ICC-ES Evaluation Report

ESR-3068

Reissued July 1, 2011

This report is subject to renewal in two years.

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

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EVALUATION SUBJECT:

POWERS TAPPER+™ SCREW ANCHOR IN UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2009 *International Building Code*® (2009 IBC)
- 2009 *International Residential Code*® (2009 IRC)
- 2006 *International Building Code*® (2006 IBC)
- 2006 *International Residential Code*® (2006 IRC)
- 2003 *International Building Code*® (2003 IBC)
- 2003 *International Residential Code*® (2003 IRC)
- 1997 *Uniform Building Code*™ (UBC)

Property evaluated:

Structural

2.0 USES

The Powers Tapper+™ screw anchors are used to resist static and wind tension and shear loads in uncracked normal-weight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The anchoring system is an alternative to cast-in-place anchors described in Sections 1911 and 1912 of the 2009 and 2006 IBC, Sections 1912 and 1913 of the 2003 IBC, and Sections 1923.1 and 1923.2 of the UBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the 2009, 2006 and 2003 IRC.

3.0 DESCRIPTION

3.1 Tapper+ Anchors:

Tapper+ screw anchors are comprised of a one-piece threaded anchor body with either a hex head, slotted hex head, phillips flat head or trim flat head.

Product names for the report holder and the additional listees are presented in Table A of this report. Available nominal sizes are $^3/_{16}$ inch and $^1/_4$ inch (4.8 and 6.4 mm). The anchors are manufactured from low-carbon steel that is case hardened and have a Perma-Seal® coating available in various colors. The Powers Tapper+™ screw anchor is illustrated in Figure 2 of this report.

The anchor body is formed with alternating high-low threads and a gimlet point tip. The anchors are installed in a predrilled hole with a powered tool during which the threads on the anchor body tap into the sides of the predrilled hole and interlock with the base material during installation.

3.2 Concrete:

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

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General:

The design strength of anchors under the 2009 and 2003 IBC, as well as Section 301.1.3 of the 2009 and 2003 IRC and the UBC, must be determined in accordance with ACI 318-08 Appendix D and this report.

The design strength of anchors under the 2006 IBC and 2006 IRC must be determined in accordance with ACI 318-05 Appendix D and this report.

A design example according to ACI 318 is given in Figure 4 of this report.

Design parameters are based on the 2009 IBC (ACI 318-08) unless noted otherwise in Sections 4.1.1 through 4.1.11 of this report.

The strength design of anchors must comply with ACI 318 D.4.1, except as required in ACI 318 D.3.3.

Design parameters are provided in Table 3 and Table 4 of this report. Strength reduction factors, ϕ, as given in ACI 318 D.4.4 must be used for load combinations calculated in accordance with Section 1605.2.1 of the IBC, Section 9.2 of ACI 318 or Section 1612.2 of the UBC. Strength reduction factors, ϕ, as given in ACI 318 D.4.5 must be used for load combinations calculated in accordance with ACI 318 Appendix C or Section 1909.2 of the UBC.

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, D.5.1.2, is given in Table 3 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 D.5.2, with modifications as described in this section. The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated according to ACI 318 D.5.2.2, using the values of h_{ef} and k_{uncr} as given in Table 3 of this report, in lieu of h_{ef} and k_c, respectively. The value of f'_c is limited to 8,000 psi (55.2 MPa), maximum, in accordance with ACI 318 Section D.3.5. The value of $\psi_{c,N}$ = 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 D.5.3.1 and D.5.3.2 in uncracked concrete, $N_{p,uncr}$, is given in Table 3 of this report. In lieu of ACI 318 D.5.3.6, $\psi_{c,P}$ = 1.0 for all design cases. The nominal pullout strength can be adjusted by calculation according to Eq-1:

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

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

where f'_c is the specified concrete compressive strength and whereby the exponent n = 0.3 for $^3/_{16}$-inch-diameter (4.8 mm) anchors and n = 0.4 for $^1/_4$-inch-diameter (6.4 mm) anchors.

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 D.6.1.2 is given in Table 4 of this report and must be used in lieu of the values derived by calculation from ACI 318, Eq. D-20.

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 D.6.2, 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 D.6.2.2 using the value of ℓ_e and d_a (d_o) given in Table 4 of this report.

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 D.6.3, 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 4.1.2 of this report.

4.1.8 Requirements for Interaction of Tensile and Shear Forces: For loadings that include combined tension and shear, the design must be performed in accordance with ACI 318 Section D.7.

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 D.5.2, must be further multiplied by the factor $\psi_{cp,N}$ given by Eq-2:

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

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 D.8.6, values of c_{ac} provided in Table 3 of this report must be used.

4.1.10 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} must comply with Table 1 of this report. In lieu of ACI 318 D.8.5, minimum member thicknesses, h_{min}, must comply with in Table 1 of this report.

4.1.11 Structural Sand-lightweight Concrete: For ACI 318-08, when anchors are used in structural sand-lightweight concrete, the modification factor λ for concrete breakout strength must be taken as 0.6. In addition, the pullout strength, $N_{p,uncr}$ must be multiplied by 0.6, as applicable.

For ACI 318-05, the values N_b, $N_{p,uncr}$, and V_b must be multiplied by 0.60, in lieu of ACI 318 D.3.4.

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 or Section 1612.3 of the UBC, must be established using the following equations:

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

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

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 either 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16, as applicable (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 either 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16, 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 5 of this report.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated, as follows:

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

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

For all other cases: $\frac{T}{T_{allowable,ASD}} + \frac{V}{V_{allowable,ASD}} \le 1.2$ (Eq-5)

4.3 Installation:

Installation parameters are provided in Table 1 and Figure 1 of this report. Anchor locations must comply with this report and plans and specifications approved by the code official. The Tapper+ must be installed according to manufacturer's published installation instructions and this report. Anchors must be installed in holes drilled using carbide-tipped masonry drill bits (Tapper+ bit) supplied by Powers Fasteners, and complying with the tolerances given in Table 1 of this report. The nominal Tapper+ bit diameter must be equal to the nominal anchor size. The minimum drilled hole depth must comply with Table 1 of this report. Dust and debris must be removed from the hole using a hand pump, compressed air or a vacuum. The anchor must be driven into the predrilled hole using a Tapper 1000 installation socket tool (hex head versions) with phillips bit tip (flat head versions) and a percussion drill set to rotary only mode until the minimum nominal embedment depth is achieved.

4.4 Special Inspection:

Special inspection is required in accordance with Section 1704.13 of the IBC or 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, hole cleaning procedure, drill bit size and type, anchor spacing, edge distances, concrete member 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." 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 Tapper+™ screw anchors 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 The anchors must be installed in accordance with the manufacturer's published installation instructions and this report. In case of a 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 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).

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

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

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

5.7 Anchor spacing(s) and edge distance(s), and minimum member thickness, must comply with Table 1 of this report, unless otherwise noted.

5.8 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.

5.9 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of 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 must not 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.

5.11 The anchors may be used to resist short-term loading due to wind, and for seismic load combinations are limited to locations designated as Seismic Design Categories A and B, under the IBC, and Seismic Zones 0, 1 and 2A under the UBC, subject to the conditions of this report.

5.12 Anchors are not permitted to support fire-resistance-rated construction. Where not otherwise prohibited by code, anchors are permitted for installation in fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- 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 resist wind or seismic forces only.
- 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 inspection must be provided in accordance with Section 4.4.

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

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated February 2010, which incorporates requirements in ACI 355.2-07 / ACI 355.2-04, for use in uncracked concrete.

6.2 Quality control documentation.

7.0 IDENTIFICATION

The Tapper+ anchors are identified in the field by dimensional characteristics and packaging. A length letter code is stamped on each anchor head along with a plus sign "+". Packages are identified with the anchor name; part number; type; anchor size and length; quantity; the company name as set forth in Table A of this report; the name of the inspection agency (CEL, AA-639); and the evaluation report number (ICC-ES ESR-3068).

TABLE A—PRODUCT NAMES BY COMPANY

COMPANY NAME	PRODUCT NAME
Powers Fasteners	Tapper+
All Points Screw, Bolt & Specialty	AP Tapper+
Grabber Construction Products	Grabcon+
L. H. Dottie	Dottie Tapper+
Peco Fasteners	Peco Tapper+
The Hillman Group	Hillman Tapper+

TABLE B—MEAN AXIAL STIFFNESS VALUES, β, FOR POWERS TAPPER+™ SCREW ANCHOR IN NORMAL-WEIGHT CONCRETE[1]

Concrete State	Units	Nominal Anchor Size	
		$^3/_{16}$ inch	$^1/_4$ inch
Uncracked concrete	10^3 lbf/in. (kN/mm)	50.9 (8.9)	84.6 (14.8)

[1]Mean values shown; actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

TABLE 1—POWERS TAPPER+™ SCREW ANCHOR INSTALLATION SPECIFICATIONS[1]

Anchor Property / Setting Information	Symbol	Units	Nominal Anchor Size (inch)	
			$^3/_{16}$	$^1/_4$
Nominal outside anchor diameter	d_a (d_o)[3]	in. (mm)	0.145 (3.7)	0.185 (4.7)
Nominal drill bit diameter	d_{bit}	in.	$^3/_{16}$ Tapper+ bit	$^1/_4$ Tapper+ bit
Tapper+ bit tolerance range	-	in.	0.170 to 0.176	0.202 to 0.207
Nominal embedment depth	h_{nom}	in. (mm)	$1^3/_4$ (44)	$1^3/_4$ (44)
Effective embedment	h_{ef}	in. (mm)	1.23 (32.2)	1.23 (32.2)
Minimum member thickness	h_{min}	in. (mm)	$3^1/_4$ (83)	$3^1/_4$ (83)
Critical edge distance	c_{ac}	in. (mm)	3 (76)	3 (76)
Minimum edge distance	c_{min}	in. (mm)	$1^3/_4$ (44)	$1^3/_4$ (44)
Minimum spacing distance	s_{min}	in. (mm)	1 (25)	2 (51)
Minimum hole depth[4]	h_o	in. (mm)	h_{nom} + $^1/_4$ (6.4)	h_{nom} + $^1/_4$ (6.4)
Minimum overall anchor length[2]	ℓ_{anch}	in. (mm)	$2^1/_4$ (57)	$2^1/_4$ (57)
Hex head wrench / socket size	d_h	in.	$^1/_4$	$^5/_{16}$
Hex head height	-	in.	$^7/_{64}$	$^9/_{64}$
Phillips flat head bit tip size	-	No.	2	3

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

[1]The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D. See Figure 1 for location of dimensions.
[2]The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and consideration of a fixture attachment. See the anchor detail (Figure 1) for hex head Tapper+; the overall anchor length for the flat head versions of the Tapper+ are measured from the top of the head to the tip of the anchor.
[3]The notation in parenthesis is for the 2006 IBC.
[4]The actual minimum hole depth can be calculated as $h_o = \ell_{anch} - t + {}^1/_4$ inch.

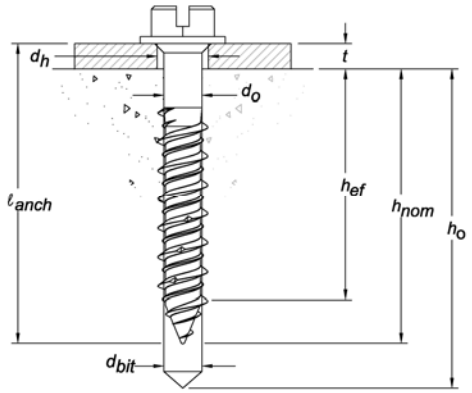


FIGURE 1—TAPPER+ ANCHOR DETAIL
(slotted hex head version pictured)

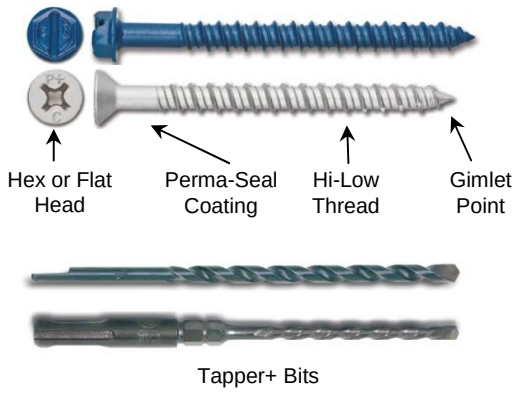
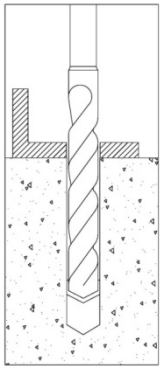


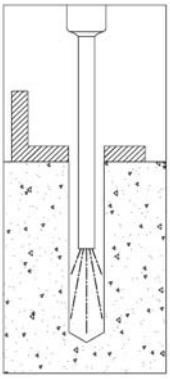
FIGURE 2—TAPPER+ ANCHOR AND TAPPER+ BITS
(slotted hex head and flat head versions pictured)

TABLE 2—TAPPER+ LENGTH CODE IDENTIFICATION SYSTEM

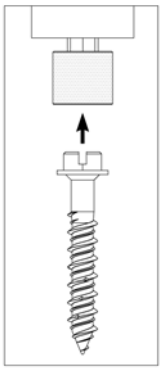
Length ID marking on head		☐	A	B	C	D	E	F	G	H	I	J
Overall anchor length, ℓ_{anch}, (inches)	From	1	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5	$5^1/_2$	6
	Up to but not including	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5	$5^1/_2$	6	$6^1/_2$



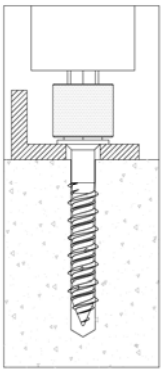
1.) Using the proper Tapper+ drill bit size, drill a hole into the base material to the required depth. The tolerances of the Tapper+ bit used must meet the requirements of the published range in Table 1.



2.) Remove dust and debris from hole using a hand pump, compressed air or a vacuum to remove loose particles left from drilling.



3.) Attach a Tapper 1000 installation socket tool for the selected anchor size to a percussion drill and set the drill to rotary only mode. Mount the screw anchor head into the socket. For flat head versions a phillips bit tip must be used with the socket tool.



4.) Place the point of the Tapper+ anchor through the fixture into the predrilled hole and drive the anchor until it is fully seated at the proper embedment. The socket tool will automatically disengage from the head of the Tapper+.

FIGURE 3—TAPPER+ INSTALLATION INSTRUCTIONS

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

Design Characteristic	Notation	Units	Nominal Anchor Size (inch)	
			$^3/_{16}$	$^1/_4$
Anchor category	1, 2 or 3	-	1	1
Nominal embedment depth	h_{nom}	in. (mm)	$1^3/_4$ (44)	$1^3/_4$ (44)
STEEL STRENGTH IN TENSION[4]				
Minimum specified ultimate strength	f_{uta}[8]	ksi (N/mm^2)	100.0 (689)	100.0 (689)
Effective tensile stress area	$A_{se,N}$ [A_{se}][9]	in^2 (mm^2)	0.0162 (10.5)	0.0268 (17.3)
Steel strength in tension	N_{sa}[8]	lbf (kN)	1,620 (7.2)	2,680 (11.9)
Reduction factor for steel strength[3]	ϕ	-	0.65	
CONCRETE BREAKOUT IN TENSION[7]				
Effective embedment	h_{ef}	in. (mm)	1.23 (31)	1.23 (31)
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24
Modification factor for concrete[5]	$\Psi_{c,N}$	-	1.0 See note 5	1.0 See note 5
Critical edge distance	c_{ac}	in. (mm)	3 (76)	3 (76)
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)	
PULLOUT STRENGTH IN TENSION[7]				
Characteristic pullout strength, uncracked concrete (2,500 psi)[6]	$N_{p,uncr}$	lbf (kN)	635 (2.8)	940 (4.2)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)	

For **SI:** 1 inch = 25.4 mm, 1 ksi = 6.895 N/mm^2, 1 lbf = 0.0044 kN.

[1]The data in this table is intended to be used with the design provisions of ACI 318 Appendix D.
[2]Installation must comply with published instructions and details.
[3]All values of ϕ were determined from the load combinations of UBC Section 1605.2.1, UBC Section 1612.2.1, or ACI 318 Section 9.2. If the load combinations of UBC Section 1902.2 or ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.5. For reinforcement that meets ACI 318 Appendix D requirements for Condition A, see ACI 318 D.4.4 for the appropriate ϕ factor.
[4]The Tapper+ anchor is considered a brittle steel element as defined by ACI 318 D.1. Tabulated values for steel strength in tension must be used for design.
[5]For all design cases use $\Psi_{c,N}$ = 1.0. The effectiveness factor for uncracked concrete (k_{uncr}) must be used.
[6]For all design cases use $\psi_{c,P}$ = 1.0. The value of N_{puncr}, may be increased in accordance with Section 4.1.4 of this report.
[7]Anchors are permitted to be used in structural sand-lightweight concrete in accordance with Section 4.1.10 of this report.
[8]For the 2003 IBC, f_{uta} replaces f_{ut}; N_{sa} replaces N_s; and $\Psi_{c,N}$ replaces Ψ_3.
[9]The notation in brackets is for the 2006 IBC.

TABLE 4—SHEAR DESIGN INFORMATION FOR POWERS TAPPER+™ ANCHORS IN CONCRETE (For use with load combinations taken from ACI 318, Section 9.2)[1,2]

Design Characteristic	Notation	Units	Nominal Anchor Size (inch)	
			$^3/_{16}$	$^1/_4$
Anchor category	1, 2 or 3	-	1	1
Nominal embedment depth	h_{nom}	in. (mm)	$1^3/_4$ (44)	$1^3/_4$ (44)
STEEL STRENGTH IN SHEAR[4]				
Steel strength in shear[5]	V_{sa}[7]	lbf (kN)	810 (3.6)	1,180 (5.3)
Reduction factor for steel strength[3]	ϕ	-	0.60	
CONCRETE BREAKOUT IN SHEAR[6]				
Load bearing length of anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e[7]	in. (mm)	1.23 (32)	1.23 (32)
Nominal outside anchor diameter	d_a (d_o)[8]	in. (mm)	0.145 (3.7)	0.185 (4.7)
Reduction factor for concrete breakout strength[3]	ϕ	-	0.70 (Condition B)	
PRYOUT STRENGTH IN SHEAR[6]				
Coefficient for pryout strength (1.0 for h_{ef} < 2.5 in, 2.0 for h_{ef} ≥ 2.5 in)	k_{cp}	-	1.0	1.0
Effective embedment	h_{ef}	in. (mm)	1.23 (32)	1.23 (32)
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)	

For **SI:** 1 inch = 25.4 mm, 1 lbf = 0. 0044 kN.

[1]The data in this table is intended to be used with the design provisions of ACI 318 Appendix D.
[2]Installation must comply with Section 4.3 of this report.
[3]All values of ϕ were determined from the load combinations of UBC Section 1605.2.1, UBC Section 1612.2.1, or ACI 318 Section 9.2. If the load combinations of UBC Section 1902.2 or ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.5. For reinforcement that meets ACI 318 Appendix D requirements for Condition A, see ACI 318 D.4.4 for the appropriate ϕ factor.
[4]The Tapper+ anchor is considered a brittle steel element as defined by ACI 318 D.1.
[5]Tabulated values for steel strength in shear must be used for design.
[6]Anchors are permitted to be used in structural sand-lightweight concrete in accordance with Section 4.1.10 of this report.
[7]For 2003 IBC, V_{sa} replaces V_s; and ℓ_e replaces ℓ.
[8]The notation in parenthesis is for the 2006 IBC.

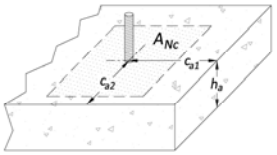
TABLE 5—EXAMPLE ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7,8,9]

Anchor Diameter (inch)	Nominal Embedment Depth (inches)	Effective Embedment (inches)	Allowable Tension Load (pounds)
$^3/_{16}$	$1^3/_4$	1.23	280
$^1/_4$	$1^3/_4$	1.23	410

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

[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 Section 9.2 (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 where supplementary reinforcement in accordance with ACI 318 D.4.4 is not provided.

Given: Calculate the factored resistance strength, $\boldsymbol{\phi N_n}$, and the allowable stress design value, $T_{allowable,ASD}$, for a $^1/_4$-inch-diameter Tapper+ anchor assuming the given conditions in Table 5.



Calculation in accordance with ACI 318-08 (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	§4.1.2
$\boldsymbol{\phi N_{sa}} = (0.65)(2{,}680) = 1{,}742\ lbs.$		Table 3
Step 2. Calculate concrete breakout strength of a single anchor in tension:	D.5.2.1	§4.1.3
$\phi N_{cb} = \phi \frac{A_{Nc}}{A_{Nc0}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$		
$N_b = k_c \lambda \sqrt{f'_c} (h_{ef})^{1.5}$	D.5.2.2	Table 3
$N_b = (24)(1.0)\sqrt{2{,}500}(1.23)^{1.5} = 1{,}637\ lbs.$		
$\boldsymbol{\phi N_{cb}} = (0.65)\frac{(13.6)}{(13.6)}(1.0)(1.0)(1.0)(1{,}637) = 1{,}064\ lbs.$		
Step 3. Calculate pullout strength:	D.5.3.2	§4.1.4
$\phi N_{pn} = \phi N_{p,uncr} \psi_{c,P} \left(\frac{f'_{c,act}}{2{,}500}\right)^{0.4}$		Table 3
$\boldsymbol{\phi N_{pn}} = (0.65)(940)(1.0)(1.0) = 611\ lbs.$		
Step 4. Determine controlling resistance strength in tension:	D.4.1.1	
$\boldsymbol{\phi N_n} = \min\lvert\phi N_{sa}, \phi N_{cb}, \phi N_{pn}\rvert = \phi N_{pn} = 611\ lbs.$		
Step 5. Calculate allowable stress design conversion factor for loading condition:	9.2	§4.2
Controlling load combination: 1.2*D* + 1.6*L*		
$\boldsymbol{\alpha}$ = 1.2(30%) + 1.6(70%) = 1.48		
Step 6. Calculate allowable stress design value:		
$\boldsymbol{T_{allowable,ASD}} = \frac{\boldsymbol{\phi N_n}}{\boldsymbol{\alpha}} = \frac{\mathbf{611}}{\mathbf{1.48}} = \mathbf{413\ lbs}.$		

FIGURE 4—EXAMPLE STRENGTH DESIGN CALCULATION INCLUDING ASD CONVERSION FOR ILLUSTRATIVE PURPOSES

ICC-ES Evaluation Report

ESR-3068 Supplement

Reissued July 1, 2011
This report is subject to renewal in two years.

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EVALUATION SUBJECT:

POWERS TAPPER+™ SCREW ANCHOR IN 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 USES

This supplement is issued to indicate that the Powers Tapper+™ Screw Anchor in uncracked concrete as described in the master report complies 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.

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 on July 1, 2011.