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ESR-3251

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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:

GRK FASTENERS, A DIVISION OF ILLINOIS TOOL WORKS, INC.

1452 BREWSTER CREEK BOULEVARD
BARTLETT, ILLINOIS 60103

EVALUATION SUBJECT:

CALIBURN XL 7.5 SCREW ANCHOR IN CRACKED AND UNCRACKED CONCRETE



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Section: 03 16 00—Concrete Anchors

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EVALUATION SUBJECT:

CALIBURN XL 7.5 SCREW ANCHOR IN CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012, 2009, and 2006 *International Building Code*® (IBC)
- 2015, 2012, 2009, and 2006 *International Residential Code*® (IRC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)[†]

[†]The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

Properties evaluated:

Nonstructural

2.0 USES

The Caliburn XL 7.5 screw anchors are used to resist static, wind and seismic (Seismic Design Categories A and B under the IBC), tension and shear loads in cracked and uncracked normal-weight concrete and lightweight concrete having a specified compressive strength, f'_c , of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

The Caliburn XL 7.5 screw anchors may only be used for redundant applications, where multiple anchors support linear elements (e.g., ductwork) when designed in accordance with Section 4.0 of this report.

The anchoring system is an alternative to anchors described in Section 1901.3 of the 2015 IBC; Sections

1908 and 1909 of the 2012 IBC, Sections 1911 and 1912 of the 2009 and 2006 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 Caliburn XL 7.5 Screw Anchors:

Caliburn XL 7.5 screw anchors are manufactured from carbon steel using a cold-forming process and are heat-treated. The anchors have a proprietary finish (Climatek™ coating) for corrosion protection. The available nominal diameter is $19/64$ inch (7.5 mm). The Caliburn screw anchor is shown in Figure 2.

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 General:

For an anchoring system designed with redundancy, the load maintained by an anchor that experiences failure or excessive deflection must be transmitted to neighboring anchors without significant consequences to the fixture or the remaining resistance of the anchoring system. In addition to the requirements for anchors, the fixture being attached must be able to resist the forces acting on it assuming one of the fixing points is not carrying load. It is assumed that by adhering to and specifying the limits shown for n_1 , n_2 and n_3 illustrated in Figures 4a and 4b of this report, redundancy is satisfied, where n_1 is the total number of anchorage points supporting the linear element, n_2 is the number of anchors per anchorage point and n_3 is the factored design load, N_{ua} or V_{ua} , or a combination of both on an anchorage point based on the critical load combination from Section 1605.2 of the 2015 and 2012 IBC, Section 1605.2.1 of the 2009 and 2006 IBC, or ACI 318-14 Section 5.3 or ACI 318 (-11, -08, -05) Section 9.2, as applicable.

For redundant fastening, the Caliburn XL 7.5 screw anchors are used to resist tension and shear loads, or any combination thereof, in accordance with Section 2.0 of this report and with the following limitations:

- Applications must be limited to the support of nonstructural elements.
- Single anchor point applications are prohibited.
- Anchor design must be limited to structures assigned to IBC Seismic Design Category A or B.

- The specified concrete compressive strength f'_c used for calculation purposes must equal 2,500 psi (17.2 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

4.2 Strength Design:

For redundant applications of anchors in concrete loaded in tension and shear, the following equations must be satisfied:

$$\phi_{ra} F_{ra} \geq N_{ua} \quad (\text{Eq-1})$$

$$\phi_{ra} F_{ra} \geq V_{ua} \quad (\text{Eq-2})$$

where:

F_{ra} = the characteristic strength (resistance) for the anchors as shown in Table 3 of this report (lbf for kN).

N_{ua} = factored tensile force applied at each anchorage point (lbf for kN).

V_{ua} = factored shear force applied at each anchorage point (lbf or kN).

Corresponding strength reduction factors for redundant applications, ϕ_{ra} , are given in Table 3. F_{ra} is independent of load direction and applicable for cracked and uncracked concrete. For combined tension and shear loading of redundant applications, the following equation must be satisfied:

$$\phi_{ra} F_{ra} \geq \sqrt{(N_{ua})^2 + (V_{ua})^2} \quad (\text{Eq-3})$$

For redundant applications of anchors installed in lightweight concrete, the design strength $\phi_{ra} F_{ra}$ in Eq-1, Eq-2 and Eq-3 must be further multiplied by the modification factor λ_a equal to 0.8 λ .

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

For ACI 318-05 (2006 IBC), λ shall be taken as 0.75 for all lightweight concrete and 0.85 for sand-lightweight concrete. Linear interpolation shall be permitted if partial sand replacement is used.

4.3 Allowable Stress Design:

Design values for redundant applications of anchors for use with Allowable Stress Design must be calculated in accordance with Section 4.2 of this report and Eq-4:

$$R_{\text{allowable, ASD}} = \frac{\phi_{ra} F_{ra}}{\alpha} \quad (\text{Eq-4})$$

where $R_{\text{allowable, ASD}}$ is the allowable load (lbf or kN) for redundant applications and where α is the conversion factor calculated as a weighted average of the load factors for the controlling load combination. The conversion factor, α , is equal to 1.4 assuming dead load only.

4.4 Requirements for Minimum Member Thickness, Critical Edge Distance, Minimum Anchor Spacing and Minimum Edge Distance:

The values of c_{min} , c_{ac} , s_{min} and h_{min} must comply with Table 1 of this report.

4.5 Installation:

Installation parameters are provided in Table 1 and Figure 1. Installation instructions are provided in Figure 3. Anchor locations must comply with this report and with plans and specifications approved by the code official. The Caliburn XL 7.5 screw anchors must be installed in accordance with the manufacturer's published installation instructions and this report. Anchors must be installed in holes drilled using

carbide-tipped masonry drill bits supplied by GRK Canada Ltd., and complying with the tolerances given in Table 1. The minimum drilled hole depth is given in Table 1. Dust and debris must be removed from the hole using a hand pump, compressed air or a vacuum. The anchor must be driven with the proper driver bit until the proper nominal embedment depth is achieved. The Caliburn screw must be installed with an impact screw driver with a maximum power output of 33 lb-ft (45 Nm). Anchors may not be loosened or removed and reinstalled after installation.

4.6 Special Inspection:

Periodic special inspection is required in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 IBC or 2012 IBC, as applicable; Section 1704.15 and Table 1704.4 of the 2009 IBC; or Section 1704.13 of the 2006 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, drill bit size and type, anchor spacing, edge distances, concrete thickness, anchor embedment, and adherence to the manufacturer's printed installation instructions. The special inspector must be present as often as required in accordance with the "statement of special inspection." Under the IBC, additional requirements as set forth in Sections 1705, 1706 or 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE

The Caliburn XL 7.5 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 following conditions:

- 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.
- Anchor sizes, dimensions, and minimum embedment depths are as set forth in this report.
- Anchors must be installed in cracked or 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) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].
- The values of f'_c used for calculation purposes must equal 2,500 psi (17.2 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].
- Strength Design values must be established in accordance with Section 4.2.
- Allowable Stress Design values must be established in accordance with Section 4.3.
- Anchor spacings and edge distances, and minimum member thickness, must comply with Table 1.
- 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.
- 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.
- Anchors may be installed in regions of concrete where cracking has occurred or where analysis

indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.

5.11 The anchors are limited to structures assigned to Seismic Design Category A or B under the IBC.

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

- Anchors are used to resist wind or seismic forces only.
- Anchors that support gravity load-bearing structural elements are within a fire-resistance-rated envelope or a fire-resistance-rated membrane, are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support nonstructural elements.

5.13 For redundant applications, the ability of the fixed element to transfer loads to adjacent anchors must be justified by the design professional to the satisfaction of the code official.

5.14 Anchors have been tested in accordance with TAS 114-95 Appendix E for corrosion resistance. For all other applications, use of anchors is limited to dry, interior locations.

5.15 Anchors have been evaluated for resistance to brittle failure and found to be not significantly sensitive to stress-induced hydrogen embrittlement.

5.16 Special inspection must be provided in accordance with Section 4.6.

5.17 Anchors are manufactured under an approved quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated October 2015, for qualification of redundant fastening.

6.2 Data in accordance with TAS 114-95 Appendix E for corrosion resistance.

6.3 Quality control documentation.

7.0 IDENTIFICATION

The Caliburn XL 7.5 screw anchors are identified in the field by the designation “CLB” on the head of each screw, along with the diameter and length in millimeters. Packages are identified with the anchor name, part number, type, anchor size and length, quantity, and the evaluation report number (ESR-3251).

TABLE 1—GRK CALIBURN XL 7.5 SCREW ANCHORS INSTALLATION SPECIFICATIONS

ANCHOR PROPERTY / SETTING INFORMATION	SYMBOL	UNITS	NOMINAL ANCHOR SIZE	
			¹⁹ / ₆₄ INCH (7.5 mm)	
Nominal anchor diameter	$d_a [d_a]^1$	in. (mm)	0.295 (7.5)	
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	⁵ / ₁₆ (7.9)	
Nominal drill bit diameter	d_{bit}	mm	6	
Bit tolerance range	-	mm	6.15 to 6.40	
Maximum impact torque power rating	$T_{impact,max}$	ft-lb. (Nm)	33 (45)	
Screw length	L	in. (mm)	3.62 (92)	4.92 (125)
Minimum nominal embedment depth	h_{nom}	in. (mm)	2.76 (70)	3.35 (85)
Length of thread	l_{gew}	in. (mm)	2.83 (72)	3.43 (87)
Minimum member thickness	h_{min}	in. (mm)	4.33 (110)	5.32 (135)
Minimum edge distance	$c_{min} = c_{ac}$	in. (mm)	5.67 (144)	5.67 (144)
Minimum spacing distance	s_{min}	in. (mm)	7.56 (192)	7.56 (192)
Minimum hole depth	h_o	in. (mm)	3.35 (85)	3.94 (100)

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

¹The notation in brackets is for the 2006 IBC.

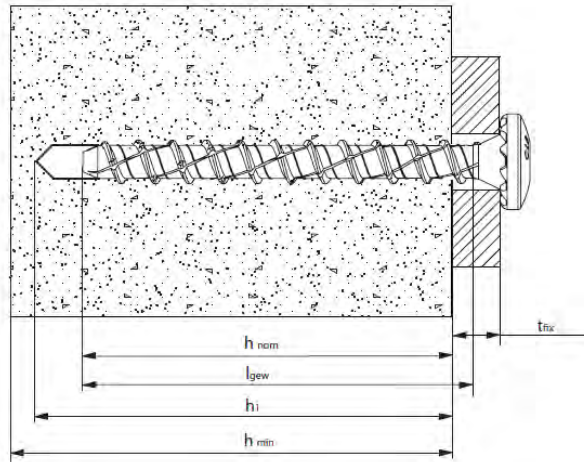


FIGURE 1—CALIBURN XL 7.5 SCREW ANCHOR DETAIL

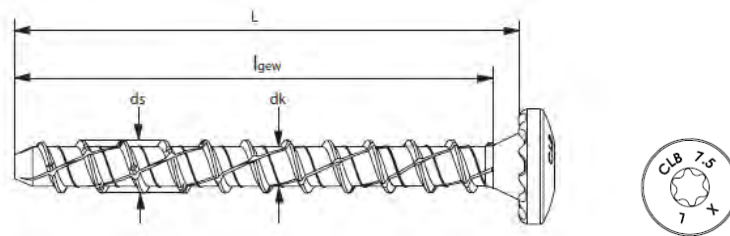


FIGURE 2—GRK CALIBURN XL 7.5 SCREW ANCHOR

TABLE 2—LENGTH IDENTIFICATION SYSTEM

TYPE	SIZE	LENGTH (L) INCHES (mm)		ds	dk
CLB	19/64	3 5/8	5	19/64	7/32
	(7.5)	(92)	(125)	(7.5)	(5.5)

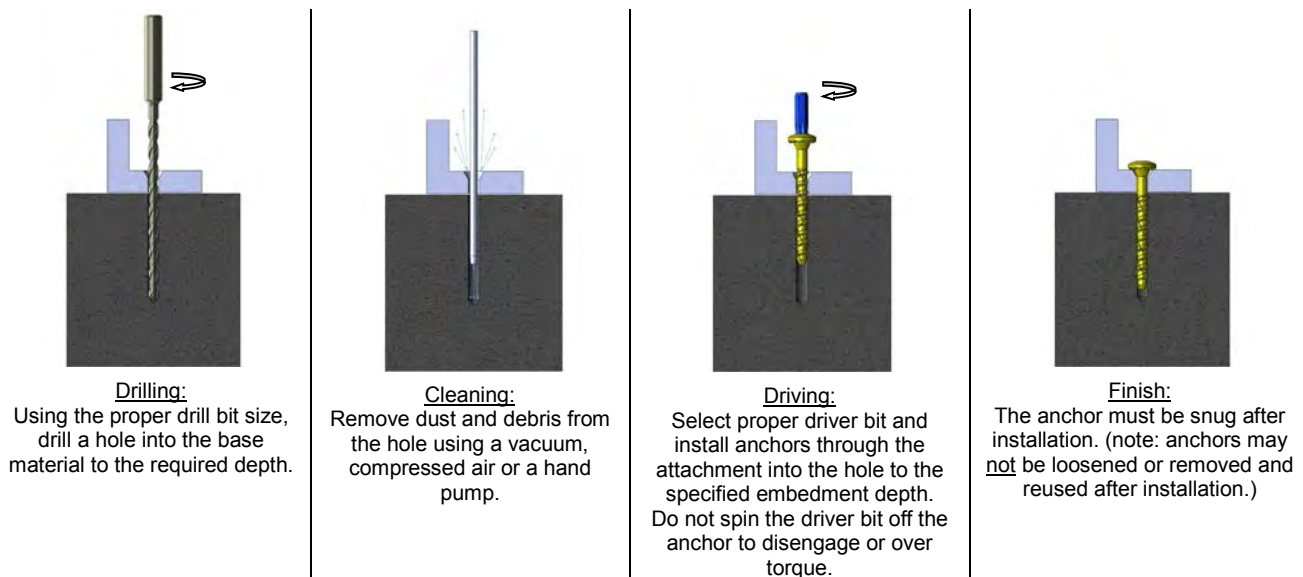


FIGURE 3—GRK CALIBURN XL 7.5 SCREW ANCHOR INSTALLATION INSTRUCTIONS

A redundant system is achieved by specifying and limiting the following variables:

n_1 = the total number of anchorage points supporting the linear element

n_2 = the number of anchors per anchorage point

n_3 = factored load at each anchorage point using the load combinations from Section 1605.2 IBC, or ACI 318-14 Section 5.3 or ACI 318 (-11, -08, -05) Section 9.2

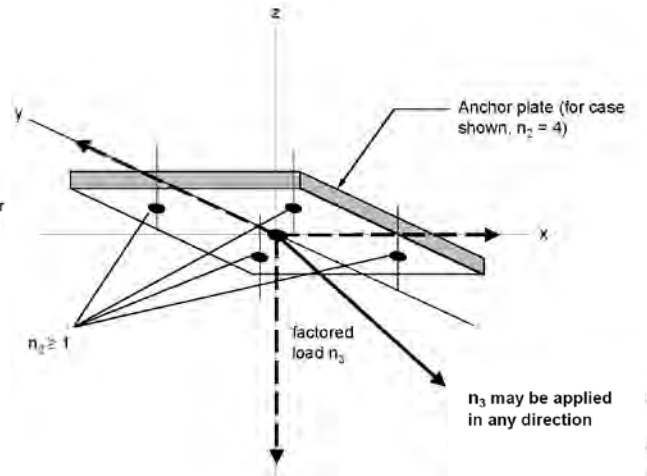
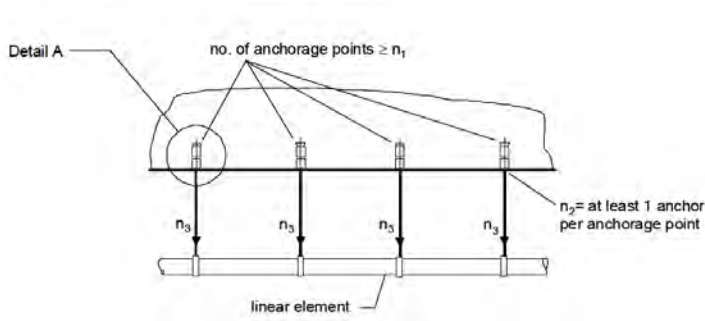


FIGURE 4a—REDUNDANT FASTENING APPLICATION REQUIREMENTS FOR STRENGTH DESIGN OF TYPICAL FIXTURES

FIGURE 4b—DETAIL A: ANCHORAGE POINT

TABLE 3—REDUNDANT FASTENING STRENGTH DESIGN INFORMATION FOR GRK CALIBURN XL 7.5 SCREW ANCHORS^{1,2,5}

DESIGN CHARACTERISTIC	NOTATION	UNITS	NOMINAL ANCHOR SIZE ¹ / ₄ inch			
			2.76 (70)	3.35 (85)		
Anchor category	1, 2 or 3	-	3			
Minimum Nominal Embedment Depth	h_{nom}	in. (mm)	2.76 (70)	3.35 (85)		
CHARACTERISTIC STRENGTH (RESISTANCE) INSTALLED IN NORMAL-WEIGHT CONCRETE⁴						
Resistance at each anchorage point, cracked or uncracked concrete (2,500 psi)	F_{ra}	lb (kN)	Number of anchorage points			
			$n_1 \geq 4$	$n_1 \geq 3$	$n_1 \geq 4$	$n_1 \geq 3$
			675 (3.0)	450 (2.0)	675 (3.0)	450 (2.0)
Strength reduction factor ³	ϕ_{ra}	-	0.45			

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

¹The data in this table is intended to be used with Strength Design provisions of Section 4.2 of this report; loads are independent of direction and may be applied in tension, shear or any combination thereof.

²Installation must comply with published installation instructions and this report.

³All values of ϕ were determined from the load combinations of Section 1605.2 of the IBC, or ACI 318-14 Section 5.3 or ACI 318 (-11, -08, -05) Section 9.2.

⁴Anchors are permitted to be used in lightweight concrete providing the design strength $\phi_r F_{ra}$ is multiplied by the modification factor, λ_a , as applicable. See Section 4.2 of this report.

⁵For Allowable Stress Design, see Section 4.3 of this report.