KWIK HUS (KH) Carbon Steel Screw Anchor 3.3.7

3.3.7.1 Product Description

Hilti KWIK HUS (KH) anchors are comprised of a body with hex washer head. The anchor is manufactured from carbon steel and is heat treated. It has a minimum 0.0003 inch (8 µm) zinc coating in accordance with DIN EN ISO 4042. The anchoring system is available in a variety of lengths with diameters of 3/8 inch, 1/2 inch, 5/8 inch and 3/4 inch (9.5mm, 12.7mm, 15.9mm and 19.1mm). The hex head is larger than the diameter of the anchor and is formed with serrations on the underside. The anchor body is formed with threads running most of the length of the anchor body. The anchor is installed in a predrilled hole with a powered impact wrench or torque wrench. The anchor threads cut into the base material on the sides of the hole and interlock with the base material during installation. Applicable base materials include normal-weight concrete, structural lightweight concrete lightweight concrete over metal deck, and grout filled concrete masonry.

Guide Specifications

Screw anchors shall be KWIK HUS as supplied by Hilti, Inc. Anchors shall be manufactured from heat treated carbon steel material, zinc plated to a minimum thickness of 8µm. Anchor head shall display product name, (KH) diameter and length. Anchors shall be installed using a drill bit of same nominal diameter as anchor.

Product Features

- Quick and easy to install.
- Length and diameter identification clearly stamped on head facilitates quality control and inspection after installation.
- Through fixture installation improves productivity and accurate installation.
- Thread design enables quality setting and exceptional load values in wide variety of base material strengths.
- Anchor is fully removable
- Anchor size is same as drill bit size and uses standard diameter drill bits.
- Suitable for reduced edge distances and spacing.
- Suitable for uncracked normal weight concrete, lightweight concrete and grout filled concrete masonry.

3.3.7.2 Material Specifications

Hilti KWIK HUS anchors are manufactured from carbon steel. The anchors are dull zinc plated to a minimum thickness of 8µm.

Listings/Approvals

ICC-ES (International Code Council)
AC 106 ESR Pending
(Grout filled concrete masonry)

3.3.7 KWIK HUS (KH) Carbon Steel Screw Anchor

3.3.7.3 Technical Data

Figure 1 — KWIK HUS (KH) Anchor Installation Details

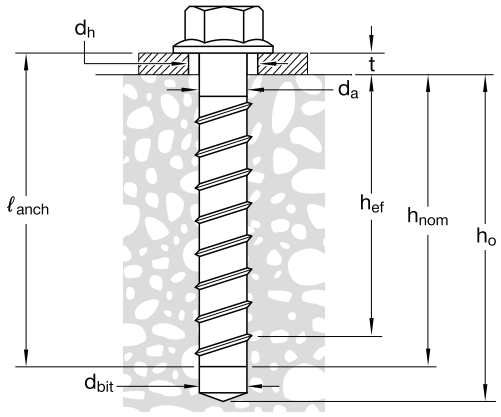

Table 1 – KWIK HUS (KH) Specification Table[1,2,3]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)									
			3/8			1/2			5/8		3/4	
Nominal Diameter	d_a	in.	3/8			1/2			5/8		3/4	
Drill Bit Diameter	d_{bit}	in.	3/8			1/2			5/8		3/4	
Baseplate Clearance Hole Diameter	d_h	in.	1/2			5/8			3/4		7/8	
Installation Torque[4]	T_{inst}	ft-lbf	40			45			85		115	
Impact Wrench Torque Rating[3]	T_{impact}	ft-lbf	114	450		137	450		450		450	
Minimum Nominal Embedment Depth	h_{nom}	in.	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	6-1/4
Effective Embedment Depth	h_{ef}	in.	1.11	1.86	2.20	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Minimum Hole Depth	h_o	in.	1-7/8	2-3/4	3-1/2	2-5/8	3-3/8	4-5/8	3-5/8	5-3/8	4-3/8	6-5/8
Critical Edge Distance[2]	c_{ac}	in.	2.50	3.12	3.74	2.75	3.70	5.25	3.63	5.81	4.41	7.28
Minimum Spacing at Critical Edge Distance	$s_{min,cac}$	in.	2.25			3					4	
Minimum Edge Distance[2]	c_{min}	in.	1.50			1.75						
Minimum Spacing at Minimum Edge Distance	s_{min}	in.	3								4	
Minimum Concrete Thickness	h_{min}	in.	3.25	4	4.875	3.75	4.75	6.75	5	7	6	8.125
Wrench Socket Size	-	in.	9/16			3/4			15/16		1-1/8	
Head Height	-	in.	0.35			0.49			0.57		0.70	
Effective tensile stress area	A_{se}	in.^{2}	0.086			0.161			0.268		0.392	
Minimum specified ultimate strength	f_{ut}	psi	107,120			97,140			90,180		81,600	

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 Pa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm

1 The data presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D.

2 For installations through the soffit of steel deck into concrete (see figure 2) anchors installed in the lower flute may be installed with a maximum 1 inch offset in either direction from the center of the flute.

3 Because of variability in measurement procedures, the published torque of an impact tool may not correlate properly with the above setting torques. Over-torquing can damage the anchor and/or reduce its holding capacity.

4 T_{inst} applies to installations using a calibrated torque wrench.

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Table 2 – KWIK HUS (KH) Tension and Shear Strength Design Information[1,2,3,4,5]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)									
			3/8			1/2			5/8		3/4	
Anchor Category 1,2 or 3			1									
Nominal Embedment Depth	h_{nom}	in.	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	6-1/4
Steel Strength in Tension (ACI 318 D.5.1)												
Tension Resistance of Steel	N_{sa}	lb.	9,213			15,640			24,210		32,013	
Reduction Factor for Steel Strength	Φ_{sa}	-	0.65									
Concrete Breakout Strength in Tension (ACI 318 D.5.2)												
Effective Embedment Depth	h_{ef}	in.	1.11	1.86	2.20	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Critical Edge Distance	c_{ac}	in.	2.10	2.92	3.30	2.75	3.88	5.25	3.63	5.82	4.41	7.28
Effectiveness Factor – Uncracked Concrete	k_{uncr}	-	24						27			
Reduction Factor for Concrete Breakout Strength – Tension	Φ_{cb}	-	0.65 (Condition B)									
Characteristic Pullout Strength, Uncracked Concrete (2,500psi)	$N_{p,uncr}$	lb.	N/A									
Steel Strength in Shear (ACI 318 D.6.1)												
Shear Resistance of Steel – Static	V_{sa}	lb.	5,155			8,186			11,221		16,662	
Reduction Factor for Steel Strength	Φ_{sa}	-	0.60									
Concrete Breakout in Shear (ACI 318 D.6.2)												
Nominal Diameter	d_a	in.	0.375			0.500			0.625		0.750	
Load Bearing Length of Anchor	ℓ_e	in.	1.11	1.86	2.20	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Reduction Factor for Concrete Breakout Strength — Shear	Φ_{cb}	-	0.70									
Concrete Pryout Strength in Shear (ACI 318 D.6.3)												
Coefficient for Pryout Strength	k_{cp}	-	1.0	1.0	1.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0
Reduction Factor for Pryout Strength	Φ_{cp}	-	0.70									

For SI: 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 6.89 Pa, 1 in^2 = 645 mm^2

1 The data in this table is intended for use with the design provisions of ACI 318 Appendix D.

2 Values of Φ in this table applies when the load combinations for ACI 318 Section 9.2, IBC Section 1605.2.1 are used and the requirements of ACI 318 D.4.4 for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of Φ must be used. For situations where reinforcement meets the requirements of Condition A, ACI 318 Section D.4.4 provides the appropriate Φ factor.

3 N/A denotes that pullout resistance does not govern and does not need to be considered.

4 The characteristic pullout resistance for concrete compressive strengths greater than 2500 psi may be increased by multiplying the value in the table by $(f'_c/2{,}500)^{1/2}$ for psi or $(f'_c/17.2)^{1/2}$ for MPa.

5 For sand-lightweight concrete, multiply concrete capacity values and pullout values by 0.60.

3.3.7 KWIK HUS (KH) Carbon Steel Screw Anchor

Table 3 – KWIK HUS (KH) Tension and Shear Design Data for installation in the Underside of Concrete-filled Profile Steel Deck Assemblies[1,2,3,4,5]

Characteristic	Symbol	Units										Upper Flute				
			3/8			1/2			5/8		3/4	1/4		3/8		1/2
Embedment	h_{nom}	in.	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	1-5/8	2-1/2	1-5/8	2-1/2	2-1/4
Minimum Hole Depth	h_{hole}	in.	1-7/8	2-3/4	3-1/2	2-5/8	3-3/8	4-5/8	3-5/8	5-3/8	4-3/8	2	2-7/8	1-7/8	2-7/8	2-5/8
Effective Embedment Depth	h_{ef}	in.	1.11	1.86	2.20	1.52	2.16	3.22	2.39	3.88	2.92	1.18	1.92	1.11	1.86	1.52
Pullout Resistance, (uncracked concrete)	$N_{p,deck,uncr}$	lb.	1285	2240	3920	1305	3060	5360	4180	9495	4180	1490	1960	1015	2920	1395
Steel Strength in Shear	$V_{sa,deck}$	lb.	1670	1511	3605	1605	2922	3590	3470	4190	3762	1205	3265	3935	6090	7850

1 Installation must comply with Figure 2.

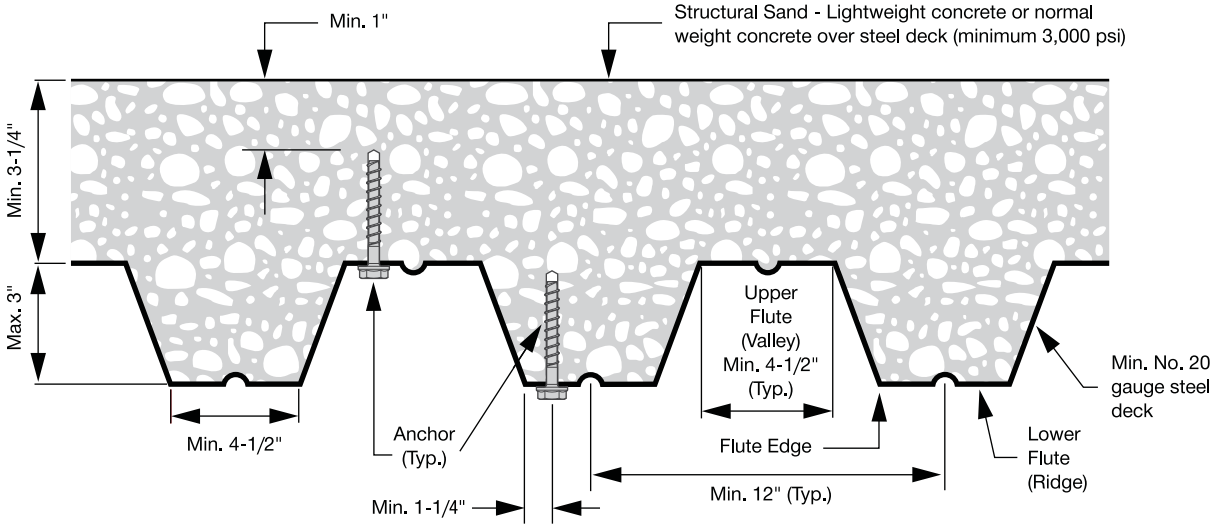
2 The values in this table shall be used with the appropriate equal in ACI 318 Appendix D_1 equations D.5.3.1 and D.5.3.2.

3 The values for Φ_p in tension can be found in Table 2 of this report and the values for Φ_{sa} in shear can be found in Table 3.

4 For installations through the soffit of steel deck into concrete (see Figure 2) anchors installed in the lower flute shall be installed with a maximum 1 inch offset in either direction from the centerline of the flute.

5 The characteristic pullout resistance for concrete compressive strengths greater than 2,500 psi may be increased by multiplying the value in the table by $(f'_c / 3{,}000)^{1/2}$ for psi or $(f'_c / 20.7)^{1/2}$ for MPa.

Figure 2 – Installation of KWIK HUS (KH) in Soffit of Concrete over Steel Deck Floor and Roof Assemblies



1 Anchors may be placed in the upper or lower flute of the steel deck profile provided the minimum concrete cover above the drilled hole is satisfied. Anchors in the lower flute may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

KWIK HUS (KH) Carbon Steel Screw Anchor 3.3.7

Table 4 – KWIK HUS (KH) Allowable Stress Design Values for Illustrative Purposes[1,2,3,4,5,6,7,8,9,12]

Nominal Anchor Diameter [in.]	Embedment Depth, h_{nom} [in.]	Effective Embedment Depth, h_{ef} [in.]	Allowable Tension Load[10] [lbs]	Allowable Shear Load[11] [lbs]
3/8	1-5/8	1.11	633	682
	2-1/2	1.86	1374	1480
	3-1/4	2.20	1768	1903
1/2	2-1/4	1.52	1142	1093
	3	2.16	1934	1852
	4-1/4	3.22	3521	3411
5/8	3-1/4	2.39	2252	2425
	5	3.88	4657	4675
3/4	4	2.92	3041	6549
	6-1/4	4.84	6489	6943

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

1 Single anchor with static tension or shear load only.

2 Concrete determined to remain uncracked for the life of the anchorage.

3 Load combinations are taken from ACI 318 Section 9.2 (no seismic loading).

4 40% dead load and 60% live load, controlling load combination 1.2D + 1.6L.

5 Calculation of weighted average for conversion factor α = 1.2(0.4) + 1.6(0.6) = 1.44.

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 where supplementary reinforcement in accordance with ACI 318 D.4.4 is not provided.

10 Allowable tension load = factored load (Concrete Breakout from Table 2) ÷ 1.44

11 Allowable Shear Load = factored Load (Lessor of V_{sa} or Concrete Pryout from Table 2) ÷ 1.44

12 Values are for single anchors installed without influence of base material edge distance or adjacent anchors.

3.3.7 KWIK HUS (KH) Carbon Steel Screw Anchor

Table 5 – Allowable Tension Loads for KWIK HUS installed in Grout-filled Masonry Walls (lb)[1,2,7,8]

Anchor Diameter (inches)	Embedment (inches)[3]	Loads @ C_{cr} and S_{cr}	Spacing			Edge Distance		
			Critical - S_{cr} (inches)[4]	Minimum - S_{min} (inches)[4]	Load Reduction Factor at S_{min}[6]	Critical - C_{cr} (inches)[5]	Minimum C_{min} (inches)[5]	Load Reduction Factor[6]
3/8	1 5/8	535	4	2	0.70	4	4	1.00
	2 1/2	895	6	4	0.80			
	3 1/4	1210						
1/2	2 1/4	710	4	2	0.60	4	4	1.00
	3	1110	8	4				
	4 1/4	1515						
5/8	3 1/4	1155	10	4	0.60	10	4	1.00
	5	1735						
3/4	4	1680	12	4	0.60	12	4	1.00
	6 1/4	2035						

Table 6 – Allowable Shear Loads for KWIK HUS installed in Grout-filled Masonry Walls (lb)[1,2,3,7,8]

Anchor Diameter (inches)	Embedment (inches)[3]	Load at C_{cr} and S_{cr}	Spacing			Edge Distance			
			Critical - S_{cr} (inches)[4]	Minimum - S_{min} (inches)[4]	Load Reduction Factor at S_{min}[6]	Critical - C_{cr} (inches)[5]	Minimum - C_{min} (inches)[5]	Load Reduction Factor at C_{min}	
								Load Direction Perpendicular to Edge	Load Direction Parallel to Edge
3/8	1 5/8	1140	6	4	0.94	6	4	0.61	1.00
	2 1/2	1165						0.70	1.00
	3 1/4	1190						0.70	1.00
1/2	2 1/4	1845	8	4	0.88	8	4	0.50	1.00
	3	2055						0.45	0.94
	4 1/4	2745						0.40	0.89
5/8	3 1/4	3040	10	4	0.36	10	4	0.36	0.82
	5	3485						0.34	0.92
3/4	4	3040	10	4	0.36	12	4	0.36	0.82
	6 1/4	3485						0.34	0.92

1 All values are for anchors installed in fully grouted masonry with minimum masonry prism strength of 1500psi. Concrete masonry units shall be light-weight or normal-weight.

2 Anchors may not be installed within one inch in any direction of a vertical joint.

3 Embedment depth is measured from the outside face of the concrete masonry embedment.

4 S_{cr} is anchor spacing where full load values in the Table may be used. S_{min} is the minimum anchor spacing for which values are available and installation is recommended. Spacing is measured from the center of one anchor to the center of an adjacent anchor.

5 C_{cr} is the edge distance where full load values in the table may be used. C_{min} is the minimum edge distance for which values are available and installation is recommended. Edge distance is measured from the center of the anchor to the closest edge.

6 Load reduction factors are multiplicative, both spacing and edge distance load reduction factors must be considered.

Load values for anchors installed at less than C_{cr} or S_{cr} must be multiplied by the appropriate load reduction factor based on actual edge distance (C) or spacing (S).

7 Linear interpolation of load values between minimum spacing (S_{min}) and critical spacing (S_{cr}) and between minimum edge distance (C_{min}) and critical edge distance (C_{cr}) is permitted.

8 For combined loading: $\left(\frac{T_{applied}}{T_{allowable}}\right)^{5/3} + \left(\frac{V_{applied}}{V_{allowable}}\right)^{5/3} \leq 1$

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Table 7 – KWIK HUS Allowable Loads installed in Top of Grout-Filled Concrete Masonry Construction (lb)

Anchor Diameter (inches)	Minimum Embedment Depth (inches)[2]	Minimum Edge Distance (inches)	Minimum Spacing (inches)	Minimum End Distance (inches)	Tension	Shear	
						Perpendicular to Edge of Masonry Wall	Parallel to Edge of Masonry Wall
1/2	4 1/4	1 3/4	8	4	680	305	1110
5/8	5	1 3/4	10	5	1310	305	1165

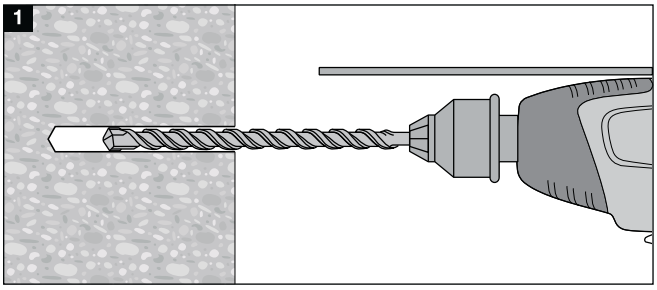
1 All values are for anchors installed in fully grouted masonry with minimum masonry prism strength of 1500psi. Concrete masonry units shall be light-weight or normal-weight.

2 Embedment depth is measured from the top of the masonry construction.

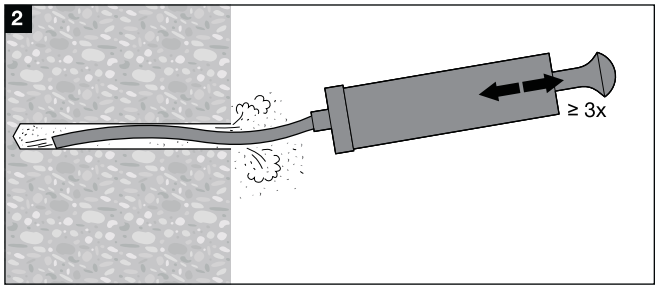
3 For combined loading: $\left(\frac{T_{applied}}{T_{allowable}}\right)^{5/3} + \left(\frac{V_{applied}}{V_{allowable}}\right)^{5/3} \leq 1$

3.3.7.4 Installation Instructions

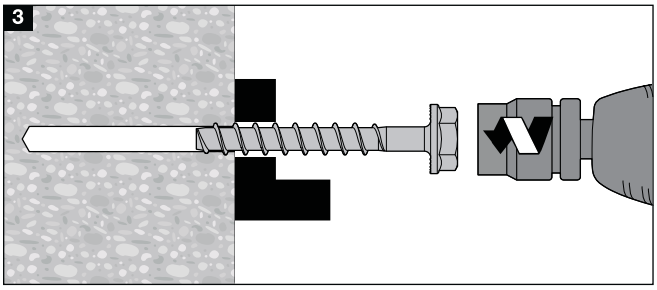
Drill holes in base material using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The nominal drill bit diameter must be equal to that of the anchor. The minimum drilled hole depth is given in Table 1. Prior to installation, dust and debris must be removed from the drilled hole using a hand pump, compressed air or a vacuum. The anchor must be installed into the predrilled hole using a powered impact wrench or installed with a torque wrench until the proper nominal embedment depth is obtained. The impact wrench torque, T_{impact} and installation torque, T_{inst} for the manual torque wrench must be in accordance with Table 1. The KWIK HUS (KH) may be loosened by a maximum of one turn and reinstalled with a socket wrench or powered impact wrench to facilitate fixture attachment or realignment. For member thickness and edge distance restrictions for installations into the soffit of concrete on steel deck assemblies, see Figure 2.



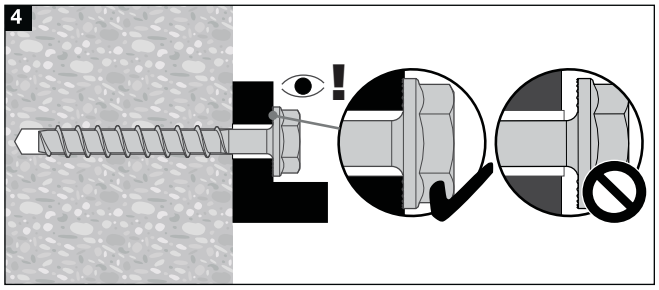
Drill hole in base material using proper diameter drill bit.



Clean drilled hole to remove debris.



Fasten anchor tightly against fastened part.



Install anchor using proper impact tool or torque wrench.

3.3.7.5 KWIK HUS (KH) Carbon Steel Screw Anchor

The data below is developed from testing performed in accordance with ACI 355.2. It is intended for applications designed according to CSA A23.3-04 Update No. 3 (August 2009) Design of Concrete Structures Annex D and is generally suitable for the conditions described in the introduction of Annex D.

Table 8 – Disign Information for use with CSA A23.3-04

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)										Code Ref.
			3/8			1/2			5/8		3/4		
Anchor Category (1, 2 or 3)			1										
Nominal Embedment Depth	h_{nom}	mm	41	64	83	57	76	108	83	127	102	159	
Concrete material resistance factor for concrete	ϕ_c	-	0.65										8.4.2
Steel material resistance factor	ϕ_s	-	0.85										8.4.3
Ultimate strength of anchor steel	f_{ut}	MPa	739			670			622		563		
Effective cross-sectional area of anchor	A_{se}	mm^2	55.5			103.9			172.9		252.9		
Minimum Edge Distance	c_{min}	mm	44										
Minimum Spacing	s_{min}	mm	76						102				
Minimum Concrete Thickness	h_{min}	mm	83	102	121	95	127	152	127	178	152	203	
Steel Strength in Tension (CSA A23.3 D.6.1)[2]													
Factored Steel Resistance in tension	N_{sr}	kN	24.4			41.4			64.0		84.7		D.6.1.2
Reduction Factor for Steel Strength	R	-	0.70										D.5.4b
Concrete Breakout Strength in Tension (CSA A23.3 D.6.2)													
Effective Embedment Depth	h_{ef}	mm	28	47	56	39	55	82	61	99	74	123	
Critical Edge Distance	c_{ac}	mm	64	79	95	70	99	133	92	148	112	185	
Effectiveness Factor — Uncracked Concrete	k_{uncr}	-	10										D.6.2.2
Modification factor for uncracked concrete	$\Psi_{c,N}$	-	1.4										D.6.2.6
Reduction Factor for Concrete Breakout Strength	R	-	1.15 (Condition A), 1.00 (Condition B)										D.5.4c
Pullout Strength in Tension (CSA A23.3 D.6.3)[1]													
Factored Pullout Resistance, uncracked concrete (20 MPa)	$N_{pr,uncr}$	kN	N/A										D.6.3.2
Reduction Factor for pullout strength	R		1.15 (Condition A), 1.00 (Condition B)										
Steel Strength in Shear (CSA A23.3 D.7.1)[2]													
Factored Shear Resistance of Steel - Static	V_{sr}	kN	12.7			20.1			27.6		40.9		D.7.1.2c
Reduction Factor for Steel Strength	R		0.65										D.5.4b
Concrete Breakout Strength in Shear (CSA A23.3 D.7.2)													
Nominal Diameter	d_o	mm	9.5			12.7			15.9		19.1		
Load Bearing Length of Anchor	ℓ_e	mm	28	47	56	39	55	82	61	99	74	123	
Reduction Factor for Concrete Breakout Strength	R	-	1.15 (Condition A), 1.00 (Condition B)										
Concrete Pryout Strength in Shear (CSA A23.3 D.7.3)													
Coefficient for Pryout Strength	k_{cp}		1.0	1.0	1.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0	
Reduction Factor for Pryout Strength	R		1.15 (Condition A), 1.00 (Condition B)										

1 N/A denotes that pullout resistance does not govern and does not need to be considered.

2 The KWIK HUS (KH) is considered a brittle steel element as defined by CSA A23.3 D.2.

3 The KWIK HUS (KH) is suitable for uncracked concrete applications only. For cracked concrete applications (i.e. tension zone anchorages), consider the KWIK HUS (KH) anchor

This table replaces Table 2 of this Supplement for anchorage design in normal weight concrete in accordance with CSA A23.3-04.

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3.3.7.6 Ordering Information

Description	Hole Diameter	Total Length without Anchor Head	Minimum Embedment Depth	Qty (pcs) Box
KH 3/8" x 2-1/8"	3/8"	2-1/8"	1-5/8"	50
KH 3/8" x 3"	3/8"	3"	2-1/2"	50
KH 3/8" x 3-1/2"	3/8"	3-1/2"	2-1/2"	50
KH 3/8" x 4"	3/8"	4"	3-1/4"	50
KH 3/8" x 5"	3/8"	5"	3-1/4"	30
KH 1/2" x 3"	1/2"	3"	2-1/4"	30
KH 1/2" x 3-1/2"	1/2"	3-1/2"	3"	25
KH 1/2" x 4"	1/2"	4"	3"	25
KH 1/2" x 4-1/2"	1/2"	4-1/2"	4- 1/4"	25
KH 1/2" x 5"	1/2"	5"	4-1/4"	25
KH 1/2" x 6"	1/2"	6"	4-1/4"	25
KH 5/8" x 4"	5/8"	4"	3-1/4"	15
KH 5/8" x 5-1/2"	5/8"	5-1/2"	3-1/4"	15
KH 5/8" x 6-1/2"	5/8"	6-1/2"	3-1/4"	15
KH 3/4" x 4-1/2"	3/4"	4-1/2"	4"	10
KH 3/4" x 5-1/2"	3/4"	5-1/2"	4"	10
KH 3/4" x 7"	3/4"	7"	4"	10
KH 3/4" x 9"	3/4"	9"	4"	10