The following excerpt are pages from the North American Product Technical Guide, Volume 2: Anchor Fastening, Edition 21.

Please refer to the publication in its entirety for complete details on this product including data development, product specifications, general suitability, installation, corrosion and spacing and edge distance guidelines.
US&CA: https://submittals.us.hilti.com/PTGVol2/

To consult directly with a team member regarding our anchor fastening products, contact Hilti's team of technical support specialists between the hours of 7:00am – 6:00pm CST.
US: 877-749-6337 or HNATechnicalServices@hilti.com
CA: 1-800-363-4458, ext. 6 or CATechnicalServices@hilti.com

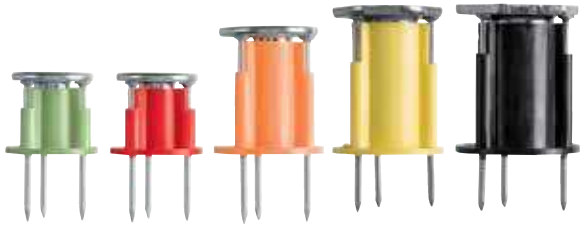
Hilti, Inc.
7250 Dallas Parkway, Suite 1000
Plano, TX 75024

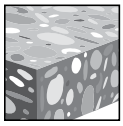
1-800-879-8000
www.hilti.com

3.3.17 KCS-WF CAST-IN ANCHOR

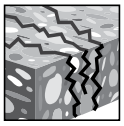
PRODUCT DESCRIPTION

KCS-WF cast-in anchors

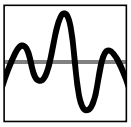
Anchor System		Features and Benefits
	KCS-WF internally threaded cast-in anchors for wood	• Installation performed on top of the formwork. No overhead drilling. No scissor lift rental • Hexagonal head prevents spinning in concrete • Anchor bodies are color coded for quick identification • KCS-WF have large plastic flanges for secure seating to wood form. This prevents concrete seepage into the threading. • KCS-WF have notched nails that snap off easily at the concrete surface after the wood forms are stripped.



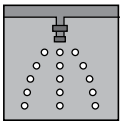
Uncracked concrete



Cracked concrete



Seismic design categories A-F



Fire Sprinkler Listings

Approvals/Listings	
ICC-ES (International Code Council) 2015 International Building Code / International Residential Code (IBC/IRC)	ESR-4006 in concrete per ACI 318 Ch. 17 / ICC-ES AC446
City of Los Angeles	RR 26069
FM (Factory Mutual)	Pipe hanger components for automatic sprinkler systems for 3/8 through 3/4
Florida Building Code	2017 FBC Supplement (within ESR-4006)
UL LLC (Underwriters Laboratory LLC)	Pipe hanger equipment for fire protection services for 3/8 through 3/4

MATERIAL SPECIFICATIONS

Component	KCS-WF
Insert body	Heat treated carbon steel
Flange	Engineered plastic
Spring	N/A
Plating	Zinc clear chromate plating
Protective sleeve	N/A

Table 1 — Hilti KCS-WF specification table

Setting information	Symbol	Units	Nominal anchor diameter				
			1/4	3/8	1/2	5/8	3/4
Insert thread	d	UNC	1/4-20	3/8-16	1/2-13	5/8-11	3/4-10
Minimum thread engagement	ℓ_{th}	in.	1/4	3/8	1/2	5/8	3/4
		(mm)	(6)	(10)	(13)	(16)	(19)
Plastic flange diameter	d_{pf}	in.	1.33	1.33	1-1/2	1.60	1-2/3
		(mm)	(33)	(33)	(38)	(41)	(43)
Plastic flange thickness	t_{pf}	in.	.11	.11	.11	.11	.11
		(mm)	(2.8)	(2.8)	(2.8)	(2.8)	(2.8)
Length	ℓ	in.	1-1/4	1-1/4	1-3/4	2.14	2.14
		(mm)	(32)	(32)	(45)	(54)	(54)
Steel head thickness	t_{sh}	in.	1/8	1/8	1/8	.14	.14
		(mm)	(3.3)	(3.3)	(3.1)	(3.5)	(3.5)
Length of break-off nails	ℓ_n	in.	1	1	1	3/4	3/4
		(mm)	(24.4)	(24.4)	(23.5)	(19.0)	(19.0)
Minimum slab thickness	h	in.	2-1/2	2-1/2	2-1/2	3-3/4	3-3/4
		(mm)	(64)	(64)	(64)	(95)	(95)

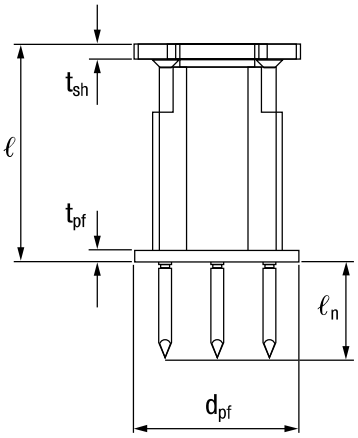


Figure 1 — KCS-WF specifications

DESIGN INFORMATION IN CONCRETE PER ACI 318

ACI 318 Chapter 17

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-4006 and the equations within ACI 318 Chapter 17. For a detailed explanation of the Hilti Simplified Design Tables, refer to section 3.1.8. Data tables from ESR-4006 are not contained in this section, but can be found at www.icc-es.org or at www.hilti.com.

Table 2 — Hilti KCS-WF cast-in insert design strength with concrete/pullout failure in uncracked concrete[1,2,3,4,5]

Nominal anchor internal diameter in.	Effective embed. depth in. (mm)	Tension - ϕN_n				Shear - ϕV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.1 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.1 MPa) lb (kN)
1/4 and 3/8	1.11 (28)	1,230 (5.5)	1,350 (6.0)	1,560 (6.9)	1,910 (8.5)	1,230 (5.5)	1,350 (6.0)	1,560 (6.9)	1,910 (8.5)
1/2	1.63 (42)	2,190 (9.7)	2,400 (10.7)	2,770 (12.3)	3,395 (15.1)	2,190 (9.7)	2,400 (10.7)	2,770 (12.3)	3,395 (15.1)
5/8	1.90 (48)	2,750 (12.2)	3,015 (13.4)	3,480 (15.5)	4,265 (19.0)	2,750 (12.2)	3,015 (13.4)	3,480 (15.5)	4,265 (19.0)
3/4	1.83 (46)	2,590 (11.5)	2,835 (12.6)	3,275 (14.6)	4,015 (17.9)	2,590 (11.5)	2,835 (12.6)	3,275 (14.6)	4,015 (17.9)

Table 3 — Hilti KCS-WF cast-in insert design strength with concrete/pullout failure in cracked concrete[1,2,3,4,5]

Nominal anchor internal diameter in.	Effective embed. depth in. (mm)	Tension - ϕN_n				Shear - ϕV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.1 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.1 MPa) lb (kN)
1/4 and 3/8	1.11 (28)	985 (4.4)	1,080 (4.8)	1,245 (5.5)	1,530 (6.8)	985 (4.4)	1,080 (4.8)	1,245 (5.5)	1,530 (6.8)
1/2	1.63 (42)	1,750 (7.8)	1,920 (8.5)	2,215 (9.9)	2,715 (12.1)	1,750 (7.8)	1,920 (8.5)	2,215 (9.9)	2,715 (12.1)
5/8	1.90 (48)	2,200 (9.8)	2,410 (10.7)	2,785 (12.4)	3,410 (15.2)	2,200 (9.8)	2,410 (10.7)	2,785 (12.4)	3,410 (15.2)
3/4	1.83 (46)	2,070 (9.2)	2,270 (10.1)	2,620 (11.7)	3,210 (14.3)	2,070 (9.2)	2,270 (10.1)	2,620 (11.7)	3,210 (14.3)

1 See section 3.1.8 to convert design strength value to ASD value.

2 Linear interpolation between concrete compressive strengths is not permitted.

3 Tabular values are for single anchor located at edge distance (c) and spacing (s) greater than $3h_{ef}$. For anchors with edge distance or spacing less than $3h_{ef}$ use ACI 318 to calculate load reduction factor. Compare the value to the steel values in Table 11. 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 = 0.85; for all-lightweight, λ_a = 0.75

5 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic tension loads, multiply cracked concrete tabular values in tension by $\alpha_{N,seis}$ = 0.75. No reduction needed for seismic shear.

Table 4 — Design strength for steel failure of common threaded rods and KCS-WF inserts[1]

Nominal anchor diameter in.	Grade A36 threaded rod			ASTM A 193 B7 or ASTM F1554 Gr. 105 threaded rod			KCS-WF insert	
	Tensile[2] $\phi N_{sa,rod}$ or $\phi N_{sa,eq,rod}$ lb (kN)	Shear[3] $\phi V_{sa,rod}$ lb (kN)	Seismic shear[4] $\phi V_{sa,eq,rod}$ lb (kN)	Tensile[2] $\phi N_{sa,rod}$ or $\phi N_{sa,eq,rod}$ lb (kN)	Shear[3] $\phi V_{sa,rod}$ lb (kN)	Seismic shear[4] $\phi V_{sa,eq,rod}$ lb (kN)	Tensile $\phi N_{sa,insert}$ or $\phi N_{sa,eq,insert}$ lb (kN)	Shear $\phi V_{sa,insert}$ or $\phi V_{sa,eq,insert}$ lb (kN)
1/4	1,390 (6.2)	720 (3.2)	505 (2.2)	3,000 (13.3)	1,550 (6.9)	1,085 (4.8)	2,450 (10.9)	1,650 (7.3)
3/8	3,395 (15.1)	1,750 (7.8)	1,225 (5.4)	7,315 (32.5)	3,780 (16.8)	2,646 (11.8)	2,450 (10.9)	1,650 (7.3)
1/2	6,175 (27.5)	3,210 (14.3)	2,245 (10.0)	13,315 (59.2)	6,915 (30.8)	4,841 (21.5)	8,465 (37.7)	2,110 (9.4)
5/8	9,835 (43.7)	5,110 (22.7)	3,575 (15.9)	21,190 (94.3)	11,020 (49.0)	7,714 (34.3)	9,100 (40.5)	5,215 (23.2)
3/4	14,550 (64.7)	7,565 (33.7)	5,295 (23.6)	31,405 (139.7)	16,305 (72.5)	11,414 (50.8)	9,100 (40.5)	5,440 (24.2)

1 See section 3.1.8 to convert design strength value to ASD value.
2 Tensile values determined by static tension tests with $\phi N_{sa} = \phi A_{se,N} f_{uta}$ as noted in ACI 318 Chapter 17.
3 Shear values determined by static shear tests with $\phi V_{sa} = \phi 0.60 A_{se,V} f_{uta}$ as noted in ACI 318 Chapter 17.
4 Seismic shear values determined by seismic shear tests with $\phi V_{sa} \leq \phi 0.60 A_{se,V} f_{uta}$ as noted in ACI 318 Chapter 17.

Table 5 — UL LLC and FM approvals[1,2]

Nominal anchor diameter in.	KCS-WF		
	UL max pipe size (in.)	UL test load (lb)	FM max pipe size (in.)
3/8	4	1,500	4
1/2	8	4,050	8
5/8	8	4,050	–
3/4	8	4,050	–

1 UL LLC Listing based on successful completion of testing in accordance with UL 203.
2 FM Approval based on successful completion of testing in accordance with FM 1952.

DESIGN INFORMATION IN CONCRETE PER CSA A23.3

Limit State Design of anchors is described in the provisions of CSA A23.3 Annex D for post-installed anchors tested and assessed in accordance with ACI 355.2 for mechanical anchors and ACI 355.4 for adhesive anchors. This section contains the Limit State Design tables with unfactored characteristic loads that are based on the published loads in ICC Evaluation Services ESR-4006. These tables are followed by factored resistance tables. The factored resistance tables have characteristic design loads that are prefactored by the applicable reduction factors for a single anchor with no anchor-to-anchor spacing or edge distance adjustments for the convenience of the user of this document. All the figures in the previous ACI 318 Chapter 17 design section are applicable to Limit State Design and the tables will reference these figures.

For a detailed explanation of the tables developed in accordance with CSA A23.3 Annex D, refer to Section 3.1.8. Technical assistance is available by contacting Hilti Canada at (800) 363-4458 or at www.hilti.com.

Table 6 — Hilti KCS-WF design information in accordance with CSA A23.3 Annex D[1]

Design parameter	Symbol	Units	Nominal anchor diameter					Ref
			1/4	3/8	1/2	5/8	3/4	A23.3-04
Anchor O.D.	d_a	in. (mm)	0.51 (13)		0.67 (17)	0.87 (22)	1 (25)	
Effective embedment	h_{ef}	in. (mm)	1.11 (28)		1.63 (41)	1.9 (48)	1.83 (46)	
Minimum concrete thickness	h_{min}	in. (mm)	2-1/2 (64)			3-3/4 (95)		
Minimum edge distance	c_{min}	in. (mm)	1-1/2 (38)					
Minimum anchor spacing	$s_{min,untor}$	in. (mm)	2.04 (52)		2.68 (68)	3.48 (88)	4.00 (102)	
Steel embed. material resistance factor for reinforcement	ϕ_s	-	0.85					8.4.3
Resistance modification factor for tension, steel failure modes[2]	R	-	0.70					D.5.3
Resistance modification factor for shear, steel failure modes[2]	R	-	0.65					D.5.3
Factored steel resistance in tension	N_{sar}	lb (kN)	2,243 (10.0)	2,243 (10.0)	7,747 (34.4)	8,330 (37.0)	8,330 (37.0)	D.6.1.2
Factored steel resistance in tension	$N_{sar,\ eq}$	lb (kN)	2,243 (10.0)	2,243 (10.0)	7,747 (34.4)	8,330 (37.0)	8,330 (37.0)	D.6.1.2
Factored steel resistance in shear	V_{sar}	lb (kN)	1,519 (6.8)	1,519 (6.8)	1,945 (8.6)	4,801 (21.3)	5,011 (22.3)	D.7.1.2
Factored steel resistance in shear, seismic	$V_{sar,eq}$	lb (kN)	1,519 (6.8)	1,519 (6.8)	1,945 (8.6)	4,801 (21.3)	5,011 (22.3)	D.7.1.2
Coeff. for factored conc. breakout resistance, uncracked concrete	$k_{c,uncr}$	-	10					D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete	$k_{c,cr}$	-	10					D.6.2.2
Modification factor for anchor resistance, tension, uncracked conc.	$\psi_{c,N}$	-	1.25					D.6.2.6
Modification factor for anchor resistance, tension, cracked conc.	$\psi_{c,N}$	-	1.0					D.6.2.6
Anchor category	-	-	Cast-in					D.5.3 (c)
Concrete material resistance factor	ϕ_c	-	0.65					8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[3]	R	-	1.00					D.5.3 (c)

1 Design information in this table is taken from ICC-ES ESR-4006, dated 11/2017, tables 1 and 3, and converted for use with CSA A23.3 (R2014) Annex D.

2 The carbon steel KCS-WF is considered a brittle steel element as defined by CSA A23.3 (R2014) Annex D section D.2.

3 For use with the load combinations of CSA A23.3 (R2014) chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 (R2014) section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

Table 7 — Hilti KCS-WF cast-in insert design strength with concrete / pullout failure in uncracked concrete[1,2,3,4,5]

Nominal anchor diameter in.	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - N_r				Shear - V_r			
			f'_c = 20 MPa (2,900psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
1/4 and 3/8	1.11 (28)	1.18 (30)	1,230 (5.5)	1,375 (6.1)	1,505 (6.7)	1,740 (7.7)	1,230 (5.5)	1,375 (6.1)	1,505 (6.7)	1,740 (7.7)
1/2	1.63 (42)	1.81 (46)	2,185 (9.7)	2,440 (10.9)	2,675 (11.9)	3,090 (13.8)	2,185 (9.7)	2,440 (10.9)	2,675 (11.9)	3,090 (13.8)
5/8	1.90 (48)	2.24 (57)	2,740 (12.2)	3,065 (13.6)	3,360 (15.0)	3,880 (17.3)	2,740 (12.2)	3,065 (13.6)	3,360 (15.0)	3,880 (17.3)
3/4	1.83 (46)	2.24 (57)	2,580 (11.5)	2,885 (12.8)	3,160 (14.1)	3,650 (16.2)	2,580 (11.5)	2,885 (12.8)	3,160 (14.1)	3,650 (16.2)

Table 8 — Hilti KCS-WF cast-in insert design strength with concrete / pullout failure in cracked concrete[1,2,3,4,5]

Nominal anchor diameter in.	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - N_r				Shear - V_r			
			f'_c = 20 MPa (2,900psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
1/4 and 3/8	1.11 (28)	1.18 (30)	985 (4.4)	1,100 (4.9)	1,205 (5.4)	1,390 (6.2)	985 (4.4)	1,100 (4.9)	1,205 (5.4)	1,390 (6.2)
1/2	1.63 (42)	1.81 (46)	1,745 (7.8)	1,955 (8.7)	2,140 (9.5)	2,470 (11.0)	1,745 (7.8)	1,955 (8.7)	2,140 (9.5)	2,470 (11.0)
5/8	1.90 (48)	2.24 (57)	2,195 (9.8)	2,455 (10.9)	2,685 (11.9)	3,100 (13.8)	2,195 (9.8)	2,455 (10.9)	2,685 (11.9)	3,100 (13.8)
3/4	1.83 (46)	2.24 (57)	2,065 (9.2)	2,310 (10.3)	2,530 (11.3)	2,920 (13.0)	2,065 (9.2)	2,310 (10.3)	2,530 (11.3)	2,920 (13.0)

1 See section 3.1.8 to convert factored resistance value to ASD value.
2 Linear interpolation between concrete compressive strengths is not permitted.
3 Tabular values are for single anchor located at edge distance (c) and spacing (s) greater than $3h_{ef}$. For anchors with edge distance or spacing less than $3h_{ef}$ use CSA A23.3 to calculate load reduction factor. Compare the value to the steel values in Table 23. The lesser of the values is to be used for the design.
4 Tablular values are for normal weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.85; for all-lightweight, λ_a = 0.75.
5 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75.

INSTALLATION INSTRUCTIONS

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. 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.

ORDERING INFORMATION[1]

KCS – WF cast-in anchor for use in wood forms

Description	Sleeve color[2]	Qty / box
KCS – WF 1/4	Green	150
KCS – WF 3/8	Red	150
KCS – WF 1/2	Orange	100
KCS – WF 5/8	Yellow	100
KCS – WF 3/4	Black	100