area	A_{se}	in² (mm²)	0.0138 (9)	0.0238 (15)
Steel strength in shear - static	V_{sa}	lbf (kN)	775 (3.4)	1,405 (6.3)
Strength Reduction Factor-Steel Failure[2]	ϕ_{sa}	-	0.60	
Concrete Breakout Strength in Shear (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2)				
Nominal Diameter	d_a	in. (mm)	$^3/_{16}$ (4.8)	$^1/_4$ (6.4)
Load Bearing Length of Anchor in Shear (h_{ef} or $8d_o$, whichever is less)	l_e	in. (mm)	1½ (38)	
Strength Reduction Factor-Concrete Breakout Failure[2]	ϕ_{cb}	-	0.70	
Concrete Pryout Strength in Shear (ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3)				
Coefficient for Pryout Strength	k_{cp}	-	1.0	
Strength Reduction Factor-Concrete Pryout Failure[2]	ϕ_{cp}	-	0.7	

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45 N, 1 psi = 0.00689 MPa = 0.00689 N/mm², 1 in² = 645 mm².

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318-19 and ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable.
[2]The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.

Design Example to Calculate Allowable Stress Design Tension Capacity for Illustrative Purposes[1,2,3,4,5,6,7,8,9]:

Drillcrete Concrete Screw $^{3}/_{16}$ -inch diameter, with an effective embedment (h_{ef}) of 1½ -inch, assuming the conditions given in Table 3

	PROCEDURE		CALCULATION
Step 1	Determine steel strength of a single anchor in tension per ACI 318-19 17.6.1.2, ACI 318-14 17.4.1.2, ACI 318-11 D 5.1.2, Table 3 of this report:	ϕN_{sa}	$= \phi N_{sa}$ =0.65*1,725 **=1,121 lbs steel strength**
Step 2	Determine concrete breakout strength of a single anchor in tension per ACI 318-19 17.6.2.2, ACI 318-14 17.4.2.2, ACI 318-11 D.5.2.2, Table 3 of this report:	N_b	$= k_{uncr} \sqrt{f`_c}\ h_{ef}^{1.5}$ $= 24* \sqrt{2,500} *1.5^{1.5}$ = 2,204 lbs
		ϕN_{cb}	$=\phi A_{NC}/A_{NC0}\, \psi_{ed,N}\, \psi_{c,N}\, \psi_{cp,N}\, N_b$ = 0.65*1.0*1.0*1.0*1.0*2,204 = 0.65*2,204 **= 1,432 lbs concrete breakout strength**
Step 3	Determine pullout strength per Table 3 of this report:	$\phi N_{p,uncr}$	$=\phi N_{p,uncr}\, \psi_{c,P}$ = 0.65 * 500 * 1.0 = **325 lbs pullout strength**
Step 4	Determine controlling resistance strength in tension per ACI 318-19 17.5.2, ACI 318-14 17.3.1.1, ACI 318-11 D 4.1.1:		**= 325 lbs controlling resistance (pullout)**
Step 5	Determine allowable stress design conversion factor for loading condition per ACI 318-19 and ACI 318-14 Section 5.3, ACI 318-11 Section 9.2:	α	=1.2*D* + 1.6*L* =1.2(0.3) + 1.6(0.7) **=1.48**
Step 6	Determine allowable stress design value per Section 4.2 of this report:	$T_{allowable,ASD}$	$= \phi N_n / \alpha$ = 325 / 1.48 **= 220 lbs allowable stress design**

[1]Single anchor with static tension load only.
[2]Concrete determined to remain uncracked for the life of the anchorage.
[3]Load combinations are taken from ACI 318 (-19 and -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable (no seismic loading considered).
[4]Assumes 30% dead load and 70% live load, controlling load combination 1.2*D* + 1.6*L*.
[5]Calculation of weighted average for conversion factor α = 1.2(0.3) + 1.6(0.7) = 1.48.
[6] f'_c = 2,500 psi (normal weight concrete).
[7] $c_{a1} = c_{a2} \geq c_{ac}$.
[8] $h \geq h_{min}$.
[9]Values are for Condition B (no supplementary reinforcement provided) in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3.

FIGURE 4—EXAMPLE DESIGN CALCULATION

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

ROBERTSON, INC.

EVALUATION SUBJECT:

DRILLCRETE CONCRETE SCREWS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Drillcrete concrete screws, described in ICC-ES evaluation report ESR-4421, have also been evaluated for compliance with the codes noted below as adopted by Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2020 *City of Los Angeles Building Code* (LABC)
- 2020 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Drillcrete concrete screws, described in Sections 2.0 through 7.0 of the evaluation report ESR-4421, comply with LABC Chapter 19, and LARC, and are subjected to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Drillcrete concrete screws described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-4421.
- The design, installation, conditions of use and labeling of the anchors are in accordance with the 2018 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-4421.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable design values listed in the evaluation report and tables are for the connection of the anchors to concrete substrate. The connection between the anchors and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragm applications, anchors shall be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2020-071.

This supplement expires concurrently with the evaluation report, reissued August 2024.

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

ROBERTSON, INC.

EVALUATION SUBJECT:

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1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Drillcrete concrete screws, described in ICC-ES evaluation report ESR-4421, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2019 *California Building Code* (CBC)

For evaluation of applicable chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) AKA: California Department of Health Care Access and Information (HCAI) and the Division of State Architect (DSA), see Sections 2.1 and 2.2 below.

- 2019 *California Residential Code* (CRC)

2.0 CONCLUSIONS

The Drillcrete concrete screws, described in Sections 2.0 through 7.0 of the evaluation report ESR-4421, comply with CBC Chapter 19 and CRC Section R301.1.3, provided the design and installation are in accordance with the 2018 *International Building Code®* (IBC), as applicable, provisions noted in the evaluation report, and the additional inspection requirements of the CBC Sections 16 and 17.

2.1 OSHPD:

The Drillcrete concrete screws, described in Sections 2.0 through 7.0 of the evaluation report ESR-4421, comply with CBC amended Sections in Chapters 16, 17 and 19, and Chapters 16A, 17A and 19A, provided the design and installation are in accordance with the 2018 *International Building Code®* (IBC), as applicable, provisions noted in the evaluation report, and the additional requirements in Sections 2.1.1 to 2.1.3 of this supplement:

2.1.1 Verification Test Requirements: The installation verification test loads, frequency, and acceptance criteria shall be in accordance with Section 1901.3.4 [OSHPD 1R, 2 and 5] and 1910A.5 [OSHPD 1 & 4] of the CBC, as applicable.

2.1.2 Special Inspection Requirements: Periodic special inspection is required, in accordance with Section 1705.1.1 and Table 1705.3 [OSHPD 1R, 2 and 5], or Section 1705A.1.1, and Table 1705A.3 [OSHPD 1 & 4] of the CBC, as applicable. In addition, special inspection is required for special seismic certification for designated seismic system in accordance with amended Section 1705.13.3.1 [OSHPD 1R, 2 and 5] and Section 1705A.12.4 [OSHPD 1 & 4] of the CBC, as applicable.

2.1.3 Conditions of Use:

1. Where moment resistance is assumed at the base of the superstructure elements, deformation of the superstructure to foundation connection shall be considered in accordance with Section 1617A.1.16 [OSHPD 1 & 4] of the CBC.

2. The screw anchors may be loosened and retightened in accordance with Section 4.3 of the evaluation report to perform verification test requirements specified in Section 2.1.1 of this supplement. Re-use of screw anchors or screw anchor holes shall not be permitted.

2.2 DSA:

The Drillcrete concrete screws, described in Sections 2.0 through 7.0 of the evaluation report ESR-4421, comply with CBC amended Sections in Chapters 16 and 19, and Chapters 16A, 17A and 19A, provided the design and installation are in accordance with the 2018 *International Building Code*® (IBC), as applicable, provisions noted in the evaluation report, and the additional requirements in Sections 2.2.1 to 2.2.3 of this supplement:

2.2.1 Verification Test Requirements: The installation verification test loads, frequency, and acceptance criteria shall be in accordance with Sections 1909.2.7 [DSA-SS/CC] and 1910A.5 [DSA-SS] of the CBC, as applicable.

2.2.2 Special Inspection Requirements: Periodic special inspection is required, in accordance with Section 1705A.1.1, and Table 1705A.3 [DSA-SS, DSA-SS/CC] of the CBC. In addition, special inspection is required for special seismic certification for designated seismic system in accordance Section 1705A.12.4 [DSA-SS, DSA-SS/CC] of the CBC, as applicable.

2.2.3 Conditions of Use:

1. Where moment resistance is assumed at the base of the superstructure elements, deformation of the superstructure to foundation connection shall be considered in accordance with Section 1617.11.14 [DSA-SS/CC] or Section 1617A.1.16 [DSA-SS] of the CBC.

2. The screw anchors may be loosened and retightened in accordance with Section 4.3 of the evaluation report to perform verification test requirements specified in Section 2.1.1 of this supplement. Re-use of screw anchors or screw anchor holes shall not be permitted.

This supplement expires concurrently with the evaluation report, reissued August 2024.

ICC-ES Evaluation Report

ESR-4421 FBC Supplement

Reissued August 2024

This report is subject to renewal July 2025.

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

ROBERTSON, INC.

EVALUATION SUBJECT:

DRILLCRETE CONCRETE SCREWS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Drillcrete concrete screws, described in ICC-ES evaluation report ESR-4421, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2020 *Florida Building Code—Building*
- 2020 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Drillcrete concrete screws, described in Sections 2.0 through 7.0 of ICC-ES evaluation report ESR-4421, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design requirements are determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable. The installation requirements noted in ICC-ES evaluation report ESR-4421 for the 2018 *International Building Code®* meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable.

Use of the Drillcrete concrete screws has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential*, with the following condition:

a) For anchorage to wood members, the connection subject to uplift, must be designed for no less than 700 pounds (3114 N).

For products falling under Florida Rule 61G20-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued August 2024.