ICC-ES Evaluation Report

ESR-2272*

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DIVISION: 03—CONCRETE
Section: 03151—Concrete Anchoring

REPORT HOLDER:

POWERS FASTENERS, INC
2 POWERS LANE
BREWSTER, NEW YORK 10509
(914) 235-6300 or (800) 524-3244
www.powers.com
engineering@powers.com

ADDITIONAL LISTEE:

L.H. DOTTIE
6131 SOUTH GARFIELD AVENUE
COMMERCE, CALIFORNIA 90040
lane@lhdottie.com

EVALUATION SUBJECT:

POWERS SNAKE+ ANCHORS IN CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 *International Building Code®* (IBC)
- * ~~2006 *International Residential Code®* (IRC)~~
- ~~2003 *International Building Code®* (IBC)~~
- ~~2003 *International Residential Code®* (IRC)~~

Property evaluated:

Structural

2.0 USES

The Powers Snake+ anchor is used to resist static, wind and seismic tension and shear loads in cracked and uncracked structural normal-weight concrete and structural sand-lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa); and in cracked and uncracked normal-weight or structural sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa). The anchoring system is an alternative to cast-in-place anchors described in Sections 1911 and 1912 of * the 2006 IBC ~~and 1912 and 1913 of the 2003 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the 2006 and 2003 IRC~~.

3.0 DESCRIPTION

3.1 Snake+ Anchors:

Snake+ anchors are one-piece, internally threaded screw anchors which receive threaded steel inserts. The anchors are manufactured from carbon steel, which are case hardened and have a minimum 0.0002-inch (5 μm) zinc plating. The Snake+ anchor is illustrated in Figure 1. Installation information and dimensions are set forth in Section 4.3, Table 1 and Figure 3.

3.2 Steel Insert Elements:

Threaded steel insert elements must be threaded into the Snake+ Anchors to form a connection. The material properties of the steel insert elements must comply with Tables 2 and 3.

3.3 Concrete:

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

3.4 Steel Deck Panels:

Steel deck panels must comply to the requirements of ASTM A 653 and have a minimum base metal thickness of 0.035-inch (20 gage).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strengths must be determined in * accordance with ACI 318-05 (2006 IBC) Appendix D ~~or ACI 318-02 (2003 IBC) Appendix D,~~ and this report. Design parameters are provided in Tables 2 and 3. Strength reduction factors, ϕ, as given in Tables 2 and 3 must be used for load combinations calculated in accordance with Section 1605.2.1 of the IBC or Section 9.2 of ACI 318.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal static steel strength, N_{sa}, of steel insert elements in tension must be calculated in accordance with ACI 318 D.5.1. The resulting values for a single anchor are described in Table 2 of this report.

4.1.3 Requirements for Static Concrete Breakout Strength of Anchor or Anchors in Tension N_{cb} or N_{cbg}: The nominal concrete breakout strength in tension, N_{cb} and N_{cbg}, respectively, must be calculated in accordance with ACI 318 D.5.2, with modifications as described in this section. The basic concrete breakout strength of a single anchor in tension must be calculated in accordance with ACI 318 D.5.2.2, using the values of h_{ef} where analysis indicates no cracking in accordance with ACI 318 D.5.2.6, the nominal concrete breakout strength in tension must be calculated with $\psi_{c,N}$ = 1.0 and k_{uncr} as given in Table 2. For

***Revised June 2009**

Snake+ anchors installed in the soffit of structural sand-lightweight or normal weight concrete on steel deck floor and roof assemblies, as shown in Figure 4, evaluation of concrete breakout capacity in accordance with ACI 318 D.5.2 is not required.

4.1.4 Requirements for Critical Edge Distance: For the Snake+ anchor, $c_{ac} = c_{a,min}$ with the value as given in Table 2. For the concrete breakout strength in tension for cracked and uncracked concrete, calculated according to ACI 318 D.5.2, the value $\psi_{ed,N}$ = 1.0 for all cases.

4.1.5 Requirements for Static Pullout Strength of Anchor in Tension, N_{pn}: Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Table 2, the pullout strength in tension in cracked and uncracked concrete need not be evaluated. The pullout strength in tension of the Snake+ anchor installed in the soffit of structural sand-lightweight or normal weight concrete on steel deck floor and roof assemblies, as shown in Figure 4, is provided in Table 2 of this report.

4.1.6 Requirements for Static Steel Shear Capacity, V_{sa}: In lieu of the values for nominal steel strength in shear, V_{sa}, as given in ACI 318 D.6.1.2 (c), the shear values given in Table 3 of this report must be used. The shear strength as governed by steel element failure of the Snake+ anchors installed in the soffit of structural sand-lightweight or normal weight concrete on steel deck floor and roof assemblies, $V_{sa,deck}$, as shown in Figure 4, is given in Table 3. The required steel insert strengths are presented in Table 3.

4.1.7 Requirements for Concrete Breakout Strength of Anchor or Anchors 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 D.6.2, with modifications as described in this section. The basic concrete breakout strength in shear, V_b, must be calculated in accordance with ACI 318 D.6.2 using the value of ℓ_e and d_o provided in Table 3. The value of ℓ_e used in ACI 318 Equation (D-24) is equal to h_{ef}.

For anchors installed in the soffit of structural sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 4, calculation of the concrete breakout strength in accordance with ACI 318 D.6.2 is not required.

4.1.8 Requirements for Concrete Pryout Strength of Anchor or Anchors in Shear, V_{cp} or V_{cpg}: The nominal concrete pryout strength of a single anchor or group of anchors, V_{cp} or V_{cpg}, respectively, must be calculated in accordance with ACI 318 D.6.3, modified by using the value of k_{cp} described in Table 3 of this report and the value of N_{cb} or N_{cbg} as calculated in Section 4.1.3 of this report.

For anchors installed in the soffit of structural sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 4, calculation of the concrete pryout strength in accordance with ACI 318 D.6.3 is not required.

4.1.9 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: In lieu of ACI 318 D.8.3, values of c_{min} and s_{min} as given in Table 1 of this report must be used. In lieu of ACI 318 D.8.5, minimum member thicknesses, h_{min}, as given in Table 1 of this report must be used.

For anchors installed through the soffit of steel deck assemblies, the anchors must be installed in accordance with Figure 4 of this report and must have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

4.1.10 Requirements for Seismic Design: For load combinations including seismic loads, the design must consider the additional requirements of ACI 318 D.3.3 as * modified by Section 1908.1.16 of the 2006 IBC ~~or the following~~:

~~Code~~	~~ACI 318 D.3.3 Seismic Region~~	~~Code Equivalent Design~~
~~2003 IBC and IRC~~	~~Moderate or high seismic risk~~	~~Seismic Design Categories C, D, E and F~~

The nominal steel strength and the nominal concrete breakout strength for anchors in tension, and the nominal concrete breakout strength for anchors in shear, must be calculated according to ACI 318 Sections D.5 and D.6, respectively, taking into account the corresponding values given in Tables 2 and 3.

The nominal pullout strength N_{eq} and nominal steel strength in shear V_{eq} must be evaluated with the values given in Table 2 and Table 3, respectively. Anchor steel must be classified as brittle in seismic tension calculations. Anchor steel may be classified as ductile for seismic shear calculations for the inserts recognized in this report. Applicable strength reduction factors, ϕ, are given in Table 2 and Table 3.

4.1.11 Interaction of Tensile and Shear Forces: Anchors or groups of anchors that are subject to the effects of combined axial (tensile) and shear, the design must be performed in accordance with ACI 318 D.7.

4.1.12 Structural Sand-Lightweight Concrete: When anchors are used in structural sand-lightweight concrete, N_b, N_{eq}, $N_{p,cr}$, $N_{p,uncr}$, V_b, V_{cp} and V_{cpg} must be multiplied by 0.60, in lieu of ACI 318 D.3.4.

For anchors installed in the soffit of structural sand-lightweight concrete-filled steel deck floor and roof assemblies, this reduction is not required.

4.2 Allowable Stress Design (ASD):

4.2.1 General: Design values for use with allowable stress design load combinations calculated in accordance with Section 1605.3 of the IBC must be established using the following equations:

$$T_{allowable,ASD} = \phi N_n / \alpha \quad \text{(Eq-1)}$$

$$V_{allowable,ASD} = \phi V_n / \alpha \quad \text{(Eq-2)}$$

where:

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

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

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 Appendix D, Section 4.1 of this report and 2006 IBC Section 1908.1.16, as appropriate (lbf or kN).

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 Appendix D, Section 4.1 of this report and 2006 IBC Section 1908.1.16, as appropriate (lbf or kN).

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 over-strength.

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Limits on edge distance, anchor spacing and member thickness as given in Table 1 of this report must apply. An example of Allowable Stress Design tension values is given in Table 4 of this report.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318 D.7, as follows:

For shear loads $V \leq 0.2V_{allowable,ASD}$, the full allowable load in tension $T_{allowable,ASD}$ must be permitted.

For tension loads $T \leq 0.2T_{allowable,ASD}$, the full allowable load in shear $V_{allowable,ASD}$ must be permitted.

For all other cases: $$\frac{T}{T_{allowable,ASD}} + \frac{V}{V_{allowable,ASD}} \leq 1.2 \quad \text{(Eq-3)}$$

4.3 Installation:

Installation parameters are provided in Table 1, and Figures 2, 3 and 4. The Snake+ anchor must be installed according to manufacturer's published installation instructions and this report. Anchors must be installed in holes drilled into concrete using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The drill bit size and drilled hole depth must be in accordance with Table 1. The anchors must be installed in drilled holes with a powered impact screwdriver and fitted with a Snake+ setting tool supplied by Powers Fasteners. The allowable ranges of installation parameters for the Snake+ anchors using powered impact screwdriver are given in Table 1. The anchors must be driven until the shoulder of the Snake+ setting tool comes into contact with the surface of the concrete. The minimum thread engagement of a threaded rod or bolt insert element assembly into the Snake+ anchor must be full anchor depth.

4.4 Special Inspection:

Special inspection is required in accordance with Section * 1704.13 of the IBC ~~and, as applicable, Section 1701.5.2 of the UBC~~. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, steel insert element type and dimensions, anchor spacing, edge distances, concrete thickness, anchor embedment, steel insert element depth, maximum tightening torque and adherence to the manufacturer's printed installation instructions. 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 and 1706 must be observed, where applicable.

5.0 CONDITIONS OF USE

The Powers Snake+ anchors described in this report comply with, or are suitable alternatives to what is specified in, those codes indicated in Section 1.0 of this report, subject to the following conditions:

5.1 Anchor and steel insert element sizes, dimensions, and minimum embedment depth are as set forth in this report.

5.2 The anchors and inserts must be installed in accordance with the manufacturer's published installation instructions and this report. In case of conflict, this report governs.

5.3 Anchors must be limited to use in cracked and uncracked normal weight concrete and structural sand-lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa), and cracked and uncracked normal weight or structural sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

5.4 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55.1 MPa).

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

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

5.7 Anchor spacing and edge distance, as well as minimum member thickness, must comply with Table 1 of this report.

5.8 Prior to installation, calculations justifying that the design loads comply 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.

5.9 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of screw 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.

5.10 Anchors may be installed in regions of concrete where cracking under service load conditions has occurred or where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.

5.11 Anchors may be used to resist short-term loading due to wind or seismic forces in locations designated as Seismic Design Categories A through F, subject to the conditions of this report.

5.12 Anchors are not permitted to support fire-resistance-rated construction. Where not otherwise prohibited by the code, anchors are permitted for installation in 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 Snake+ anchors must not be removed from concrete and reused.

5.14 Anchors have been evaluated for reliability against brittle failure and found to be not significantly sensitive to brittle failure such as hydrogen embrittlement.

5.15 Special inspection must be provided in accordance with Section 4.4 of this report.

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

5.17 Anchors are manufactured under an approved quality control program with inspections by CEL Consulting (AA-639).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), which incorporates requirements in ACI 355.2-04, dated February 2009, for use in cracked and uncracked concrete and quality control documentation.

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7.0 IDENTIFICATION

The Snake+ anchors are identified by their dimensional characteristics and anchor size. Packages are identified with the anchor name, type and size, the company name as set forth in Table A of this report, and the name of the quality control agency (CEL), and evaluation report number (ESR-2272).

TABLE A—PRODUCT NAMES BY COMPANY

COMPANY NAME	PRODUCT NAME
Powers Fasteners, Inc.	Wedge-Bolt+
L. H. Dottie Co.	Dottie Snake+

FIGURE 1—SNAKE+ SCREW ANCHOR AND SETTING TOOL

TABLE 1—INSTALLATION INFORMATION FOR SNAKE+ SCREW ANCHOR

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size
			$^3/_8$ inch
Nominal outside anchor diameter	d_o	in. (mm)	$^1/_2$ (12.7)
Internal thread diameter (UNC)	d	in. (mm)	0.375 (9.5)
Nominal drill bit diameter	d_{bit}	in.	$^1/_2$ ANSI
Nominal embedment depth	h_{nom}	in. (mm)	1-$^5/_8$ (41)
Effective embedment	h_{ef}	in. (mm)	1.10 (28)
Minimum hole depth	h_o	in. (mm)	2 (51)
Minimum concrete member thickness[1]	h_{min}	in. (mm)	4 (102)
Overall anchor length	ℓ_{anch}	in. (mm)	1-$^1/_4$ (32)
Minimum edge distance[1]	c_{min}	in. mm	3 (76)
Minimum spacing distance[1]	s_{min}	in. mm	3 (76)
Critical edge distance[1]	c_{ac}	in. (mm)	3 (76)
Maximum impact screwdriver power (torque)	T_{screw}	ft.-lb. (N-m)	345 (468)
Minimum diameter of hole clearance in fixture for steel insert element (following anchor installation)	d_h	in (mm)	$^7/_{16}$ (11)
Maximum tightening torque of steel insert element (threaded rod or bolt)	T_{max}	ft.-lb. (N-m)	8 (11)

[1]For installations into the soffit of concrete over steel deck floor and roof assemblies, see Figure 4. Anchors in the lower flute may be installed with a maximum 1-inch (25.4 mm) offset in either direction. In addition, anchors must have an axial spacing along the flute equal to or greater of $3h_{ef}$ or 1.5 times the flute width.

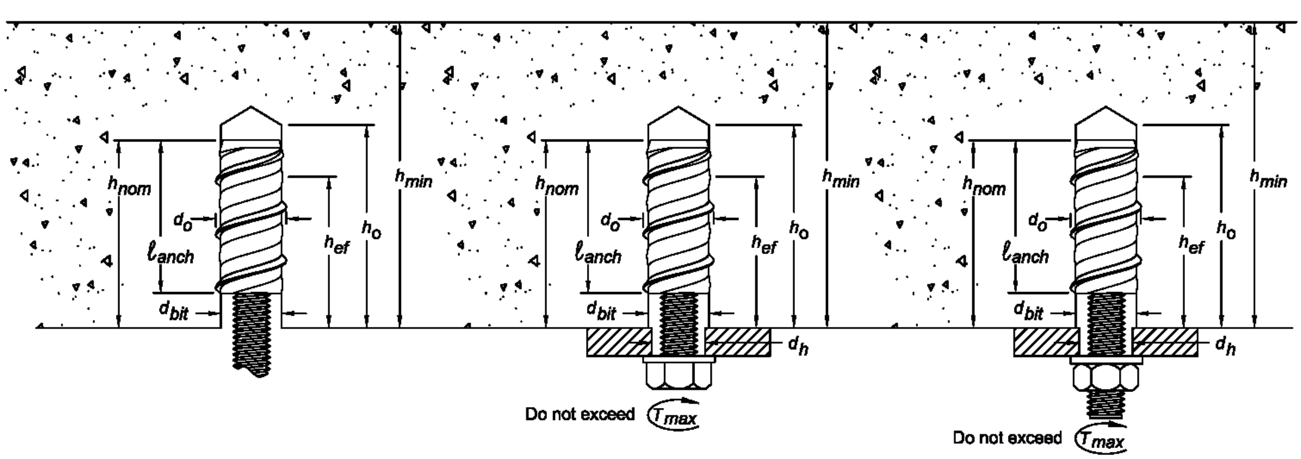
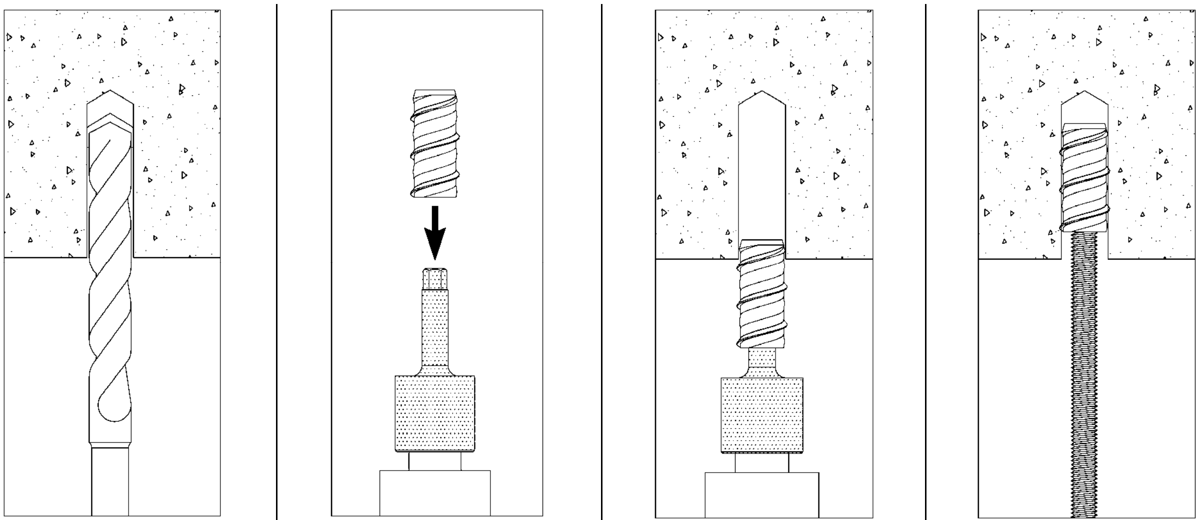


FIGURE 2—SNAKE+ SCREW ANCHOR INSTALLED WITH STEEL INSERT ELEMENT



1. *Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the carbide drill bit used should meet the requirements of ANSI Standard B212.15.*

2. *Select a powered impact wrench that does not exceed the maximum torque,* T_{screw}, *for the selected anchor diameter. Attach the Snake+ setting tool supplied by Powers Fasteners to the impact wrench. Mount the anchor onto the setting tool.*

3. *Drive the anchor into the hole until the shoulder of the Snake+ setting tool comes into contact with the surface of the base material. Do not spin the setting tool off the anchor to disengage.*

4. *Insert threaded rod or a bolt into the Snake+, taking care not to exceed the maximum specified tightening torque of the steel insert element,* T_{max}. *Minimum thread engagement must be full anchor depth.*

FIGURE 3—SNAKE+ SCREW ANCHOR INSTALLATION INSTRUCTIONS

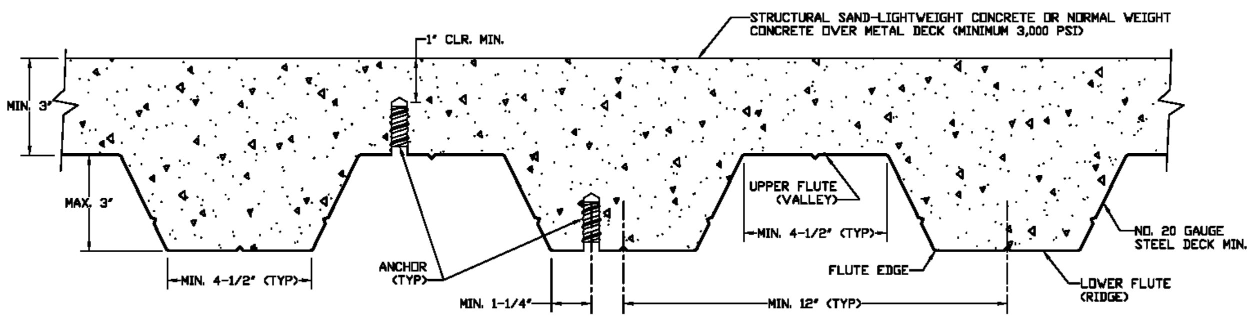


FIGURE 4—SNAKE+ SCREW ANCHOR INSTALLATION IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES

TABLE 2—TENSION DESIGN INFORMATION FOR SNAKE+ SCREW ANCHORS IN CONCRETE
(For use with load combinations taken from ACI 318 Section 9.2)[1,2]

Design Characteristic	Notation	Units	Nominal Anchor Size	
			$^{3}/_{8}$"	
Anchor category	1, 2 or 3	-	1	
Nominal embedment depth	h_{nom}	in.	1-$^{5}/_{8}$	
STEEL STRENGTH IN TENSION[4]				
Minimum specified yield strength of steel insert element (threaded rod or bolt)	f_y	ksi (N/mm^2)	SAE J429, Grade 2 or ASTM A 307, Grade C	36.0 (248)
		ksi (N/mm^2)	ASTM A193, Grade B7	105.0 (724)
Minimum specified ultimate strength of steel insert element (threaded rod or bolt)	f_{uta}[10]	ksi (N/mm^2)	SAE J429, Grade 2 or ASTM A 307, Grade C	58.0 (400)
		ksi (N/mm^2)	ASTM A193, Grade B7	125.0 (862)
Effective tensile stress area of steel insert element (threaded rod or bolt)	A_{se}	in^2 (mm^2)	0.0775 (50)	
Steel insert strength in tension	N_{sa}[10]	lb (kN)	SAE J429, Grade 2 or ASTM A 307, Grade C	4,495 (20.0)
		lb (kN)	ASTM A193, Grade B7	9,685 (43.1)
Reduction factor for steel strength[3]	ϕ	-	0.65	
CONCRETE BREAKOUT STRENGTH IN TENSION[8]				
Effective embedment	h_{ef}	in. (mm)	1.10 (28)	
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	
Effectiveness factor for cracked concrete	k_{cr}	-	17	
Modification factor for cracked and uncracked concrete	$\Psi_{c,N}$[10]	-	1.0 See note 5	
Critical edge distance	c_{ac}	in. (mm)	3 (76)	
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)	
PULLOUT STRENGTH IN TENSION (NON-SEISMIC APPLICATIONS)[8]				
Characteristic pullout strength, uncracked concrete (2,500 psi)	$N_{p,uncr}$	lb (kN)	See note 7	
Characteristic pullout strength, cracked concrete (2,500 psi)	$N_{p,cr}$	lb (kN)	See note 7	
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)	
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS[8]				
Characteristic pullout strength, seismic (2,500 psi)	N_{eq}[10]	lb (kN)	See note 7	
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)	
PULLOUT STRENGTH IN TENSION FOR STRUCTURAL SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK				
Characteristic pullout strength, uncracked concrete over steel deck[6,9]	$N_{p,deck,uncr}$	lb (kN)	1,515 (6.7)	
Characteristic pullout strength, cracked concrete over steel deck[6,9]	$N_{p,deck,cr}$	lb (kN)	1,075 (4.8)	
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)	

[1]The data in this table is intended to be used with the design provisions of ACI 318 Appendix D; for anchors resisting seismic loads the additional requirements of ACI 318 D.3.3 shall apply.
[2]Installation must comply with published instructions and details and information in this report.
[3]All values of ϕ were determined from the load combinations of ACI 318 Section 9.2 and IBC Section 1605.2 and Condition B in accordance with ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.5.
[4]It is assumed that the threaded rod or bolt used with the Snake+ screw anchor will be a ductile steel element as defined by ACI 318 D.1.
[5]For all design cases use $\Psi_{c,N}$ = 1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be selected.
[6]For concrete compressive strength greater than 3,000 psi, N_{pn} = (Pullout strength value from table)*(specified concrete compressive strength/3000)$^{0.5}$
[7]Pullout strength does not control design of indicated anchors and does not need to be calculated.
[8]Anchors are permitted to be used in structural sand-lightweight concrete provided that N_b, N_{eq} and N_{pn} are multiplied by a factor of 0.60.
[9]Values for $N_{p,deck}$ are for structural sand-lightweight concrete ($f'_{c,min}$ = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318 D.5.2 is not required for anchors installed in the flute (soffit).
* ~~[10]For 2003 IBC code basis replace f_{uta} with f_{ut} ; N_{sa} with N_s ; $\Psi_{c,N}$ with Ψ_3 and N_{eq} with $N_{p,seis}$.~~

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TABLE 3—SHEAR DESIGN INFORMATION FOR SNAKE+ SCREW ANCHORS IN CONCRETE
(For use with load combinations taken from ACI 318 Section 9.2)[1,2]

Design Characteristic	Notation	Units	Nominal Anchor Size	
			$^{3}/_{8}$"	
Anchor category	1, 2 or 3	-	1	
Nominal embedment depth	h_{nom}	in.	1-$^{5}/_{8}$	
STEEL STRENGTH IN SHEAR[4]				
Minimum specified yield strength of steel insert element (threaded rod or bolt)	f_y	ksi (N/mm^2)	SAE J429, Grade 2 or ASTM A 307, Grade C	36.0 (248)
		ksi (N/mm^2)	ASTM A193, Grade B7	105.0 (724)
Minimum specified ultimate strength of steel insert element (threaded rod or bolt)	f_{uta}[8]	ksi (N/mm^2)	SAE J429, Grade 2 or ASTM A 307, Grade C	58.0 (400)
		ksi (N/mm^2)	ASTM A193, Grade B7	125.0 (862)
Effective shear stress area of steel insert element (threaded rod or bolt)	A_{se}	in^2 (mm^2)	0.0775 (50)	
Steel insert strength in shear	V_{sa}[8]	lb (kN)	SAE J429, Grade 2 or ASTM A 307, Grade C	770 (3.4)
		lb (kN)	ASTM A193, Grade B7	1,655 (7.3)
Reduction factor for steel strength[3]	ϕ	-	0.65	
CONCRETE BREAKOUT STRENGTH IN SHEAR[5]				
Load bearing length of anchor (h_{ef} or 8d_o, whichever is less)	ℓ_e[8]	in. (mm)	1.10 (28)	
Nominal anchor diameter	d_o	in. (mm)	0.375 (9.5)	
Reduction factor for concrete breakout strength[3]	ϕ	-	0.70 (Condition B)	
CONCRETE PRYOUT STRENGTH IN SHEAR[5]				
Coefficient for pryout strength (1.0 for h_{ef} < 2.5 in., 2.0 for h_{ef} ≥ 2.5 in.)	k_{cp}	-	1.0	
Effective embedment	h_{ef}	in. (mm)	1.10 (28)	
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)	
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS				
Steel insert strength in shear, seismic	V_{eq}[8]	lb (kN)	SAE J429, Grade 2 or ASTM A 307, Grade C	770 (3.4)
		lb (kN)	ASTM A193, Grade B7	1,655 (7.4)
Reduction factor for steel strength in shear for seismic applications[3]	ϕ	-	0.65	
STEEL STRENGTH IN SHEAR FOR STRUCTURAL SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[7]				
Steel strength in shear, concrete over steel deck[6]	$V_{sa,deck}$	lb (kN)	SAE J429, Grade 2 or ASTM A 307, Grade C	770 (3.4)
		lb (kN)	ASTM A193, Grade B7	1,655 (7.4)
Reduction factor for steel strength in shear for steel deck applications[3]	ϕ	-	0.65	

[1]The data in this table is intended to be used with the design provisions of ACI 318 Appendix D; for anchors resisting seismic loads the additional requirements of ACI 318 D.3.3 shall apply.

[2]Installation must comply with published instructions and details and information in this report.

[3]All values of ϕ were determined from the load combinations of ACI 318 Section 9.2, Condition B in accordance with ACI 318 D.4.4 and IBC Section 1605.2. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.5.

[4]It is assumed that the threaded rod or bolt used with the Snake+ anchor will be a ductile steel element as defined by ACI 318 D.1.

[5]Anchors are permitted to be used in structural sand-lightweight concrete provided that N_b and N_{pn} are multiplied by a factor of 0.60.

[6]Values for $V_{sa,deck}$ are for structural sand-lightweight concrete ($f'_{c,min}$ = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318 D.6.2 and the pryout capacity in accordance with ACI 318 D.6.3 are not required for anchors installed in the flute (soffit).

[7]Shear loads for anchors installed through steel deck into concrete may be applied in any direction.

* ~~[8]For 2003 IBC code basis replace f_{uta} with f_{ut} ; V_{sa} with V_s ; and ℓ_e with ℓ and V_{eq} with $V_{sa,seis}$.~~

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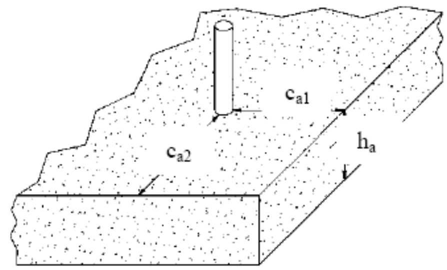
GIVEN:

1. Single 3/8-inch Snake+ anchor loaded in static tension only
2. Anchor used with ASTM A307, Grade C bolt (f_{uta} = 58,000 psi)
3. Concrete determined to remain uncracked for the life of the anchorage
4. No supplementary reinforcing present (assume Condition B)
5. f'_c = 2,500 psi (normal-weight concrete)
6. $c_{a1} = c_{a2} \geq c_{ac}$
7. $h_a \geq h_{min}$
8. Load combinations from ACI 318 Section 9.2 (no seismic loading)
9. 30% dead load and 70% live load, controlling load combination 1.2*D* + 1.6*L*



Calculate the factored resistance strength, $\boldsymbol{\phi N_n}$, and the allowable stress design value, $\boldsymbol{T_{allowable,ASD}}$, for the given conditions.

Calculation in accordance with ACI 318-05 Appendix D and this report:	Code Ref.	Report Ref.
Step 1. Calculate steel strength of a single anchor in tension:	D.5.1.2	Table 2
$\phi N_{sa} = \phi A_{se} f_{uta}$		
$\phi N_{sa} = (0.65)(0.0775)(58{,}000) = 2{,}922\ lbs.$		
Step 2. Calculate concrete breakout strength of a single anchor in tension:	D.5.2.1	Table 2
$\phi N_{cb} = \phi \frac{A_{Nc}}{A_{Nc0}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$	D.5.2.2	Table 2
$N_b = k_c \sqrt{f'_c} h_{ef}^{1.5}$		
$N_b = (24)\sqrt{2{,}500}(1.10)^{1.5} = 1{,}384\ lbs.$		
$\phi N_{cb} = (0.65)\frac{(10.89)}{(10.89)}(1.0)(1.0)(1.0)(1{,}384) = 900\ lbs.$		
Step 3. Calculate pullout strength:	D.5.3.2	Table 2
$\phi N_{pn} = \phi N_p \psi_{c,P}$		
ϕN_{pn} = n/a (pullout strength does not control, see Table 2, footnote 7)		
Step 4. Determine controlling resistance strength in tension:	D.4.1.1	
$\boldsymbol{\phi N_n} = \min\lvert \phi N_{sa}, \phi N_{cb}, \phi N_{pn} \rvert = \phi N_{cb} = 900\ lbs.$		
Step 5. Calculate allowable stress design conversion factor for loading condition:	9.2	
Controlling load combination: 1.2D + 1.6L		
α = 1.2(30%) + 1.6(70%) = 1.48		
Step 6. Calculate allowable stress design value		Sec. 4.2
$T_{allowable,ASD} = \frac{\phi N_n}{\alpha}$		
$\boldsymbol{T_{allowable,ASD}} = \frac{900}{1.48} = 608\ lbs.$		

FIGURE 5—EXAMPLE OF FACTORED RESISTANCE STRENGTH AND CONVERSION TO ALLOWABLE STRESS DESIGN VALUE FOR ILLUSTRATIVE PURPOSES

ICC-ES Evaluation Report

ESR-2272 Supplement

Issued June 1, 2009

This report is subject to re-examination on September 1, 2009.

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DIVISION: 03—CONCRETE
Section: 03151—Concrete Anchoring

REPORT HOLDER:

POWERS FASTENERS, INC.
2 POWERS LANE
BREWSTER, NY 10509
(914) 235-6300 or (800) 524-3244
www.powers.com
engineering@powers.com

ADDITIONAL LISTEE:

L.H. DOTTIE
6131 SOUTH GARFIELD AVENUE
COMMERCE, CALIFORNIA 90040
lane@lhdottie.com

* **EVALUATION SUBJECT:**

POWERS SNAKE+ ANCHORS IN CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2007 *Florida Building Code—Building*
- 2007 *Florida Building Code—Residential*

Property Evaluated:

Structural

2.0 PURPOSE OF THIS SUPPLEMENT

This supplement is issued to indicate that the Powers Snake+ Anchors in Cracked and Uncracked Concrete described in Sections 2.0 through 7.0 of the master report comply with the 2007 *Florida Building Code—Building* and the 2007 *Florida Building Code—Residential*, when designed and installed in accordance with the master evaluation report.

Use of the Powers Snake+ Anchors in Cracked and Uncracked Concrete as described in the master evaluation report for compliance with the High-Velocity Hurricane Zone provisions of the 2007 *Florida Building Code—Building* has not been evaluated, and is outside the scope of this supplement.

For products falling under Florida Rule 9B-72, 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 master report issued September 1, 2008.

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