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ESR-2272

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Reissued 12/2017
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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:

DEWALT

**701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286**

EVALUATION SUBJECT:

**SNAKE+™ ANCHORS IN CRACKED AND UNCRACKED CONCRETE
(DEWALT / POWERS)**



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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:

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EVALUATION SUBJECT:

SNAKE+™ ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

1.0 EVALUATION SCOPE

Compliance with the following codes:

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

Properties evaluated:

- Structural

2.0 USES

The Snake+ anchor is used as anchorage to resist static, wind and seismic tension and shear loads in cracked and uncracked normal-weight concrete and 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 $\frac{3}{8}$ -inch-diameter (9.5 mm) anchors may be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c , of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The $\frac{3}{8}$ -inch- and $\frac{1}{2}$ -inch-diameter (9.5 mm and 12.7 mm) anchors may be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c , of 3,000 psi (20.7 MPa).

The Snake+ anchors are an alternative to anchors described in Section 1901.3 of 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 Snake+ Anchors:

Snake+ anchors are one-piece, internally threaded screw anchors which receive threaded steel inserts such as threaded rods and bolts in $\frac{3}{8}$ -inch and $\frac{1}{2}$ -inch diameters.

Product names for the report holder and the additional listee are presented in the following table.

COMPANY NAME	PRODUCT NAME
DEWALT	Snake+
Powers Fasteners	Snake+

Available nominal sizes are $\frac{3}{8}$ -inch and $\frac{1}{2}$ -inch. The anchors are manufactured from carbon steel, which are case hardened and have a minimum 0.0002-inch (5 μ m) zinc plating in accordance with ASTM B633. The Snake+ anchor is illustrated in Figure 1.

The anchors are installed in predrilled holes with a powered impact wrench. The threads on the anchor body tap into the sides of the predrilled hole and interlock with the base material during installation.

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 the minimum specifications as given in Table 2 of this report, or an equivalent.

3.3 Concrete:

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

3.4 Steel Deck Panels:

Steel deck panels must comply with the configuration in Figure 4 and 5 and have a minimum base-metal thickness of 0.035 inch (0.89 mm) [No. 20 gage]. Steel must comply with ASTM A653/A653M SS Grade 36, and have a minimum yield strength of 36 ksi (248 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

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

Design strength of anchors complying with the 2012 IBC, as well as 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, as well as Section R301.1.3 of the 2009 IRC, must be determined in accordance with ACI 318-08 Appendix D and this report.

A design example according to the 2015 and 2012 IBC is given in Figure 6 of this report.

Design parameters are based on the 2015 IBC (ACI 318-14) and 2012 IBC (ACI 318-11) unless noted otherwise in Sections 4.1.1 through 4.1.12 of this report.

The strength design of anchors must comply with ACI 318-14 17.3.1 or ACI 318-11 D.4.1, as applicable, except as required in ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Strength reduction factors, ϕ , as given in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, and noted in Tables 2 and 3, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC, Section 5.3 of ACI 318-14, or Section 9.2 of ACI 318-11, as applicable. Strength reduction factors, ϕ , described in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with Appendix C of ACI 318-11. Strength reduction factors, ϕ , corresponding to brittle steel elements must be used.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa} : The nominal static steel strength of a single anchor in tension, N_{sa} , calculated in accordance with ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, is given in Table 2 of this report.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension N_{cb} or N_{cbg} : The nominal concrete breakout strength of a single anchor or a group of anchors in tension, N_{cb} or N_{cbg} , respectively, must be calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with modifications as described in this section. The basic concrete breakout strength of a single anchor in tension, N_b , must be calculated in accordance with ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of h_{ef} and k_{cr} as given in Table 2 of this report. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, must be calculated with the value of k_{uncr} as given in Table 2 and with $\psi_{c,N} = 1.0$.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figure 5, calculation of the concrete breakout strength in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, is not required.

4.1.4 Requirements for Static Pullout Strength in Tension, N_{pn} : The nominal pullout strength of a single anchor in cracked and uncracked concrete, $N_{p,cr}$ and $N_{p,uncr}$, respectively, in accordance with ACI 318-14 17.4.3 or ACI 318-11 D.5.3, as applicable, is provided in Table 2.

The nominal pullout strength in tension of the anchors installed in the soffit of sand-lightweight or normal-weight

concrete filled steel deck floor and roof assemblies, as shown in Figure 5, is provided in Table 2. In accordance with ACI 318-14 17.4.3.2 or ACI 318-11 D.5.3.2, as applicable, the nominal pullout strength in cracked concrete must be calculated according to Eq-1:

$$N_{p,f'_c} = N_{p,deck,cr} \sqrt{\frac{f'_c}{3,000}} \quad (\text{lb, psi}) \quad (\text{Eq-1})$$

$$N_{p,f'_c} = N_{p,deck,cr} \sqrt{\frac{f'_c}{20.7}} \quad (\text{N, MPa})$$

where f'_c is the specified concrete compressive strength.

In regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.3.6 or ACI 318-11 D.5.3.6, as applicable, the nominal pullout strength in tension can be adjusted by calculation according to Eq-2:

$$N_{p,f'_c} = N_{p,deck,uncr} \sqrt{\frac{f'_c}{3,000}} \quad (\text{lb, psi}) \quad (\text{Eq-2})$$

$$N_{p,f'_c} = N_{p,deck,uncr} \sqrt{\frac{f'_c}{20.7}} \quad (\text{N, MPa})$$

where f'_c is the specified concrete compressive strength.

4.1.5 Requirements for Static Steel Shear Capacity, V_{sa} : The nominal steel strength in shear, V_{sa} , of a single anchor in accordance with ACI 318-14 17.5.1.2 ACI 318-11 D.6.1.2, as applicable, is given in Table 3 of this report and must be used in lieu of the values derived by calculation from ACI 318-14 Eq. 17.5.1.2b, ACI 318-11 or Eq. D-29, as applicable.

The shear strength, $V_{sa,deck}$, of anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figure 5, is given in Table 3.

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 318-14 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 318-14 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 3 of this report.

For anchors installed in the topside of concrete-filled steel deck assemblies, as shown in Figure 4, 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 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, using the actual member thickness, $h_{min,deck}$, in the determination of A_{vc} . Minimum member topping thickness for anchors in the topside of concrete-filled steel deck assemblies is given Table 1 of this report.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figure 5, calculation of the concrete breakout strength in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2 is not required.

4.1.7 Requirements for Static Concrete Pryout Strength 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 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, 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 sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 5, calculation of the concrete pryout strength in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, is not required.

4.1.8 Requirements for Seismic Design:

4.1.8.1 General: For load combinations including seismic loads, the design must be performed in accordance with ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Modifications to ACI 318-14 17.2.3 shall be applied under Section 1905.1.8 of the 2015 IBC. For the 2012 IBC, Section 1905.1.9 shall be omitted. Modifications to ACI 318-08 D.3.3 shall be applied under Section 1908.1.9 of the 2009 IBC.

The nominal steel strength and nominal concrete breakout strength for anchors in tension, and the nominal concrete breakout strength and pryout strength for anchors in shear, must be calculated according to ACI 318-14 17.4 and 17.5 or ACI 318-11 D.5 and D.6, respectively, as applicable, taking into account the corresponding values given in Tables 2 and 3 of this report.

The anchors comply with ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, as brittle steel elements and must be designed in accordance with ACI 318-14 17.2.3.4, 17.2.3.5, 17.2.3.6 or 17.2.3.7; ACI 318-11 D.3.3.4, D.3.3.5, D.3.3.6 or D.3.3.7; ACI 318-08 D.3.3.5 or D.3.3.6; or ACI 318-05 D.3.3.5, as applicable. Strength reduction factors, ϕ , are given in Table 2 and Table 3.

The $3/8$ -inch and $1/2$ -inch anchors may be installed in regions designated as IBC Seismic Design Categories A through F.

4.1.8.2 Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated according to ACI 318-14 17.4.1 and 17.4.2 or ACI 318-11 D.5.1 and D.5.2, respectively, as applicable, as described in Sections 4.1.3 and 4.1.4 of this report. In accordance with ACI 318-14 17.4.3.2 or ACI 318-11 D.5.3.2, as applicable, the appropriate value for pullout strength in tension for seismic loads, $N_{p,eq}$ or $N_{p,deck,eq}$, described in Table 2 of this report, must be used in lieu of N_p . $N_{p,eq}$ or $N_{p,deck,eq}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report.

Where values for $N_{p,eq}$ are not provided in Table 2, the pullout strength in tension for seismic loads need not be evaluated.

4.1.8.3 Seismic Shear: The nominal concrete breakout strength and pryout strength for anchors in shear must be calculated according to ACI 318-14 17.5.2 and 17.5.3 or ACI 318-11 D.6.2 and D.6.3, respectively, as applicable, as described in Sections 4.1.6 and 4.1.7 of this report. In accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, the appropriate value for nominal steel strength in shear for seismic loads, $V_{sa,eq}$ or $V_{sa,deck,eq}$, described in Table 3 of this report, must be used in lieu of V_{sa} .

4.1.9 Requirements for the Interaction of Tensile and Shear Forces: Anchors or groups of anchors that are subject to the effects of combined axial (tensile) and shear forces must be designed in accordance with ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.10 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 318-14 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-3:

$$\psi_{cp,N} = \frac{c}{c_{ac}} \quad (\text{Eq-3})$$

whereby the factor $\psi_{cp,N}$ need not be taken less than $\frac{1.5h_{ef}}{c_{ac}}$.

For all other cases, $\psi_{cp,N} = 1.0$. In lieu of using ACI 318-14 17.7.6 or ACI 318-11 D.8.6, values of c_{ac} provided in Table 2 of this report must be used.

4.1.11 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: In lieu of 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 Table 1 of this report. In lieu of ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, the minimum member thicknesses, h_{min} , as given in Table 1 must be used.

For anchors installed in the topside of concrete-filled steel deck assemblies, the anchors must be installed in accordance with Table 1 and Figure 4.

For anchors installed through the soffit of steel deck assemblies, the anchors must be installed in accordance with Figure 5 and must have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

4.1.12 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 318-14 (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.

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

4.2 Allowable Stress Design (ASD):

4.2.1 General: Where design values for use with allowable stress design load combinations in accordance with Section 1605.3 of the IBC are required, these are calculated using Eq-4 and Eq-5 as follow:

$$T_{allowable,ASD} = \phi N_n / \alpha \quad (\text{Eq-4})$$

$$V_{allowable,ASD} = \phi V_n / \alpha \quad (\text{Eq-5})$$

where:

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

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

$$\phi N_n = \text{Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9, as applicable (lbf or kN).}$$

$$\phi V_n = \text{Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 and IBC 2015 Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9, as applicable (lbf or kN).}$$

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.

The requirements for member thickness, edge distance and anchor spacing, described in this report, must apply. An example of allowable stress design tension values for illustrative purposes is shown in Table 4.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318-14 17.6 or ACI 318 (-11, -08) D.7, as applicable, as follows:

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

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

For all other cases: $\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2$ (Eq-6)

4.3 Installation:

Installation parameters are provided in Table 1, and Figures 2, 3, 4, and 5. 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 DEWALT / 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.

For installation in the topside of concrete-filled steel deck assemblies, installation must comply with Figure 4.

For installation in the soffit of concrete-filled steel deck assemblies, the hole in the steel deck may not be more than $\frac{1}{8}$ inch (3.2 mm) larger than the diameter of the hole in the concrete. Member thickness and edge distance restrictions for installations in the soffit of concrete-filled steel deck assemblies must comply with Figure 5.

4.4 Special Inspection:

Special inspection is required in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 IBC and 2012 IBC, or Section 1704.15 and Table 1704.4 of the 2009 IBC. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, drill bit size, anchor spacing, edge distances, concrete thickness, anchor embedment 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."

5.0 CONDITIONS OF USE

The Snake+ anchors described in this report 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 The anchors must be installed in accordance with the manufacturer's published installation instructions and this report. In case of conflict, this report governs.
- 5.2 Anchor sizes, dimensions and minimum embedment depths are as set forth in this report.
- 5.3 Anchors must be installed in cracked and uncracked normal-weight concrete and 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 sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c , of 3,000 psi (20.7 MPa).
- 5.4 The $\frac{3}{8}$ -inch (9.5 mm) anchors may be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength f'_c , of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).
- 5.5 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55.1 MPa); for redundant fastening (nonstructural) the values of f'_c used for calculation purposes must equal 2,500 psi (17.2 MPa).
- 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 Redundant fastening design values must be established in accordance with Section 4.3 of this report.
- 5.9 Anchor spacing and edge distance, as well as minimum member thickness, must comply with Table 1 and Figures 4 and 5 of this report.
- 5.10 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. 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.
- 5.11 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.
- 5.12 Anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.
- 5.13 The $\frac{3}{8}$ -inch- and $\frac{1}{2}$ -inch-diameter anchors may be used to resist short-term loading due to wind or seismic forces (Seismic Design Categories A through F under the IBC), subject to the conditions of this report.
- 5.14 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.

- 5.15 Snake+ anchors must not be removed from concrete and reused.
- 5.16 Anchors have been evaluated for reliability against brittle failure and found to be not significantly sensitive to stress-induced hydrogen embrittlement.
- 5.17 Special inspection must be provided in accordance with Section 4.5 of this report.
- 5.18 Use of anchors is limited to dry, interior locations.
- 5.19 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, which incorporates requirements in ACI 355.2-07 / ACI 355.2-04, for use in cracked and uncracked concrete; including optional suitability tests 12 and 13 (AC193, Table 4.2) for seismic tension and shear; and quality control documentation.

7.0 IDENTIFICATION

The Snake+ anchors are identified in the field by their dimensional characteristics and packaging. Packages are identified with the anchor name, part number, type, size, the company name as set forth in Section 3.1 of this report, and the evaluation report number (ESR-2272).

TABLE 1—SNAKE+ ANCHOR INSTALLATION SPECIFICATIONS¹

Anchor Property / Setting Information	Symbol	Units	Nominal Anchor Size / Threaded Coupler Diameter (inch)	
			³ / ₈	¹ / ₂
Nominal outside anchor diameter	d_a	in.	0.500	0.750
Internal thread diameter (UNC)	d	in.	0.375	0.500
Minimum diameter of hole clearance in fixture for steel insert element (following anchor installation)	d_h	in.	⁷ / ₁₆	⁹ / ₁₆
Nominal drill bit diameter	d_{bit}	in.	¹ / ₂ ANSI	³ / ₄ ANSI
Minimum nominal embedment depth ²	h_{nom}	in.	⁵ / ₈	² ³ / ₁₆
Effective embedment	h_{ef}	in.	1.10	1.54
Minimum hole depth	h_{hole}	in.	2	² ¹ / ₂
Overall anchor length	l_{anch}	in.	¹ ¹ / ₄	¹ ¹¹ / ₁₆
Maximum impact screwdriver power (torque)	T_{screw}	ft.-lb.	345	345
Maximum tightening torque of steel insert element (threaded rod or bolt)	T_{max}	ft.-lb.	8	36
Anchors Installed in Concrete Construction²				
Minimum member thickness ²	h_{min}	in.	4	4
Critical edge distance ²	c_{ac}	in.	3	4
Minimum edge distance ²	c_{min}	in.	3	4
Minimum spacing distance ²	s_{min}	in.	3	4
Anchors installed in the Topside of Concrete-filled Steel Deck Assemblies⁵				
Minimum member topping thickness	$h_{min,deck}$	in.	³ ¹ / ₄	Not applicable
Critical edge distance	$c_{ac,deck,top}$	in.	3	Not applicable
Minimum edge distance	$c_{min,deck,top}$	in.	3	Not applicable
Minimum spacing distance	$s_{min,deck,top}$	in.	3	Not applicable

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

¹The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.

²For installations through the soffit of steel deck into concrete, see Figure 5. Anchors in the lower flute may be installed with a maximum 1-inch offset in either direction from center of the flute. In addition, anchors shall have an axial spacing along the flute a minimum 1.5 times the flute width.

³For ³/₈-inch diameter anchors installed in the topside of concrete-filled steel deck assemblies, see Figure 4 of this report.



FIGURE 1—SNAKE+ SCREW ANCHOR AND SETTING TOOL

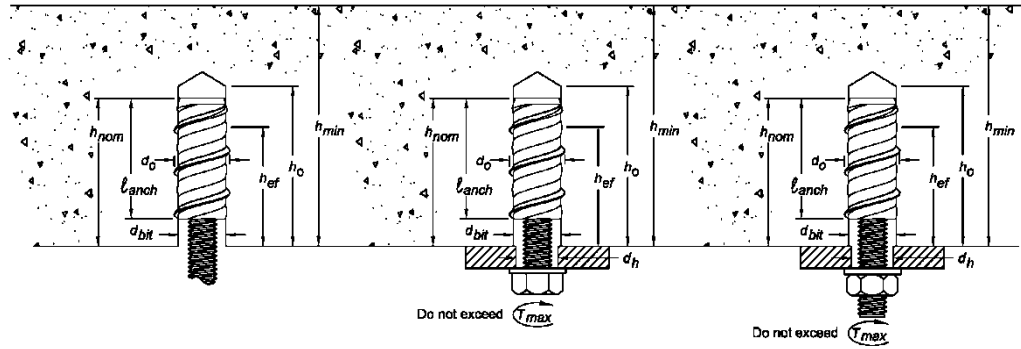
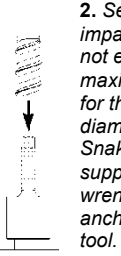


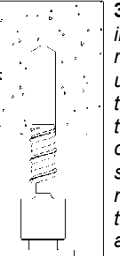
FIGURE 2—SNAKE+ SCREW ANCHOR INSTALLED WITH STEEL INSERT ELEMENT



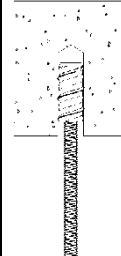
1. Using the proper drill bit size, drill a hole into the base material to the required depth (e.g. dust extractor, hollow bit). The tolerances of the carbide drill bit used should meet the requirements of ANSI Standard B212.15.



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 the impact wrench. Mount the anchor onto the setting tool.

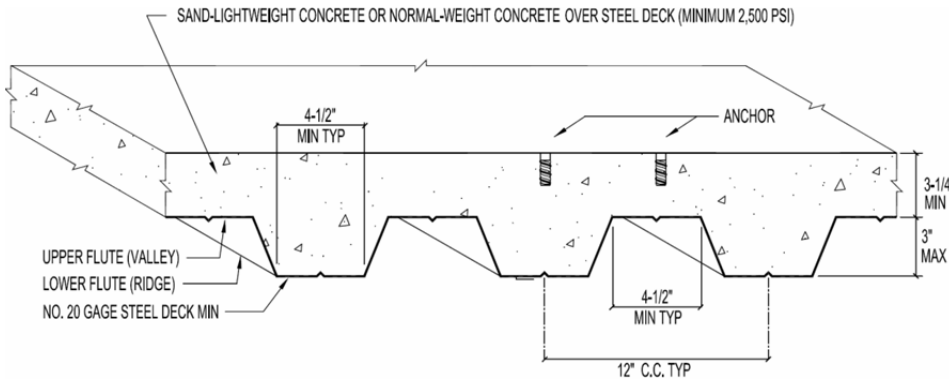


3. Drive the anchor into the hole to the required embedment until the shoulder of the Snake+ setting tool comes into contact with the surface of the base material. Do not spin the setting tool off the anchor to disengage.



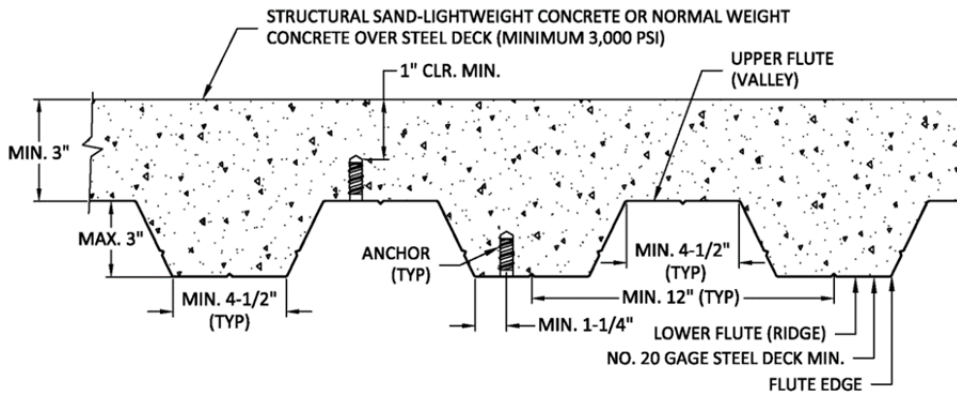
4. Insert threaded rod or a bolt into the Snake+, taking care not to exceed the maximum specified tightening torque of the steel insert element, T_{max} . Minimum thread engagement must be full anchor depth.

FIGURE 3—SNAKE+ SCREW ANCHOR INSTALLATION INSTRUCTIONS



¹ 3/8-inch diameter anchors may be placed in the topside of floor or roof steel deck profiles provided the minimum topping thickness, minimum spacing distance and minimum edge distance are satisfied as given in Table 1 of this report.

FIGURE 4—SNAKE+ INSTALLATION DETAIL FOR ANCHORS IN THE TOPSIDE OF CONCRETE-FILLED STEEL DECK ASSEMBLIES¹



¹ Anchors may be placed in the upper or lower flute of floor or roof steel deck profiles provided the minimum hole clearance is satisfied. Anchors in the lower flute may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

FIGURE 5—SNAKE+ INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK ASSEMBLIES¹

TABLE 2—TENSION DESIGN INFORMATION FOR SNAKE+ ANCHORS IN CONCRETE
(For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)^{1,2}

Design Characteristic	Notation	Units	Nominal Anchor Size / Threaded Coupler Diameter (in.)			
			³ / ₈ inch		¹ / ₂ inch	
Anchor category	1, 2 or 3	-	1		1	
Nominal embedment depth	h_{nom}	in.	1 ⁵ / ₈		2 ³ / ₁₆	
STEEL STRENGTH IN TENSION⁴						
Minimum specified yield strength of steel insert element (threaded rod or bolt)	f_y	ksi	ASTM A36 36.0	ASTM A193, Gr. B7 105.0	ASTM A36 36.0	
Minimum specified ultimate strength of steel insert element (threaded rod or bolt)	f_{uta}	ksi	ASTM A36 58.0	ASTM A193, Gr. B7 125.0	ASTM A36 58.0	
Effective tensile stress area of steel insert element (threaded rod or bolt)	$A_{se,N}$	in ²	0.0318		0.1419	
Steel strength in tension	N_{sa}	lbf	ASTM A36 4,495	ASTM A193, Gr. B7 9,685	ASTM A36 8,230	
Reduction factor for steel strength ³	ϕ	-	0.65			
CONCRETE BREAKOUT STRENGTH IN TENSION⁸						
Effective embedment	h_{ef}	in.	1.10		1.54	
Effectiveness factor for uncracked concrete	k_{uncr}	-	24		30	
Effectiveness factor for cracked concrete	k_{cr}	-	17		24	
Modification factor for cracked and uncracked concrete ⁵	$\psi_{c,N}$	-	1.0 (see note 5)		1.0 (see note 5)	
Critical edge distance (uncracked concrete only)	c_{ac}	in.	3		4	
Reduction factor for concrete breakout strength ³	ϕ	-	0.65 (Condition B)			
PULLOUT STRENGTH IN TENSION⁸						
Characteristic pullout strength, uncracked concrete (2,500 psi)	$N_{p,uncr}$	lbf	See note 7		See note 7	
Characteristic pullout strength, cracked concrete (2,500 psi)	$N_{p,cr}$	lbf	See note 7		1,665	
Reduction factor for pullout strength ³	ϕ	-	0.65 (Condition B)			
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS⁸						
Characteristic pullout strength, seismic (2,500 psi)	$N_{p,eq}$	lbf	See note 7		1,665	
Reduction factor for pullout strength, seismic ³	ϕ	-	0.65 (Condition B)			
PULLOUT STRENGTH IN TENSION FOR SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL WEIGHT CONCRETE OVER STEEL DECK						
Characteristic pullout strength, uncracked concrete over steel deck ^{6,9}	$N_{p,deck,uncr}$	lbf	1,515		1,625	
Characteristic pullout strength, cracked concrete over steel deck ^{6,9}	$N_{p,deck,cr}$	lbf	1,075		1,300	
Characteristic pullout strength, concrete over steel deck, seismic ^{6,9}	$N_{p,deck,eq}$	lbf	1,075		1,300	
Reduction factor for pullout strength, concrete over steel deck ³	ϕ	-	0.65 (Condition B)			
Mean axial stiffness values service load range ¹⁰	Uncracked concrete	β	10 ³ lbf/in.	2800		545
	Cracked concrete	β	10 ³ lbf/in.	900		160

For SI: 1 inch = 25.4 mm, 1 ksi = 6.894 N/mm²; 1 lbf = 0.0044 kN.

¹The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, must apply.

²Installation must comply with published instructions and details.

³All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2. If the load combinations ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor.

⁴It is assumed that the threaded rod or bolt used with the Snake+ anchor is a ductile steel element with minimum specified properties as listed in the table or an equivalent steel element. The Snake+ anchor is considered a brittle steel element in tension as defined by ACI 318-14 2.3 or ACI 318-11D.1, as applicable. Tabulated values for steel strength in tension must be used for design.

⁵For all design cases use $\psi_{c,N} = 1.0$. The appropriate effectiveness factor for cracked concrete (k_{cr}) and uncracked concrete (k_{uncr}) must be used.

⁶For all design cases use $\psi_{c,p} = 1.0$. For calculation of N_{pn} , see Section 4.1.4 of this report.

⁷Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.

⁸Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.

⁹Values for $N_{p,deck}$ are for 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 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, is not required for anchors installed in the deck soffit (flute).

¹⁰Mean values shown actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

TABLE 3—SHEAR DESIGN INFORMATION FOR SNAKE+ ANCHORS IN CONCRETE
(For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)^{1,2}

Design Characteristic	Notation	Units	Nominal Anchor Size / Threaded Coupler Diameter (in.)		
			³ / ₈ inch	¹ / ₂ inch	
Anchor category	1, 2 or 3	-	1		1
Nominal embedment depth	h_{nom}	in.	1 ⁵ / ₈		2 ³ / ₁₆
STEEL STRENGTH IN SHEAR⁴					
Steel strength in shear ⁵	V_{sa}	lbf	ASTM A36 770	ASTM A193, Gr. B7 1,655	ASTM A36 1,995
Reduction factor for steel strength ³	ϕ	-	0.60		
CONCRETE BREAKOUT IN SHEAR⁶					
Load bearing length of anchor	ℓ_e	in.	1.10		1.54
Nominal outside anchor diameter	d_a	in.	0.500		0.750
Reduction factor for concrete breakout strength ³	ϕ	-	0.70 (Condition B)		
PRYOUT STRENGTH IN SHEAR⁶					
Coefficient for pryout strength	k_{cp}	-	1.0		1.0
Effective embedment	h_{ef}	in.	1.10		1.54
Reduction factor for pryout strength ³	ϕ	-	0.70 (Condition B)		
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS					
Steel strength in shear, seismic ⁷	$V_{sa,eq}$	lbf	ASTM A36 770	ASTM A193, Gr. B7 1,655	ASTM A36 1,995
Reduction factor for steel strength in shear, seismic ³	ϕ	-	0.60		
STEEL STRENGTH IN SHEAR FOR SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL WEIGHT CONCRETE OVER STEEL DECK⁹					
Steel strength in shear, concrete over steel deck ⁸	$V_{sa,deck}$	lbf	ASTM A36 770	ASTM A193, Gr. B7 1,655	ASTM A36 1,995
Steel strength in shear, concrete over steel deck, seismic ⁸	$V_{sa,deck,eq}$	lbf	ASTM A36 770	ASTM A193, Gr. B7 1,655	ASTM A36 1,995
Reduction factor for steel strength in shear, concrete over steel deck ³	ϕ	-	0.60		

For SI: 1 inch = 25.4 mm, 1 lbf = 0.0044 kN.

¹The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3 shall apply.

²Installation must comply with published instructions and details.

³All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor.

⁴It is assumed that the threaded rod or bolt used with the Snake+ anchor will be a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.

⁵Tabulated values for steel strength in shear must be used for design. These tabulated values are lower than calculated results using equation 17.5.1.2b in ACI 318-14, D-29 in ACI 318-11, and ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable.

⁶Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.

⁷Tabulated values for steel strength in shear are for seismic applications and based on test results in accordance with ACI 355.2 Section 9.6.

⁸Tabulated values for $V_{sa,deck}$ are for 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 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3 are not required for anchors installed in the deck soffit (flute).

⁹Shear loads for anchors installed through steel deck into concrete may be applied in any direction.

TABLE 4—EXAMPLE ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES^{1,2,3,4,5,6,7,8,9}

Nominal Anchor Size (inches)	Steel Insert Element (ASTM) ¹⁰	Nominal Embedment Depth (inches)	Effective Embedment (inches)	Allowable Tension Load (pounds)
³ / ₈	A36	1 ⁵ / ₈	1.10	610
	A193, Gr. B7	1 ⁵ / ₈	1.10	610
¹ / ₂	A 36	2 ³ / ₁₆	1.54	1,260

For SI: 1 inch = 25.4 mm, 1 lbf = 0.0044 kN.

¹Single anchor with static tension load only.

²Concrete determined to remain uncracked for the life of the anchorage.

³Load combinations are taken from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable (no seismic loading).

⁴Assumes 30% dead load and 70% live load, controlling load combination 1.2D + 1.6L.

⁵Calculation of weighted average for conversion factor $\alpha = 1.2(0.3) + 1.6(0.7) = 1.48$.

⁶ $f'_c = 2,500$ psi (normal weight concrete).

⁷ $c_{a1} = c_{a2} \geq c_{ac}$.

⁸ $h \geq h_{min}$.

⁹Values are for Condition B where supplementary reinforcement in accordance with ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, is not provided.

¹⁰The threaded rod or bolt used with the Snake+ anchor must have the minimum specified properties as listed in Table 2 or an equivalent steel element.

ICC-ES Evaluation Report

ESR-2272 FBC Supplement

Reissued December 2017

This report is subject to renewal on December 2018.

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Section: 03 16 00—Concrete Anchors

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Section 05 05 19—Post-Installed Concrete Anchors

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EVALUATION SUBJECT:

SNAKE+™ ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Powers Snake+ Anchors in Cracked and Uncracked Concrete, recognized in ICC-ES master evaluation report [ESR-2272](#), have also been evaluated for compliance with the codes noted below.

Compliance with the following codes:

- 2017 Florida Building Code—Building
- 2017 Florida Building Code—Residential

2.0 PURPOSE OF THIS SUPPLEMENT

The Powers Snake+ Anchors in Cracked and Uncracked Concrete described in Sections 2.0 through 7.0 of the master evaluation report ESR-2272 comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2015 *International Building Code*® (IBC) provisions noted in 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 *Florida Building Code—Building* and the *Florida Building Code—Residential*, has not been evaluated, and is outside the scope of this supplement.

For products falling under Florida Rule 9N-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 master report, reissued December 2017.