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ICC-ES Evaluation Report
ESR-5290

Issued September 2023

This report is subject to renewal September 2024.

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:

BRITISH FASTENING SYSTEMS LIMITED OPERATING AS UCAN FASTENING PRODUCTS

EVALUATION SUBJECT:

UTB 14158RH POST INSTALLED ROD HANGER SCREW IN CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018 and 2015 *International Building Code®* (IBC)
- 2021, 2018 and 2015 *International Residential Code®* (IRC)

Properties evaluated:

- Structural

2.0 USES

The UTB 14158RH Post Installed Rod Hanger Screw is used as an anchorage to resist static, wind and seismic loads (Seismic Design Categories A through F), tension and shear loads when installed into cracked and uncracked normal-weight concrete and lightweight concrete members having a specified compressive strength, *f′c*, from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The UTB 14158RH Post Installed Rod Hanger Screw $^{1}/_{4}$-inch (6.4 mm) diameter with effective embedment according to Table 1 is to be used in single anchor applications or in group anchorages when designed according to ACI 318-19 Chapter 17.

The UTB 14158RH Post Installed Rod Hanger Screws are an alternative to cast-in-place anchors described in Section 1901.3 of the 2021, 2018 and 2015 IBC. The anchor 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 UTB 14158RH Post Installed Rod Hanger Screw:

The UTB 14158RH Post Installed Rod Hanger Screw is a carbon steel threaded anchor with an oversized hex-washer head that is internally threaded. The anchor is available zinc-plated, with nominal diameter of $^{1}/_{4}$ (6.4 mm). The anchor bodies have a high-low alternating thread form and $^{3}/_{8}$-inch diameter (9.5 mm) internal threads in the hex coupler head.

3.2 Concrete:

The concrete must be normal-weight concrete or lightweight concrete conforming to Sections 1903 and 1905 of the IBC.

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of the UTB anchor 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 the anchor 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 parameters and references are based on the 2021 IBC (ACI 318-19), on the 2018 and 2015 IBC (ACI 318-14), unless noted otherwise in Sections 4.1.1 through 4.1.12 of this report.

The strength design of the UTB anchor must comply with ACI 318-19 17.5.1.2 or ACI 318-14 17.3.1, as applicable, except as required in ACI 318-19 17.10 or ACI 318-14 17.2.3.

Strength reduction factors, ϕ, as given in ACI 318-19 17.5.3 or ACI 318-14 17.3.3, as applicable, and noted in Tables 2 and 3 of this report, 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 and 2015 IBC, as applicable.

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 318-19 17.3.1 or ACI 318-14 17.2.7, as applicable.

4.1.2 Requirements for Static Steel Strength in Tension: The nominal static steel strength of a single UTB anchor in tension, N_{sa}, calculated in accordance with ACI 318-19 17.6.1.2 or ACI 318-14 17.4.1.2, as applicable, is given in Table 3 of this report. The strength reduction factor, ϕ, corresponding to a brittle steel element must be used as given in Table 3.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension: The nominal concrete breakout strengths of a single UTB anchor or a group of anchors in tension, N_{cb} and N_{cbg}, respectively, must be calculated in accordance with ACI 318-19 17.6.2 or ACI 318-14 17.4.2, as applicable, with modifications as described in this section. The basic concrete breakout strength of a single UTB anchor in tension in cracked concrete, N_b, must be calculated in accordance with ACI 318-19 17.6.2.2 or ACI 318-14 17.4.2.2, as applicable, using the values of h_{ef} and k_{cr} as given in Table 2 of this report. The nominal concrete breakout strength in tension in regions of concrete where analysis indicates no cracking at service loads in accordance with ACI 318-19 17.6.2.5.1(a) or ACI 318-14 17.4.2.6, 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: 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, respectively, as applicable, in cracked and uncracked concrete, $N_{p,cr}$ and n_{cr}, $N_{p,uncr}$ and n_{uncr}, respectively, are given in Table 2. For all design cases $\Psi_{c,P}$ = 1.0. In accordance with ACI 318-19 17.6.3 or ACI 318-14 17.4.3, as applicable, the nominal pullout strength in cracked concrete may be calculated in accordance with the following equation:

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

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

In regions where analysis indicates no cracking in accordance with ACI 318-19 17.6.3.3 or ACI 318-14 17.4.3.6, as applicable, the nominal pullout strength in tension may be calculated in accordance with the following equation:

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

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

4.1.5 Requirements for Static Steel Strength in Shear: The nominal steel strength in shear, V_{sa}, of a single UTB anchor in accordance with ACI 318-19 17.7.1.2 or ACI 318-14 17.5.1.2, 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 or ACI 318-14 Eq. 17.5.1.2b, as applicable. The strength reduction factor, ϕ, corresponding to a brittle steel element must be used, as described in Table 3.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear: The nominal concrete breakout strength in shear of a single UTB anchor or group of anchors, V_{cb} and V_{cbg}, respectively, must be calculated in accordance with ACI 318-19 17.7.2 or ACI 318-14 17.5.2, as applicable, with modifications as provided in this section. The basic concrete breakout strength in shear, V_b, must be calculated in accordance with ACI 318-19 17.7.2.2.1 or ACI 318-14 17.5.2.2, as applicable, using the values of l_e and d_a described in Table 3 of this report. In no case shall l_e be taken as greater than 8d_a in the calculation of V_{cb} or V_{cbg}. The value of ℓ_e used in ACI 318-19 Eq. 17.7.2.2.1a or ACI 318-14 Eq. 17.5.2.2a must be taken as no greater than the lesser of h_{ef} or 8d_a. Anchors installed in light-weight concrete must use the reduction factors provided in ACI 318-19 17.2.4 or ACI 318-14 17.2.6, as applicable.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear: The nominal concrete pryout strength of a single UTB anchor or a group of anchors, V_{cp} and V_{cpg}, respectively, must be calculated in accordance with ACI 318-19 17.7.3 or ACI 318-14 17.5.3, 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 Seismic Design:

4.1.8.1 General: When the UTB anchor design includes seismic loads, the design must be performed in accordance with ACI 318-19 17.10 or ACI 318-14 17.2.3, as applicable. Modifications to ACI 318-19 17.10 or ACI 318-14 17.2.3 must be applied under Section 1905.1.8 of the 2021, 2018 and 2015 IBC, as applicable.

Except for use in Seismic Design Category A or B of the IBC, design strengths must be determined presuming the concrete is cracked unless it can be demonstrated that the concrete remains uncracked.

The nominal steel strength and nominal concrete breakout strength of the UTB anchors in tension, and the nominal concrete breakout strength and pryout strength of the UTB anchors in shear, must be calculated according to ACI 318-19 17.6 and 17.7 or ACI 318-14 17.4 and 17.5, as applicable, respectively, taking into account the corresponding values in Tables 1 through 5 of this report.

The UTB anchors comply with ACI 318 (-19 and -14) 2.3, as applicable, as brittle steel elements and must be designed in accordance with ACI 318-19 17.10.5 or 17.10.6 or ACI 318-14 17.2.3.4 or 17.2.3.4, as applicable.

4.1.8.2 Seismic Tension: The nominal steel strength and concrete breakout strength of UTB anchors in tension must be determined in accordance with ACI 318-19 17.6.1 and 17.6.2 or ACI 318-14 17.4.1 and 17.4.2, as applicable, as described in Sections 4.1.2 and 4.1.3 of this report. In accordance with ACI 318-19 17.6.3.2.1 or ACI 318-14 17.4.3.2, as applicable, the appropriate value for nominal pullout strength in tension for seismic loads, $N_{p,eq}$, described in Table 3 of this report, must be used in lieu of N_p. The value of $N_{p,eq}$ may be adjusted by calculation for concrete strength in accordance with Eq-1 and Section 4.1.4.

4.1.8.3 Seismic Shear: The nominal concrete breakout and concrete pryout strength in shear must be determined in accordance with ACI 318-19 17.7.2 and 17.7.3 or ACI 318-14 17.5.2 and 17.5.3, as applicable, as described in Sections 4.1.6 and 4.1.7 of this report. In accordance with ACI 318-19 17.7.1.2 or ACI 318-14 17.5.1.2, as applicable, the appropriate value for nominal steel strength in shear for seismic loads, $V_{sa,eq}$, described in Table 3 of this report, must be used in lieu of V_{sa}.

4.1.9 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 318-19 17.8 or ACI 318-14 17.6, as applicable.

4.1.10 Requirements for Critical Edge Distance, c_{ac}: In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318-19 17.6.2 or ACI 318-14 17.4.2, as applicable must be further multiplied by the factor $\psi_{cp,N}$ given by Eq-3:

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

where the factor $\psi_{cp,N}$ need not be taken as less than 1.5h_{ef}/c_{ac}. For all other cases, $\psi_{cp,N}$=1.0. In lieu of ACI 318-19 17.9.5 or ACI 318-14 17.7.6, as applicable, the values for the critical edge distance, c_{ac}, must be taken from Table 2.

4.1.11 Requirements for Minimum Member Thickness, Minimum UTB Anchor Spacing, and Minimum Edge Distance: In lieu of ACI 318-19 17.9.2 or ACI 318-14 17.7.1 and 17.7.3, as applicable, values of s_{min} and c_{min} must comply with Tables 2 and 3 of this report. In lieu of ACI 318-19 17.9.4 or ACI 318-14 17.7.5, as applicable, minimum member thicknesses, h_{min}, must comply with Table 1 of this report.

4.1.12 Lightweight Concrete: For the use of UTB 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), λ must be determined in accordance with the corresponding version of ACI 318.

4.2 Allowable Stress Design (ASD, Structural):

4.2.1 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 and 2015 IBC are required. These are calculated using Eq-4 and Eq-5 as follows:

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

and

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

where:

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

$V_{allowable,ASD}$ = Allowable shear load (lbf or N).

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 (-19 and -14) Chapter 17 , as applicable, and 2021, 2018 and 2015 IBC Section 1905.1.8, as applicable, and Section 4.1 of this report, as applicable (lbf or N).

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 (-19 and -14) Chapter 17, as applicable, and 2021, 2018 and 2015 IBC Section 1905.1.8, as applicable, and Section 4.1 of this report, as applicable (lbf or N).

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 overstrength.

The requirements for member thickness, edge distance and spacing, described in this report, must apply.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318-19 17.8 or ACI 318-14 17.6, as applicable, as follows:

If $T_{applied} \leq 0.2T_{allowable,ASD}$, then the full allowable strength in shear, $V_{allowable,ASD}$, is to be used.

If $V_{applied} \leq 0.2V_{allowable,ASD}$, then the full allowable strength in tension, $T_{allowable,ASD}$, is to be used.

For all other cases:

$$\frac{T_{applied}}{T_{allowable,ASD}}+\frac{V_{applied}}{V_{allowable,ASD}}\leq 1.2 \qquad \text{(Eq-6)}$$

4.3 Installation:

Installation parameters are provided in Table 1. The manufacturer's printed installation instructions (MPII) are reproduced in Figure 2. Anchor locations must comply with this report and the plans and specifications approved by the code official. The UTB 14158RH Post Installed Rod Hanger Screw must be installed in accordance with the manufacturer's published installation instructions and this report. In case of conflict, this report governs. Holes must be predrilled in concrete with a carbide drill bit that conforms to the requirement of ANSI B212.15-1994, of the specified nominal diameter using a rotary-hammer drill to the minimum specified hole-depth. It is necessary to ensure enough concrete dust and debris is removed from the hole by blowing out the hole so that the anchor can be installed to the required depth. The dust can be removed using compressed air or a suitable vacuum. The anchor is then inserted in the top of the hole and driven with a powered impact or torque wrench into the hole until the head of the anchor comes in contact with the base material. A threaded element can then be inserted into the coupler head on the anchor for connection.

4.4 Special Inspection:

Special inspection is required in accordance with Section 1705.1.1 and Table 1705.3 of the 2021, 2018 or 2015 IBC. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, hole cleaning procedure, embedment depth, concrete type, concrete compressive strength, concrete member thickness, hole dimensions, anchor spacing, edge distance, installation torque, maximum impact wrench torque rating, and adherence to the manufacturer's published 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 and 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE

The UTB 14158RH Post Installed Rod Hanger Screw for use in cracked and uncracked concrete described in this report comply with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 UTB Anchor sizes, dimensions, and other installation parameters are as set forth in this report.

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

5.3 The UTB anchors must be installed in accordance with Section 4.3 of this report in cracked or uncracked normal-weight and lightweight concrete having a 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 The concrete must have attained its minimum design strength prior to the installation of anchors.

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

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

5.8 UTB Anchor spacing (s), edge distance (c), and minimum member thickness must comply with Tables 2 and 3 of this report.

5.9 Reported values for the UTB Rod Hanger do not consider the strength of the internally threaded element, which must be verified by the design professional.

5.10 Prior to installation, calculations and details justifying that the applied loads demonstrate 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.

5.11 Since 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 UTB anchors under such conditions is beyond the scope of this report.

5.12 UTB Anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.

5.13 UTB Anchors may be used to resist short-term loading due to wind or seismic forces in locations designated as Seismic Design Categories A through F under the IBC, subject to the conditions of this report.

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

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

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

5.16 Use of anchors is limited to dry, interior locations.

5.17 Special inspections must be provided in accordance with Section 4.4 of this report.

5.18 Anchor design in accordance with ACI 318-19 Chapter 17 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.

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

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated October 2017, editorially revised December 2020, including an optional suitability test for seismic tension and shear; mechanical properties tests; calculations; and quality-control documentation.

7.0 IDENTIFICATION

7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-5290) 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 UTB 14158RH Post Installed Rod Hanger Screws are packaged in cartons bearing labels that provide the manufacturer name, name of the product (UTB 14158RH), and screw description (rod hanger shank diameter and internal thread diameter).

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

BRITISH FASTENING SYSTEMS LIMITED
OPERATING AS UCAN FASTENING PRODUCTS
155 CHAMPAGNE DRIVE, UNIT 10
TORONTO, ONTARIO M3J 2C6, CANADA
(416) 631-9400
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TABLE 1—INSTALLATION INFORMATION FOR UTB 14158RH POST INSTALLED ROD HANGER SCREW [1,2]

ANCHOR INFORMATION	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER (inch)
			$^1/_4$
Nominal Outside Anchor Diameter	d_a	in. (mm)	$^1/_4$ (6.4)
Drill Bit Diameter	d_{bit}	in. (mm)	$^1/_4$ (6.4)
Maximum Installation Torque	$T_{inst,max}$	ft-lbf (N-m)	19 (26)
Nominal Embedment Depth	h_{nom}	in. (mm)	1 $^5/_8$ (41)
Effective Embedment Depth	h_{ef}	in. (mm)	1.20 (30)
Minimum Hole Depth	h_{hole}	in. (mm)	2 (51)
Minimum Concrete Thickness	h_{min}	in. (mm)	4 (102)

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

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318 (-19 or -14) Chapter 17, as applicable.
[2]See Figure 2 for additional information.

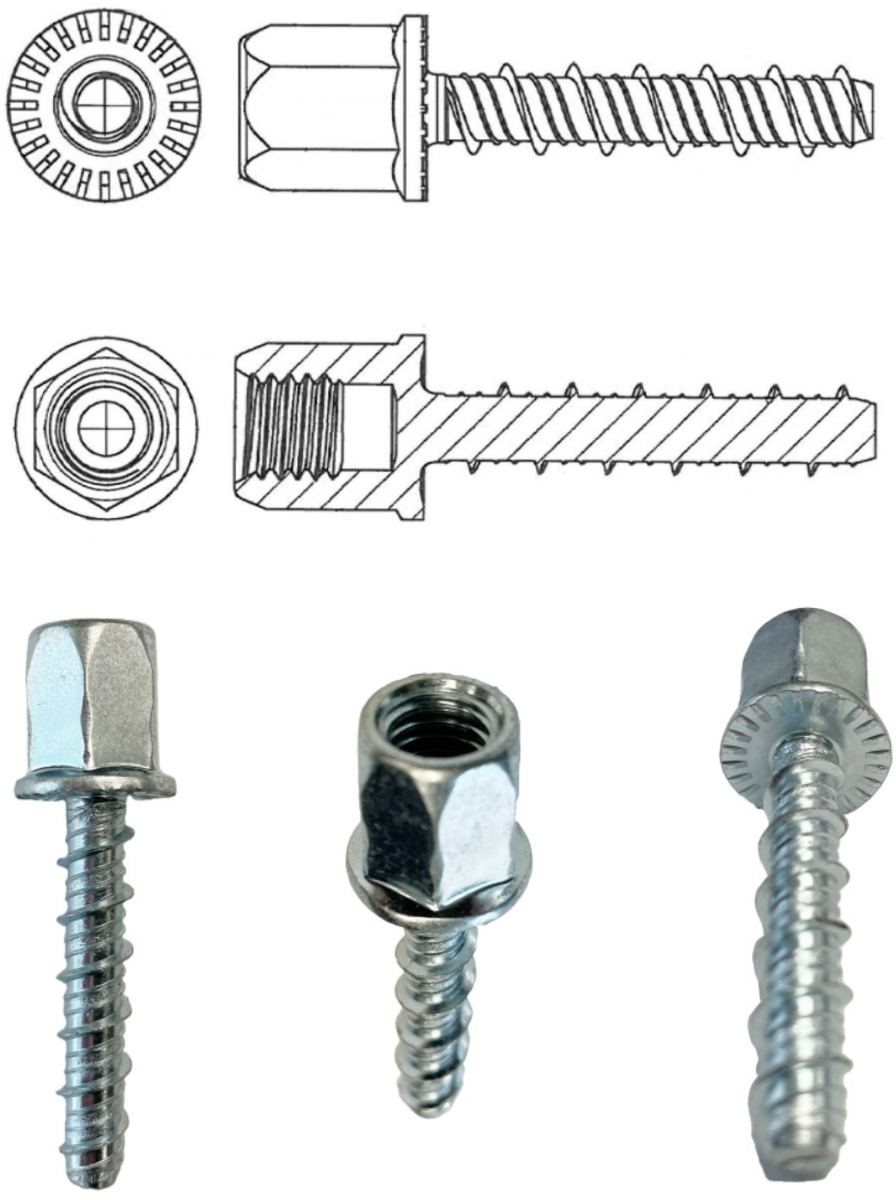


FIGURE 1- UTB 14158RH POST INSTALLED ROD HANGER SCREW

INSTALLATION INSTRUCTIONS – UTB 14158RH

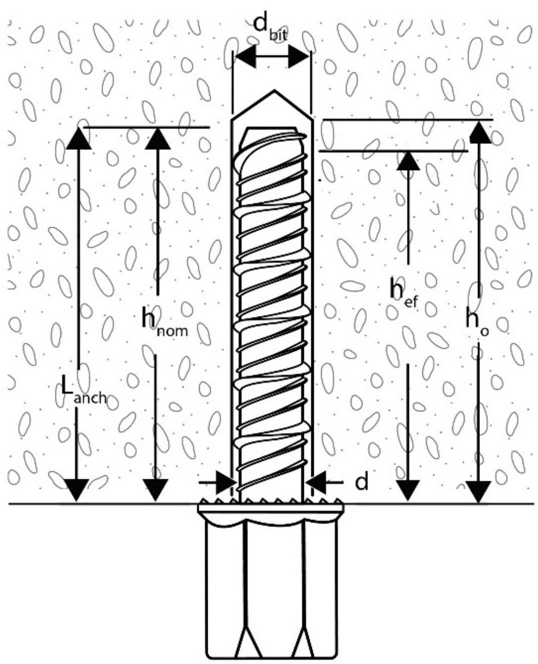
INSTALLATION SPECIFICATIONS

Anchor Property		Notation	Units	Nominal Anchor Diameter (inch)
				3/8
Coupler/Threaded Rod Connection thread size (UNC)		-	in.	3/8-16
Coupler Head Style		-	-	Internally Threaded
Nominal Anchor Diameter (Screw anchor body)		d_a	in. (mm)	0.250 (6.4)
Nominal Drill Bit Diameter (ANSI)		d_{bit}	in.	1/4
Minimum Nominal Embedment Depth[2]		h_{nom}	in. (mm)	1-5/8 (41)
Minimum Hole Depth		h_o	in. (mm)	2 (51)
Minimum Concrete Member Thickness		h_{min}	in. (mm)	4 (102)
Minimum Edge Distance		-	in. (mm)	1-1/2 (38)
Minimum Spacing Distance		-	in. (mm)	1-1/2 (38)
Maximum Installation Torque[1]		$T_{inst, max}$	ft.-lbf. (N-m)	19[1] (26)
Coupler Head	Wrench Socket Size	-	in.	1/2
	Max. Head Height	-	in.	0.670
	Max. Washer Diameter	-	in.	0.667

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

NOTE: The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.

INSTALLATION INSTRUCTIONS – UTB 14158RH



Nomenclature

d = Diameter of Anchor

d_{bit} = Diameter of Drill Bit

h_{nom} = Minimum Nominal Embedment

h_{ef} = Effective Embedment

h_o = Minimum Hole Depth

L_{anch} = Nominal Anchor Length

INSTALLATION INSTRUCTIONS

1. Drill a hole into the base material to the required embedment depth, using the correct size drill bit. The drill bit must meet the requirements of ANSI Standard B212.15-1994 (R2000).
2. Remove all dust and debris from hole using either a dust extractor, blow out pump, suction or compressed air.
3. Attach a 1/2" hex socket to a powered impact or torque wrench, mount the screw anchor head into the socket. Set the torque to the recommended installation torque.
4. Drive the anchor with the powered impact or torque wrench into the hole until the head of the anchor comes in contact with the base material. Pull the hex socket (attached to the powered impact or torque wrench) off the head of the anchor to disengage it. DONOT spin the socket off the anchor.
5. Insert 3/8-16 threaded rod or threaded bolt attachment to the internally threaded head of the anchor.

FIGURE 2- INSTALLATION INSTRUCTIONS (MPII)

TABLE 2—TENSION STRENGTH DESIGN INFORMATION FOR UTB 14158RH POST INSTALLED ROD HANGER SCREWS [1]

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER (inch)
			$^1/_4$
Anchor Category	1, 2 or 3	-	3
Nominal Embedment Depth	h_{nom}	in. (mm)	$1^5/_8$ (41)
Critical Edge Distance	c_{ac}	in. (mm)	3 (76)
Minimum Edge Distance	c_{min}	in. (mm)	1 $^1/_2$ (38)
Minimum Spacing	s_{min}	in. (mm)	1 $^1/_2$ (38)
Steel Strength in Tension (ACI 318-19 17.6.1 or ACI 318-14 17.4.1)			
Minimum Specified Yield Strength	f_{ya}	psi (N/mm²)	100,000 (689)
Minimum Specified Tensile Strength	f_{uta}	psi (N/mm²)	125,000 (862)
Effective Tensile Stress Area	A_{se}	in^2 (mm²)	0.0382 (25)
Steel Strength in Tension	N_{sa}	lbf (kN)	4,775 (21.2)
Strength Reduction Factor-Steel Failure[2]	ϕ_{sa}	-	0.65
Concrete Breakout Strength in Tension (ACI 318-19 17.6.2 or ACI 318-14 17.4.2)			
Effective Embedment Depth	h_{ef}	in. (mm)	1.20 (30)
Effectiveness Factor-Uncracked Concrete	k_{uncr}	-	24
Effectiveness Factor-Cracked Concrete	k_{cr}	-	17
Strength Reduction Factor-Concrete Breakout Failure[2]	ϕ_{cb}	-	0.45
Modification Factor for Concrete[3]	$\Psi_{c,N}$	-	1.00
Pull-Out Strength in Tension (ACI 318-19 17.6.3 or ACI 318-14 17.4.3)			
Pull-Out Resistance Uncracked Concrete (f'_c = 2,500 psi)[4]	$N_{p,uncr}$	lbf (kN)	1,736 (7.72)
Pull-Out Resistance Cracked Concrete (f'_c = 2,500 psi)[4]	$N_{p,cr}$	lbf (kN)	1,259 (5.60)
Strength Reduction Factor-Pullout Failure[2]	ϕ_p	-	0.45
Tension Strength for Seismic Applications (ACI 318-19 17.10.3 or ACI 318-14 17.2.3.3)			
Nominal Pullout Strength for Seismic Loads (f'_c=2,500 psi)[4]	$N_{p,eq}$	lbf (kN)	1,259 (5.60)
Strength Reduction Factor forPullout Failure[2]	ϕ_{eq}	-	0.45
Tension, normalization factor			
Normalization factor, uncracked concrete	n_{uncr}	-	0.27
Normalization factor,cracked concrete, seismic	n_{un}	-	0.32
Axial stiffness			
Axial stiffness in service load range in uncracked concrete	β_{uncr}	lb/in (N/mm)	155,254 (27,189)
Axial stiffness in service load range in cracked concrete	β_{cr}	lb/in (N/mm)	73,309 (12,838)

For **SI:** 1 inch = 25.4mm, 1lbf = 4.45N, 1 lb/in = 0.175 N/mm, 1 psi = 0.00689 MPa = 0.00689 N/mm², 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm.

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318 (-19 or -14) Chapter 17, as applicable.
[2]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 or ACI 318-14 17.3.3, as applicable, are met. The strength reduction factors are applicable with supplementary reinforcement not present. Greater strength reduction factors may be used in areas where supplementary reinforcement can be verified.
[3] For all design cases, $\Psi_{c,N}$ = 1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
[4] For all design cases, $\Psi_{c,P}$ = 1.0. Tabulated value for pullout strength is for a concrete compressive strength of 2,500 psi (17.2 MPa). Pullout strength for concrete compressive strength greater than 2,500 psi (17.2 MPa) may be increased by multiplying the tabular pullout strength by $(f'_c / 2{,}500)^n$ for psi, or $(f'_c / 17.2)^n$ for MPa, where n is given as n_{uncr} for uncracked concrete and n_{cr} for cracked concrete.

TABLE 3—SHEAR STRENGTH DESIGN INFORMATION FOR UTB 14158RH POST INSTALLED ROD HANGER SCREWS [1]

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER (inch)
			$^{1}/_{4}$
Anchor Category	1, 2 or 3	-	3
Nominal Embedment Depth	h_{nom}	in. (mm)	$1^{5}/_{8}$ (41)
Critical Edge Distance	c_{ac}	in. (mm)	3 (76)
Minimum Edge Distance	c_{min}	in. (mm)	1 $^{1}/_{2}$ (38)
Minimum Spacing	s_{min}	in. (mm)	1 $^{1}/_{2}$ (38)
Effective Embedment Depth	h_{ef}	in. (mm)	1.20 (30)
Steel Strength in Shear (ACI 318-19 17.7.1)			
Minimum Specified Yield Strength	f_{ya}	psi (N/mm²)	100,000 (689)
Minimum Specified Tensile Strength	f_{uta}	psi (N/mm²)	125,000 (862)
Effective Shear Stress Area	A_{se}	in² (mm²)	0.0382 (25)
Steel strength in shear - static	V_{sa}	lbf (kN)	1,287 (5.72)
Strength Reduction Factor-Steel Failure[2]	ϕ_{sa}	-	0.60
Concrete Breakout Strength in Shear (ACI 318-19 17.7.2)			
Nominal Diameter	d_a	in. (mm)	$^{1}/_{4}$ (6.4)
Load Bearing Length of Anchor in Shear (h_{ef} or $8d_o$, whichever is less)	l_e	in. (mm)	1.20 (30)
Strength Reduction Factor-Concrete Breakout Failure[2]	ϕ_{cb}	-	0.70
Concrete Pryout Strength in Shear (ACI 318-19 17.7.3)			
Coefficient for Pryout Strength	k_{cp}	-	1.0
Strength Reduction Factor-Concrete Pryout Failure[2]	ϕ_{cp}	-	0.70
Shear Resistance of Single Anchor for Seismic Loads (f'_c=2,500 psi)	$V_{sa,eq}$	lbf (kN)	1,173 (5.22)
Strength Reduction Factor -Steel Failure[2]	ϕ_{eq}	-	0.70

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45 N, 1 psi = 0.00689 MPa = 0.00689 N/mm², 1 in² = 645 mm².

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318 (-19 or -14) Chapter 17, as applicable.
[2]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 or ACI 318-14 17.3.3, as applicable, are met. The strength reduction factors are applicable with supplementary reinforcement not present. Greater strength reduction factors may be used in areas where supplementary reinforcement can be verified.

Design Example to Calculate Allowable Stress Design Tension Capacity for Illustrative Purposes[1,2,3,4,5,6,7,8,9]:

UTB 14158RH $^1/_4$ -inch diameter, with an effective embedment (h_{ef}) of 1.20 inch, assuming the conditions given in Table 2

	PROCEDURE		CALCULATION
Step 1	Determine steel strength of a single anchor in tension per ACI 318-19 17.6.1.2 and Table 2 of this report:	ϕN_{sa}	$= \phi N_{sa}$ =0.65*4,775 **=3,104 lbs steel strength**
Step 2	Determine concrete breakout strength of a single anchor in tension per ACI 318-19 17.6.2.2 and Table 2 of this report:	N_b ϕN_{cb}	$= k_{uncr} \sqrt{f'_c}\ h_{ef}^{1.5}$ $= 24^* \sqrt{2,500}\ ^*1.20^{1.5}$ = 1,577 lbs $=\phi\ A_{NC}/A_{NC0}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ = 0.45*1.0*1.0*1.0*1.0*1,577 = 0.45*1,577 **= 710 lbs concrete breakout strength**
Step 3	Determine pullout strength per Table 2 of this report:	$\phi N_{p,uncr}$	$=\phi\ N_{p,uncr}\ \psi_{c,P}$ = 0.45 * 1,736 * 1.0 = **781 lbs pullout strength**
Step 4	Determine controlling resistance strength in tension per ACI 318-19 17.5.2:		**= 710 lbs controlling resistance (breakout)**
Step 5	Determine allowable stress design conversion factor for loading condition per ACI 318-19 Section 5.3:	α	=1.2*D* + 1.6*L* =1.2(0.3) + 1.6(0.7) **=1.48**
Step 6	Determine allowable stress design value per Section 4.2 of this report:	$T_{allowable,ASD}$	$= \phi\ N_n / \alpha$ = 710 / 1.48 **= 479 lbs allowable stress design**

[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 and -14) Section 5.3 (no seismic loading considered), as applicable.
[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 (no supplementary reinforcement provided) in accordance with ACI 318-19 17.5.3 or ACI 318-14 17.3, as applicable.

FIGURE 3—EXAMPLE DESIGN CALCULATION