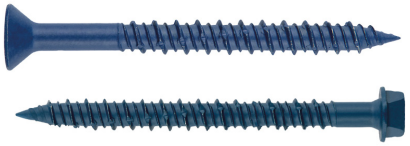
1XCS CONCRETE SCREWS

FLAT HEAD TORX DRIVE & HEX HEAD SCREWS

ICC ESR-5175

1XCS-F & 1XCS-H Concrete Screws are used as anchorages to resist static, wind and seismic (Seismic Design Categories A and B only) tension and shear loads in uncracked normal-weight and lightweight concrete.

The concrete screws are manufactured from carbon steel with supplementary heat treatment and induction. The anchors have an alternating high-low thread form on the shank.



KEY BENEFITS

- ICC-ES ESR-5175 for use in uncracked normal-weight and lightweight concrete
- Resists static, wind and earthquake loading in tension and shear - (IBC Seismic Design Categories A and B only)
- Hex Head & Flat Head Torx Drive Head Types
- Range of Diameters & Lengths
- Blue Ruspert Coating

STANDARDS & APPROVALS

- ICC-ES (Concrete) ESR-5175
- IBC 2021, 2018, 2015 & 2012
- IRC 2021, 2018, 2015 & 2012
- LABC & LARC 2020
- CBC & CRC 2019
- FBC & FRC 2020

APPLICATIONS & MATERIALS

- Window Installations
- Door Frames
- Exterior Installation Into Concrete or Masonry
- Interior Hand Rails
- Joint Flashing
- HVAC Strapping
- Wood Headers
- Electrical Equipment Shelving Brackets

ESR-5175 EVALUATION REPORT

1.0 RECOGNITION & CERTIFICATIONS

1XCS-F & 1XCS-H Concrete Screws evaluated in this report shows compliance to the following codes and regulations:

- ICC-ESR 5175
- 2021, 2018, 2015 & 2012 International Building Code® (IBC)
- 2021, 2018, 2015 & 2012 International Residential Code® (IRC)

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS) see ESR-5175 LABC and LARC Supplement.

Property evaluated: Structural

2.0 USES

The XCS-H & XCS-F concrete screws are used as anchorages to resist static, wind, and Seismic (A and B only) tension and shear loads in uncracked normal-weight 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 anchoring system is an alternative to anchors described in Section 1901.3 of the 2021, 2018 and 20215 IBC, and Sections 1908 and 1909 of the 2012 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 XCS-H & XCS-F Concrete Screws:

XCS-H and XCS-F concrete screws are manufactured from carbon steel with supplementary heat treatment and induction. The anchors have an alternating high-low thread form on the shank and have a variety of lengths with nominal diameters of 3/16 and 1/4 inch (4.8mm and 6.4mm). The XCS-H concrete screws are available in an unslotted hex washer head with underhead ribs, hex washer head with hexalobular recess with underhead ribs and the XCS-F concrete screws are available in flat head with hexalobular recess. The XCS-H and XCS-F concrete screws have an epoxy coating in various colors, illustrations of anchors are provided in Figure 1 of this report.

3.2 Concrete:

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

4.0 DESIGN & INSTALLATION

4.1 Strength Design:

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

Design strength of anchors complying with the 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, 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 parameters are based on the 2021 (ACI 318-19), 2018 and 2015 IBC (ACI318-14), and 2012 IBC (318-11) unless noted otherwise in Sections 4.1.1 through 4.1.11 of this report.

The strength design of anchors must comply with ACI 318-19 17.5.1.2, ACI 318-14 17.3.1 or ACI318-11 D4.1, as applicable, except as required in ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Strength reduction factors, Φ, as given in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, and noted in Tables 2 and 3, must be used for load combinations calculated in accordance with Section 1605.1 of the 2021 IBC or Section 1605.2.1 of the 2018, 2015 and 2012 IBC, Section 5.3 ACI 318 (-19 or -14) or Section 9.2 of ACI 318-11 D.4.4, must be used for load combinations calculated in accordance with ACI 318-11 Appendix C. The value of f'_c used in the calculations must be limited to 8,000 psi (55.2 MPa), maximum, in accordance with ACI 318-19 17.3, ACI 318-14 17.2.7 or ACI 318-11 Section D.3.7, as applicable. An example calculation in accordance with the 2021 IBC is provided in Table 4.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The normal static steel strength of a single anchor in tension, N_{sa}, calculated in accordance with ACI 318-19 17.6.1.2, ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, i 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 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with modifications as described in this section. The basic concrete breakout strength of a single anchor in tension, Nb, must be calculated according to

4.0 DESIGN & INSTALLATION (CONTINUED)

ACI 318-19 17.6.2.2, 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_{uncr} as given in Table 2 of this report, in lieu of hef and kc, respectively. The value of $\Psi_{c,N}$= 1.0.

4.1.4 Requirements for Static Pullout Strength in Tension, N_{pm}: The nominal pullout strength of a single anchor in accordance with ACI 318-19 17.6.3.1 and 17.6.3.2.1, ACI 318-14 17.4.3.1 and 17.4.3.2 or ACI 318-11 D.5.3.1 and D.5.3.2, respectively, as applicable, in uncracked concrete, $N_{p,uncr}$, is given in Table 2 of this report. In lieu of ACI 318-19 17.6.3.3, ACI 318-14 17.4.3.6 or ACI 318-11 D.5.3.6, as applicable, $\Psi_{c,P}$= 1.0 for all design cases. The nominal pullout strength can be adjusted by calculation according to Eq-1:

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

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

Where f'_c is the specified concrete compressive strength and whereby the exponent *n* the normalization exponent given in Table 2.

4.1.5 Requirements for Static Steel Shear Strength, V_{sa}: The nominal steel strength in shear, Vsa, of a single anchor in accordance with ACI 318-19 17.7.1.2, ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, is given in Table 3 of this report, and must be used in lieu of the values derived by calculation from ACI 318-19 Eq. 17.7.1.2b, ACI 318-14 Eq. 17.5.1.2b or ACI 318-11 Eq. D-29, as applicable.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: The nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, with modifications as described in this section. The basic concrete breakout strength of a single anchor in shear, Vb, must be calculated in accordance with ACI 318-19 17.7.2.2.1, ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the value of ℓ_e and d_a (d_o) given in Table 3 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_{cpb}, respectively, must be calculated in accordance with ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, modified by using the value of k_{cp} provided in Table 3 and the value of N_{cb} or N_{cbg} as calculated in Section 4.1.3 of this report.

4.1.8 Requirements for Interaction of Tensile and Shear Forces: For loadings that include combined tension and shear, the design must be performed in accordance with ACI 318-19 17.8, ACI 318-14 17.6 or ACI 318-11 Section D.7, as applicable.

4.1.9 Requirements for Critical Edge Distance, C_{ac}: In applications where c <cac and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, must be further multiplied by the factor $\Psi_{cp,N}$ given by Eq-2:

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

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

For all cases where $\Psi_{cp,N}$ = 1.0. In lieu of using ACI 318-19 17.9.5, ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, values of c_{ac} provided in Table 2 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 318-19 17.9.2, ACI 318-14 17.7.1 and 17.7.3 or ACI 318-11 D.8.1 and D.8.3, respectively, as applicable, values of s_{min} and c_{min} must comply with Table 1 of this report. In lieu of ACI 318-19 17.9.4, ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, minimum member thickness, h_{min}, must comply with Table 1 of this report.

4.1.11 Lightweight Concrete: For the use of anchors in lightweight concrete, the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n. For ACI 318-19 (2021 IBC), ACI 318-14 (2018 and 2015 IBC) and ACI 318-11 (2021 IBC), λ shall be determined in accordance with the corresponding version of ACI 318.

4.0 DESIGN & INSTALLATION (CONTINUED)

4.2 Allowable Stress Design (ASD):

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

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

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

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

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 us shown in Table 5 of this report.

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

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

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

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

4.3 Installation:

Installation parameters are provided in Table 1 and Figure 3 of this report. Anchor locations must comply with this report and plans and specifications approved by the code official. The XCS-H and XCS-F must be installed according to manufacturer's published installation instructions (MPII) and this report. In case of conflict, this report governs. Hole must be predrilled in concrete with a carbide-tipped drill bit complying with ANSI B212.15-1994. The hole must be drilled to the specified nominal embedment depth plus a minimum of 1/4 inch (6.4mm). Before anchor installation, dust and other debris must be removed using a vacuum or compressed air. The anchors must be then installed through the fixture into the hole to the specified nominal embedment depth using a hammer drill in a rotary-only mode with XCS setting tool and drive socket.

4.4 Special Inspection:

Special inspection is required in accordance with Section 1705.1.1 and Table 1705.3 of the 2021, 2018, 2015 and 2012 IB, 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, hole cleaning procedure, drill bit size and type, anchor spacing, edge distances, concrete member thickness, anchor embedment, drill bit type and dimension 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 XCS-H and XCS-F concrete screws 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. 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. Anchors 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 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 calculations 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 strength must be established in accordance with section 4.2 of this report.

5.7. Anchor spacing(s) and edge distance(s), and minimum members thickness, must comply with 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. 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 limited to locations designated as Seismic Design Categories And B under the IBC, 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 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 ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated October 2017 (Editorially revised December 2020), which incorporates requirements in ACI 355/2 (-19 and -07), for use in uncracked concrete.

Quality control documentation.

7.0 IDENTIFICATION

7.1. The ICC-ES mark of conformity, electronic labeling, or the evaluation report numbers (ICC-ES ESR-5175) along with the name, registered trademark, or registered logo of the report holder must be included in the product label.

7.2. In addition, the XCS-H and XCS-F concrete screws are identified in the field by packaging labeled with the manufacturer's name, contact information, anchor name, anchor size and the evaluation report numbers (ESR-5175). The company logo 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.

7.3. The report holder's contact information is the following

Allfasteners USA, LLC.
959 Lake Road
Medina, Ohio 44256
(888) 859-6060
www.allfasteners.com

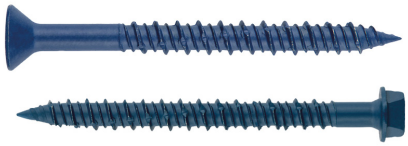
1XCS CONCRETE SCREWS

FLAT HEAD TORX DRIVE & HEX HEAD SCREWS

ICC ESR-5175

FIGURES

FIGURE 1: XCS-H AND XCS-F CONCRETE SCREWS



INSTALLATION INSTRUCTIONS

1. Using a carbide-tipped drill bit complying with ANSI B212.15-119, drill the hole 1/4 inch (6.4mm) deeper than anchor embedment.

2. Clean hole with compressed air or vacuum to remove any excess dust/debris.

3. Place XCS setting tool with drive socket over drill bit.

4. Using drill, hammer mode disabled, drive the anchor through fixture and into hole until nut driver spins free from head of anchor.

INSTALLATION PARAMETERS

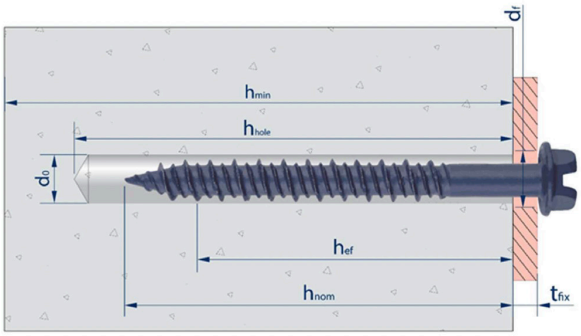


FIGURE 2: LENGTH IDENTIFICATION SYSTEM

LENGTH MARKING ON ANCHOR HEAD		B	C	D	E	F	G	H	I	J
Length of Anchor (in.)	From	2	2-1/2	3	3-1/2	4	4-1/2	5	5-1/2	6
	Up to, But Not Including	2-1/2	3	3-1/2	4	4-1/2	5	5-1/2	6	6-1/2

INSTALLATION PARAMETERS

TABLE 1: XCS-H AND XCS-F SCREW ANCHOR INSTALLATION AND SUPPLEMENTAL INFORMATION[1]

ANCHOR PROPERTY / SETTING INFORMATION	SYMBOL	UNITS	NOMINAL ANCHOR SIZE (IN)	
			3/16	1/4
Nominal Outside Anchor Diameter	d_a	in (mm)	3/16 (4.8)	1/4 (6.4)
Nominal Drill Bit Diameter	d_{bit}	in	5/32	3/16
Nominal Embedment Depth	h_{nom}	in (mm)	2.00 (51)	2.10 (53)
Effective Embedment	h_{ef}	in (mm)	1.45 (37)	1.45 (37)
Minimum Member Thickness	h_{min}	in (mm)	3-1/2 (89)	3-1/2 (89)
Minimum Edge Distance	c_{min}	in (mm)	2 (51)	2 (51)
Minimum Spacing Distance	s_{min}	in (mm)	2-1/2 (64)	2-1/2 (64)
Minimum Hole Depth[4]	h_o	in (mm)	h_{nom} + 1/4 (h_{nom} + 6.4)	h_{nom} + 1/4 (h_{nom} + 6.4)
Minimum Overall Anchor Length[2,3]	ℓ_{anch}	in (mm)	2-1/4 (57)	2-1/4 (57)
Maximum Installation Torque[6]	T_{screw} or $T_{inst,max}$	ft.-lbf	Not Applicable[6]	
Hex Head Wrench/Socket Size	d_h	in (mm)	1/4 (6.4)	5/16 (7.9)
Hex Head Height	-	in (mm)	0.14 (3.6)	0.18 (4.6)
Flat Head Bit Tip Size	-	No.	PH2 / T25	PH3 /T30
Effective Tensile Stress Area	A_{se}	in^2 (mm^2)	0.0131 (8.5)	0.0233 (15)
Minimum Specified Ultimate Strength	f_{uta}	psi (N/mm^2)	125,000 (862)	125,000 (862)
Minimum Specified Yield Strength	f_{ya}	psi (N/mm^2)	100,000 (689)	100,000 (689)
Mean Axial Stiffness, Uncracked Concrete[5]	$ß_{uncr}$	10^3 lbf/in (N/mm)	91,231 (15977)	83,502 (14448)
Maximum Baseplate Clearance Hole Diameter	d_h	in (mm)	7/32 (5.6)	9/32 (7.1)
Critical Edge Distance	c_{ac}	in (mm)	3 (76)	3 (76)
Fixture Thickness	t_{fix}	in (mm)	L - 2 (L - 52)	L - 2.1 (L - 53)
Spanner	Hexagonal	SW	1/4	5/16
	Countersunk		PH2	PH3

For SI: 1inch = 25.4mm, 1lbf - 1.356 N-m, 1psi = 0069 N/mm^2 (MPa).

[1]The information presented in this table is to be used in conjunction with the design criteria of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable/ 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 and flat head screw anchors. The overall anchor length of the hex head versions is measured from the underside of the head to the tip of the anchor; for the flat head versions the overall anchor length is measured from the top of the head to the tip of the anchor.

[3]The minimum overall anchor length for the 1/4in hex head versions can be 2-1/4in (57mm) provided the fixture amount does not exceed 0.15in (3.81mm) in thickness.

[4]The actual minimum hole depth can be calculated as $h_o = \ell_{anch} - t + 1/4in$.

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

[6]Installation must be performed with Allfasteners provided installation setting tool. See installation instructions of this report.

TECHNICAL DATA

TABLE 2: TENSION DESIGN INFORMATION FOR XCS-H AND XCS-F CONCRETE SCREW IN CONCRETE[1,2]

DESIGN CHARACTERISTIC	NOTATION	UNITS	NOMINAL ANCHOR SIZE (IN)	
			3/16	1/4
Anchor Category	1, 2 or 3	-	2	1
Nominal Embedment Depth	h_{nom}	in (mm)	2.00 (51)	2.10 (53)
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14.4.1 or ACI 318-11 D.5.1)[4]				
Minimum Specified Ultimate Tensile Strength	f_{uta}	psi^2 (N/mm^2)	125,000 (862)	125,000 (862)
Minimum Specified Yield Strength	f_y	psi^2 (N/mm^2)	100,000 (689)	100,000 (689)
Effective Tensile Stress Area	$A_{se,N}$	in^2 (mm^2)	0.0131 (8.5)	0.0233 (15.0)
Steel Strength in Tension[5]	N_{sa}	lbf (kN)	1,638 (7.28)	2,913 (12.96)
Reduction Factor for Steel Strength	ϕ	-	0.65	
CONCRETE BREAKOUT IN TENSION (ACI 318-19 17.6.2, ACI 318-14.4.2 or ACI 318-11 D.5.2)[7]				
Effective Embedment	h_{ef}	in (mm)	1.45 (37)	1.45 (37)
Effectiveness Factor for Uncracked Concrete	k_{uncr}	-	24	24
Modification Factor for Concrete[6]	$\Psi_{c,N}$	-	1.0	1.0
Critical Edge Distance	c_{ac}	in (mm)	3 (76)	3 (76)
Reduction Factor for Concrete Breakout Strength[3]	ϕ	-	0.55	0.65
Axial Stiffness in Service Load Range[7]	β_{uncr}	lb/in (kN/mm)	91,231 (15,977)	83,502 (14,623)
PULLOUT STRENGTH IN TENSION (ACI 318-19 17.6.3, ACI 318-14.4.3 or ACI 318-11 D.5.3)[8]				
Characteristic Pullout Strength, Uncracked Concrete (2,500 psi)[7]	$N_{p,uncr}$	lbf (kN)	1,695 (7.54)	2,153 (9.58)
Reduction Factor for Pullout Strength[3]	ϕ	-	0.55	0.65
Normalization Exponent	n	-	0.07	0.29

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

[1]The data in this table is intended to be used with the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable.

[2]Installation must comply with the published instructions and details.

[3]The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.

[4]The XCS-H and XCS-F anchor is considered a brittle steel element as defined by ACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1, as applicable.

[5]Tabulated values for steel strength in tension must be used for design.

[6]For all design cases use $\Psi_{c,N} = 1.0$. The effectiveness factor for uncracked concrete (k_{uncr}) must be used.

[7]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.

[8]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.11 of this report.

[9]Tabulated values for steel strength in shear must be used for design.

TECHNICAL DATA

TABLE 3: SHEAR DESIGN INFORMATION FOR XCS-H AND XCS-F CONCRETE SCREW IN CONCRETE[1,2]

DESIGN CHARACTERISTIC	NOTATION	UNITS	NOMINAL ANCHOR SIZE (IN)	
			3/16	1/4
Anchor Category	1, 2 or 3	-	2	1
Nominal Embedment Depth	h_{nom}	in (mm)	2.00 (51)	2.10 (53)
STEEL STRENGTH IN SHEAR (ACI 318-19 17.6.1, ACI 318-14.4.1 or ACI 318-11 D.5.1)[4]				
Minimum Specified Ultimate Tensile Strength	f_{uta}	psi[2] (N/mm[2])	125,000 (862)	125,000 (862)
Minimum Specified Yield Strength	f_y	psi[2] (N/mm[2])	100,000 (689)	100,000 (689)
Effective Tensile Stress Area	$A_{se,N}$	in[2] (mm[2])	0.0131 (8.5)	0.0233 (15.0)
Steel Strength in Shear[9]	V_{sa}	lbf (kN)	844 (3.8)	1,653 (7.4)
Reduction Factor for Steel Strength[3]	ϕ	-	0.60	
CONCRETE BREAKOUT IN SHEAR (ACI 318-19 17.6.2, ACI 318-14.4.2 or ACI 318-11 D.5.2)[7]				
Load Bearing Length of Anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e	in (mm)	1.45 (37)	1.45 (37)
Nominal Outside Anchor Diameter	d_a	in (mm)	3/16 (4.8)	1/4 (6.4)
Reduction Factor for Concrete Breakout Strength[3]	ϕ	-	0.70	
PULLOUT STRENGTH IN SHEAR (ACI 318-19 17.6.3, ACI 318-14.4.3 or ACI 318-11 D.5.3)[8]				
Coefficient Pryout Strength	k_{cp}	-	1.0	1.0
Effective Embedment	h_{ef}	in (mm)	1.45 (37)	1.45 (37)
Reduction Factor for Pryout Strength[3]	φ	-	0.70	

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

[1]The data in this table is intended to be used with the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable.

[2]Installation must comply with the published instructions and details.

[3]The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.

[4]The XCS-H and XCS-F anchor is considered a brittle steel element as defined by ACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1, as applicable.

[5]Tabulated values for steel strength in tension must be used for design.

[6]For all design cases use $\Psi_{c,N} = 1.0$. The effectiveness factor for uncracked concrete (k_{uncr}) must be used.

[7]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.

[8]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.11 of this report.

[9]Tabulated values for steel strength in shear must be used for design.

TECHNICAL DATA

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

ANCHOR DIAMETER (IN)	NOMINAL EMBEDMENT DEPTH (IN)	EFFECTIVE EMBEDMENT (IN)	ALLOWABLE TENSION LOAD (LBS)
3/16	2.00	1.45	666
1/4	2.10	1.45	973

For SI: 1inch = 25.4mm, 1lbf - 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 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable (no seismic loading considered).

[4]Assumes 50% dead load and 50% live load, controlling load combination 1.2 D + 1.6L.

[5]Calculation of weighted average for conversion factor a = 1.2(0.5) = 1.6(0.5) = 1.40.

[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 (supplementary reinforcement not present) where supplementary reinforcement in accordance with ACI 318-19 17.5.3(b), ACI 318-14 17.3.3 or CI 318-11 D.4.3, as applicable, is not provided.

TABLE 5: ILLUSTRATIVE PROCEDURE TO CALCULATE ALLOWABLE STRESS DESIGN TENSION VALUE XCS-H & XCS-F

Concrete screw 1/4 diameter, using effective embedment (h_{ef}) or 1.45 inches, assuming the conditions given in Table 3.

PROCEDURE		CALCULATION	
Step 1	Calculate steel strength of a single anchor in tension per ACI 318-19 17.6.1.2, Table 2 of this report.	ϕN_{sa}	$=\phi N_{sa}$ $=0.65 \times 2{,}913$ = **1,893 lbf steel strength**
Step 2	Calculate concrete breakout strength of a single anchor in tension per ACI 318-19 17.6.2, Table 2 of this report.	N_b ϕN_b	$=k_{uncr}\sqrt{f'_c}\, h_{ef}^{1.5}$ $= 24\sqrt{2500}\ 1.45^{1.5}$ =2,095 lbf $=\phi A_{Nc}/A_{Nc0}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N}N_b$ $= 0.65 \times 1.0 \times 1.0 \times 1.0 \times 1.0 \times 2{,}095$ **=1,362 lbf concrete breakout strength**
Step 3	Calculate pullout breakout strength of a single anchor in tension per ACI 318-19 16.3.1 and 17.6.3.2.1, Table 2 of this report.	$\phi N_{p,uncr}$	$=\phi N_{p,uncr}\,\Psi_{c,p}$ $=0.65 \times 2{,}153 \times 1.0$ **=1,399 lbf pullout strength**
Step 4	Determine controlling resistance strength in tension.	N_n	**=1,362 lbf controlling resistance (concrete breakout)**
Step 5	Calculate allowable stress design conversion factor for loading condition.	a	$=1.2D + 1.6L$ $=1.2\ (0.5) + 1.6\ (0.5)$ $=1.40$
Step 6	Calculate allowable stress design value per Section 4.2 of this report.	$T_{allowable,ASD}$	$=\phi N_n/a$ $=1{,}362/1.40$ **=973 lbf allowable stress design**

TECHNICAL DATA

TABLE 6: TENSION AND SHEAR DESIGN STRENGTHS IN UNCRACKED CONCRETE

ANCHOR DIA. (IN)	NOMINAL EMBEDMENT DEPTH (IN)	MINIMUM CONCRETE COMPRESSIVE STRENGTH									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_n TENSION (LBS.)	ϕV_n SHEAR (LBS.)	ϕN_n TENSION (LBS.)	ϕV_n SHEAR (LBS.)	ϕN_n TENSION (LBS.)	ϕV_n SHEAR (LBS.)	ϕN_n TENSION (LBS.)	ϕV_n SHEAR (LBS.)	ϕN_n TENSION (LBS.)	ϕV_n SHEAR (LBS.)
3/16	2.00	932	506	944	506	963	506	991	506	1,011	506
1/4	2.10	1,362	992	1,475	992	1,604	992	1,804	992	1,893	992

Key: Pullout Concrete/Pryout Steel

TABLE 7: CONVERTED ALLOWABLE LOADS IN UNCRACKED CONCRETE

ANCHOR DIA. (IN)	NOMINAL EMBEDMENT DEPTH (IN)	MINIMUM CONCRETE COMPRESSIVE STRENGTH									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_n TENSION (LBS.)	ϕV_n SHEAR (LBS.)	ϕN_n TENSION (LBS.)	ϕV_n SHEAR (LBS.)	ϕN_n TENSION (LBS.)	ϕV_n SHEAR (LBS.)	ϕN_n TENSION (LBS.)	ϕV_n SHEAR (LBS.)	ϕN_n TENSION (LBS.)	ϕV_n SHEAR (LBS.)
3/16	2.00	666	362	674	362	688	362	708	362	722	362
1/4	2.10	973	708	1,054	708	1,146	708	285	708	1,352	708

[1]Allowable load values are calculated using a conversion factor, α, from factored design strengths.

[2]Tabulated allowable load values assume 30% dead load and 70% live load, with controlling load combination 1,2D + 1,6L. Calculated weighted average for the conversion factor, $\alpha_{1.5}$ = 1,2*(0,5) + 1,6*(0,5) = 1,40.

ESR-5175 LABC AND LARC SUPPLEMENT

1.0 REPORT PURPOSE & SCOPE

The purpose of this evaluation report supplement is to indicate that XCS-H and XCS-F concrete screws, described in ICC-ES evaluation report ESR 5175, have also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS)

Applicable Code Editions:

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

2.0 CONCLUSIONS

The XCS-H and XCS-F concrete screws, described in Sections 2.0 through 7.0 of the evaluation report ESR-5175, comply with LABC Chapter 19, and the LARC, and are subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The XCS-H and XCS-F concrete screws described in this evaluation report supplement must comply with all the following conditions:

- All applicable sections in the evaluation report ESR-5175.
- The design, installation, conditions, of use and identification of the screw anchors are in accordance with the 2018 International Building Code (IBC) provisions noted in the evaluation report ESR-5175.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable strength and design strength values listed in the evaluation report and table are for the connection of the anchors to the concrete. The connection between the anchors and the connected members must be checked for capacity (which may govern).
- For all in wall anchorage assemblies to flexible diaphragm applications, anchors must be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2020-71.

This supplement expires concurrently with the evaluation report, issued December 2022 and revised January 2023.

ESR-5175 CBC AND CRC SUPPLEMENT

1.0 REPORT PURPOSE & SCOPE

The purpose of this evaluation report supplement is to indicate that XCS-H and XCS-F concrete screws for use in uncracked concrete, described in ICC-ES evaluation report ESR-5175, have also been evaluated for compliance with the codes noted below:

Applicable Code Editions:

- 2019 California Building Code (CBC)

For evaluation of applicable chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) AKA: California Department of Health Care Access and Information (HCAI) and the Division of the State Architect (DSA), see Sections 2.1.1 and 2.1.2 below.

- 2019 California Residential Code (CRC)

2.0 CONCLUSIONS

2.1 **CBC:** The XCS-H and XCS-F concrete screws for use in uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-5175, comply with CBC Chapter 19, provided the design and installation are in accordance with the 2018 International Building Code (IBC), provisions noted in the evaluation report, and the additional inspection requirements of the CBC Chapters 16 and 17.

2.1.1 **OSHPD:** The applicable OSHPD Sections and Chapters of the CBC are beyond the scope of this supplement.

2.1.2 **DSA:** The applicable DSA Sections and Chapters of the CBC are beyond the scope of this supplement.

2.2 **CRC:** The XCS-H and XCS-F concrete screws for use in uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-5175, comply with CRC Part III, Chapter 3, provided the design and installation are in accordance with the 2018 International Residential Code (IRC) provisions noted in the evaluation report and the additional requirements of CRC Part III, Chapter 3.

The supplement expires concurrently with the evaluation report, issued December 2022 and revised January 2023.

ESR-5175 FBC SUPPLEMENT

1.0 REPORT PURPOSE & SCOPE

The purpose of this evaluation report supplement is to indicate that XCS-H and XCS-f concrete screws, described in ICC-ES evaluation report ESR-5175, has also been evaluated for compliance with the codes noted below:

Compliance with the Following Codes:

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

2.0 PURPOSE OF THIS SUPPLEMENT

The XCS-H and XCS-F concrete screws, described in Sections 2.0 through 7.0 of ICC ES evaluation report ESR-5175, comply with the Florida Building Code - Building and Florida Building Code - Residential, provided the design requirements are determined in accordance with the Florida Building Code-Building or the Florida Building Code-Residential, as applicable. The installation requirements noted in ICC-ES evaluation report ESR-5175 for the 2018 International Building Code meet the requirements of the Florida Building Code-Building or the Florida Building Code-Residential, as applicable, with the following conditions.

Use of the XCS-H and XCS-F concrete screws have also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the Florida Building Code-Building and the Florida Building Code-Residential with the following condition:

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

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

This supplement expires concurrently with the evaluation report, issues December 2022 and revised January 2023.