ICC-ES Evaluation Report

ESR-2202

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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:

ITW BUILDEX

ADDITIONAL LISTEE:

ITW RESIDENTIAL & RENOVATION

EVALUATION SUBJECT:

ITW BUILDEX TAPCON® SCREW ANCHORS FOR USE IN UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

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

Property evaluated:

Structural

2.0 USES

The $^{3}/_{16}$-inch- and $^{1}/_{4}$-inch-diameter (4.8 mm and 6.4 mm) Tapcon® Screw Anchors with Advanced Threadform Technology are used as anchorage to resist static and wind, tension and shear loads in uncracked normal-weight and lightweight concrete having a specified compressive strength f'_c = 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The anchoring system is an alternative to anchors described in Section 1901.3 of the 2018 and 2015 IBC, Sections 1908 and 1909 of the 2012 IBC; and Sections 1911 and 1912 of the 2009 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 Tapcon® Screw Anchors with Advanced Threadform Technology:

The Tapcon® Screw Anchors with Advanced Threadform Technology are manufactured from carbon steel with supplementary heat treatment. The anchors have an alternating high-low thread form on the shank and are available in a variety of lengths with nominal diameters of $^{3}/_{16}$ inch and $^{1}/_{4}$ inch (4.8 mm and 6.4 mm). The Tapcon® Screw Anchors are available with a slotted hex washer head, slotted hex washer head with under head ribs, and Phillips flat head, and have a blue Climaseal® coating. Illustrations of anchors are provided in Figure 1.

3.2 Concrete:

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

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

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

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

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

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

The strength design must comply with ACI 318-14 17.3.1 or ACI 318-11 D.4.1, 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 Section 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 and Section 5.3 of ACI 318-14 or Section 9.2 of ACI 318-11, as applicable. Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations set forth in ACI 318-11 Appendix C.

The value of f'_c used in the calculations must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable. An example calculation in accordance with the 2018, 2015 and 2012 IBC is provided in Figure 4.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal static steel strength of a single anchor in tension is calculated in accordance with ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable. The N_{sa} values of a single anchor are given in Table 2 of this report. Strength reduction factors, ϕ, corresponding to brittle steel elements as defined in ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, and provided in Table 2, must be used.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal static concrete breakout strength for a single anchor or 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 nominal concrete breakout strength in tension in regions of concrete where analysis indicates no cracking at service loads in accordance with ACi 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, must be calculated using the values of k_{uncr} as given in Table 2 of this report with $\psi_{c,N}$ = 1.0.

4.1.4 Requirements for Static Pullout Strength in Tension, N_p: The nominal pullout strength of a single anchor in tension in accordance with ACI 318-14 17.4.3.1 and 17.4.3.2 or ACI 318-11 D.5.3.1 and D.5.3.2, as applicable, in uncracked concrete, $N_{p,uncr}$, is given in Table 2 of this report. For all design cases $\psi_{c,P}$ = 1.0.

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 may be adjusted for concrete strengths according to Eq-1:

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

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

where f'_c is the specified compressive strength and n is the factor defining the influence of concrete strength on the pullout strength. For all diameters, n is 0.5.

4.1.5 Requirements for Static Steel Strength in Shear, V_{sa}: The nominal steel strength in shear, V_{sa}, of a single anchor in accordance with ACI 318-14 17.5.1.2 or 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 or ACI 318-11 Eq. D-29, as applicable. The strength reduction factor, ϕ, corresponding to brittle steel elements as defined in ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, and provided in Table 3, must be used.

4.1.6 Requirements for Static Concrete Breakout Strength of Anchor in Shear, V_{cp} or V_{cpg}: The nominal static concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, 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, based on the values provided in Table 3. The value of l_e used in ACI 318-14 Eq. 17.5.2.2a or ACI 318-11 Eq. D-33, as applicable, must be taken as no greater than the lesser of h_{ef} or $8d_a$.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear, V_{cp} or V_{cpg}: The nominal static concrete pryout strength of a single anchor or group of anchors in shear, V_{cp} or V_{cpg}, must be calculated in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, using the value of k_{cp} described in Table 3, and the values of N_{cb} or N_{cbg} as calculated in Section 4.1.3 of this report.

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

4.1.9 Requirements for Critical Edge Distance, c_{ac}: In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, must be further multiplied by the factor $\psi_{cp,N}$ given by Eq-2:

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

whereby the factor $\Psi_{cp,N}$ need not be taken as less than $\frac{1.5h_{ef}}{c_{ac}}$. For all other cases, $\Psi_{cp,N} = 1.0$. In lieu of ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, the values for the critical edge distance, c_{ac}, must be taken from Table 1.

4.1.10 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} as given in Table 1 of this report must be used. In lieu of ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, minimum concrete thickness h_{min} as given in Table 1 of this report must be used.

4.1.11 Lightweight Concrete: For the use of anchors in lightweight concrete, the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n.

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

4.2 Allowable Stress Design:

4.2.1 General: Design values for use with allowable stress design (working stress design) load combinations calculated in accordance with Section 1605.3 of the IBC, must be established as follows**:**

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

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

where:

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

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

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

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 and 2018 and 2015 IBC Section 1905.1.8, ACI

318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9 and Section 4.1 of this report, as applicable (lbf or kN). For the 2012 IBC, Section 1905.1.9 shall be omitted.

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

Limits on edge distance, anchor spacing and member thickness as given in Section 4.1.10 of this report must apply. An illustrative example of allowable stress design values 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 follows:

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

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

For all other cases:

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

4.3 Installation:

Installation parameters are provided in Table 1 and Figure 3 of this report. The Tapcon® Screw Anchors must be installed in accordance with the manufacturer's published instructions and this report. In case of conflict, this report governs. Anchor locations must comply with this report and the plans and specifications approved by the code official. Holes must be predrilled in concrete with a Tapcon® carbide-tipped drill bit supplied by ITW. The hole must be drilled to the specified nominal embedment depth plus a minimum of $^1/_4$ inch (6.4 mm). Before anchor installation, dust and other debris must be removed using a vacuum or compressed air. The anchors must then be installed through the attachment into the hole, in accordance with ITW's instructions, to the specified nominal embedment depth using a hammer drill in a rotary-only mode with an ITW Buildex Condrive® Tool and drive socket.

4.4 Special Inspection:

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

5.0 CONDITIONS OF USE

The Tapcon® Screw Anchors described in this report are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

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

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

5.3 The Tapcon® Screw Anchors must be limited to use in 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).

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, edge distance, and minimum concrete thickness must comply with Section 4.1.10 and Table 1 of this report.

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

5.9 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 these conditions is beyond the scope of this report.

5.10 The Tapcon® Screw Anchors may be used to resist short-term loading due to wind forces and for seismic load combinations in locations designated as Seismic Design Categories A and B under the IBC, subject to the conditions of this report.

5.11 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 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.

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

5.13 The design of anchor groups in accordance with ACI 318-14 Chapter 17 or ACI 318 (-11, -08) Appendix D, as applicable, is valid for screw anchors with a thread length of at least 80 percent of the nominal embedment depth. Anchors with a thread length less than 80 percent of the nominal embedment depth shall be designed as single anchors.

5.14 Use of anchors must be limited to dry, interior locations.

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

5.16 Anchors are manufactured in the U.S.A. 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; and quality-control documentation.

7.0 IDENTIFICATION

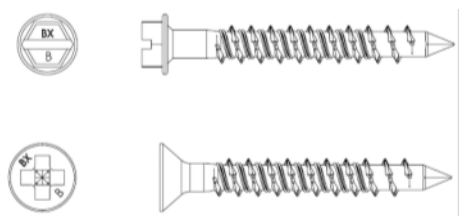
7.1 The Tapcon® Screw Anchors are identified by packaging labeled with the manufacturer's name (ITW Buildex or ITW Residential & Renovation), contact information, anchor name, anchor size, and evaluation report number (ESR-2202). The letters "BX" or "TAPCON" and a length identification code letter are stamped on the head of each anchor. See the length identification system illustrated in Figure 2 of this report.

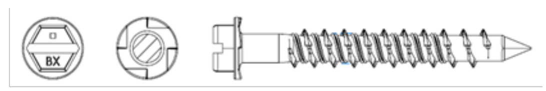
7.2 The report holder's contact information is the following:

ITW BUILDEX
155 HARLEM AVE, N4E
GLENVIEW, IL 60025
(800) 848-5611
www.itwbuildex.com
techsupport@itwcna.com

7.3 The Additional Listee's contact information is the following:

ITW RESIDENTIAL & RENOVATION
155 HARLEM AVE, N3E
GLENVIEW, IL 60025
(877) 489-2726
www.tapcon.com





(TOP) SLOTTED HEX WASHER HEAD
(BOTTOM) PHILLIPS FLAT HEAD

SLOTTED HEX WASHER HEAD WITH UNDER HEAD RIBS

FIGURE 1—TAPCON® SCREW ANCHOR WITH ADVANCED THREADFORM TECHNOLOGY

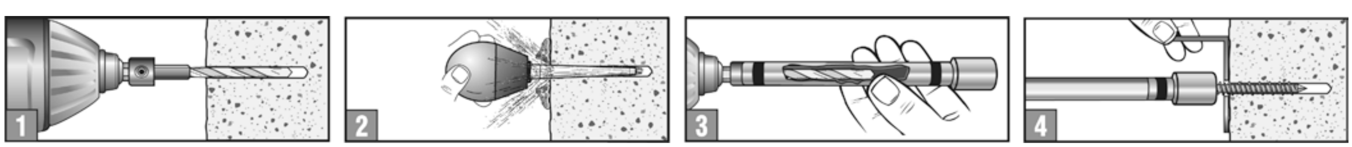
LENGTH MARKING ON ANCHOR HEAD			**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Length of anchor (inches)	From	1	$1^{1}/_{2}$	2	$2^{1}/_{2}$	3	$3^{1}/_{2}$	4	$4^{1}/_{2}$	5	$5^{1}/_{2}$	6
	Up to, but not including	$1^{1}/_{2}$	2	$2^{1}/_{2}$	3	$3^{1}/_{2}$	4	$4^{1}/_{2}$	5	$5^{1}/_{2}$	6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

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

FIGURE 2—LENGTH IDENTIFICATION SYSTEM

Buildex Tapcon® #1 CHOICE OF PROFESSIONALS

Installation Instructions for $^{3}/_{16}$" and $^{1}/_{4}$" diameter Tapcon® Screw Anchors



1) Using a Tapcon® drill bit, drill the hole $^{1}/_{4}$" deeper than anchor embedment.
2) Clean hole with compressed air or vacuum to remove any excess dust/debris.
3) Place Condrive® tool with drive socket over drill bit.
4) Using drill, hammer mode disabled, drive anchor thru fixture and into hole until nut driver spins free from head of anchor.

FIGURE 3—INSTALLATION INSTRUCTIONS FOR TAPCON® SCREW ANCHOR

TABLE 1—INSTALLATION INFORMATION FOR TAPCON® SCREW ANCHOR[1]

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER (inch)	
			$^{3}/_{16}$	$^{1}/_{4}$
Head Style	—	—	Hex Head/Flat Head	Hex Head/Flat Head
Nominal Outside diameter (shank)	d_a	in.	0.15	0.19
Nominal Outside diameter (threads)	—	in.	0.20	0.25
Drill bit specification	d_{bit}	in.	$^{5}/_{32}$ Tapcon® Bit	$^{3}/_{16}$ Tapcon® Bit
Minimum base plate clearance hole diameter	d_h	in.	$^{7}/_{32}$	$^{1}/_{4}$
Maximum installation torque	$T_{inst, max}$	ft-lbf	Not applicable[2]	Not applicable[2]
Maximum Impact Wrench Torque Rating	$T_{impact, max}$	ft-lbf	Not applicable[2]	Not applicable[2]
Minimum Effective embedment depth	h_{ef}	in.	1.50	1.50
Minimum nominal embedment depth[6]	h_{nom}	in.	2.00	2.10
Minimum hole depth	h_{hole}	in.	2.25	2.35
Minimum concrete member thickness	h_{min}	in.	4	4
Critical edge distance	c_{ac}	in.	4	4
Minimum edge distance	c_{min}	in.	2	$2^{1}/_{2}$
Minimum spacing	s_{min}	in.	3	4

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

[1]The data 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.
[2]Installation must be performed with an ITW Buildex Condrive® Tool and drive socket. See Section 4.3 for additional information.

TABLE 2—TENSION STRENGTH DESIGN INFORMATION FOR TAPCON® SCREW ANCHOR[1]

CHARACTERISTIC	SYMBOL[5]	UNITS	NOMINAL ANCHOR DIAMETER (inch)	
			$^{3}/_{16}$	$^{1}/_{4}$
Head Style	—	—	Hex Head/Flat Head	Hex Head/Flat Head
Drill bit specification		in.	$^{5}/_{32}$ Tapcon® Bit	$^{3}/_{16}$ Tapcon® Bit
Anchor category	1, 2 or 3	—	1	1
Effective embedment depth	h_{ef}	in.	1.50	1.50
Minimum concrete member thickness	h_{min}	in.	4	4
Critical edge distance	c_{ac}	in.	4	4
Data for Steel Strength in Tension				
Minimum specified yield strength	f_y	psi	100,000	100,000
Minimum specified ultimate strength	f_{uta}	psi	125,000	125,000
Effective tensile stress area	A_{se}	in^2	0.0147	0.0241
Steel strength in tension	N_{sa}	lbf	2,025	3,800
Strength reduction factor ϕ for tension, steel failure modes[2]	ϕ_{sa}	—	0.65	0.65
Data for Concrete Breakout Strength in Tension				
Effectiveness factor -uncracked concrete	k_{uncr}	—	24	24
Modification factor for cracked and uncracked concrete[3]	$\Psi_{c,N}$	—	1.0	1.0
Strength reduction factor ϕ for tension, concrete failure modes, Condition B[3]	ϕ_{cb}	—	0.65	0.65
Data for Pullout Strength in Tension				
Pullout strength, uncracked concrete	$N_{p,uncr}$	lbf	590	795
Strength reduction factor ϕ for tension, pullout failure modes, Condition B[3]	ϕ_p	—	0.65	0.65
Additional Anchor Data				
Axial stiffness in service load range in uncracked concrete	β_{uncr}	lbf /in	317,000	467,000

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

[1]The data 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.
[2]The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. 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(b).
[3]The tabulated value of ϕ_{cb} and ϕ_{cp} applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for Condition B are met. 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(c) for Condition B.

TABLE 3—SHEAR STRENGTH DESIGN INFORMATION FOR TAPCON® SCREW ANCHOR[1]

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER (inch)	
			$^{3}/_{16}$	$^{1}/_{4}$
Head Style	—	—	Hex Head/Flat Head	Hex Head/Flat Head
Drill bit specification		in.	$^{5}/_{32}$ Tapcon® Bit	$^{3}/_{16}$ Tapcon® Bit
Anchor category	1, 2 or 3	—	1	1
Effective embedment depth	h_{ef}	in.	1.50	1.50
Minimum concrete member thickness	h_{min}	in.	4	4
Critical edge distance	c_{ac}	in.	4	4
Data for Steel Strengths in Shear				
Minimum specified yield strength	f_y	psi	100,000	100,000
Minimum specified ultimate strength	f_{uta}	psi	125,000	125,000
Effective shear stress area	A_{se}	in^2	0.0147	0.0241
Steel strength in shear - static	V_{sa}	lbf	715	1,300
Strength reduction factor ϕ for shear, steel failure modes[2]	ϕ_{sa}	—	0.60	0.60
Data for Concrete Breakout and Concrete Pryout Strengths in Shear				
Nominal Outside diameter (shank)	d_a	in.	0.15	0.19
Load bearing length of anchor	ℓ_e	—	1.50	1.50
Coefficient for Pryout Strength	κ_{cp}	—	1.0	1.0
Strength reduction factor for shear, concrete breakout[3]	ϕ_{cb}	—	0.70	0.70
Strength reduction factor for shear, pryout[3]	ϕ_{cp}	—	0.70	0.70

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

[1]The data 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.
[2]The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. 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(b).
[3]The tabulated value of ϕ_{cb} and ϕ_{cp} applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for Condition B are met. 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(c) for Condition B.

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

NOMINAL ANCHOR DIAMETER (inch)	NOMINAL EMBEDMENT DEPTH (inches)	EFFECTIVE EMBEDMENT DEPTH (inches)	ALLOWABLE TENSION LOAD (pounds)
$^{3}/_{16}$	2.00	1.50	260
$^{1}/_{4}$	2.10	1.50	350

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 0.006895 MPa.

[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 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, (no seismic loading).
[4]Thirty percent dead load and 70 percent live load, controlling load combination 1.2D + 1.6L.
[5]Calculation of weighted average for α = 0.3* 1.2 + 0.7* 1.6 = 1.48.
[6]Normal weight concrete, f'_c = 2,500 psi
[7]$c_{a1} = c_{a2} > c_{ac}$.
[8]$h \geq h_{min}$.
[9]Condition B where supplementary reinforcement in accordance with ACI 318 Section D.4.4 is not provided.

Illustrative Procedure to Calculate Allowable Stress Design Tension Value:
Tapcon® Screw Anchor $^{1}/_{4}$-inch diameter, using an effective embedment (h_{ef}) of $1^{1}/_{2}$-inches, assuming the conditions given in Table 4.

PROCEDURE		CALCULATION	
Step 1	Calculate steel strength of a single anchor in tension per ACI 318-14 17.4.1.2, ACI 318-11 D 5.1.2, Table 2 of this report:	ϕN_{sa}	$= \phi N_{sa}$ =0.65*3,800 **=2,470 lbs steel strength**
Step 2	Calculate concrete breakout strength of a single anchor in tension per ACI 318-14 17.4.2.2, ACI 318-11 D.5.2.2, Table 2 of this report:	N_b ϕN_{cb}	$= k_{uncr} \sqrt{f'_c}\ h_{ef}^{1.5}$ $= 24^* \sqrt{2,500}\ ^*1.5^{1.5}$ = 2,205 lbs $=\phi\ A_{NC}/A_{NC0}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ = 0.65*1.0*1.0*1.0*1.0*2,205 = 0.65*2,205 **= 1,433 lbs concrete breakout strength**
Step 3	Calculate pullout strength per Table 2 of this report:	$\phi N_{p,uncr}$	$=\phi\ N_{p,uncr}\ \psi_{c,P}$ = 0.65 * 795 * 1.0 = **517 lbs pullout strength**
Step 4	Determine controlling resistance strength in tension per ACI 318-14 17.3.1.1 and 17.3.1.2, ACI 318-11 D 4.1.1 and D 4.1.2:		**= 517 lbs controlling resistance (pullout)**
Step 5	Calculate allowable stress design conversion factor for loading condition per ACI 318-14 Section 5.3, ACI 318-11 Section 9.2:	α	=1.2*D* + 1.6*L* =1.2(0.3) + 1.6(0.7) **=1.48**
Step 6	Calculate allowable stress design value per Section 4.2 of this report:	$T_{allowable,ASD}$	$= \phi\ N_n / \alpha$ = 517 / 1.48 **= 350 lbs allowable stress design**

FIGURE 4—EXAMPLE DESIGN CALCULATION

ICC-ES Evaluation Report

ESR-2202 FBC Supplement

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

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

REPORT HOLDER:

ITW BUILDEX

EVALUATION SUBJECT:

ITW BUILDEX TAPCON® SCREW ANCHORS FOR USE IN UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that ITW Buildex Tapcon® Screw Anchors for use in uncracked concrete, recognized in ICC-ES master evaluation report ESR-2202, 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 ITW Buildex Tapcon® Screw Anchors for use in uncracked concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-2202, comply with the *Florida Building Code—Building* and *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2015 *International Building Code®* provisions noted in the master report.

Use of the ITW Buildex Tapcon® Screw Anchors for use in uncracked concrete, for compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and *Florida Building Code—Residential*, has not been evaluated, and is outside the scope of this supplemental report.

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 evaluation report, reissued October 2019 and revised December 2019.