ICC EVALUATION SERVICE®

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

ICC-ES Evaluation Report
ESR-4006

Reissued November 2021

This report is subject to renewal November 2022.

DIVISION: 03 00 00—CONCRETE
Section: 03 15 19—Cast-in Concrete Anchors
Section: 03 16 00—Concrete Anchors

REPORT HOLDER:

HILTI, INC.

EVALUATION SUBJECT:

HILTI KWIK CAST KCS-WF HEADED CAST-IN SPECIALTY INSERTS IN CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015, and 2012 *International Building Code®* (IBC)
- 2021, 2018, 2015, and 2012 *International Residential Code®* (IRC)

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see ESR-4006 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

The Hilti Kwik Cast KCS-WF Headed Cast-In Specialty Insert is used to resist static, wind, and seismic (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight or lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 10,000 psi (17.2 MPa to 68.9 MPa).

Reference to "inserts" in this report refers to the proprietary specialty anchorage products (KCS-WF) used in concrete; reference to "steel insert elements" refers to threaded rods or bolts; reference to "anchors" or "insert anchor system" in this report refers to the installed inserts in concrete with threaded rods or bolts.

The insert anchor system is an alternative to cast-in anchors described in Section 1901.3 of the 2021, 2018 and 2015 IBC, and Sections 1908 and 1909 of the 2012 IBC. The insert anchor system may be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 Kwik Cast KCS-WF:

Hilti Kwik Cast KCS-WF are steel internally threaded headed cast-in specialty inserts which receive threaded steel insert elements such as threaded rods and bolts in $^1/_4$-inch, $^3/_8$-inch, $^1/_2$-inch, $^5/_8$-inch, and $^3/_4$-inch thread diameters.

The KCS-WF inserts are manufactured from carbon steel and have a minimum 5.1 µm (0.0002 inch) zinc coating. The KCS-WF steel outer shell is covered in a thin plastic housing up to the steel head bearing surface. The KCS-WF is illustrated in Figure 1.

The KCS-WF insert is installed into the wood-form for a concrete member using the attached nails prior to the casting of the concrete. The inserted threaded rod or bolt can be installed into the internally threaded section of the KCS-WF after the wood-form is removed from the concrete.

The inserts are color coded as indicated in Tables 1 for each diameter of threaded rod or other steel element that is threaded into the insert. Figure 1 shows a diagram of the installed KCS-WF in a concrete member.

3.2 Steel Insert Elements:

3.2.1 Threaded Steel Rods and Bolts: Threaded steel rods (all-thread) or bolts must be threaded into the KCS-WF. Table 3 includes design information for several grades of common threaded rod or bolts for the applicable diameters. Carbon steel threaded rods or bolts must be furnished with a minimum 5.1 µm (0.0002 inch) zinc plating.

3.2.2 Ductility: In accordance with ACI 318 (-19 and -14) 2.3 or ACI 318-11 D.1, as applicable, in order for a steel anchor element to be considered ductile, the tested elongation must be at least 14 percent and the reduction of area must be at least 30 percent. Steel elements with a tested elongation of less than 14 percent or a reduction of area less than 30 percent, or both, are considered brittle. Values for common steel threaded rod insert elements are provided in Table 3 of this report. The Hilti KCS-WF Headed Cast-In Specialty Insert steel bodies are considered brittle elements. Where values are nonconforming or unstated, the steel element must be considered brittle.

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2021 ICC Evaluation Service, LLC. All rights reserved.

3.3 Concrete:

Normal-weight and lightweight concrete must conform to Sections 1903 and 1905 of the IBC.

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with the 2021 IBC as well as Section R301.1.3 of the 2021 IRC, must be determined in accordance with ACI 318-19 Chapter 17 and this report. Design strength of anchors complying with the 2018 and 2015 IBC as well as Section R301.1.3 of the 2018 and 2015 IRC, must be determined in accordance with ACI 318-14 Chapter 17 and this report.

Design strength of anchors complying with the 2012 IBC as well as Section R301.1.3 of the 2012 IRC, must be determined in accordance with ACI 318-11 Appendix D and this report.

Design parameters provided in this report are based on the 2021 IBC (ACI 318-19), 2018 and 2015 IBC (ACI 318-14) and the 2012 IBC (ACI 318-11) unless noted otherwise in Sections 4.1.1 through 4.1.13. The strength design of anchors must comply with ACI 318-19 17.5.1.2, ACI 318-14 17.3.1 or ACI 318-11 D.4.1, except as required in ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Strength reduction factors, ϕ, as given in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for cast-in headed anchors, must be used for load combinations calculated in accordance with Section 1605.1 of the 2021 IBC, or Section 1605.2 of the 2018, 2015 or 2012 IBC, Section 5.3 of ACI 318-14, or Section 9.2 of ACI 318-11, as applicable. Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C. The value of f'_c used in the calculations must be limited to a maximum of 10,000 psi (68.9 MPa), in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

4.1.2 Requirements for Static Steel Strength in Tension: The nominal static steel strength in tension, N_{sa}, of a single anchor must be calculated in accordance with ACI 318-19 17.6.1.2, ACI 318-14 17.4.1 or ACI 318-11 D.5.1, as applicable, for the threaded rod, not to exceed the values of $N_{sa,insert}$ in Table 2 of this report. Strength reduction factor, ϕ, corresponding to non-ductile steel shall be used when $\phi N_{sa,insert}$, controls the design strength. When the threaded rod strength controls, the strength reduction factor, ϕ, corresponding to the threaded rod shall be used. Tension values for common threaded rods are given in Table 3.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension: For the KCS-WF, the nominal concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} or N_{cbg}, respectively, must be calculated in accordance with ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, for cast-in headed bolts. The basic concrete breakout strength in tension, N_b, must be calculated in accordance with ACI 318-19 17.6.2.2, ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of h_{ef} given in Table 1, and with k_c = 24. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318-19 17.6.2.5, ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, must be calculated with $\Psi_{c,N}$ = 1.25.

4.1.4 Static Pullout Strength in Tension: For the KCS-WF, the Pullout Strength in tension for the KCS-WF does not control design, and need not be calculated.

4.1.5 Requirements for Static Side-Face Blowout Strength in Tension: For the KCS-WF, the nominal side-face blowout strength of a headed insert, N_{sb}, must be calculated in accordance with ACI 318-19 17.6.4.1, ACI 318-14 17.4.4.1 or ACI 318-11 D.5.4.1, as applicable, for the cast-in headed insert, using the values of A_{brg} as given in Table 1 of this report, as applicable.

4.1.6 Requirements for Static Steel Strength in Shear: For the KCS-WF, the nominal static steel strength of a single anchor in shear, $V_{sa,insert}$, is given the Table 2 and must be used in lieu of the values derived by calculation from ACI 318-19 Eq. 17.7.1.2a or 17.7.1.2b, ACI 318-14 Eq. 17.5.1.2a or 17.5.1.2b or ACI 318-11 D-28 or D-29, as applicable.

The values given in Table 3 is for the insert only. Determination of the shear capacity of the threaded rod or other material inserted into the cast-in insert is the responsibility of the design professional, and may be the controlling strength in shear. Shear values for common threaded rods are given in Table 3.

4.1.7 Requirements for Static Concrete Breakout Strength in Shear: For the KCS-WF, the nominal static concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable. The basic concrete breakout strength, V_b, must be calculated in accordance with ACI 318-19 17.7.2.2, ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2 based on the values provided in Table 1. The values of ℓ_e (=h_{ef}) and d_a used in ACI 318-19 17.7.2.2.1a, ACI 318-14 Eq. 17.5.2.2a or ACI 318-11 Eq. D-33, as applicable, are provided in Table 1 of this report.

4.1.8 Requirements for Static Concrete Pryout Strength in Shear: For KCS-WF inserts, the nominal concrete pryout strength of a single anchor or group of anchors, V_{cp} or V_{cpg}, respectively, must be calculated in accordance with ACI 318 (-19 or -14) 17.5.3 or ACI 318-11 D.6.3, as applicable.

4.1.9 Requirements for Seismic Design:

4.1.9.1 General: For load combinations including seismic, the design must be performed in accordance with ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Modifications to ACI 318-19 17.10, ACI 318-14 17.2.3 shall be applied under Section 1905.1.8 of the 2021, 2018 and 2015 IBC. For the 2012 IBC, Section 1905.1.9 shall be omitted. The anchors may be installed in Seismic Design Categories A through F of the IBC. The KCS-WF inserts comply with ACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1, as applicable, as non-ductile steel elements.

For the KCS-WF inserts, the nominal steel strength, nominal concrete breakout strength and nominal concrete side-face blowout strength for anchors in tension; and the nominal concrete breakout strength and pryout strength in shear, must be calculated in accordance with ACI 318-19 17.6 and 17.7, ACI 318-14 17.4 and 17.5 or ACI 318-11 D.5 and D.6, as applicable, using the values in Table 1 and Table 2, as applicable.

4.1.9.2 Seismic Tension: For KCS-WF inserts, the nominal steel strength in tension, N_{sa}, of a single anchor must be calculated in accordance with ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1, as applicable, for the threaded steel element, $N_{sa,rod,eq}$, as given in Table 3, not to exceed the corresponding values of $N_{sa,insert,eq}$ in Table 2 of this report; the nominal concrete breakout strength for anchors in tension must be calculated in accordance with ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, as described in Section

4.1.3 of this report; the nominal pullout strength in accordance with ACI 318-19 17.6.3.1 and 17.6.3.2.2a, ACI 318-14 17.4.3.1 or ACI 318-11 D.5.3.1, as applicable, need not be considered as noted in Section 4.1.4 of this report; the nominal concrete side-face blowout strength must be calculated in accordance with ACI 318-19 17.6.4.1 and 17.6.4.2, ACI 318-14 17.4.4.1 and 17.4.4.2 or ACI 318-11 D.5.4.1 and D.5.4.2, as applicable, and Section 4.1.5 of this report.

4.1.9.3 Seismic Shear: For KCS-WF inserts, the nominal concrete breakout strength and pryout strength in shear must be calculated in accordance with ACI 318-19 17.7.2 and 17.7.3, ACI 318-14 17.5.2 and 17.5.3 or ACI 318-11 D.6.2 and D.6.3, as applicable, as described in Sections 4.1.7 and 4.1.8 of this report. In accordance with ACI 318-19 17.7.1.2, ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, the nominal steel strength for seismic loads, $V_{sa,eq}$, must be taken as the threaded steel element strength, $V_{sa,rod,eq}$, given in Table 3 of this report, not to exceed the corresponding values of $V_{sa,insert,eq}$, in Table 2.

4.1.10 Requirements for Interaction of Tensile and Shear Forces: For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-19 17.8, ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.11 Requirements for Minimum Member Thickness, h_{min}, Minimum Anchor Spacing, s_{min}, and Minimum Edge Distance, c_{min}: Requirements on headed cast-in specialty anchor edge distance, spacing, member thickness, and concrete strength must be in accordance with the requirements in ACI 318 (-19 and -14) or ACI 318-11, as applicable, for cast-in bolts.

4.1.12 Requirements for Critical Edge Distance: The calculation of the critical edge distance, c_{ac}, is not required, since the modification factor $\Psi_{cp,N}$ = 1.0 for cast-in anchors in accordance with ACI 318-19 17.9.2, ACI 318-14 17.4.2.7 or ACI 318-11 D.5.2.7, as applicable.

4.1.13 Lightweight Concrete: For the KCS-WF in lightweight concrete, the modification factor λ, for concrete breakout strength must be in accordance with ACI 318-19 17.2.4 (2021 IBC), ACI 318-14 17.2.6 (2018 and 2015 IBC), ACI 318-11 D.3.6 (2012 IBC), as applicable.

4.2 Allowable Stress Design (ASD):

4.2.1 General: Design values for use with allowable stress design (working stress design) load combinations calculated in accordance with Section 1605.2 of the 2021 IBC or Section 1605.3 of the 2018, 2015 and 2012 IBC, must be established as follows:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha}$$

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha}$$

where:

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

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

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 (-19 or -14) 17.3.1 and 2018 or 2015 IBC Section 1905.1.8; ACI 318 (-11, -08) D.4.1; and Section 4.1 of this report, as applicable (lbf or N). For the 2012 IBC, Section 1905.1.9 shall be omitted.

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 (-19 or -14) 17.3.1 and 2018 or 2015 IBC Section 1905.1.8; ACI 318 (-11, -08) D.4.1; and Section 4.1 of this report, as applicable (lbf or N). For the 2012 IBC, Section 1905.1.9 shall be omitted.

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α must include all applicable factors to account for non-ductile failure modes and required over-strength.

The requirements for member thickness, edge distance and spacing, described in this report, must apply. Examples of allowable stress design value determination for illustrative purposes are shown in Table 4.

4.2.2 Interaction of Tensile and Shear Forces: For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-19 17.8, ACI 318-14 17.6 or ACI 318-11 D.7, as applicable, as follows:

For shear loads $V_{applied} \leq 0.2V_{allowable,ASD}$, the full allowable load in tension must be permitted.

For tension loads $T_{applied} \leq 0.2T_{allowable,ASD}$, the full allowable load in shear must be permitted.

For all other cases:

$$\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2 \qquad \text{(Eq-1)}$$

4.3 Installation:

For the KCS-WF inserts, installation parameters are provided in Table 1 and Figures 1 and 2. KCS-WF inserts must be positioned on wood or similar formwork with all nails in contact with the form. The head of the KCS-WF must be impacted with sufficient force to drive nails all the way into the formwork until the plastic base sits flush and tight against the form. From beneath the deck, following the concrete pour and form removal, the three nails may be broken off, and a threaded rod or bolt element must be screwed into the internal threads of the KCS-WF until fully seated in the insert, which will result in a thread engagement equal to one diameter. The threaded steel rod or bolt element must have a minimum thread engagement equal to one steel element diameter.

Installation of KCS-WF inserts must be in accordance with this evaluation report and the manufacturer's published installation instruction (MPII) as provided in Figure 2 of this report. In the event of a conflict between this report and the MPII, this report governs.

4.4 Special Inspection:

Periodic special inspection is required in accordance with Section 1705.1.1 and Table 1705.3 of the 2021, 2018, 2015 or 2012 IBC, as applicable. The special inspector must make periodic inspections during installation of the headed cast-in specialty inserts to verify insert type, insert dimensions, concrete type, concrete compressive strength, insert spacing, edge distances, concrete member thickness, insert embedment, threaded rod fully seated into insert, and adherence to the manufacturer's printed installation instructions. The special inspector must be present as often as required in accordance with the "statement of special inspection." Under the IBC, additional requirements as set forth in Sections 1705, 1706 and 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE

The KCS-WF concrete inserts described in this report are acceptable alternatives to what is specified in the codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Specialty inserts are limited to dry interior locations.

5.2 Specialty insert sizes, dimensions, minimum embedment depths, and other installation parameters are as set forth in this report.

5.3 Specialty inserts must be installed in accordance with the manufacturer's printed installation instructions (MPII) and this report. In case of conflict, this report governs.

5.4 Specialty inserts must be limited to use in cracked and uncracked normal-weight concrete, and lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 10,000 psi (17.2 MPa to 68.9 MPa) for the KCS-WF inserts.

5.5 The values of f'_c used for calculation purposes must not exceed 10,000 psi (68.9 MPa).

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

5.7 Allowable design values are established in accordance with Section 4.2.

5.8 Specialty insert spacing and edge distance as well as minimum member thickness must comply with ACI 318-19 17.9, ACI 318-14 17.7 or ACI 318-11 Section D.8 requirements, as applicable, for cast-in-place headed anchors, and Table 1 of this report.

5.9 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.10 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of the specialty inserts subjected to fatigue or shock loading is unavailable at this time, the use of these inserts under such conditions is beyond the scope of this report.

5.11 Specialty inserts may be installed in regions of concrete where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.

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

5.13 Where not otherwise prohibited in the code, inserts are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Headed cast-in specialty inserts that support a fire-resistance-rated envelope or a fire-resistance-rated membrane are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Headed cast-in specialty inserts are used to resist wind or seismic forces only.
- Headed cast-in specialty inserts are used to support nonstructural elements.

5.14 Special inspection must be provided in accordance with Section 4.4.

5.15 Specialty inserts are manufactured under an approved quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Headed Cast-in Specialty Inserts in Concrete (AC446), dated August 2018.

6.2 Quality-control documentation.

7.0 IDENTIFICATION

7.1 Product labeling shall include, the name of the report holder or listee, and the ICC-ES mark of conformity. The listing or evaluation report number (ICC-ES ESR-4006) may be used in lieu of the mark of conformity. The KCS-WF inserts are identified by packaging labeled with the manufacturer's name (Hilti, Inc.) and contact information, insert name, insert size, lot number and evaluation report number (ESR-4006). The inserts have various colored plastic housings to identify the product size.

7.2 The report holder's contact information is as follows:

HILTI, INC.
7250 DALLAS PARKWAY, SUITE 1000
PLANO, TEXAS 75024
(800) 879-8000
www.hilti.com

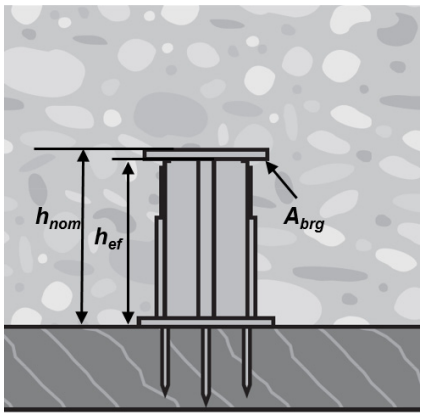

FIGURE 1—HILTI KWIK CAST KCS-WF ANCHOR INSTALLED IN CONCRETE

TABLE 1—HILTI KWIK CAST KCS-WF CAST-IN INSERT INSTALLATION INFORMATION[2,3]

DESIGN INFORMATION	SYMBOL	UNITS	Nominal anchor diameter (in.)				
			1/4	3/8	1/2	5/8	3/4
Plastic housing color	-	-	Green	Red	Orange	Yellow	Black
Insert thread size	*d*	UNC	1/4-20	3/8-16	1/2-13	5/8-11	3/4-10
Effective embedment[1]	h_{ef}	in. (mm)	1.11 (28)		1.63 (42)	1.90 (48)	1.83 (46)
Min. member thickness	h_{min}	in. (mm)	2 1/2 (64)			3 3/4 (95)	
Outside anchor diameter	d_a	in. (mm)	0.51 (13)		0.67 (17)	0.87 (22)	1.00 (25)
Bearing area	A_{brg}	in.^{2} (mm^2)	0.935 (603)		0.780 (503)	0.969 (625)	0.993 (641)

For **SI:** 1 inch = 25.4 mm. For **pound-inch** units: 1 mm = 0.03937 inch.

[1]See Figure 1.

[2]Reference ACI 318-19 17.5.2, ACI 318-14 17.3.1.1 or ACI 318-11 D.4.1.1, as applicable. The controlling strength is decisive from all appropriate failure modes (i.e. steel, concrete breakout, pryout and side-face blowout, as applicable) and design assumptions. The pullout strength in tension is not decisive for design and does not need to be evaluated.

[3]See Section 4.1.9 for requirements for seismic design, where applicable.

TABLE 2—HILTI KWIK CAST KCS-WF INSERT DESIGN INFORMATION[1,6,7]

DESIGN INFORMATION	SYMBOL	UNITS	Nominal anchor diameter (in.)				
			1/4	3/8	1/2	5/8	3/4
Characterization of insert per D.1	-	-	Non-Ductile				
Effective Embedment	h_{ef}	in. (mm)	1.11 (28)		1.63 (42)	1.90 (48)	1.83 (46)
Outside anchor diameter	d_a	in. (mm)	0.51 (13)		0.67 (17)	0.87 (22)	1.00 (25)
Nominal steel strength in tension as governed by the insert[2]	$N_{sa,insert}$	lb (kN)	3,770 (16.8)	3,770 (16.8)	13,020 (57.9)	14,000 (62.3)	14,000 (62.3)
Nominal seismic steel strength in tension as governed by the insert[2]	$N_{sa,insert,eq}$	lb (kN)	3,770 (16.8)	3,770 (16.8)	13,020 (57.9)	14,000 (62.3)	14,000 (62.3)
Nominal steel strength in shear as governed by the insert[2]	$V_{sa,insert}$	lb (kN)	2,750 (12.2)	2,750 (12.2)	3,520 (15.7)	8,690 (38.6)	9,070 (40.3)
Nominal seismic steel strength in shear as governed by the insert[2]	$V_{sa,insert,eq}$	lb (kN)	2,750 (12.2)	2,750 (12.2)	3,520 (15.7)	8,690 (38.6)	9,070 (40.3)
Modification factor for tension in uncracked concrete	$\psi_{c,N}$	-	1.25				
Modification factor for tension in cracked concrete	$\psi_{c,N}$	-	1.0				
Strength reduction factor ϕ for tension, steel failure of insert[3]	ϕ	-	0.65				
Strength reduction factor ϕ for shear, steel failure of insert[3]	ϕ	-	0.60				
Effectiveness factor cracked[4]	k_{cr}	-	24				
Coefficient for pryout strength	k_{cp}	-	1.0				
Strength reduction factor ϕ for tension, concrete failure modes, Condition B[3,5]	ϕ	-	0.70				
Strength reduction factor ϕ for shear, concrete failure modes, Condition B[3,5]	ϕ	-	0.70				
Concrete pullout, uncracked	$N_{p,uncr}$	-	NA				
Concrete pullout, cracked	$N_{p,cr}$	-	NA				

For **SI:** 1 inch = 25.4 mm. For **pound-inch** units: 1 mm = 0.03937 inch.

[1]Installation must comply with Section 4.3 and Figure 1 of this report.
[2]The design strength must be in accordance with ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D, as applicable, and Section 4.1 of this report. Values are for the insert only. The capacity of the threaded rod or other material threaded into the insert must be also be determined. See Table 5 for steel design information for common threaded rod elements.
[3]See ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable.
[4]See ACI 318-19 17.6.4.2, ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable.
[5]For use with load combinations of ACI 318 (-19 and -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable. Condition B applies where supplementary reinforcement in conformance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided. For cases where the presence of supplementary reinforcement can verified, the strength reduction factors associated with Condition A may be used.
[6]Inserts must be installed in concrete with a minimum compressive strength f'_c of 2,500 psi.
[7]The design professional is responsible for checking threaded rod or bolt strength in tension, shear, and combined tension and shear, as applicable.

TABLE 3—STEEL DESIGN INFORMATION FOR COMMON THREADED ROD ELEMENTS USED WITH HILTI KWIK CAST KCS CONCRETE INSERTS[1,2,3,4]

DESIGN INFORMATION	SYMBOL	UNITS	1/4-inch	3/8-inch	1/2-inch	5/8-inch	3/4-inch
Threaded rod nominal outside diameter	d_{rod}	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Threaded rod effective cross-sectional area	A_{se}	in^2 (mm^2)	0.032 (21)	0.078 (50)	0.142 (92)	0.226 (146)	0.335 (216)
Nominal tension strength of ASTM A36 threaded rod in tension as governed by steel strength for static or seismic loading	$N_{sa,rod,A36}$ or $N_{sa,rod,eq,A36}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,400 (86.3)
Nominal tension strength of ASTM F1554, Gr. 105 threaded rod in tension as governed by steel strength for static or seismic loading	$N_{sa,rod,F1554}$ or $N_{sa,rod,eq,F1554}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Nominal tension strength of ASTM A193 threaded rod in tension as governed by steel strength for static or seismic loading	$N_{sa,rod,A193}$ or $N_{sa,rod,eq,A193}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Nominal shear strength of ASTM A36 threaded rod in shear as governed by steel strength for static loading	$V_{sa,rod,A36}$	lb (kN)	1,105 (4.9)	2,695 (12.0)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)
Nominal shear strength of ASTM A36 threaded rod in shear as governed by steel strength for seismic loading	$V_{sa,rod,eq,A36}$	lb (kN)	780 (3.5)	1,900 (8.4)	3,460 (15.4)	5,505 (24.5)	8,160 (36.3)
Nominal shear strength of ASTM F1554, Gr. 105 threaded rod in shear as governed by steel strength for static loading	$V_{sa,rod,F1554}$	lb (kN)	2,385 (10.6)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)
Nominal shear strength of ASTM F1554, Gr. 105 threaded rod in shear as governed by steel strength for seismic loading	$V_{sa,rod,eq,F1554}$	lb (kN)	1,680 (7.5)	4,095 (18.2)	7,455 (34.2)	11,865 (52.8)	17,590 (78.2)
Nominal shear strength of ASTM A193 threaded rod in shear as governed by steel strength for static loading	$V_{sa,rod,A193}$	lb (kN)	2,385 (10.6)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)
Nominal shear strength of ASTM A193 threaded rod in shear as governed by steel strength for seismic loading	$V_{sa,rod,eq,A193}$	lb (kN)	1,680 (7.5)	4,095 (18.2)	7,455 (34.2)	11,865 (52.8)	17,590 (78.2)

For SI: 1 inch = 25.4 mm, 1 pound = 0.00445 kN, 1 in^2 = 645.2 mm^2. For pound-inch unit: 1 mm = 0.03937 inches.

[1]Values provided for steel element material types, or equivalent, based on minimum specified strength; $N_{sa,rod}$ and $V_{sa,rod}$ calculated in accordance with ACI 318 Eq. 17.6.1 and 17.7.1.2b, ACI 318-14 Eq. (17.4.1.2) and Eq. (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29) respectively. $V_{sa,rod,eq}$ must be taken as $0.7V_{sa,rod}$. Materials of other strengths may be used and calculated in similar manner.

[2]ϕN_{sa} shall be the lower of the $\phi N_{sa,rod}$ or $\phi N_{sa,insert}$ for static steel strength in tension; for seismic loading $\phi N_{sa,eq}$ shall be the lower of the $\phi N_{sa,rod,eq}$ or $\phi N_{sa,insert,eq}$.

[3]ϕV_{sa} shall be the lower of the $\phi V_{sa,rod}$, $\phi V_{sa,insert}$ or $\phi V_{sa,deck}$ for static steel strength in tension; for seismic loading $\phi V_{sa,eq}$ shall be the lower of the $\phi V_{sa,rod,eq}$ or $\phi V_{sa,insert,eq}$, or $\phi V_{sa,deck,eq}$.

[4]Strength reduction factors shall be taken from ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for steel elements. Strength reduction factors for load combinations in accordance with ACI 318 17.5.3., ACI 318-14 5.3 or ACI 318-11 9.2 governed by steel strength of ductile steel elements shall be taken as 0.75 for tension and 0.65 for shear. The value of ϕ applies when the load combinations of Section 1605.1 of the 2021 IBC, 1605.2 of the 2018, 2015 or 2012 IBC, ACI 318-14 5.3, or ACI 318-11 Section 9.2 are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

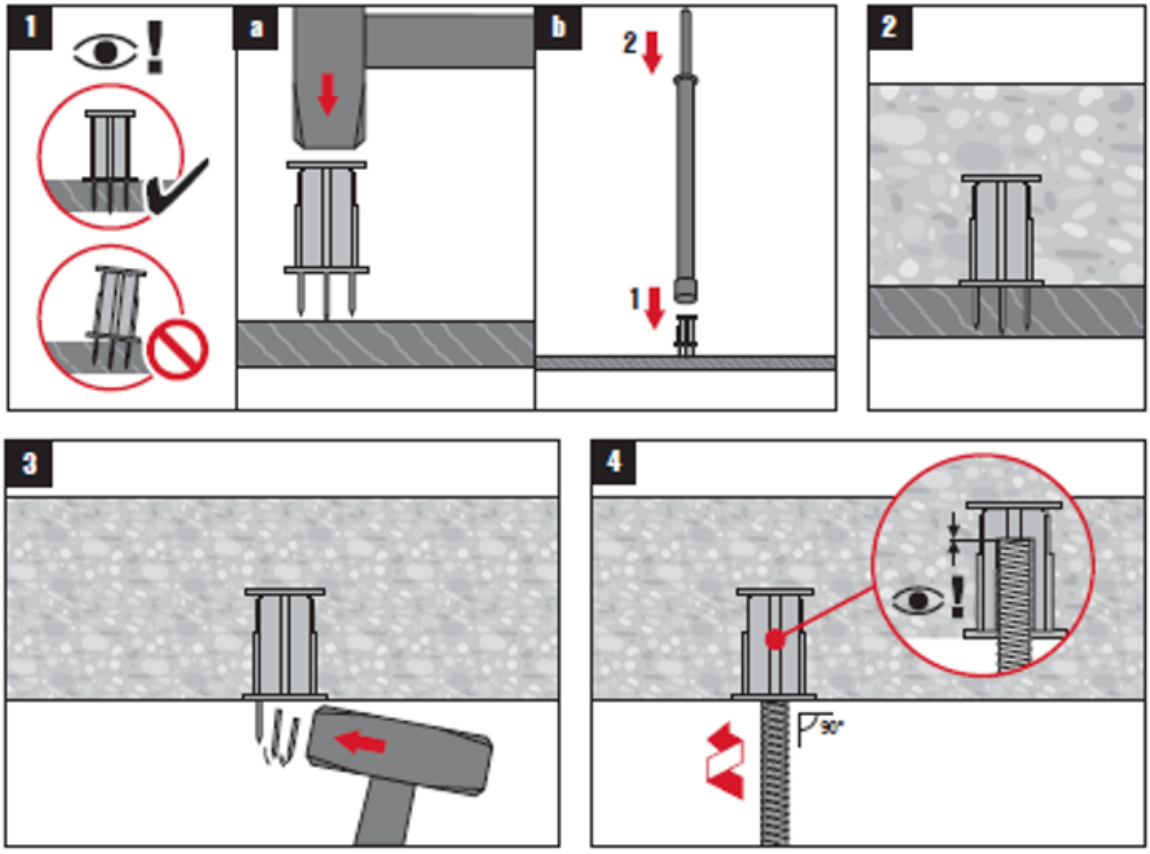

FIGURE 2—KWIK CAST KCS-WF CONCRETE INSERTS MANUFACTUER PRINTED INSTALLATION INSTRUCTIONS (MPII)

DIVISION: 03 00 00—CONCRETE
Section: 03 15 19—Cast-in Concrete Anchors
Section: 03 16 00—Concrete Anchors

REPORT HOLDER:

HILTI, INC.

EVALUATION SUBJECT:

HILTI KWIK CAST KCS-WF HEADED CAST-IN SPECIALTY INSERTS IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Hilti Kwik Cast KCS-WF Headed Cast-in Specialty Inserts in Cracked and Uncracked Concrete, described in ICC-ES evaluation report ESR-4006, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2020 *City of Los Angeles Building Code* (LABC)
- 2020 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Hilti Kwik Cast KCS-WF Headed Cast-in Specialty Inserts in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-4006, complies with LABC Chapter 19, and LARC, and is subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Hilti Kwik Cast KCS-WF Headed Cast-in Specialty Inserts in Cracked and Uncracked Concrete, described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-4006.
- The design, installation, conditions of use and labeling of the Hilti Kwik Cast KCS-WF Headed Cast-in Specialty Inserts in Cracked and Uncracked Concrete are in accordance with the 2018 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-4006.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The strength design values listed in the evaluation report and tables are for the connection of the inserts to the concrete. The connection between the inserts and the connected members shall be checked for capacity (which may govern).

This supplement expires concurrently with the evaluation report, reissued November 2021.

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2021 ICC Evaluation Service, LLC. All rights reserved.

DIVISION: 03 00 00—CONCRETE
Section: 03 15 19—Cast-in Concrete Anchors
Section: 03 16 00—Concrete Anchors

REPORT HOLDER:

HILTI, INC.

EVALUATION SUBJECT:

HILTI KWIK CAST KCS-WF HEADED CAST-IN SPECIALTY INSERTS IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the HILTI Kwik Cast KCS-WF Headed Cast-In Specialty Inserts in Cracked and Uncracked Concrete, described in ICC-ES evaluation report ESR-4006, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2020 *Florida Building Code—Building*
- 2020 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The HILTI Kwik Cast KCS-WF Headed Cast-In Specialty Inserts in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of ICC-ES evaluation report ESR-4006, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design requirements are determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable. The installation requirements noted in ICC-ES evaluation report ESR-4006 for the 2018 *International Building Code®* meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable.

Use of the HILTI Kwik Cast KCS-WF Headed Cast-In Specialty Inserts in Cracked and Uncracked Concrete have also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and *Florida Building Code—Residential*, with the following condition.

a) For anchorage of wood members, the connection subject to uplift, must be designed for no less than 700 pounds (3114 N).

For products falling under Florida Rule 61G20-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued November 2021.

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2021 ICC Evaluation Service, LLC. All rights reserved.