Attached are page(s) from the 2014 Hilti North American Product Tech Guide. For complete details on this product, including data development, product specifications, general suitability, installation, corrosion, and spacing and edge distance guidelines, please refer to the Technical Guide, or contact Hilti.

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3.3.5.1 KWIK Bolt TZ product description

The KWIK Bolt TZ (KB-TZ) is a torque controlled expansion anchor which is especially suited to seismic and cracked concrete applications. This anchor line is available in carbon steel, type 304 and type 316 stainless steel versions. The anchor diameters range from 3/8-, 1/2-, 5/8- and 3/4-inch in a variety of lengths. Applicable base materials include normal-weight concrete, structural lightweight concrete, and lightweight concrete over metal deck.

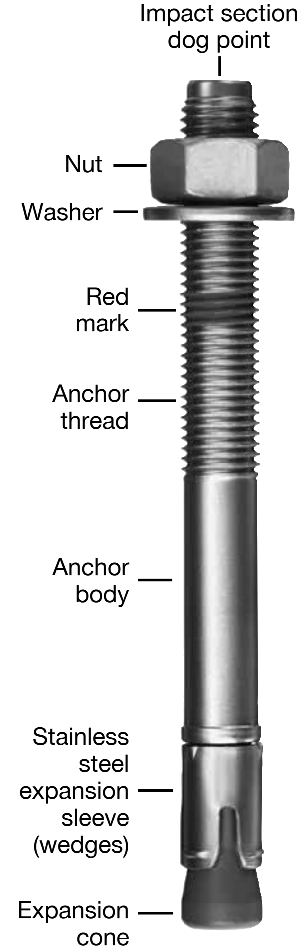
Guide specifications

Torque controlled expansion anchors shall be KWIK Bolt TZ (KB-TZ) supplied by Hilti meeting the description in Federal Specification A-A 1923A, type 4. The anchor bears a length identification mark embossed into the impact section (dog point) of the anchor surrounded by four embossed notches identifying the anchor as a Hilti KWIK Bolt TZ. Anchors are manufactured to meet one of the following conditions:

- The carbon steel anchor body, nut, and washer have an electroplated zinc coating conforming to ASTM B633 to a minimum thickness of 5 µm. The stainless steel expansion sleeve conforms to type 316.
- Stainless steel anchor body, nut and washer conform to type 304. Stainless steel expansion sleeve conforms to type 316.
- Stainless steel anchor body, nut, washer, and expansion sleeve conform to type 316 stainless steel.

Product features

- Product and length identification marks facilitate quality control after installation.
- Through fixture installation and variable thread lengths improve productivity and accommodate various base plate thicknesses.
- Type 316 stainless steel wedges provide superior performance in cracked concrete.
- Ridges on expansion wedges provide increased reliability.
- Mechanical expansion allows immediate load application.
- Raised impact section (dog point) prevents thread damage during installation.
- Bolt meets ductility requirements of ACI 318 Section D1.
- ACI 349-01 Nuclear Design Guide is available. Call Hilti Technical Support.



3.3.5

Listings/Approvals

ICC-ES (International Code Council)
ESR-1917
City of Los Angeles
Research Report No. 25701
FM (Factory Mutual)
Pipe Hanger Components for Automatic Sprinkler Systems for 3/8 through 3/4
UL LLC
Pipe Hanger Equipment for Fire Protection Services for 3/8 through 3/4

Independent code evaluation

IBC® / IRC® 2012
IBC® / IRC® 2009
IBC® / IRC® 2006

3.3.5 KWIK Bolt TZ Expansion Anchor

3.3.5.2 Material specifications

Carbon steel with electroplated zinc

Carbon steel KB-TZ anchors have the following minimum bolt fracture loads.[1]

Anchor diameter (in.)	Shear (lb)	Tension (lb)
3/8	NA	6,744
1/2	7,419	11,240
5/8	11,465	17,535
3/4	17,535	25,853

Carbon steel anchor components plated in accordance with ASTM B633 to a minimum thickness of 5 μm.

Nuts conform to the requirements of ASTM A563, Grade A, Hex.

Washers meet the requirements of ASTM F844.

Expansion sleeves (wedges) are manufactured from type 316 stainless steel

Stainless steel

Stainless steel KB-TZ anchors are made of type 304 or 316 material and have the following minimum bolt fracture loads.[1]

Anchor diameter (in.)	Shear (lb)	Tension (lb)
3/8	5,058	6,519
1/2	8,543	12,364
5/8	13,938	19,109
3/4	22,481	24,729

All nuts and washers are made from type 304 or type 316 stainless steel respectively.

Nuts meet the dimensional requirements of ASTM F594.

Washers meet the dimensional requirements of ANSI B18.22.1, Type A, plain.

Expansion sleeve (wedges) are made from type 316 stainless steel.

1 Bolt fracture loads are determined by testing in a universal tensile machine for quality control at the manufacturing facility. These loads are not intended for design purposes. See tables 4 and 16 for the steel design strengths of carbon steel and stainless steel, respectively.

3.3.5.3 Technical data

The technical data contained in this section are Hilti Simplified Design Tables. The load values were developed using the Strength Design parameters and variables of ESR-1917 and the equations within ACI 318-11 Appendix D. For a detailed explanation of the Hilti Simplified Design Tables, refer to section 3.1.7. Data tables from ESR-1917 are not contained in this section, but can be found at www.icc-es.org or at www.us.hilti.com.

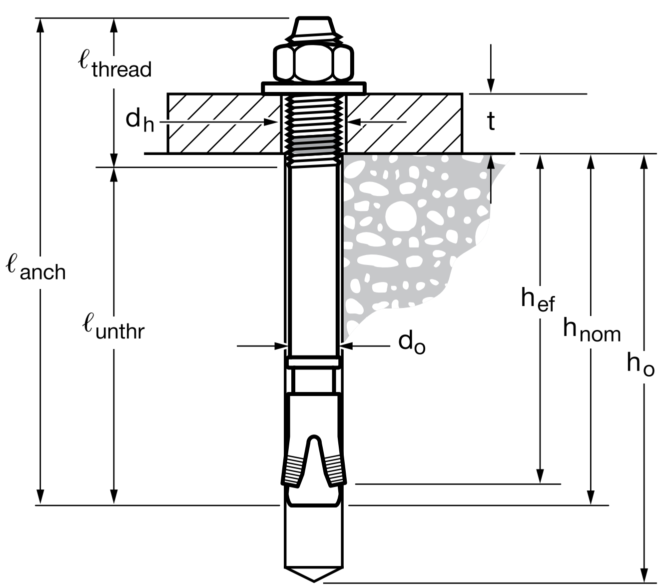
KWIK Bolt TZ Expansion Anchor 3.3.5

Table 1 - KWIK Bolt TZ specifications

Setting information	Symbol	Units	Nominal anchor diameter d_o													
			3/8			1/2				5/8				3/4		
Nominal bit diameter	d_{bit}	in.	3/8			1/2				5/8				3/4		
Minimum nominal embedment	h_{nom}	in.	2-5/16			2-3/8		3-5/8		3-9/16		4-7/16		4-5/16		5-9/16
		(mm)	(59)			(60)		(91)		(91)		(113)		(110)		(142)
Effective minimum embedment	h_{ef}	in.	2			2		3-1/4		3-1/8		4		3-3/4		4-3/4
		(mm)	(51)			(51)		(83)		(79)		(102)		(95)		(121)
Min. hole depth	h_o	in.	2-5/8			2-5/8		4		3-3/4		4-3/4		4-5/8		5-3/4
		(mm)	(67)			(67)		(102)		(95)		(121)		(117)		(146)
Min. thickness of fixture[1]	t_{min}	in.	1/8			1/8		n/a		1/8		n/a		1/8		n/a
		(mm)	(3)			(3)				(3)				(3)		
Max. thickness of fixture	t_{max}	in.	2-1/4			4		2-3/4		5-5/8		4-3/4		4-5/8		3-5/8
		(mm)	(57)			(101)		(70)		(143)		(121)		(117)		(92)
Installation torque	T_{inst}	ft-lb	25			40				60				110		
		(Nm)	(34)			(54)				(81)				(149)		
Fixture hole diameter	d_h	in.	7/16			9/16				11/16				13/16		
		(mm)	(11.1)			(14.3)				(17.5)				(20.6)		
Available anchor lengths	ℓ_{anch}	in.	3	3-3/4	5	3-3/4	4-1/2	5-1/2	7	4-3/4	6	8-1/2	10	5-1/2	8	10
		(mm)	(76)	(95)	(127)	(95)	(114)	(140)	(178)	(121)	(152)	(216)	(254)	(140)	(203)	(254)
Threaded length including dog point	ℓ_{thread}	in.	7/8	1-5/8	2-7/8	1-5/8	2-3/8	3-3/8	4-7/8	1-1/2	2-3/4	5-1/4	6-3/4	1-1/2	4	6
		(mm)	(22)	(41)	(73)	(41)	(60)	(86)	(178)	(38)	(70)	(133)	(171)	(38)	(102)	(152)
Unthreaded length	ℓ_{unthr}	in.	2-1/8			2-1/8				3-1/4				4		
		(mm)	(54)			(54)				(83)				(102)		

1 Minimum thickness of fixture is a concern only when the anchor is installed at the minimum nominal embedment. When KWIK Bolt TZ anchors are installed at this embedment, the anchor threading ends near the surface of the concrete. If the fixture is sufficiently thin, it could be possible to run the nut to the bottom of the threading during application of the installation torque. If fixtures are thin, it is recommended that embedment be increased accordingly.

Figure 1 - KWIK Bolt TZ specifications



3.3.5 KWIK Bolt TZ Expansion Anchor

Table 2 - Hilti KWIK Bolt TZ carbon steel design strength with concrete / pullout failure in uncracked concrete[1,2,3,4]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n				Shear - ϕV_n			
			f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)"	f'_c = 6000 psi lb (kN)	f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	1,635 (7.3)	1,790 (8.0)	2,070 (9.2)	2,535 (11.3)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
1/2	2 (51)	2-3/8 (60)	2,205 (9.8)	2,415 (10.7)	2,790 (12.4)	3,420 (15.2)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
	3-1/4 (83)	3-5/8 (91)	3,585 (15.9)	3,925 (17.5)	4,535 (20.2)	5,555 (24.7)	9,845 (43.8)	10,785 (48.0)	12,450 (55.4)	15,250 (67.8)
5/8	3-1/8 (79)	3-9/16 (91)	4,310 (19.2)	4,720 (21.0)	5,450 (24.2)	6,675 (29.7)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	14,380 (64.0)
	4 (102)	4-7/16 (113)	5,945 (26.4)	6,510 (29.0)	7,520 (33.5)	9,210 (41.0)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
3/4	3-3/4 (95)	4-5/16 (110)	5,380 (23.9)	5,895 (26.2)	6,810 (30.3)	8,340 (37.1)	12,200 (54.3)	13,365 (59.5)	15,430 (68.6)	18,900 (84.1)
	4-3/4 (121)	5-9/16 (142)	6,940 (30.9)	7,605 (33.8)	8,780 (39.1)	10,755 (47.8)	17,390 (77.4)	19,050 (84.7)	22,000 (97.9)	26,945 (119.9)

Table 3 - Hilti KWIK Bolt TZ carbon steel design strength with concrete / pullout failure in cracked concrete[1,2,3,4,5]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n				Shear - ϕV_n			
			f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)	f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	1,475 (6.6)	1,615 (7.2)	1,865 (8.3)	2,285 (10.2)	1,685 (7.5)	1,845 (8.2)	2,130 (9.5)	2,605 (11.6)
1/2	2 (51)	2-3/8 (60)	1,565 (7.0)	1,710 (7.6)	1,975 (8.8)	2,420 (10.8)	1,685 (7.5)	1,845 (8.2)	2,130 (9.5)	2,605 (11.6)
	3-1/4 (83)	3-5/8 (91)	3,195 (14.2)	3,500 (15.6)	4,040 (18.0)	4,950 (22.0)	6,970 (31.0)	7,640 (34.0)	8,820 (39.2)	10,800 (48.0)
5/8	3-1/8 (79)	3-9/16 (91)	3,050 (13.6)	3,345 (14.9)	3,860 (17.2)	4,730 (21.0)	6,575 (29.2)	7,200 (32.0)	8,315 (37.0)	10,185 (45.3)
	4 (102)	4-7/16 (113)	4,420 (19.7)	4,840 (21.5)	5,590 (24.9)	6,845 (30.4)	9,520 (42.3)	10,430 (46.4)	12,040 (53.6)	14,750 (65.6)
3/4	3-3/4 (95)	4-5/16 (110)	4,010 (17.8)	4,395 (19.5)	5,075 (22.6)	6,215 (27.6)	8,640 (38.4)	9,465 (42.1)	10,930 (48.6)	13,390 (59.6)
	4-3/4 (121)	5-9/16 (142)	5,720 (25.4)	6,265 (27.9)	7,235 (32.2)	8,860 (39.4)	12,320 (54.8)	13,495 (60.0)	15,585 (69.3)	19,085 (84.9)

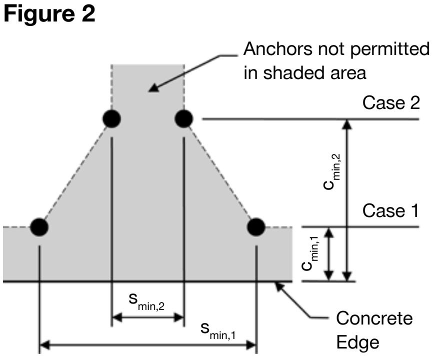
1 See section 3.1.7.3 to convert design strength value to ASD value.
2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
3 Apply spacing, edge distance, and concrete thickness factors in tables 6 to 11 as necessary. Compare to the steel values in table 4. The lesser of the values is to be used for the design.
4 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: for sand-lightweight, λ_a = 0.68; for all-lightweight, λ_a = 0.60
5 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.7.4 for additional information on seismic applications.

Table 4 - Steel strength for Hilti KWIK Bolt TZ carbon steel anchors[1,2]

Nominal anchor diameter	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)	Seismic shear[5] ϕV_{sa} lb (kN)
3/8	4,875 (21.7)	2,335 (10.4)	1,465 (6.5)
1/2	8,030 (35.7)	3,570 (15.9)	3,570 (15.9)
5/8	12,880 (57.3)	5,260 (23.4)	4,940 (22.0)
3/4	18,840 (83.8)	8,890 (39.5)	7,635 (34.0)

1 See section 3.1.7.3 to convert design strength value to ASD value.
2 Hilti KWIK Bolt TZ carbon steel anchors are to be considered ductile steel elements.
3 Tensile $\phi N_{sa} = \phi A_{se,N} f_{uta}$ as noted in ACI 318 Appendix D.
4 Shear values determined by static shear tests with $\phi V_{sa} < \phi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Appendix D.
5 Seismic shear values determined by seismic shear tests with $\phi V_{sa} < \phi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Appendix D. See section 3.1.7.4 for additional information on seismic applications.

Figure 2



For a specific edge distance, the permitted spacing is calculated as follows:

$$s \geq s_{min,2} + \frac{(s_{min,1} - s_{min,2})}{(c_{min,1} - c_{min,2})}(c - c_{min,2})$$

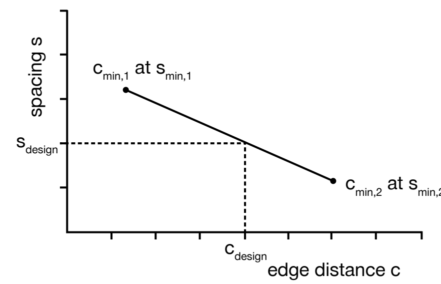


Table 5 - KWIK Bolt TZ carbon steel installation parameters[1]

Setting information	Symbol	Units	Nominal anchor diameter d_o											
			3/8		1/2				5/8			3/4		
Effective minimum embedment	h_{ef}	in. (mm)	2 (51)		2 (51)		3-1/4 (83)		3-1/8 (79)	4 (102)		3-3/4 (95)		4-3/4 (121)
Min. member thickness	h_{min}	in. (mm)	4 (102)	5 (127)	4 (102)	6 (152)	6 (152)	8 (203)	5 (127)	6 (152)	8 (203)	6 (152)	8 (203)	8 (203)
Case 1	$c_{min,1}$	in. (mm)	2-1/2 (64)		2-3/4 (70)		2-3/8 (60)		3-5/8 (92)	3-1/4 (83)		4-3/4 (121)		4-1/8 (105)
	for $s_{min,1} \geq$	in. (mm)	5 (127)		5-3/4 (146)		5-3/4 (146)		6-1/8 (156)	5-7/8 (149)		10-1/2 (267)		8-7/8 (225)
Case 2	$c_{min,2}$	in. (mm)	3-5/8 (92)		4-1/8 (105)		3-1/2 (89)		4-3/4 (121)	4-1/4 (108)		9-1/2 (241)		7-3/4 (197)
	for $s_{min,2} \geq$	in. (mm)	2-1/2 (64)		2-3/4 (70)		2-3/8 (60)		3-1/2 (89)	3 (76)		5 (127)		4 (102)

1 Linear interpolation is permitted to establish an edge distance and spacing combination between Case 1 and Case 2. Linear interpolation for a specific edge distance c, where $c_{min,1} < c < c_{min,2}$, will determine the permissible spacings.

3.3.5 KWIK Bolt TZ Expansion Anchor

Table 6 - Load adjustment factors for 3/8-in. diameter carbon steel KWIK Bolt TZ in uncracked concrete[1,2]

3/8-in. KB-TZ CS uncracked concrete		Spacing factor in tension f_{AN}	Edge distance factor in tension f_{RN}	Spacing factor in shear[3] f_{AV}	Edge distance in shear		Conc. thickness factor in shear[4] f_{HV}
					⊥ Toward edge f_{RV}	II To edge f_{RV}	
Effective embed. h_{ef}	in. (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}	in. (mm)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-1/2 (64)	0.71	0.60	0.60	0.49	0.60	n/a
	3 (76)	0.75	0.69	0.62	0.64	0.69	n/a
	3-1/2 (89)	0.79	0.80	0.64	0.81	0.81	n/a
	3-5/8 (92)	0.80	0.83	0.65	0.85	0.85	n/a
	4 (102)	0.83	0.91	0.67	0.99	0.99	0.81
	4-1/2 (114)	0.88	1.00	0.69	1.00	1.00	0.86
	5 (127)	0.92		0.71			0.91
	5-1/2 (140)	0.96		0.73			0.95
	6 (152)	1.00		0.75			1.00
	7 (178)			0.79			
	8 (203)			0.83			
	9 (229)			0.87			
	10 (254)			0.91			
	11 (279)			0.95			
	12 (305)			1.00			

Table 7 - Load adjustment factors for 3/8-in. diameter carbon steel KWIK Bolt TZ in cracked concrete[1,2]

3/8-in. KB-TZ CS cracked concrete		Spacing factor in tension f_{AN}	Edge distance factor in tension f_{RN}	Spacing factor in shear[3] f_{AV}	Edge distance in shear		Conc. thickness factor in shear[4] f_{HV}
					⊥ Toward edge f_{RV}	II To edge f_{RV}	
Effective embed. h_{ef}	in. (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}	in. (mm)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-1/2 (64)	0.71	0.87	0.60	0.49	0.87	n/a
	3 (76)	0.75	1.00	0.62	0.65	1.00	n/a
	3-1/2 (89)	0.79	1.00	0.65	0.82	1.00	n/a
	3-5/8 (92)	0.80	1.00	0.65	0.86	1.00	n/a
	4 (102)	0.83		0.67	1.00		0.82
	4-1/2 (114)	0.88		0.69	1.00		0.87
	5 (127)	0.92		0.71			0.91
	5-1/2 (140)	0.96		0.73			0.96
	6 (152)	1.00		0.75			1.00
	7 (178)			0.79			
	8 (203)			0.83			
	9 (229)			0.87			
	10 (254)			0.92			
	11 (279)			0.96			
	12 (305)			1.00			

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 5 and figure 2 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

KWIK Bolt TZ Expansion Anchor 3.3.5

Table 8 - Load adjustment factors for 1/2-in. diameter carbon steel KWIK Bolt TZ in uncracked concrete[1,2]

1/2-in. KB-TZ CS uncracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)
Nominal embed. h_{nom}		in. (mm)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-3/8	(60)	n/a	0.62	n/a	0.41	n/a	0.54	n/a	0.13	n/a	0.26	n/a	n/a
	2-1/2	(64)	n/a	0.63	n/a	0.42	n/a	0.55	n/a	0.14	n/a	0.28	n/a	n/a
	2-3/4	(70)	0.73	0.64	0.51	0.44	0.62	0.55	0.51	0.16	0.51	0.33	n/a	n/a
	3	(76)	0.75	0.65	0.55	0.46	0.63	0.55	0.55	0.19	0.55	0.37	n/a	n/a
	3-1/2	(89)	0.79	0.68	0.64	0.51	0.65	0.56	0.64	0.23	0.64	0.47	n/a	n/a
	4	(102)	0.83	0.71	0.73	0.56	0.68	0.57	0.73	0.29	0.73	0.56	0.84	n/a
	4-1/8	(105)	0.84	0.71	0.75	0.57	0.68	0.57	0.75	0.30	0.75	0.57	0.85	n/a
	4-1/2	(114)	0.88	0.73	0.82	0.61	0.70	0.58	0.82	0.34	0.82	0.61	0.89	n/a
	5	(127)	0.92	0.76	0.91	0.67	0.72	0.59	0.91	0.40	0.91	0.67	0.94	n/a
	5-1/2	(140)	0.96	0.78	1.00	0.73	0.74	0.60	1.00	0.46	1.00	0.73	0.98	n/a
	5-3/4	(146)	0.98	0.79		0.77	0.75	0.60		0.49		0.77	1.00	n/a
	6	(152)	1.00	0.81		0.80	0.76	0.61		0.53		0.80		0.66
	7	(178)		0.86		0.93	0.81	0.63		0.66		0.93		0.71
	8	(203)		0.91		1.00	0.85	0.64		0.81		1.00		0.76
	9	(229)		0.96			0.89	0.66		0.97				0.81
	10	(254)		1.00			0.94	0.68		1.00				0.85
	11	(279)					0.98	0.70						0.89
	12	(305)					1.00	0.72						0.93
	14	(356)						0.75						1.00
	16	(406)						0.79						
	18	(457)						0.83						
	> 20	(508)						0.86						

3.3.5

Table 9 - Load adjustment factors for 1/2-in. diameter carbon steel KWIK Bolt TZ in cracked concrete[1,2]

1/2-in. KB-TZ CS cracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)
Nominal embed. h_{nom}		in. (mm)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-3/8	(60)	n/a	0.62	n/a	0.63	n/a	0.54	n/a	0.13	n/a	0.26	n/a	n/a
	2-1/2	(64)	n/a	0.63	n/a	0.65	n/a	0.55	n/a	0.14	n/a	0.29	n/a	n/a
	2-3/4	(70)	0.73	0.64	0.93	0.68	0.62	0.55	0.62	0.16	0.93	0.33	n/a	n/a
	3	(76)	0.75	0.65	1.00	0.71	0.63	0.55	0.71	0.19	1.00	0.38	n/a	n/a
	3-1/2	(89)	0.79	0.68	1.00	0.79	0.65	0.56	0.89	0.24	1.00	0.47	n/a	n/a
	4	(102)	0.83	0.71	1.00	0.86	0.68	0.57	1.00	0.29	1.00	0.58	0.84	n/a
	4-1/8	(105)	0.84	0.71	1.00	0.88	0.68	0.58	1.00	0.30	1.00	0.61	0.85	n/a
	4-1/2	(114)	0.88	0.73		0.94	0.70	0.58		0.34		0.69	0.89	n/a
	5	(127)	0.92	0.76		1.00	0.72	0.59		0.40		0.81	0.94	n/a
	5-1/2	(140)	0.96	0.78			0.74	0.60		0.47		0.93	0.98	n/a
	5-3/4	(146)	0.98	0.79			0.75	0.60		0.50		1.00	1.00	n/a
	6	(152)	1.00	0.81			0.76	0.61		0.53		1.00		0.66
	7	(178)		0.86			0.81	0.63		0.67				0.71
	8	(203)		0.91			0.85	0.65		0.82				0.76
	9	(229)		0.96			0.90	0.66		0.98				0.81
	10	(254)		1.00			0.94	0.68		1.00				0.85
	11	(279)					0.98	0.70						0.90
	12	(305)					1.00	0.72						0.94
	14	(356)						0.76						1.00
	16	(406)						0.79						
	18	(457)						0.83						
	> 20	(508)						0.86						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 5 and figure 2 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

3.3.5 KWIK Bolt TZ Expansion Anchor

Table 10 - Load adjustment factors for 5/8-in. diameter carbon steel KWIK Bolt TZ in uncracked concrete[1,2]

5/8-in. KB-TZ CS uncracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)
Nominal embed. h_{nom}	in. (mm)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm) 3	(76)	n/a	0.63	n/a	n/a	n/a	0.55	n/a	n/a	n/a	n/a	n/a	n/a
3-1/4	(83)	n/a	0.64	n/a	0.46	n/a	0.55	n/a	0.17	n/a	0.34	n/a	n/a
3-1/2	(89)	0.69	0.65	n/a	0.48	0.57	0.56	n/a	0.19	n/a	0.38	n/a	n/a
3-5/8	(92)	0.69	0.65	0.60	0.48	0.57	0.56	0.28	0.20	0.56	0.40	n/a	n/a
4	(102)	0.71	0.67	0.64	0.51	0.58	0.56	0.32	0.23	0.64	0.47	n/a	n/a
4-1/4	(108)	0.73	0.68	0.67	0.53	0.58	0.57	0.35	0.26	0.67	0.51	n/a	n/a
4-1/2	(114)	0.74	0.69	0.70	0.56	0.59	0.57	0.38	0.28	0.70	0.56	n/a	n/a
4-3/4	(121)	0.75	0.70	0.73	0.58	0.59	0.58	0.42	0.30	0.73	0.58	n/a	n/a
5	(127)	0.77	0.71	0.77	0.60	0.60	0.58	0.45	0.33	0.77	0.60	0.63	n/a
5-1/2	(140)	0.79	0.73	0.85	0.64	0.61	0.59	0.52	0.38	0.85	0.64	0.66	n/a
5-7/8	(149)	0.81	0.74	0.90	0.67	0.62	0.59	0.57	0.42	0.90	0.67	0.68	n/a
6	(152)	0.82	0.75	0.92	0.69	0.62	0.59	0.59	0.43	0.92	0.69	0.69	0.62
6-1/8	(156)	0.83	0.76	0.94	0.70	0.62	0.60	0.61	0.44	0.94	0.70	0.69	0.62
8	(203)	0.93	0.83	1.00	0.91	0.66	0.63	0.91	0.66	1.00	0.91	0.79	0.71
10	(254)	1.00	0.92		1.00	0.70	0.66	1.00	0.92		1.00	0.89	0.80
12	(305)		1.00			0.74	0.69		1.00			0.97	0.87
14	(356)					0.77	0.72					1.00	0.94
16	(406)					0.81	0.75						1.00
18	(457)					0.85	0.78						
20	(508)					0.89	0.82						
22	(559)					0.93	0.85						
> 24	(610)					0.97	0.88						

Table 11 - Load adjustment factors for 5/8-in. diameter carbon steel KWIK Bolt TZ in cracked concrete[1,2]

5/8-in. KB-TZ CS cracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)
Nominal embed. h_{nom}	in. (mm)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm) 3	(76)	n/a	0.63	n/a	n/a	n/a	0.55	n/a	n/a	n/a	n/a	n/a	n/a
3-1/4	(83)	n/a	0.64	n/a	0.66	n/a	0.55	n/a	0.17	n/a	0.35	n/a	n/a
3-1/2	(89)	0.69	0.65	n/a	0.69	0.57	0.56	n/a	0.19	n/a	0.39	n/a	n/a
3-5/8	(92)	0.69	0.65	0.83	0.71	0.57	0.56	0.28	0.20	0.56	0.41	n/a	n/a
4	(102)	0.71	0.67	0.89	0.75	0.58	0.56	0.33	0.24	0.65	0.47	n/a	n/a
4-1/4	(108)	0.73	0.68	0.93	0.78	0.58	0.57	0.36	0.26	0.71	0.52	n/a	n/a
4-1/2	(114)	0.74	0.69	0.97	0.81	0.59	0.57	0.39	0.28	0.78	0.56	n/a	n/a
4-3/4	(121)	0.75	0.70	1.00	0.84	0.59	0.58	0.42	0.31	0.84	0.61	n/a	n/a
5	(127)	0.77	0.71		0.87	0.60	0.58	0.45	0.33	0.91	0.66	0.63	n/a
5-1/2	(140)	0.79	0.73		0.93	0.61	0.59	0.52	0.38	1.00	0.76	0.66	n/a
5-7/8	(149)	0.81	0.74		0.98	0.62	0.59	0.58	0.42		0.84	0.68	n/a
6	(152)	0.82	0.75		1.00	0.62	0.60	0.60	0.43		0.87	0.69	0.62
6-1/8	(156)	0.83	0.76			0.62	0.60	0.62	0.45		0.89	0.69	0.62
8	(203)	0.93	0.83			0.66	0.63	0.92	0.67		1.00	0.79	0.71
10	(254)	1.00	0.92			0.70	0.66	1.00	0.93			0.89	0.80
12	(305)		1.00			0.74	0.69		1.00			0.97	0.87
14	(356)					0.78	0.72					1.00	0.94
16	(406)					0.82	0.75						1.00
18	(457)					0.85	0.79						
20	(508)					0.89	0.82						
22	(559)					0.93	0.85						
> 24	(610)					0.97	0.88						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

(Shaded cell) If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 5 and figure 2 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

KWIK Bolt TZ Expansion Anchor 3.3.5

Table 12 - Load adjustment factors for 3/4-in. diameter carbon steel KWIK Bolt TZ in uncracked concrete[1,2]

3/4-in. KB-TZ CS uncracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)
Nominal embed. h_{nom}	in. (mm)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (142)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): 4	(102)	n/a	0.64	n/a	n/a	n/a	0.56	n/a	n/a	n/a	n/a	n/a	n/a
4-1/8	(105)	n/a	0.64	n/a	0.55	n/a	0.56	n/a	0.21	n/a	0.41	n/a	n/a
4-1/2	(114)	n/a	0.66	n/a	0.57	n/a	0.56	n/a	0.24	n/a	0.47	n/a	n/a
4-3/4	(121)	n/a	0.67	0.49	0.59	n/a	0.57	0.35	0.26	0.49	0.51	n/a	n/a
5	(127)	0.72	0.68	0.51	0.61	0.59	0.57	0.38	0.28	0.51	0.55	n/a	n/a
5-1/2	(140)	0.74	0.69	0.55	0.65	0.60	0.58	0.43	0.32	0.55	0.64	n/a	n/a
6	(152)	0.77	0.71	0.60	0.69	0.60	0.58	0.49	0.36	0.60	0.69	0.65	n/a
7	(178)	0.81	0.75	0.70	0.78	0.62	0.60	0.62	0.46	0.70	0.78	0.70	n/a
7-3/4	(197)	0.84	0.77	0.78	0.86	0.63	0.61	0.72	0.53	0.78	0.86	0.73	n/a
8	(203)	0.86	0.78	0.80	0.89	0.64	0.61	0.76	0.56	0.80	0.89	0.75	0.67
8-7/8	(225)	0.89	0.81	0.89	0.99	0.65	0.63	0.89	0.65	0.89	0.99	0.78	0.71
9-1/2	(241)	0.92	0.83	0.95	1.00	0.66	0.63	0.98	0.72	0.98	1.00	0.81	0.73
10	(254)	0.94	0.85	1.00		0.67	0.64	1.00	0.78	1.00		0.83	0.75
10-1/2	(267)	0.97	0.87			0.68	0.65		0.84			0.85	0.77
12	(305)	1.00	0.92			0.71	0.67		1.00			0.91	0.82
14	(356)		0.99			0.74	0.70					0.99	0.89
16	(406)		1.00			0.78	0.73					1.00	0.95
18	(457)					0.81	0.75						1.00
20	(508)					0.85	0.78						
22	(559)					0.88	0.81						
> 24	(610)					0.92	0.84						

Table 13 - Load adjustment factors for 3/4-in. diameter carbon steel KWIK Bolt TZ in cracked concrete[1,2]

3/4-in. KB-TZ CS cracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)
Nominal embed. h_{nom}	in. (mm)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (142)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): 4	(102)	n/a	0.64	n/a	n/a	n/a	0.56	n/a	n/a	n/a	n/a	n/a	n/a
4-1/8	(105)	n/a	0.64	n/a	0.69	n/a	0.56	n/a	0.21	n/a	0.42	n/a	n/a
4-1/2	(114)	n/a	0.66	n/a	0.73	n/a	0.56	n/a	0.24	n/a	0.48	n/a	n/a
4-3/4	(121)	n/a	0.67	0.88	0.75	n/a	0.57	0.35	0.26	0.70	0.52	n/a	n/a
5	(127)	0.72	0.68	0.91	0.77	0.59	0.57	0.38	0.28	0.76	0.56	n/a	n/a
5-1/2	(140)	0.74	0.69	0.98	0.83	0.60	0.58	0.44	0.32	0.87	0.64	n/a	n/a
6	(152)	0.77	0.71	1.00	0.88	0.60	0.59	0.50	0.37	1.00	0.73	0.65	n/a
7	(178)	0.81	0.75	1.00	0.99	0.62	0.60	0.63	0.46	1.00	0.92	0.70	n/a
7-3/4	(197)	0.84	0.77	1.00	1.00	0.64	0.61	0.73	0.54	1.00	1.00	0.74	n/a
8	(203)	0.86	0.78	1.00		0.64	0.61	0.77	0.56	1.00		0.75	0.67
8-7/8	(225)	0.89	0.81	1.00		0.65	0.63	0.90	0.66	1.00		0.79	0.71
9-1/2	(241)	0.92	0.83	1.00		0.67	0.64	0.99	0.73	1.00		0.81	0.74
10	(254)	0.94	0.85			0.67	0.64	1.00	0.79			0.84	0.75
10-1/2	(267)	0.97	0.87			0.68	0.65		0.85			0.86	0.77
12	(305)	1.00	0.92			0.71	0.67		1.00			0.92	0.83
14	(356)		0.99			0.74	0.70					0.99	0.89
16	(406)		1.00			0.78	0.73					1.00	0.95
18	(457)					0.81	0.76						1.00
20	(508)					0.85	0.78						
22	(559)					0.88	0.81						
> 24	(610)					0.92	0.84						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

[shaded cell] If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 5 and figure 2 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

3.3.5

3.3.5 KWIK Bolt TZ Expansion Anchor

Table 14 - Hilti KWIK Bolt TZ stainless steel design strength with concrete / pullout failure in uncracked concrete[1,2,3,4]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n f'_c = 2500 psi lb (kN)	Tension - ϕN_n f'_c = 3000 psi lb (kN)	Tension - ϕN_n f'_c = 4000 psi lb (kN)	Tension - ϕN_n f'_c = 6000 psi lb (kN)	Shear - ϕV_n f'_c = 2500 psi lb (kN)	Shear - ϕV_n f'_c = 3000 psi lb (kN)	Shear - ϕV_n f'_c = 4000 psi lb (kN)	Shear - ϕV_n f'_c = 6000 psi lb (kN)
3/8	2	2-5/16	1,710	1,875	2,160	2,650	2,375	2,605	3,005	3,680
	(51)	(59)	(7.6)	(8.3)	(9.6)	(11.8)	(10.6)	(11.6)	(13.4)	(16.4)
1/2	2	2-3/8	1,865	2,045	2,360	2,890	2,375	2,605	3,005	3,680
	(51)	(60)	(8.3)	(9.1)	(10.5)	(12.9)	(10.6)	(11.6)	(13.4)	(16.4)
	3-1/4	3-5/8	3,745	4,100	4,735	5,800	9,845	10,785	12,450	15,250
	(83)	(91)	(16.7)	(18.2)	(21.1)	(25.8)	(43.8)	(48.0)	(55.4)	(67.8)
5/8	3-1/8	3-9/16	4,310	4,720	5,450	6,675	9,280	10,165	11,740	14,380
	(79)	(91)	(19.2)	(21.0)	(24.2)	(29.7)	(41.3)	(45.2)	(52.2)	(64.0)
	4	4-7/16	6,240	6,835	7,895	9,665	13,440	14,725	17,000	20,820
	(102)	(113)	(27.8)	(30.4)	(35.1)	(43.0)	(59.8)	(65.5)	(75.6)	(92.6)
3/4	3-3/4	4-5/16	5,665	6,205	7,165	8,775	12,200	13,365	15,430	18,900
	(95)	(110)	(25.2)	(27.6)	(31.9)	(39.0)	(54.3)	(59.5)	(68.6)	(84.1)
	4-3/4	5-9/16	7,825	8,575	9,900	12,125	17,390	19,050	22,000	26,945
	(121)	(142)	(34.8)	(38.1)	(44.0)	(53.9)	(77.4)	(84.7)	(97.9)	(119.9)

Table 15 - Hilti KWIK Bolt TZ stainless steel design strength with concrete / pullout failure in cracked concrete[1,2,3,4,5]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n f'_c = 2500 psi lb (kN)	Tension - ϕN_n f'_c = 3000 psi lb (kN)	Tension - ϕN_n f'_c = 4000 psi lb (kN)	Tension - ϕN_n f'_c = 6000 psi lb (kN)	Shear - ϕV_n f'_c = 2500 psi lb (kN)	Shear - ϕV_n f'_c = 3000 psi lb (kN)	Shear - ϕV_n f'_c = 4000 psi lb (kN)	Shear - ϕV_n f'_c = 6000 psi lb (kN)
3/8	2	2-5/16	1,520	1,665	1,925	2,355	1,685	1,845	2,130	2,605
	(51)	(59)	(6.8)	(7.4)	(8.6)	(10.5)	(7.5)	(8.2)	(9.5)	(11.6)
1/2	2	2-3/8	1,750	1,915	2,210	2,710	2,375	2,605	3,005	3,680
	(51)	(60)	(7.8)	(8.5)	(9.8)	(12.1)	(10.6)	(11.6)	(13.4)	(16.4)
	3-1/4	3-5/8	3,235	3,545	4,095	5,015	6,970	7,640	8,820	10,800
	(83)	(91)	(14.4)	(15.8)	(18.2)	(22.3)	(31.0)	(34.0)	(39.2)	(48.0)
5/8	3-1/8	3-9/16	3,050	3,345	3,860	4,730	6,575	7,200	8,315	10,185
	(79)	(91)	(13.6)	(14.9)	(17.2)	(21.0)	(29.2)	(32.0)	(37.0)	(45.3)
	4	4-7/16	3,795	4,160	4,800	5,880	9,520	10,430	12,040	14,750
	(102)	(113)	(16.9)	(18.5)	(21.4)	(26.2)	(42.3)	(46.4)	(53.6)	(65.6)
3/4	3-3/4	4-5/16	5,270	5,775	6,670	8,165	12,200	13,365	15,430	18,900
	(95)	(110)	(23.4)	(25.7)	(29.7)	(36.3)	(54.3)	(59.5)	(68.6)	(84.1)
	4-3/4	5-9/16	5,720	6,265	7,235	8,860	12,320	13,495	15,585	19,085
	(121)	(142)	(25.4)	(27.9)	(32.2)	(39.4)	(54.8)	(60.0)	(69.3)	(84.9)

1 See section 3.1.7.3 to convert design strength value to ASD value.
2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
3 Apply spacing, edge distance, and concrete thickness factors in tables 18 to 25 as necessary. Compare to the steel values in table 16. The lesser of the values is to be used for the design.
4 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: for sand-lightweight, λ_a = 0.68; for all-lightweight, λ_a = 0.60
5 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.7.4 for additional information on seismic applications.

Table 16 - Steel strength for Hilti KWIK Bolt TZ stainless steel anchors[1,2]

Nominal anchor diameter	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)	Seismic shear[5] ϕV_{sa} lb (kN)
3/8	4,475 (19.9)	3,070 (13.7)	1,835 (8.2)
1/2	8,665 (38.5)	4,470 (19.9)	4,470 (19.9)
5/8	13,410 (59.7)	6,415 (28.5)	6,080 (27.0)
3/4	18,040 (80.2)	10,210 (45.4)	8,380 (37.3)

1 See section 3.1.7.3 to convert design strength value to ASD value.
2 Hilti KWIK Bolt TZ stainless steel anchors are to be considered ductile steel elements.
3 Tensile $\phi N_{sa} = \phi A_{se,N} f_{uta}$ as noted in ACI 318 Appendix D.
4 Shear values determined by static shear tests with $\phi V_{sa} < \phi\ 0.60 A_{se,V} f_{uta}$ as noted in ACI 318 Appendix D.
5 Seismic shear values determined by seismic shear tests with $\phi_{Vsa} < \phi\ 0.60 A_{se,V} f_{uta}$ as noted in ACI 318 Appendix D. See section 3.1.7.4 for additional information on seismic applications.

3.3.5

Figure 3

For a specific edge distance, the permitted spacing is calculated as follows:

$$s \geq s_{min,2} + \frac{(s_{min,1} - s_{min,2})}{(c_{min,1} - c_{min,2})}(c - c_{min,2})$$

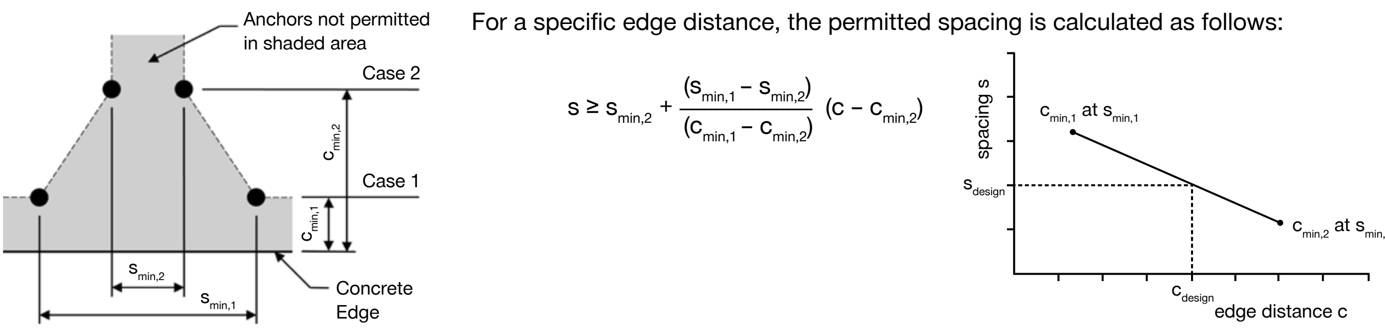


Table 17 - Stainless steel KWIK Bolt TZ installation parameters[1]

Setting information	Symbol	Units	Nominal anchor diameter d_o											
			3/8		1/2				5/8			3/4		
Effective minimum embedment[1]	h_{ef}	in.	2		2		3-1/4		3-1/8	4		3-3/4		4-3/4
		(mm)	(51)		(51)		(83)		(79)	(102)		(95)		(121)
Min. member thickness	h_{min}	in.	4	5	4	6	6	8	5	6	8	6	8	
		(mm)	(102)	(127)	(102)	(152)	(152)	(203)	(127)	(152)	(203)	(152)	(203)	
Case 1	$c_{min,1}$	in.	2-1/2		2-7/8		2-1/8		3-1/4	2-3/8		4-1/4		4
		(mm)	(64)		(73)		(54)		(83)	(60)		(108)		(102)
	for $s_{min,1} \geq$	in.	5		5-3/4		5-1/4		5-1/2	5-1/2		10		8-1/2
		(mm)	(127)		(146)		(133)		(140)	(140)		(254)		(216)
Case 2	$c_{min,2}$	in.	3-1/2		4-1/2		3-1/4		4-1/8	4-1/4		9-1/2		7
		(mm)	(89)		(114)		(83)		(105)	(108)		(241)		(178)
	for $s_{min,2} \geq$	in.	2-1/4		2-7/8		2		2-3/4	2-3/8		5		4
		(mm)	(57)		(73)		(51)		(70)	(60)		(127)		(102)

1 Linear interpolation is permitted to establish an edge distance and spacing combination between Case 1 and Case 2. Linear interpolation for a specific edge distance c, where $c_{min,1} < c < c_{min,2}$, will determine the permissible spacings.

3.3.5 KWIK Bolt TZ Expansion Anchor

Table 18 - Load adjustment factors for 3/8-in. diameter stainless steel KWIK Bolt TZ in uncracked concrete[1,2]

3/8-in. KB-TZ SS uncracked concrete			Spacing factor in tension f_{AN}	Edge distance factor in tension f_{RN}	Spacing factor in shear[3] f_{AV}	Edge distance in shear		Conc. thickness factor in shear[4] f_{HV}
						⊥ toward edge f_{RV}	II to edge f_{RV}	
Effective embed. h_{ef}	in.	(mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}	in.	(mm)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-1/4	(57)	0.69	n/a	0.59	n/a	n/a	n/a
	2-1/2	(64)	0.71	0.60	0.60	0.49	0.60	n/a
	3	(76)	0.75	0.69	0.62	0.64	0.69	n/a
	3-1/2	(89)	0.79	0.80	0.64	0.81	0.81	n/a
	4	(102)	0.83	0.91	0.67	0.99	0.99	0.81
	4-1/2	(114)	0.88	1.00	0.69	1.00	1.00	0.86
	5	(127)	0.92		0.71			0.91
	5-1/2	(140)	0.96		0.73			0.95
	6	(152)	1.00		0.75			1.00
	7	(178)			0.79			
	8	(203)			0.83			
	9	(229)			0.87			
	10	(254)			0.91			
	11	(279)			0.95			
	12	(305)			1.00			

Table 19 - Load Adjustment Factors for 3/8-in. Diameter Stainless Steel KWIK Bolt TZ in Cracked Concrete[1,2]

3/8-in. KB-TZ SS cracked concrete			Spacing factor in tension f_{AN}	Edge distance factor in tension f_{RN}	Spacing factor in shear[3] f_{AV}	Edge distance in shear		Conc. thickness factor in shear[4] f_{HV}
						⊥ toward edge f_{RV}	II to edge f_{RV}	
Effective embed. h_{ef}	in.	(mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}	in.	(mm)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-1/4	(57)	0.69	n/a	0.59	n/a	n/a	n/a
	2-1/2	(64)	0.71	0.87	0.60	0.49	0.87	n/a
	3	(76)	0.75	1.00	0.62	0.65	1.00	n/a
	3-1/2	(89)	0.79	1.00	0.65	0.82	1.00	n/a
	4	(102)	0.83		0.67	1.00		0.82
	4-1/2	(114)	0.88		0.69			0.87
	5	(127)	0.92		0.71			0.91
	5-1/2	(140)	0.96		0.73			0.96
	6	(152)	1.00		0.75			1.00
	7	(178)			0.79			
	8	(203)			0.83			
	9	(229)			0.87			
	10	(254)			0.92			
	11	(279)			0.96			
	12	(305)			1.00			

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 17 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

Table 20 - Load adjustment factors for 1/2-in. diameter stainless steel KWIK Bolt TZ in uncracked concrete[1,2]

1/2-in. KB-TZ SS uncracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)
Nominal embed. h_{nom}	in. (mm)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)													
2	(51)	n/a	0.60	n/a	n/a	n/a	0.54	n/a	n/a	n/a	n/a	n/a	n/a
2-1/8	(54)	n/a	0.61	n/a	0.39	n/a	0.54	n/a	0.11	n/a	0.22	n/a	n/a
2-7/8	(73)	0.74	0.65	0.53	0.45	0.63	0.55	0.53	0.17	0.53	0.35	n/a	n/a
3	(76)	0.75	0.65	0.55	0.46	0.63	0.55	0.55	0.19	0.55	0.37	n/a	n/a
3-1/4	(83)	0.77	0.67	0.59	0.49	0.64	0.56	0.59	0.21	0.59	0.42	n/a	n/a
3-1/2	(89)	0.79	0.68	0.64	0.51	0.65	0.56	0.64	0.23	0.64	0.47	n/a	n/a
4	(102)	0.83	0.71	0.73	0.56	0.68	0.57	0.73	0.29	0.73	0.56	0.84	n/a
4-1/2	(114)	0.88	0.73	0.82	0.61	0.70	0.58	0.82	0.34	0.82	0.61	0.89	n/a
5	(127)	0.92	0.76	0.91	0.67	0.72	0.59	0.91	0.40	0.91	0.67	0.94	n/a
5-1/4	(133)	0.94	0.77	0.95	0.70	0.73	0.60	0.95	0.43	0.95	0.70	0.96	n/a
5-1/2	(140)	0.96	0.78	1.00	0.73	0.74	0.60	1.00	0.46	1.00	0.73	0.98	n/a
6	(152)	1.00	0.81		0.80	0.76	0.61		0.53		0.80	1.00	0.66
7	(178)		0.86		0.93	0.81	0.63		0.66		0.93		0.71
8	(203)		0.91		1.00	0.85	0.64		0.81		1.00		0.76
9	(229)		0.96			0.89	0.66		0.97				0.81
10	(254)		1.00			0.94	0.68		1.00				0.85
11	(279)					0.98	0.70						0.89
12	(305)					1.00	0.72						0.93
14	(356)						0.75						1.00
16	(406)						0.79						
18	(457)						0.83						
> 20	(508)						0.86						

3.3.5

Table 21 - Load adjustment factors for 1/2-in. diameter stainless steel KWIK Bolt TZ in cracked concrete[1,2]

1/2-in. KB-TZ SS cracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)
Nominal embed. h_{nom}	in. (mm)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)													
2	(51)	n/a	0.60	n/a	n/a	n/a	0.54	n/a	n/a	n/a	n/a	n/a	n/a
2-1/8	(54)	n/a	0.61	n/a	0.60	n/a	0.54	n/a	0.11	n/a	0.22	n/a	n/a
2-7/8	(73)	0.74	0.65	0.97	0.70	0.60	0.55	0.47	0.18	0.94	0.35	n/a	n/a
3	(76)	0.75	0.65	1.00	0.71	0.60	0.55	0.50	0.19	1.00	0.38	n/a	n/a
3-1/4	(83)	0.77	0.67	1.00	0.75	0.61	0.56	0.56	0.21	1.00	0.42	n/a	n/a
3-1/2	(89)	0.79	0.68	1.00	0.79	0.62	0.56	0.63	0.24	1.00	0.47	n/a	n/a
4	(102)	0.83	0.71	1.00	0.86	0.64	0.57	0.77	0.29	1.00	0.58	0.75	n/a
4-1/2	(114)	0.88	0.73	1.00	0.94	0.66	0.58	0.92	0.34	1.00	0.69	0.79	n/a
5	(127)	0.92	0.76		1.00	0.67	0.59	1.00	0.40		0.81	0.84	n/a
5-1/4	(133)	0.94	0.77			0.68	0.60		0.43		0.87	0.86	n/a
5-1/2	(140)	0.96	0.78			0.69	0.60		0.47		0.93	0.88	n/a
6	(152)	1.00	0.81			0.71	0.61		0.53		1.00	0.92	0.66
7	(178)		0.86			0.74	0.63		0.67			0.99	0.71
8	(203)		0.91			0.78	0.65		0.82			1.00	0.76
9	(229)		0.96			0.81	0.66		0.98				0.81
10	(254)		1.00			0.85	0.68		1.00				0.85
11	(279)					0.88	0.70						0.90
12	(305)					0.92	0.72						0.94
14	(356)					0.99	0.76						1.00
16	(406)					1.00	0.79						
18	(457)						0.83						
> 20	(508)						0.86						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 17 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

3.3.5 KWIK Bolt TZ Expansion Anchor

Table 22 - Load adjustment factors for 5/8-in. diameter stainless steel KWIK Bolt TZ in uncracked concrete[1,2]

5/8-in. KB-TZ SS uncracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)
Nominal embed. h_{nom}	in. (mm)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): 2-3/8	(60)	n/a	0.60	n/a	0.39	n/a	0.54	n/a	0.11	n/a	0.21	n/a	n/a
2-3/4	(70)	0.65	0.61	n/a	0.41	0.55	0.54	n/a	0.13	n/a	0.27	n/a	n/a
3	(76)	0.66	0.63	n/a	0.43	0.56	0.55	n/a	0.15	n/a	0.30	n/a	n/a
3-1/4	(83)	0.67	0.64	0.51	0.45	0.56	0.55	0.24	0.17	0.47	0.34	n/a	n/a
3-1/2	(89)	0.69	0.65	0.54	0.47	0.57	0.56	0.26	0.19	0.53	0.38	n/a	n/a
4	(102)	0.71	0.67	0.59	0.51	0.58	0.56	0.32	0.23	0.59	0.47	n/a	n/a
4-1/2	(114)	0.74	0.69	0.65	0.55	0.59	0.57	0.38	0.28	0.65	0.55	n/a	n/a
5	(127)	0.77	0.71	0.71	0.59	0.60	0.58	0.45	0.33	0.71	0.59	0.63	n/a
5-1/2	(140)	0.79	0.73	0.79	0.63	0.61	0.59	0.52	0.38	0.79	0.63	0.66	n/a
6	(152)	0.82	0.75	0.86	0.68	0.62	0.59	0.59	0.43	0.86	0.68	0.69	0.62
7	(178)	0.87	0.79	1.00	0.79	0.64	0.61	0.75	0.54	1.00	0.79	0.74	0.67
8	(203)	0.93	0.83		0.90	0.66	0.63	0.91	0.66		0.90	0.79	0.71
10	(254)	1.00	0.92		1.00	0.70	0.66	1.00	0.92		1.00	0.89	0.80
12	(305)		1.00			0.74	0.69		1.00			0.97	0.87
14	(356)					0.77	0.72					1.00	0.94
16	(406)					0.81	0.75						1.00
18	(457)					0.85	0.78						
20	(508)					0.89	0.82						
22	(559)					0.93	0.85						
> 24	(610)					0.97	0.88						

Table 23 - Load adjustment factors for 5/8-in. diameter stainless steel KWIK Bolt TZ in cracked concrete[1,2]

5/8-in. KB-TZ SS cracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)
Nominal embed. h_{nom}	in. (mm)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): 2-3/8	(60)	n/a	0.60	n/a	0.57	n/a	0.54	n/a	011	n/a	0.22	n/a	n/a
2-3/4	(70)	n/a	0.61	n/a	0.61	n/a	0.54	n/a	0.13	n/a	0.27	n/a	n/a
3	(76)	0.66	0.63	n/a	0.64	0.56	0.55	n/a	0.15	n/a	0.31	n/a	n/a
3-1/4	(83)	0.67	0.64	0.77	0.66	0.56	0.55	0.24	0.17	0.48	0.35	n/a	n/a
3-1/2	(89)	0.69	0.65	0.81	0.69	0.57	0.56	0.27	0.19	0.53	0.39	n/a	n/a
4	(102)	0.71	0.67	0.89	0.75	0.58	0.56	0.33	0.24	0.65	0.47	n/a	n/a
4-1/2	(114)	0.74	0.69	0.97	0.81	0.59	0.57	0.39	0.28	0.78	0.56	n/a	n/a
5	(127)	0.77	0.71	1.00	0.87	0.60	0.58	0.45	0.33	0.91	0.66	0.63	n/a
5-1/2	(140)	0.79	0.73		0.93	0.61	0.59	0.52	0.38	1.00	0.76	0.66	n/a
6	(152)	0.82	0.75		1.00	0.62	0.60	0.60	0.43		0.87	0.69	0.62
7	(178)	0.87	0.79			0.64	0.61	0.75	0.55		1.00	0.74	0.67
8	(203)	0.93	0.83			0.66	0.63	0.92	0.67			0.79	0.71
10	(254)	1.00	0.92			0.70	0.66	1.00	0.93			0.89	0.80
12	(305)		1.00			0.74	0.69		1.00			0.97	0.87
14	(356)					0.78	0.72					1.00	0.94
16	(406)					0.82	0.75						1.00
18	(457)					0.85	0.79						
20	(508)					0.89	0.82						
22	(559)					0.93	0.85						
> 24	(610)					0.97	0.88						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 17 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

KWIK Bolt TZ Expansion Anchor 3.3.5

Table 24 - Load adjustment factors for 3/4-in. diameter stainless steel KWIK Bolt TZ in uncracked concrete[1,2]

3/4-in. KB-TZ CS uncracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)
Nominal embed. h_{nom}		in. (mm)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (142)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	4	(102)	n/a	0.64	n/a	0.54	n/a	0.56	n/a	0.20	n/a	0.40	n/a	n/a
	4-1/4	(108)	n/a	0.65	0.46	0.56	n/a	0.56	0.29	0.22	0.46	0.43	n/a	n/a
	4-1/2	(114)	n/a	0.66	0.48	0.57	n/a	0.56	0.32	0.24	0.48	0.47	n/a	n/a
	5	(127)	0.72	0.68	0.51	0.61	0.59	0.57	0.38	0.28	0.51	0.55	n/a	n/a
	5-1/2	(140)	0.74	0.69	0.55	0.65	0.60	0.58	0.43	0.32	0.55	0.64	n/a	n/a
	6	(152)	0.77	0.71	0.60	0.69	0.60	0.58	0.49	0.36	0.60	0.69	0.65	n/a
	7	(178)	0.81	0.75	0.70	0.78	0.62	0.60	0.62	0.46	0.70	0.78	0.70	n/a
	8	(203)	0.86	0.78	0.80	0.89	0.64	0.61	0.76	0.56	0.80	0.89	0.75	0.67
	9	(229)	0.90	0.82	0.90	1.00	0.66	0.63	0.91	0.67	0.91	1.00	0.79	0.71
	9-1/2	(241)	0.92	0.83	0.95		0.66	0.63	0.98	0.72	0.98		0.81	0.73
	10	(254)	0.94	0.85	1.00		0.67	0.64	1.00	0.78	1.00		0.83	0.75
	12	(305)	1.00	0.92			0.71	0.67		1.00			0.91	0.82
	14	(356)		0.99			0.74	0.70					0.99	0.89
	16	(406)		1.00			0.78	0.73					1.00	0.95
	18	(457)					0.81	0.75						1.00
	20	(508)					0.85	0.78						
	22	(559)					0.88	0.81						
	> 24	(610)					0.92	0.84						

Table 25 - Load adjustment factors for 3/4-in. diameter stainless steel KWIK Bolt TZ in cracked concrete[1,2]

3/4-in. KB-TZ SS cracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)
Nominal embed. h_{nom}		in. (mm)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (142)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	4	(102)	n/a	0.64	n/a	0.68	n/a	0.56	n/a	0.20	n/a	0.40	n/a	n/a
	4-1/4	(108)	n/a	0.65	0.81	0.70	n/a	0.56	0.21	0.22	0.42	0.44	n/a	n/a
	4-1/2	(114)	n/a	0.66	0.85	0.73	n/a	0.56	0.23	0.24	0.46	0.48	n/a	n/a
	5	(127)	0.72	0.68	0.91	0.77	0.57	0.57	0.27	0.28	0.54	0.56	n/a	n/a
	5-1/2	(140)	0.74	0.69	0.98	0.83	0.58	0.58	0.31	0.32	0.62	0.64	n/a	n/a
	6	(152)	0.77	0.71	1.00	0.88	0.58	0.59	0.35	0.37	0.71	0.73	0.58	n/a
	7	(178)	0.81	0.75	1.00	0.99	0.60	0.60	0.44	0.46	0.89	0.92	0.62	n/a
	8	(203)	0.86	0.78	1.00	1.00	0.61	0.61	0.54	0.56	1.00	1.00	0.67	0.67
	9	(229)	0.90	0.82	1.00		0.62	0.63	0.65	0.67	1.00		0.71	0.72
	9-1/2	(241)	0.92	0.83	1.00		0.63	0.64	0.70	0.73	1.00		0.73	0.74
	10	(254)	0.94	0.85			0.64	0.64	0.76	0.79			0.74	0.75
	12	(305)	1.00	0.92			0.67	0.67	1.00	1.00			0.82	0.83
	14	(356)		0.99			0.69	0.70					0.88	0.89
	16	(406)		1.00			0.72	0.73					0.94	0.95
	18	(457)					0.75	0.76					1.00	1.00
	20	(508)					0.78	0.78						
	22	(559)					0.81	0.81						
	> 24	(610)					0.83	0.84						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 17 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

3.3.5

3.3.5 KWIK Bolt TZ Expansion Anchor

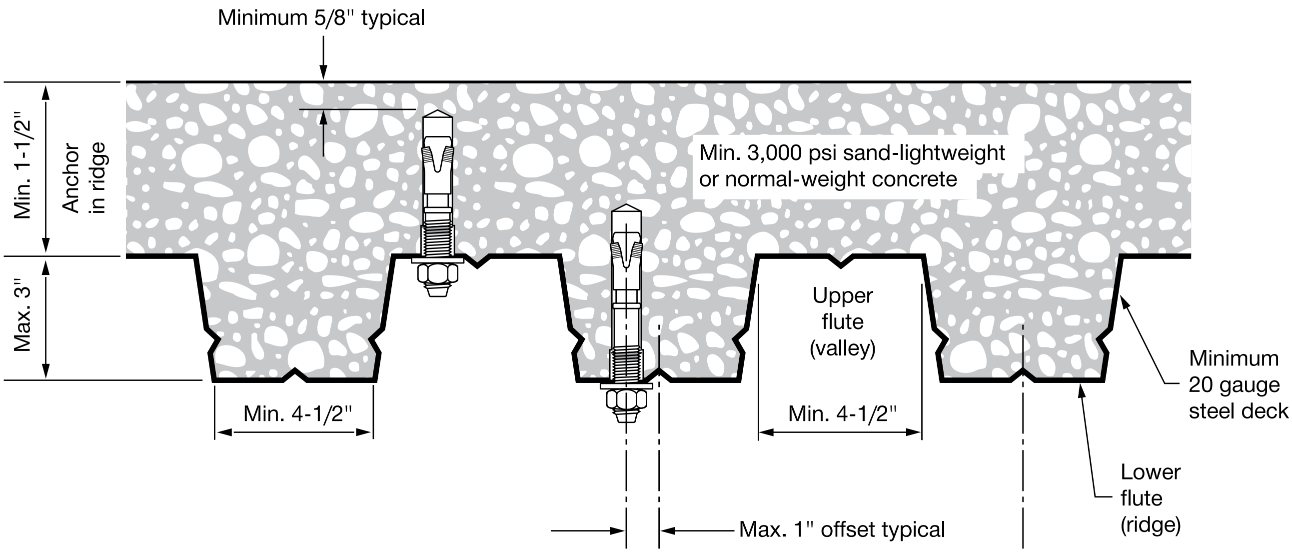


Figure 4 - Installation of KWIK Bolt TZ in the soffit of concrete over metal deck floor and roof assemblies - W Deck

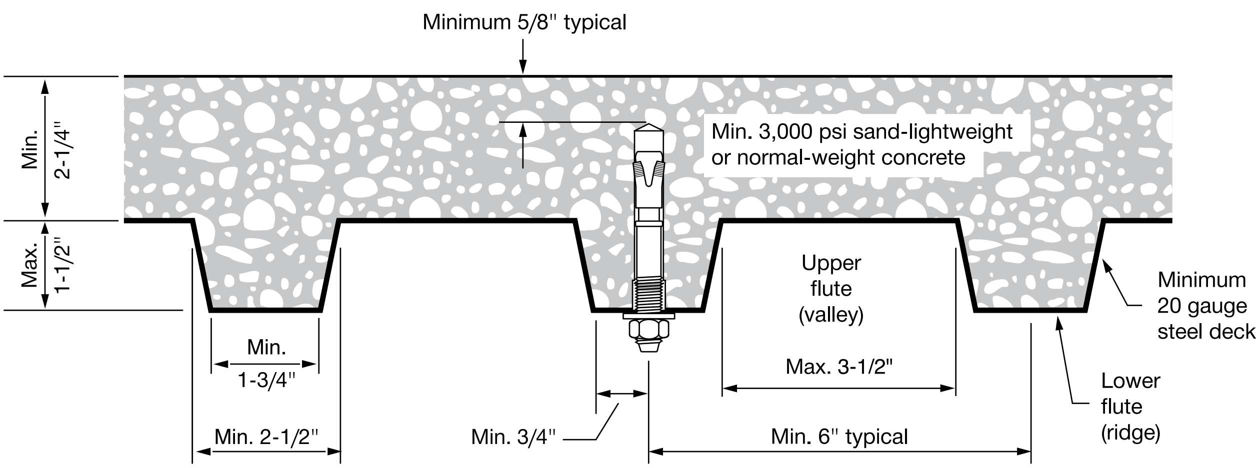


Figure 5 - Installation of KWIK Bolt TZ in the soffit of concrete over metal deck floor and roof assemblies - B Deck

KWIK Bolt TZ Expansion Anchor 3.3.5

Table 26 - Hilti KWIK Bolt TZ carbon steel design strength in the soffit of uncracked lightweight concrete over metal deck[1,2,3,4,5,6]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Loads according to Figure 4				Loads according to Figure 5			
			Tension - ϕN_n		Shear - ϕV_n		Tension - ϕN_n		Shear - ϕV_n	
			f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	1,340 (6.0)	1,545 (6.9)	1,385 (6.2)	1,385 (6.2)	1,200 (5.3)	1,385 (6.2)	1,850 (8.2)	1,850 (8.2)
1/2	2 (51)	2-3/8 (60)	1,340 (6.0)	1,545 (6.9)	1,950 (8.7)	1,950 (8.7)	1,210 (5.4)	1,395 (6.2)	1,680 (7.5)	1,680 (7.5)
	3-1/4 (83)	3-5/8 (92)	2,400 (10.7)	2,770 (12.3)	3,215 (14.3)	3,215 (14.3)	2,195 (9.8)	2,535 (11.3)	2,565 (11.4)	2,565 (11.4)
5/8	3-1/8 (79)	3-9/16 (90)	1,835 (8.2)	2,120 (9.4)	2,990 (13.3)	2,990 (13.3)	2,640 (11.7)	3,050 (13.6)	3,060 (13.6)	3,060 (13.6)
	4 (102)	4-7/16 (113)	4,260 (18.9)	4,920 (21.9)	3,925 (17.5)	3,925 (17.5)	n/a	n/a	n/a	n/a

Table 27 - Hilti KWIK Bolt TZ carbon steel design strength in the soffit of cracked lightweight concrete over metal deck[1,2,3,4,5,6,7]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Loads according to Figure 4				Loads according to Figure 5			
			Tension - ϕN_n		Shear - ϕV_n		Tension - ϕN_n		Shear - ϕV_n	
			f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	950 (4.2)	1,095 (4.9)	1,385[8] (6.2)	1,385[8] (6.2)	1,080 (4.8)	1,245 (5.5)	1,850[8] (8.2)	1,850[8] (8.2)
1/2	2 (51)	2-3/8 (60)	950 (4.2)	1,095 (4.9)	1,950 (8.7)	1,950 (8.7)	860 (3.8)	995 (4.4)	1,680 (7.5)	1,680 (7.5)
	3-1/4 (83)	3-5/8 (92)	1,705 (7.6)	1,970 (8.8)	3,215 (14.3)	3,215 (14.3)	1,955 (8.7)	2,255 (10.0)	2,565 (11.4)	2,565 (11.4)
5/8	3-1/8 (79)	3-9/16 (90)	1,300 (5.8)	1,500 (6.7)	2,990[8] (13.3)	2,990[8] (13.3)	1,875 (8.3)	2,165 (9.6)	3,060[8] (13.6)	3,060[8] (13.6)
	4 (102)	4-7/16 (113)	3,020 (13.4)	3,485 (15.5)	3,925[8] (17.5)	3,925[8] (17.5)	n/a	n/a	n/a	n/a

1 See section 3.1.7.3 to convert design strength value to ASD value.
2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
3 Tabular value is for one anchor per flute. Minimum spacing along the length of the flute is 3 x h_{ef} (effective embedment).
4 Tabular values are lightweight concrete and no additional reduction factor is needed.
5 No additional reduction factors for spacing or edge distance need to be applied.
6 Comparison to steel values in table 4 is not required. Values in tables 26 and 27 control.
7 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.7.4 for additional information on seismic applications.
8 For the following anchor sizes, an additional factor for seismic shear must be applied to the cracked concrete tabular values for seismic conditions:
3/8-inch diameter - $\alpha_{v,seis}$ = 0.63
5/8-inch diameter - $\alpha_{v,seis}$ = 0.94

3.3.5 KWIK Bolt TZ Expansion Anchor

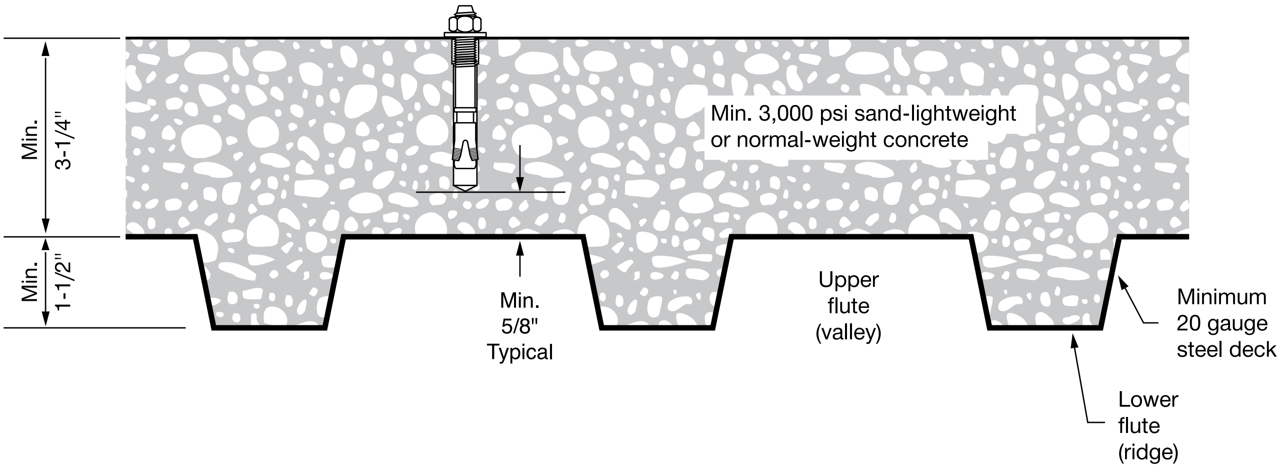


Figure 6 - Installation of the KWIK Bolt TZ on the top of sand-lightweight concrete over metal deck floor and roof assemblies

Table 28 - Hilti KWIK Bolt TZ carbon steel design strength in the top of uncracked concrete over metal deck[1,2,3,4]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n		Shear - ϕV_n	
			f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	1,790 (8.0)	2,070 (9.2)	2,605 (11.6)	3,005 (13.4)
1/2	2 (51)	2-3/8 (60)	2,415 (10.7)	2,790 (12.4)	2,605 (11.6)	3,005 (13.4)

Table 29 - Hilti KWIK Bolt TZ carbon steel design strength in the top of cracked concrete over metal deck[1,2,3,4,5]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n		Shear - ϕV_n	
			f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	1,615 (7.2)	1,865 (8.3)	1,845 (8.2)	2,130 (9.5)
1/2	2 (51)	2-3/8 (60)	1,710 (7.6)	1,975 (8.8)	1,845 (8.2)	2,130 (9.5)

1 See section 3.1.7.3 to convert design strength value to ASD value.

2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.

3 Apply spacing, edge distance, and concrete thickness factors in tables 30 and 31 as necessary. Compare to the steel values in table 4. The lesser of the values is to be used for the design.

4 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λa as follows: for sand-lightweight, λ_a = 0.68; for all-lightweight, λ_a = 0.60

5 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.7.4 for additional information on seismic applications.

Table 30 - Load adjustment factors for carbon steel KWIK Bolt TZ in the top of uncracked concrete over metal deck[1,2]

3/8-in. and 1/2-in. KB-TZ CS uncracked concrete over metal deck		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Anchor diameter d_a	in. (mm)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)
Effective embed. h_{ef}	in. (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}	in. (mm)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)
Spacing (s)/edge distance (c_a)/concrete thickness (h) - in. (mm) 3	(76)	n/a	n/a	0.33	n/a	n/a	n/a	0.64	n/a	0.64	n/a	n/a	n/a
3-1/4	(83)	n/a	n/a	0.36	n/a	n/a	n/a	0.72	n/a	0.72	n/a	0.73	0.75
3-1/2	(89)	n/a	n/a	0.39	n/a	n/a	n/a	0.81	n/a	0.81	n/a	0.76	0.78
4	(102)	0.83	n/a	0.44	n/a	0.67	n/a	0.99	n/a	0.99	n/a	0.81	0.84
4-1/2	(114)	0.88	n/a	0.50	0.50	0.69	n/a	1.00	1.00	1.00	1.00		
5	(127)	0.92	n/a	0.56	0.56	0.71	n/a						
5-1/2	(140)	0.96	n/a	0.61	0.61	0.73	n/a						
6	(152)	1.00	n/a	0.67	0.67	0.75	n/a						
6-1/2	(165)		1.00	0.72	0.72	0.77	0.78						
7	(178)			0.78	0.78	0.79	0.81						
8	(203)			0.89	0.89	0.83	0.85						
9	(229)			1.00	1.00	0.87	0.89						
10	(254)					0.91	0.94						
11	(279)					0.95	0.98						
12	(305)					1.00	1.00						

3.3.5

Table 31 - Load adjustment factors for carbon steel KWIK Bolt TZ in the top of cracked concrete over metal deck[1,2]

3/8-in. and 1/2-in. KB-TZ CS cracked concrete over metal deck		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Anchor diameter d_a	in. (mm)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)
Effective embed. h_{ef}	in. (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}	in. (mm)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)
Spacing (s)/edge distance (c_a)/concrete thickness (h) - in. (mm) 3	(76)	n/a	n/a	1.00	n/a	n/a	n/a	0.65	n/a	1.00	n/a	n/a	n/a
3-1/4	(83)	n/a	n/a		n/a	n/a	n/a	0.73	n/a		n/a	0.74	0.76
3-1/2	(89)	n/a	n/a		n/a	n/a	n/a	0.82	n/a		n/a	0.76	0.79
4	(102)	0.83	n/a		n/a	0.67	n/a	1.00	n/a		n/a	0.82	0.84
4-1/2	(114)	0.88	n/a		1.00	0.69	n/a		1.00		1.00		
5	(127)	0.92	n/a			0.71	n/a						
5-1/2	(140)	0.96	n/a			0.73	n/a						
6	(152)	1.00	n/a			0.75	n/a						
6-1/2	(165)		1.00			0.77	0.79						
7	(178)					0.79	0.81						
8	(203)					0.83	0.85						
9	(229)					0.87	0.90						
10	(254)					0.92	0.94						
11	(279)					0.96	0.98						
12	(305)					1.00	1.00						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

[shaded] - For concrete thickness greater than or equal to 4-inches, the anchor can be designed using either table 2 or table 3 of this section.

3.3.5 KWIK Bolt TZ Expansion Anchor

3.3.5.4 Installation instructions

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at **www.us.hilti.com (US)** and **www.hilti.ca (Canada)**. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

3.3.5.5 Ordering information[1]

Description			Length	Threaded length	Box quantity
KB-TZ 3/8x3	KB-TZ SS304 3/8x3	KB-TZ SS316 3/8x3	3	7/8	50
KB-TZ 3/8x3-3/4	KB-TZ SS304 3/8x3-3/4	KB-TZ SS316 3/8x3-3/4	3-3/4	1-5/8	50
KB-TZ 3/8x5	KB-TZ SS304 3/8x5		5	2-7/8	50
KB-TZ 1/2x3-3/4	KB-TZ SS304 1/2x3-3/4	KB-TZ SS316 1/2x3-3/4	3-3/4	1-5/8	20
KB-TZ 1/2x4-1/2	KB-TZ SS304 1/2x4-1/2	KB-TZ SS316 1/2x4-1/2	4-1/2	2-3/8	20
KB-TZ 1/2x5-1/2	KB-TZ SS304 1/2x5-1/2	KB-TZ SS316 1/2x5-1/2	5-1/2	3-3/8	20
KB-TZ 1/2x7	KB-TZ SS304 1/2x7		7	4-7/8	20
KB-TZ 5/8x4-3/4	KB-TZ SS304 5/8x4-3/4	KB-TZ SS316 5/8x4-3/4	4-3/4	1-1/2	15
KB-TZ 5/8x6	KB-TZ SS304 5/8x6	KB-TZ SS316 5/8x6	6	2-3/4	15
KB-TZ 5/8x8-1/2	KB-TZ SS304 5/8x8-1/2		8-1/2	5-1/4	15
KB-TZ 5/8x10	KB-TZ SS304 5/8x10		10	6-3/4	15
KB-TZ 3/4x5-1/2	KB-TZ SS304 3/4x5-1/2	KB-TZ SS316 3/4x5-1/2	5 1/2	1-1/2	10
KB-TZ 3/4x8	KB-TZ SS304 3/4x8		8	4	10
KB-TZ 3/4x10	KB-TZ SS304 3/4x10	KB-TZ SS316 3/4x10	10	6	10

1 All dimensions in inches

Table 32 - KWIK Bolt TZ length identification system

Length ID marking on bolt head		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, ℓ_{anch} in.	From	1 ½	2	2 ½	3	3 ½	4	4 ½	5	5 ½	6	6 ½	7	7 ½	8	8 ½	9	9 ½	10	11	12	13	14	15
	Up to but not including	2	2 ½	3	3 ½	4	4 ½	5	5 ½	6	6 ½	7	7 ½	8	8 ½	9	9 ½	10	11	12	13	14	15	16

Figure 7 — Bolt head with length identification mark and KWIK Bolt TZ head notch embossment