

ICC-ES Evaluation Report

ESR-3785

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DIVISION: 04 00 00—MASONRY
Section: 04 05 19.16—Masonry Anchors

REPORT HOLDER:

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EVALUATION SUBJECT:

KWIK BOLT TZ MASONRY ANCHORS

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.

Property evaluated:

Structural

2.0 USES

The Kwik Bolt TZ (KB-TZ) Masonry Anchor is used to resist static, wind, and seismic tension and shear loads in uncracked, fully grouted concrete masonry unit (CMU) construction. The anchor system is an alternative to cast-in-place anchors described in Section 8.1.3 (2013 edition) or Section 2.1.4 (2011 or 2008 editions) of TMS 402/ ACI 530/ ASCE 5 as referenced in Section 2107.1 of the IBC. The anchor systems 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 Kwik Bolt TZ:

KB-TZ anchors are torque-controlled, mechanical expansion anchors. KB-TZ anchors consist of a stud (anchor body), wedge (expansion elements), nut, and washer. The anchor (carbon steel version) is illustrated in Figure 1. The stud is manufactured from carbon steel or AISI Type 304 or Type 316 stainless steel materials.

Carbon steel KB-TZ anchors have a 5 µm (0.0002 inch) zinc plating. The expansion elements for the carbon steel and stainless steel KB-TZ anchors are fabricated from AISI Type 316 stainless steel. The hex nut for the carbon steel KB-TZ conforms to ASTM A563-04, Grade A, and the hex nut for the stainless steel KB-TZ conforms to ASTM F594.

The anchor body is comprised of a high-strength rod threaded at one end and a tapered mandrel at the other end. The tapered mandrel is enclosed by a three-section expansion element that freely moves around the mandrel. The expansion element movement is restrained by the mandrel taper at the bottom and by a collar at the top of the mandrel. The anchor is installed in a predrilled hole with a hammer. When torque is applied to the nut of the installed anchor, the mandrel is drawn into the expansion element, which is in turn expanded against the wall of the drilled hole.

3.2 Fully Grouted CMU Masonry:

Fully grouted CMU masonry must comply with Chapter 21 of the IBC. The compressive strength of masonry must be at least 1,500 psi (10.3 MPa) at the time of anchor installation. The concrete masonry must be fully grouted and constructed from the following materials:

3.2.1 Concrete Masonry Units (CMUs): Fully grouted concrete masonry walls must be constructed from minimum Type I, Grade N, lightweight, medium-weight or normal-weight concrete masonry units (CMUs) conforming to ASTM C90 (IBC). The minimum allowable nominal size of the CMU is 8 inches (203 mm) wide by 8 inches (203 mm) high by 16 inches (406 mm) long.

3.2.2 Grout: The masonry units must be fully grouted with grout complying with Section 2103.3 of the 2015 IBC, Section 2103.13 of the 2012 IBC, or Section 2103.12 of the 2009 and 2006 IBC, Section R606.2.11 of the 2015 IRC, or Section R609.1.1 of the 2012, 2009 and 2006 IRC, as applicable. Alternatively, the grout must have a minimum compressive strength, when tested in accordance with ASTM C1019, equal to its specified strength, but not less than 2,000 psi (13.8 MPa).

3.2.3 Mortar: Mortar must be Type N, S or M, prepared in accordance with Section 2103.2.1 of the 2015 IBC, Section 2103.9 of the 2012 IBC, Section 2103.8 of the 2009 and 2006 IBC, Section R606.2.7 of the 2015 IRC, or Section R607.1 of the 2012, 2009 and 2006 IRC, as applicable.

4.0 DESIGN AND INSTALLATION

4.1 Design:

Minimum embedment depth, edge distance, and spacing requirements are provided in Tables 1A, 1B, 3, and 4 of

this report. Allowable stress design tension and shear loads are provided in Tables 3 and 4. Allowable loads for Kwik Bolt TZ anchors subjected to combined shear and tension forces are determined by the following equation:

$$(P_s/P_t)^{5/3} + (V_s/V_t)^{5/3} \leq 1$$

where:

- P_s = Applied service tension load.
- P_t = Allowable service tension load.
- V_s = Applied service shear load.
- V_t = Allowable service shear load.

4.2 Installation:

Kwik Bolt TZ must be installed in holes drilled into the base material using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The nominal drill bit diameter must be equal to that of the anchor. The minimum drilled hole depth is given in Tables 1A and 1B. Prior to installation, dust and debris must be removed from the drilled hole to enable installation to the stated embedment depth. The anchor must be hammered into the predrilled hole until h_{nom} is achieved. The nut must be tightened against the washer until the torque values specified in Tables 1A and 1B are attained. See the manufacturers printed installation instructions (MPII) depicted in Figure 5 of this report.

4.3 Special Inspection:

Special inspection under the IBC and IRC must be provided in accordance with Sections 1704 and 1705 of the IBC. Under the IBC, additional requirements as set forth in Sections 1705 and 1706 must be observed, where applicable. The code official must receive a report, from an approved special inspector, that includes the following details:

1. Anchor description, including the anchor product name, nominal anchor and bolt diameters, and anchor length.
2. Hole description, including verification of drill bit compliance with ANSI B212.15-1994.
3. Installation description, including verification of masonry compressive strength and verification of anchor installation and location (spacing and edge distance) in accordance with Hilti's published installation instructions and this report.

5.0 CONDITIONS OF USE

The Kwik Bolt TZ Masonry Anchors described in this report are suitable alternatives to what is specified in the codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 Anchor sizes, dimensions, and installation must comply with this report and Hilti's printed installation instructions (MPII). In case of conflict, this report governs.
- 5.2 Allowable tension and shear loads must be as noted in Tables 3 and 4 of this report.
- 5.3 Calculations and details demonstrating compliance with this report must be submitted to the code official for approval.
- 5.4 The use of anchors must be limited to installation in uncracked fully grouted CMU masonry. Cracking

occurs when $f_t > f_r$ due to service loads or deformations.

- 5.5 Design of Kwik Bolt TZ Masonry Anchors installed in fully grouted CMU masonry to resist dead, live, wind and seismic load applications must be in accordance with Section 4.1.

- 5.6 When using the basic load combinations in accordance with IBC Section 1605.3.1, allowable loads are not permitted to be increased for wind or seismic loading. When using the alternative basic load combinations in 2009 and 2006 IBC Section 1605.3.2 that include wind or seismic loads, the allowable shear and tension loads for anchors are permitted to be increased by $33\frac{1}{3}$ percent. Alternatively, the basic load combinations may be multiplied by a factor of 0.75 when using IBC Section 1605.3.2. For the 2015 and 2012 IBC, the allowable loads or load combinations may not be adjusted. See Table 5 of this report.

- 5.7 Where not otherwise prohibited in the applicable code, anchors are permitted for use with 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 fire-resistance-rated construction or 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.

- 5.8 Use of carbon steel Kwik Bolt TZ anchors must be limited to dry, interior locations.

- 5.9 Use of stainless steel Kwik Bolt TZ anchors as specified in this report are permitted for exterior exposure and damp environments.

- 5.10 Special inspection must be provided in accordance with Section 4.3 of this report.

- 5.11 Anchors are manufactured by Hilti, Inc., under a quality control program with inspections conducted by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Expansion Anchors in Masonry Elements (AC01), approved November 2015, including seismic tests, reduced spacing tests and reduced edge distance tests.

7.0 IDENTIFICATION

The anchors are identified by packaging labeled with the manufacturer's name (Hilti, Inc.) and contact information, anchor name, anchor size, and evaluation report number (ESR-3785). The anchors have the letters KB-TZ embossed on the on the anchor stud and four notches embossed into the anchor head. The letters are visible after installation for verification as depicted in Figure 3 of this report. The letter system indicating length embossed on the head of the anchor is described in Table 2.

TABLE 1A—SETTING INFORMATION (CARBON STEEL ANCHORS)

Design information	Symbol	Units	Nominal anchor diameter (in.)															
			³ / ₈			¹ / ₂				⁵ / ₈				³ / ₄				
Anchor O.D.	<i>d_a</i> (<i>d_o</i>) ²	in. (mm)	0.375 (9.5)			0.5 (12.7)				0.625 (15.9)				0.75 (19.1)				
Nominal bit diameter	<i>d_{bit}</i>	in.	³ / ₈			¹ / ₂				⁵ / ₈				³ / ₄				
Effective min. embedment	<i>h_{ef}</i>	in. (mm)	2 (51)			2 (51)		3 ¹ / ₄ (83)		3 ¹ / ₈ (79)		4 (102)		3 ³ / ₄ (95)		4 ³ / ₄ (121)		
Nominal embedment	<i>h_{nom}</i>	in. (mm)	2 ⁵ / ₁₆ (59)			2 ³ / ₈ (60)		3 ⁵ / ₈ (91)		3 ⁹ / ₁₆ (91)		4 ⁷ / ₁₆ (113)		4 ⁵ / ₁₆ (110)		5 ⁵ / ₁₆ (136)		
Min. hole depth	<i>h_o</i>	in. (mm)	2 ⁵ / ₈ (67)			2 ⁵ / ₈ (67)		4 (102)		3 ⁷ / ₈ (98)		4 ³ / ₄ (121)		4 ¹ / ₂ (114)		5 ³ / ₄ (146)		
Min. thickness of fastened part ¹	<i>t_{min}</i>	in. (mm)	0 (0)			³ / ₄ (19)		¹ / ₄ (6)		³ / ₈ (9)		³ / ₄ (19)		0 (0)		⁷ / ₈ (23)		
Installation torque	<i>T_{inst}</i>	ft-lb (Nm)	15 (20)			25 (34)				35 (47)				70 (95)				
Min. dia. of hole in fastened part	<i>d_h</i>	in. (mm)	⁷ / ₁₆ (11.1)			⁹ / ₁₆ (14.3)				¹¹ / ₁₆ (17.5)				¹³ / ₁₆ (20.6)				
Standard anchor lengths	<i>ℓ_{anch}</i>	in. (mm)	3 (76)	3 ³ / ₄ (95)	5 (127)	3 ³ / ₄ (95)	4 ¹ / ₂ (114)	5 ¹ / ₂ (140)	7 (178)	4 ³ / ₄ (121)	6 (152)	8 ¹ / ₂ (216)	10 (254)	5 ¹ / ₂ (140)	7 (178)	8 (203)	10 (254)	
Threaded length (incl. dog point)	<i>ℓ_{thread}</i>	in. (mm)	1 ¹ / ₂ (38)	2 ¹ / ₄ (57)	3 ¹ / ₂ (89)	1 ⁵ / ₈ (41)	2 ³ / ₈ (60)	3 ³ / ₈ (86)	4 ⁷ / ₈ (124)	1 ¹ / ₂ (38)	2 ³ / ₄ (70)	5 ¹ / ₄ (133)	6 ³ / ₄ (171)	2 ¹ / ₂ (63)	4 (103)	5 (128)	7 (179)	
Unthreaded length	<i>ℓ_{unthr}</i>	in. (mm)	1 ¹ / ₂ (39)			2 ¹ / ₈ (54)				3 ¹ / ₄ (83)				3 (77)				

¹The minimum thickness of the fastened part is based on use of the anchor at minimum embedment and is controlled by the length of thread. If a thinner fastening thickness is required, increase the anchor embedment to suit.

²The notation in parenthesis is for the 2006 IBC.

TABLE 1B—SETTING INFORMATION (STAINLESS STEEL ANCHORS)

Design information	Symbol	Units	Nominal anchor diameter (in.)													
			³ / ₈			¹ / ₂				⁵ / ₈				³ / ₄		
Anchor O.D.	<i>d_o</i> (<i>d_o</i>) ²	in. (mm)	0.375 (9.5)			0.5 (12.7)				0.625 (15.9)				0.75 (19.1)		
Nominal bit diameter	<i>d_{bit}</i>	in.	³ / ₈			¹ / ₂				⁵ / ₈				³ / ₄		
Effective min. embedment	<i>h_{ef}</i>	in. (mm)	2 (51)			2 (51)	3 ¹ / ₄ (83)			3 ¹ / ₈ (79)	4 (102)			3 ³ / ₄ (95)	4 ³ / ₄ (121)	
Nominal embedment	<i>h_{nom}</i>	in. (mm)	2 ⁵ / ₁₆ (59)			2 ³ / ₈ (60)	3 ⁵ / ₈ (91)			3 ⁹ / ₁₆ (91)	4 ⁷ / ₁₆ (113)			4 ⁵ / ₁₆ (110)	5 ⁵ / ₁₆ (136)	
Min. hole depth	<i>h_o</i>	in. (mm)	2 ⁵ / ₈ (67)			2 ⁵ / ₈ (67)	4 (102)			3 ³ / ₄ (95)	4 ³ / ₄ (121)			4 ¹ / ₂ (114)	5 ³ / ₄ (146)	
Min. thickness of fastened part ¹	<i>t_{min}</i>	in. (mm)	¹ / ₄ (6)			³ / ₄ (19)	¹ / ₄ (6)			³ / ₈ (9)	³ / ₄ (19)			¹ / ₈ (3)	1 ⁵ / ₈ (28)	
Installation torque	<i>T_{inst}</i>	ft-lb (Nm)	15 (20)			25 (34)				35 (47)				70 (95)		
Min. dia. of hole in fastened part	<i>d_h</i>	in. (mm)	⁷ / ₁₆ (11.1)			⁹ / ₁₆ (14.3)				¹¹ / ₁₆ (17.5)				¹³ / ₁₆ (20.6)		
Standard anchor lengths	<i>ℓ_{anch}</i>	in. (mm)	3 (76)	3 ³ / ₄ (95)	5 (127)	3 ³ / ₄ (95)	4 ¹ / ₂ (114)	5 ¹ / ₂ (140)	7 (178)	4 ³ / ₄ (121)	6 (152)	8 ¹ / ₂ (216)	10 (254)	5 ¹ / ₂ (140)	8 (203)	10 (254)
Threaded length (incl. dog point)	<i>ℓ_{thread}</i>	in. (mm)	⁷ / ₈ (22)	1 ⁵ / ₈ (41)	2 ⁷ / ₈ (73)	1 ⁵ / ₈ (41)	2 ³ / ₈ (60)	3 ³ / ₈ (86)	4 ⁷ / ₈ (124)	1 ¹ / ₂ (38)	2 ³ / ₄ (70)	5 ¹ / ₄ (133)	6 ³ / ₄ (171)	1 ¹ / ₂ (38)	4 (102)	6 (152)
Unthreaded length	<i>ℓ_{unthr}</i>	in. (mm)	2 ¹ / ₈ (54)			2 ¹ / ₈ (54)				3 ¹ / ₄ (83)				4 (102)		

¹The minimum thickness of the fastened part is based on use of the anchor at minimum embedment and is controlled by the length of thread. If a thinner fastening thickness is required, increase the anchor embedment to suit.

²The notation in parenthesis is for the 2006 IBC.

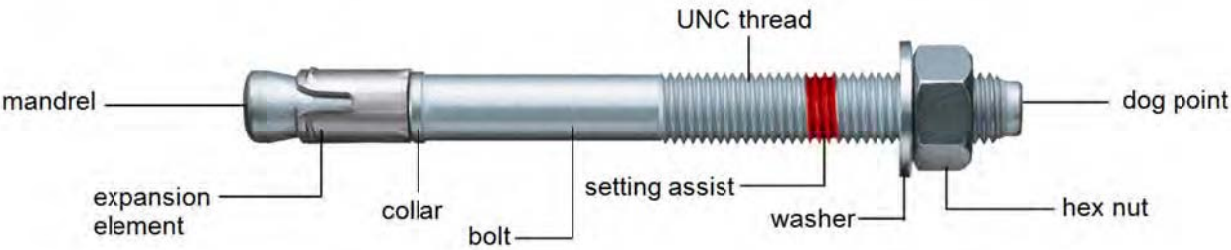


FIGURE 1—HILTI CARBON STEEL KWIK BOLT TZ (KB-TZ)

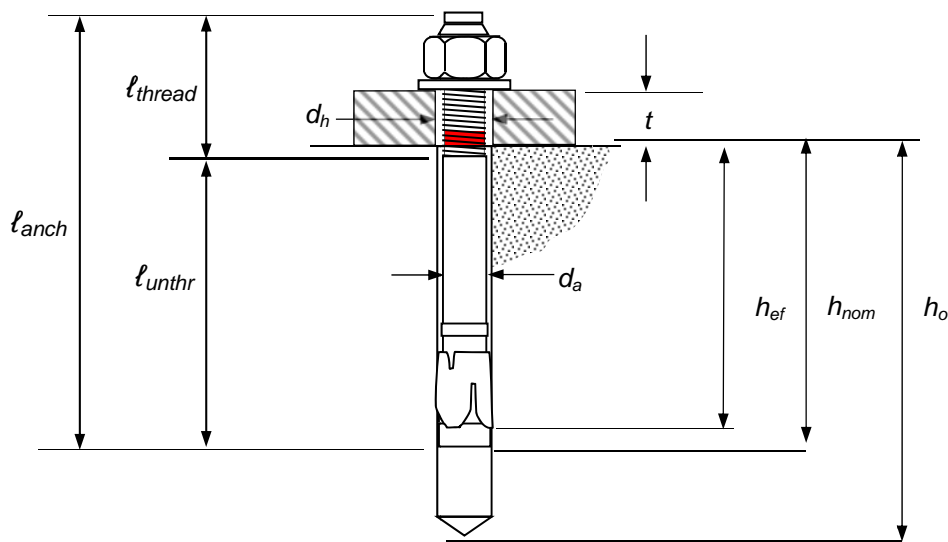


FIGURE 2—HILTI KB-TZ INSTALLED

TABLE 2—LENGTH IDENTIFICATION SYSTEM (CARBON STEEL AND STAINLESS STEEL ANCHORS)

STAMP ON ANCHOR		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Length of Anchor (inches)	From	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	11	12	13	14	15
	Up to but not including	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	11	12	13	14	15	16

For SI: 1 inch = 25.4 mm.



FIGURE 3—ANCHOR HEAD WITH LENGTH IDENTIFICATION CODE AND KB-TZ HEAD NOTCH EMBOSSEMENT

TABLE 3—ALLOWABLE TENSILE LOADS FOR CARBON STEEL AND STAINLESS STEEL KB-TZ ANCHORS IN THE FACE OF GROUT-FILLED CONCRETE MASONRY WALLS ^{1,3,4,5,6}

Nominal anchor diameter	Nominal embedment in. (mm)		Allowable Tensile Capacity at S_{cr} and C_{cr}	Spacing			Edge Distance		
				Critical Spacing, S_{cr} in (mm)	Minimum spacing, S_{min} ² in (mm)	Load Multiplier at S_{min}	Critical Edge Distance, C_{cr} in (mm)	Minimum Edge Distance, C_{min} in (mm)	Load Multiplier at C_{min}
$\frac{3}{8}$	$2\frac{5}{16}$ (59)	(59)	515 (2.3)	$9\frac{1}{4}$ (235)	3 (76)	0.49	12 (305)	4 (102)	0.70
$\frac{1}{2}$	$2\frac{3}{8}$ (60)	(60)	565 (2.5)	$9\frac{1}{2}$ (241)	4 (102)	0.49			0.85
	$3\frac{5}{8}$ (92)	(92)	735 (3.3)	$14\frac{1}{2}$ (368)		0.59			1.00
$\frac{5}{8}$	$3\frac{9}{16}$ (90)	(90)	790 (3.5)	$14\frac{1}{4}$ (362)	5 (127)	0.66			0.89
	$4\frac{7}{16}$ (113)	(113)	870 (3.9)	$17\frac{3}{4}$ (451)		0.60			1.00
$\frac{3}{4}$	$4\frac{5}{16}$ (110)	(110)	1060 (4.7)	$17\frac{1}{4}$ (438)	6 (152)	0.45			0.80
	$5\frac{9}{16}$ (141)	(141)	1165 (5.2)	$22\frac{1}{4}$ (565)		0.41			0.85

TABLE 4—ALLOWABLE SHEAR LOADS FOR CARBON STEEL AND STAINLESS STEEL KB-TZ ANCHORS IN THE FACE OF GROUT-FILLED CONCRETE MASONRY WALLS ^{1,3,4,5,6}

Nominal anchor diameter	Nominal embedment		Allowable Shear Capacity at S_{cr} and C_{cr}		Spacing				Edge Distance						
					Critical Spacing, S_{cr}		Minimum spacing, S_{min}^2		Load Multiplier at S_{min}	Critical Edge Distance, C_{cr}		Minimum Edge Distance, C_{min}	Perpendicular Load Direction Multiplier at C_{min}	Parallel Load Direction Multiplier at C_{min}	
	in	(mm)	in	(mm)	in	(mm)	in	(mm)		in	(mm)				
$\frac{3}{8}$	2 $\frac{5}{16}$	(59)	625	(2.8)	9 $\frac{1}{4}$	(235)	3	(76)	0.46	12	(305)	4	(102)	0.81	1.00
$\frac{1}{2}$	2 $\frac{3}{8}$	(60)	940	(4.2)	9 $\frac{1}{2}$	(241)	4	(102)			0.45	0.85			
	3 $\frac{5}{8}$	(92)	1055	(4.7)	14 $\frac{1}{2}$	(368)		0.41			0.88				
$\frac{5}{8}$	3 $\frac{9}{16}$	(90)	1615	(7.2)	14 $\frac{1}{4}$	(362)	5	(127)			0.40	0.87			
	4 $\frac{7}{16}$	(113)	1860	(8.3)	17 $\frac{3}{4}$	(451)		0.38			0.90				
$\frac{3}{4}$	4 $\frac{5}{16}$	(110)	1615	(7.2)	17 $\frac{1}{4}$	(438)	6	(152)			0.40	0.87			
	5 $\frac{9}{16}$	(141)	1860	(8.3)	22 $\frac{1}{4}$	(565)		0.38			0.90				

For SI: 1 inch = 25.4 mm, 1 lb = 4.45 N.

Footnotes for Table 3 and Table 4:

¹Values valid for anchors installed in face shells of Type 1, Grade N, lightweight, medium-weight, or normal-weight concrete masonry units conforming to ASTM C90. The masonry units must be fully grouted with coarse grout conforming to 2015 IBC Section 2103.3, 2012 IBC Section 2103.13, or 2009 and 2006 IBC Section 2103.12. Mortar must comply with 2015 IBC Section 2103.2.1, 2012 IBC Section 2103.9, or 2009 and 2006 IBC Section 2103.8. Masonry compressive strength must be at least 1,500 psi at the time of anchor installation.

²Loads tabulated are applicable to anchors spaced a critical distance of 16 times the anchor diameter. The anchors may be placed at a minimum spacing, S_{min} , provided that reductions are applied to the tabulated values.

³Anchor must be installed a minimum of $1\frac{3}{8}$ inches from any vertical mortar joint in accordance with Figure 4.

⁴Allowable loads or applied loads may be modified in accordance with Section 5.6 of this report for the 2009 and 2006 IBC, due to short-term wind or seismic loads.

⁵Embedment depth must be measured from the outside face of the concrete masonry unit.

⁶For intermediate edge distances, allowable loads may be determined by linearly interpolating between the allowable loads at the two tabulated edge distances.

TABLE 5—MODIFICATION FACTORS FOR ALTERNATIVE LOAD COMBINATIONS UNDER THE 2009 or 2006 IBC ^{1,2,3}

Modification factor for alternate basic load combinations		Modification factor for allowable loads for short-term loading conditions	
Tension	Shear	Tension	Shear
0.75	0.75	1.33	1.33

¹When using the basic load combinations in accordance with IBC Section 1605.3.1, allowable loads must not be increased for wind or seismic loading.

²When using the alternative basic load combinations in the 2009 or 2006 IBC Section 1605.3.2 that include wind or seismic loads, the allowable loads for anchors may be increased by the tabulated factors found in the right half of the table. Alternatively, the basic load combinations may be reduced by multiplying them by the factors found on the left half of the table. For example, the alternate basic loads for wind or seismic loading may be multiplied by 0.75 or divided by 1.33, as applicable. For the 2015 and 2012 IBC, the allowable loads or load combinations must not be adjusted.

³The above modification factors are applicable under the 2009 and 2006 IBC only for Tables 3 and 4 of this report for seismic and wind loads.

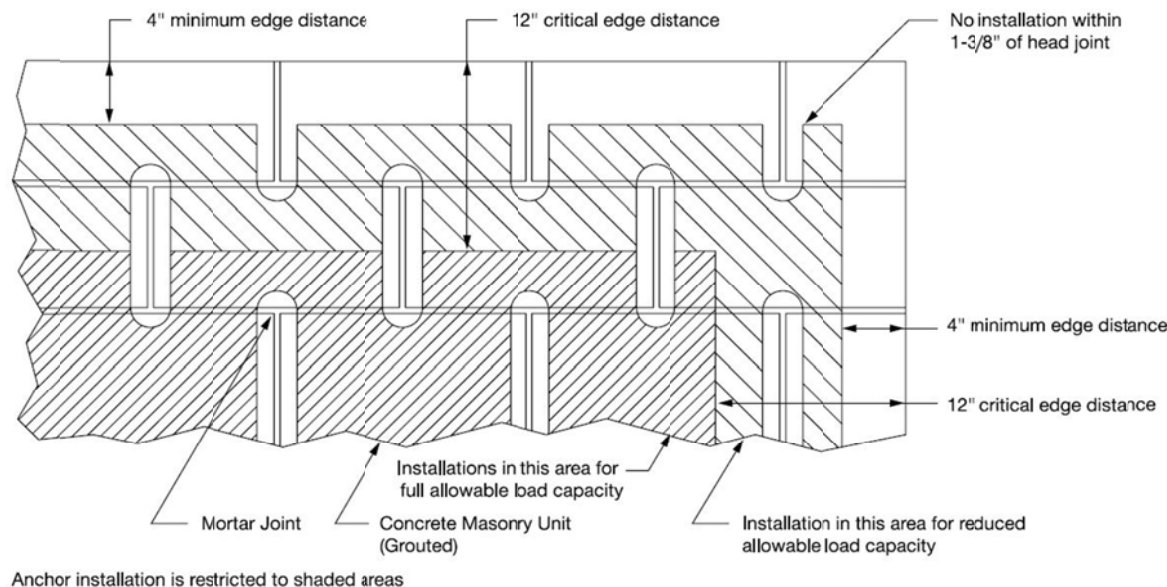


FIGURE 4—ACCEPTABLE INSTALLATION LOCATIONS (SHADED AREAS) FOR KB-TZ ANCHORS IN GROUT-FILLED CONCRETE MASONRY CONSTRUCTION

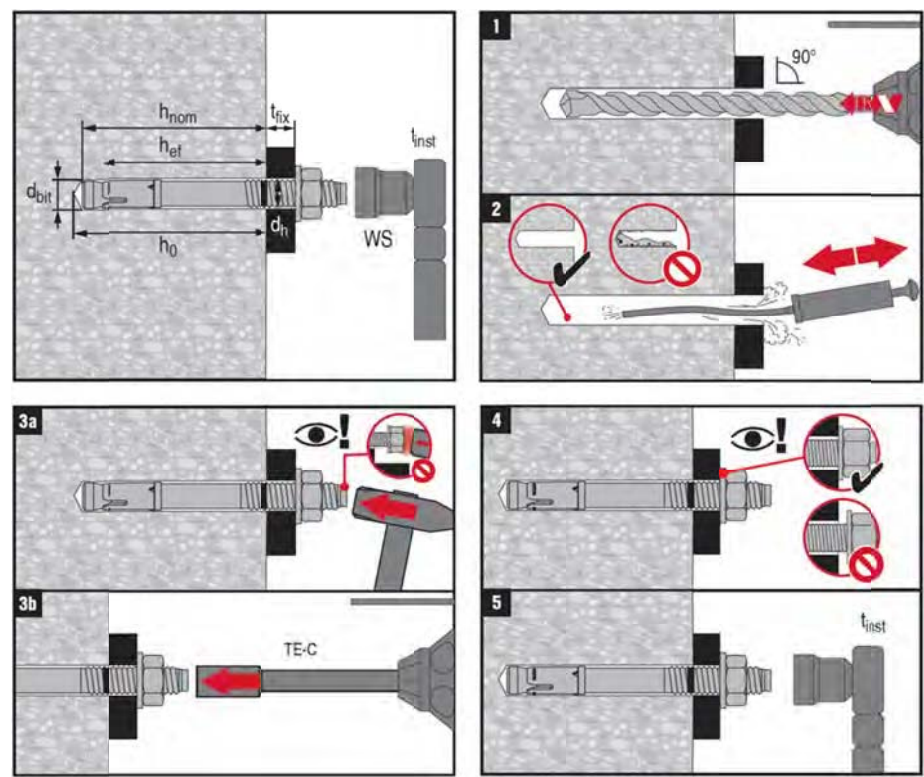


FIGURE 5—INSTALLATION INSTRUCTIONS