**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 AND KCS-MD HEADED CAST-IN SPECIALTY INSERTS IN CRACKED AND UNCRACKED CONCRETE

### 1.0 EVALUATION SCOPE

**Compliance with the following codes:**

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

**Properties 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).

The Hilti Kwik Cast KCS-MD Headed Cast-In Specialty Insert is used to resist static, wind, and seismic (Seismic Design Categories A through F) tension and shear loads in the soffit of cracked and uncracked normal-weight concrete and sand-lightweight concrete on steel deck having a specified compressive strength, $f'_c$, of 3,000 psi to 10,000 psi (20.7 MPa to 68.9 MPa).

Reference to “inserts” in this report refers to the proprietary specialty anchorage products (KCS-WF and KCS-MD) 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.
3.2.2 Ductility: In accordance with ACI 318-14 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 5 of this report. The Hilti KCS-WF and KCS-MD Headed Cast-In Specialty Insert steel bodies are considered brittle elements. Where values are nonconforming or unstated, the steel element must be considered brittle.

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

3.4 Steel Deck Panels:
Steel deck panels must be in accordance with the configuration in Figures 3, 4 and 5 and have a minimum base steel thickness of 0.035 inch (0.899 mm). Steel must comply with ASTM A653/A653M SS Grade 50 minimum and have a minimum yield strength of 50,000 psi (345 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: 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 strength of anchors complying with the 2009 IBC and Section R301.1.3 of the 2009 IRC must be determined in accordance with ACI 318-08 Appendix D and this report.

Design parameters provided in this report are based on the 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 318-14 17.3.1 or ACI 318-11 D.4.1, except as required in ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Strength reduction factors, \( \phi \), as given in 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 1605.2 of the IBC, Section 5.3 of ACI 318-14, or Section 9.2 of ACI 318-11, as applicable. Strength reduction factors, \( \phi \), as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C. An example calculation in accordance with the 2018 and 2015 IBC is provided in Figure 8 of this report. The value of \( f_y \) used in the calculations must be limited to a maximum of 10,000 psi (68.9 MPa), in accordance with 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 318-14 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 Tables 3 and 4 of this report. Strength reduction factor, \( \phi \), 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, \( \phi \), corresponding to the threaded rod shall be used. Tension values for common threaded rods are given in Table 5.

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 \( N_{cbp} \), respectively, must be calculated in accordance with 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 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of \( h_{cb} \) given in Tables 1 and 3, and with \( k_c = 24 \). The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, must be calculated with \( \psi_{c/n} = 1.25 \).

For the KCS-MD installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck assemblies, calculation of the concrete breakout strength in tension is not required.

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. For the KCS-MD installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck assemblies as shown in Figures 3, 4 and 5, pullout strength in tension, \( N_{pn,deck} \), is given in Table 4 of this report.

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 318-14 17.4.4.1 or ACI 318-11 D.5.4.1, as applicable, for the cast-in headed insert, using the values of \( A_{bg} \) as given in Table 1 of this report, as applicable.

For the KCS-MD metal deck inserts installed in the soffit of sand-lightweight or normal-weight concrete on steel deck floor and roof assemblies as shown in Figures 3, 4 and 5, calculation of the concrete side blowout strength is not required.

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 in Table 3 and must be used in lieu of the values derived by calculation from ACI 318-14 Eq. 17.5.1.2a or 17.5.1.2b or ACI 318-11 Eq. D-28 or D-29, as applicable.

For the KCS-MD, the nominal steel strength of a single insert in shear, \( V_{sa,deck} \), is given in Table 4 of this report and must be used in lieu of the values derived by calculation from ACI 318-14 Eq. 17.5.1.2a or 17.5.1.2b or ACI 318-11 Eq. D-28 or D-29, as applicable.

The values given in Tables 3 and 4 are 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 5.

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 \( V_{cbp} \), respectively, must be calculated in accordance with 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 318-14 17.5.2.2 or ACI 318-11 D.6.2.2 based on the values provided in Table 1. The values of \( f_y = (h_{cb}) \) and \( d_{cb} \) used in 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.
For the KCS-MD installed in the soffit of sand-lightweight or normal-weight concrete on steel deck floor and roof assemblies, as shown in Figures 3, 4 and 5, calculation of the concrete breakout strength in shear is not required.

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 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable.

For the KCS-MD inserts installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck assemblies, as shown in Figures 3, 4 and 5, calculation of the concrete pry-out strength is not required.

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 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Modifications to ACI 318-14 17.2.3 shall be applied under Section 1905.1.8 of the 2018 and 2015 IBC. For the 2012 IBC, Section 1905.1.9 shall be omitted. Modifications to ACI 318 D.3.3 shall be applied under Section 1908.1.9 of the 2018 and 2015 IBC. For the 2012 IBC, Section 1908.1.9 shall be omitted. Modifications to ACI 318-11 D.3.3 shall be applied under Section 1908.1.9 of the 2012 IBC. The anchors may be installed in Seismic Design Categories A through F of the IBC. The KCS-WF and KCS-MD inserts comply with ACI 318-14 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 318-14 17.4 and 17.5 or ACI 318-11 D.5 and D.6, as applicable, using the values in Table 1 and Table 3, as applicable.

For KCS-MD inserts, the nominal steel strength and nominal concrete pullout strength for anchors in tension must be calculated using the values in Table 2 and Table 4, as applicable.

4.1.9.2 Seismic Tension: For KCS-WF inserts, the nominal steel strength in tension, $N_{as}$, of a single anchor must be calculated in accordance with ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1, as applicable, for the threaded steel element, $N_{as,rod,eq}$, as given in Table 5, not to exceed the corresponding values of $N_{as,insert,eq}$ in Table 3 of this report; the nominal concrete breakout strength for anchors in tension must be calculated in accordance with 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 318-14 17.4.3 or ACI 318-11 D.5.3, 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 318-14 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.

For KCS-MD inserts, the nominal steel strength in tension, $N_{as}$, of a single anchor must be calculated in accordance with ACI 318-14 17.4.1 or ACI 318-11 D.5.1, as applicable, for the threaded steel element, $N_{as,rod,eq}$, as given in Table 5, not to exceed the corresponding values of $N_{as,insert,eq}$ in Table 4 of this report; the nominal concrete pullout strength is given in Table 4, and must be used in lieu of calculations in accordance with ACI 318-14 17.4.3 or ACI 318-11 D.5.3, as applicable, the nominal concrete breakout strength calculations in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2 are not required, as noted in Section 4.1.3 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 318-14 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 318-14 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 5 of this report, not to exceed the corresponding values of $V_{sa,insert,eq}$, in Table 3.

For KCS-MD inserts, the nominal concrete breakout strength in tension and shear and pryout strength in shear, calculations in accordance with 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, are not required. In accordance with ACI 318-14 17.5.1.2 or ACI 318 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 5 of this report, not to exceed the corresponding values of $V_{sa,insert,deck,eq}$, in Table 4.

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 318-14 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 318-14 or ACI 318-11, as applicable, for cast-in bolts.

For KCS-MD inserts installed in the soffit of sand-lightweight or normal-weight concrete over profile steel deck floor and roof assemblies, the anchors must be installed in accordance with Figures 3, 4 and 5, and shall have a minimum axial spacing along the flute equal to $3h_{tet}$.

4.1.12 Requirements for Critical Edge Distance: The calculation of the critical edge distance, $c_{tet}$, is not required, since the modification factor $\varphi_{p,e,n} = 1.0$ for cast-in anchors in accordance with 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 $\lambda$, for concrete breakout strength must be in accordance with ACI 318-14 17.2.6 (2018 and 2015 IBC), ACI 318-11 D.3.6 (2012 IBC), or ACI 318-08 D.3.4 (2009 IBC), as applicable.

For KCS-MD inserts in the soffit of sand-lightweight concrete-filled steel deck, this reduction is not required. Values shown in Table 4 are based on use in sand-lightweight concrete and are also valid for normal weight concrete. Installation details are shown in Figures 3, 4 and 5.

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 1605.3 of the IBC, must be established as follows:

$$T_{allowable, ASD} = \frac{\phi N_0}{\alpha}$$

$$V_{allowable, ASD} = \frac{\phi N_0}{\alpha}$$

where:

- $T_{allowable, ASD}$: Allowable Tensile Force
- $V_{allowable, ASD}$: Allowable Shear Force
- $\phi$: Modification Factor
- $N_0$: Design Value
For the KCS-MD inserts, installation parameters are provided in Table 2 and Figures 2, 3, 4, 5 and 7. A hole must be made in the steel deck using a hole saw in accordance with the corresponding hole diameters shown in Table 2. From the topside of the deck, the KCS-MD plastic sleeve must be placed in the hole, and following this, the head of the insert must be stepped on or impacted with sufficient force to compress the outer spring and drive the flared plastic fins of the sleeve completely through the hole in the steel deck. The KCS-MD metal base plate may be screwed to the deck for additional stability (optional). After insertion in deck, a threaded rod or bolt element must be inserted through the plastic thread protector nozzle until contact is made with the inner steel barrel. The threaded rod or bolt element must then be screwed into the KCS-MD internal threads. The rod or bolt must be tightened until fully seated in the insert, which will result in a thread engagement equal to a minimum of one rod diameter. The plastic sleeve must be cut and trimmed to the surface of the insert following the concrete pour if the insert is intended to resist shear loads. KCS-MD inserts are permitted to be installed in either the upper or lower flute of the steel deck.

Installation of KCS-WF and KCS-MD inserts must be in accordance with this evaluation report and the manufacturer’s published installation instruction (MPII) as provided in Figures 6 and 7 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 2018, 2015 or 2012 IBC, or Section 1704.15 and Table 1704.4 of the 2009 IBC, as applicable. The special inspector must make periodic inspections during installation of the headed cast-in-slab 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 and KCS-MD 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, and in cracked and uncracked normal-weight or sand-lightweight concrete filled steel deck assemblies having a specified compressive strength, \( f_c \), of 3,000 psi to 10,000 psi (20.7 MPa to 68.9 MPa) for the KCS-MD inserts.
5.5 The values of $f'$ 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 318-14 17.7 or ACI 318-11 Section D.8 requirements, as applicable, for cast-in-place headed anchors, and Tables 1 and 2, and Figures 3, 4 and 5 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 ($h > t_i$), 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 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 The KCS-WF and KCS-MD 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.us.hilti.com
HiltiTechEng@us.hilti.com
FIGURE 1—HILTI KWIK CAST KCS-WF ANCHOR INSTALLED IN CONCRETE

FIGURE 2—HILTI KWIK CAST KCS-MD ANCHOR INSTALLED IN SOFFIT OF CONCRETE FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES

TABLE 1—HILTI KWIK CAST KCS-WF CAST-IN INSERT INSTALLATION INFORMATION²³

<table>
<thead>
<tr>
<th>DESIGN INFORMATION</th>
<th>SYMBOL</th>
<th>UNITS</th>
<th>Nominal anchor diameter (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic housing color</td>
<td>-</td>
<td>-</td>
<td>Green</td>
</tr>
<tr>
<td>Insert thread size</td>
<td>d</td>
<td>UNC</td>
<td>1(\frac{1}{4})-20</td>
</tr>
<tr>
<td>Effective embedment¹</td>
<td>(h_{ef})</td>
<td>in.</td>
<td>1.11 (28)</td>
</tr>
<tr>
<td>Min. member thickness</td>
<td>(h_{min})</td>
<td>in.</td>
<td>2(\frac{1}{2}) (64)</td>
</tr>
<tr>
<td>Outside anchor diameter</td>
<td>(d_o)</td>
<td>in.</td>
<td>0.51 (13)</td>
</tr>
<tr>
<td>Bearing area</td>
<td>(A_{brg})</td>
<td>in.²</td>
<td>0.935 (603)</td>
</tr>
</tbody>
</table>

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

¹See Figure 1.
²Reference 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.
³See Section 4.1.9 for requirements for seismic design, where applicable.

TABLE 2—HILTI KWIK CAST KCS-MD CAST-IN INSERT INSTALLATION INFORMATION⁵⁶

<table>
<thead>
<tr>
<th>DESIGN INFORMATION</th>
<th>SYMBOL</th>
<th>UNITS</th>
<th>Nominal anchor diameter (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic section color</td>
<td>-</td>
<td>-</td>
<td>Red</td>
</tr>
<tr>
<td>Insert thread size</td>
<td>(d)</td>
<td>UNC</td>
<td>3(\frac{1}{8})-16</td>
</tr>
<tr>
<td>Effective embedment¹</td>
<td>(h_{ef})</td>
<td>in.</td>
<td>1.95 (50)</td>
</tr>
<tr>
<td>Metal hole saw diameter</td>
<td>(d_{bit})</td>
<td>in.</td>
<td>(\frac{3}{8})</td>
</tr>
<tr>
<td>Min. concrete cover over metal deck - upper flute install²³⁴</td>
<td>(h_{upper,min})</td>
<td>in.</td>
<td>2(\frac{1}{2}) (64)</td>
</tr>
<tr>
<td>Min. concrete cover over metal deck - lower flute install²³⁴</td>
<td>(h_{lower,max})</td>
<td>in.</td>
<td>1(\frac{1}{2}) (38)</td>
</tr>
<tr>
<td>Outside anchor diameter</td>
<td>(d_o)</td>
<td>in.</td>
<td>0.67 (17)</td>
</tr>
<tr>
<td>Bearing area</td>
<td>(A_{brg})</td>
<td>in.²</td>
<td>1.14 (735)</td>
</tr>
<tr>
<td>Min. anchor spacing</td>
<td>(s_{min})</td>
<td>in.</td>
<td>5.85 (149)</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 pound = 0.00445 kN, 1 in² = 645.2 mm². For pound-inch unit: 1 mm = 0.03937 inches.

¹See Figure 2.
²See Figure 3.
³See Figure 4.
⁴See Figure 5.
⁵Reference 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 and design assumptions.
⁶See Section 4.1.9 for requirements for seismic design, where applicable.
### TABLE 3—HILTI KWIK CAST KCS-WF INSERT DESIGN INFORMATION

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>UNITS</th>
<th>Nominal anchor diameter (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterization of insert per D.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Effective Embedment</td>
<td>$h_e$</td>
<td>in. (mm)</td>
</tr>
<tr>
<td>Outside anchor diameter</td>
<td>$d_a$</td>
<td>in. (mm)</td>
</tr>
<tr>
<td>Nominal steel strength in tension as governed by the insert$^2$</td>
<td>$N_{s,insert}$</td>
<td>lb (kN)</td>
</tr>
<tr>
<td>Nominal seismic steel strength in tension as governed by the insert$^2$</td>
<td>$N_{s,insert,eq}$</td>
<td>lb (kN)</td>
</tr>
<tr>
<td>Nominal steel strength in shear as governed by the insert$^2$</td>
<td>$V_{s,insert}$</td>
<td>lb (kN)</td>
</tr>
<tr>
<td>Nominal seismic steel strength in shear as governed by the insert$^2$</td>
<td>$V_{s,insert,eq}$</td>
<td>lb (kN)</td>
</tr>
<tr>
<td>Modification factor for tension in uncracked concrete</td>
<td>$\psi_{c,N}$</td>
<td>-</td>
</tr>
<tr>
<td>Modification factor for tension in cracked concrete</td>
<td>$\psi_{c,N}$</td>
<td>-</td>
</tr>
<tr>
<td>Strength reduction factor $\phi$ for tension, steel failure of insert$^3$</td>
<td>-</td>
<td>$\phi$</td>
</tr>
<tr>
<td>Strength reduction factor $\phi$ for shear, steel failure of insert$^3$</td>
<td>-</td>
<td>$\phi$</td>
</tr>
<tr>
<td>Effectiveness factor cracked$^4$</td>
<td>$k_{cr}$</td>
<td>-</td>
</tr>
<tr>
<td>Coefficient for pryout strength</td>
<td>$k_{ip}$</td>
<td>-</td>
</tr>
<tr>
<td>Strength reduction factor $\phi$ for tension, concrete failure modes, Condition B$^5$</td>
<td>-</td>
<td>$\phi$</td>
</tr>
<tr>
<td>Strength reduction factor $\phi$ for shear, concrete failure modes, Condition B$^5$</td>
<td>-</td>
<td>$\phi$</td>
</tr>
<tr>
<td>Concrete pullout, uncracked</td>
<td>$N_{p,uncr}$</td>
<td>-</td>
</tr>
<tr>
<td>Concrete pullout, cracked</td>
<td>$N_{p,cr}$</td>
<td>-</td>
</tr>
</tbody>
</table>

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 318-14 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 also be determined. See Table 5 for steel design information for common threaded rod elements.

$^3$See ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable.

$^4$See 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 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable. Condition B applies where supplementary reinforcement in conformance with 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 4—HILTI KWIK CAST KCS-MD INSERT DESIGN INFORMATION

<table>
<thead>
<tr>
<th>DESIGN INFORMATION</th>
<th>SYMBOL</th>
<th>UNITS</th>
<th>Nominal anchor diameter (in.)</th>
<th>( \gamma_1 )</th>
<th>( \gamma_2 )</th>
<th>( \gamma_3 )</th>
<th>( \gamma_4 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterization of insert per D.1.1</td>
<td>-</td>
<td>-</td>
<td>Non-ductile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effective embedment</td>
<td>( h_{ef} )</td>
<td>in. (mm)</td>
<td>1.95</td>
<td>(50)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outside anchor diameter</td>
<td>( d_a )</td>
<td>in. (mm)</td>
<td>0.67</td>
<td>(17)</td>
<td>0.87</td>
<td>(22)</td>
<td>1.00</td>
</tr>
<tr>
<td>Strength reduction factor for tension, steel failure</td>
<td>( \phi )</td>
<td></td>
<td>0.65</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength reduction factor for shear, steel failure</td>
<td>( \phi )</td>
<td></td>
<td>0.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength reduction factor for tension, concrete failure modes, Condition B(^7,8)</td>
<td>( \phi )</td>
<td></td>
<td>0.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength reduction factor for shear, concrete failure modes, Condition B(^7,8)</td>
<td>( \phi )</td>
<td></td>
<td>0.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal steel strength in tension as governed by the insert</td>
<td>( N_{\text{sa,insert}} )</td>
<td>lb (kN)</td>
<td>13,000</td>
<td>(58)</td>
<td>13,000</td>
<td>(58)</td>
<td>13,000</td>
</tr>
<tr>
<td>Nominal seismic steel strength in tension as governed by the insert</td>
<td>( N_{\text{sa,insert,eq}} )</td>
<td>lb (kN)</td>
<td>13,000</td>
<td>(58)</td>
<td>13,000</td>
<td>(58)</td>
<td>13,000</td>
</tr>
</tbody>
</table>

**Installations in upper flute of metal deck according to Figures 3, 4 or 5**

| Nominal pullout resistance, cracked                     | \( N_{\text{pn,deck}} \) | lb (kN) | 3,045                         | (13.5)         | 3,045          | (13.5)         | 3,045          |
| Nominal steel strength in shear as governed by the insert | \( V_{\text{sa,deck}} \) | lb (kN) | 2,865                         | (12.7)         | 2,865          | (12.7)         | 6,495          |
| Nominal seismic steel strength in shear as governed by the insert | \( V_{\text{sa,deck,eq}} \) | lb (kN) | 2,650                         | (11.8)         | 2,665          | (12.7)         | 6,495          |

**Installations in lower flute of 3-inch minimum flute height (i.e. W-deck with 4-\( \frac{3}{8} \) inch lower flute width) according to Figure 3**

| Nominal pullout resistance, cracked                     | \( N_{\text{pn,deck}} \) | lb (kN) | 1,700                         | (7.6)          | 1,700          | (7.6)          | 1,700          |
| Nominal steel strength in shear as governed by the insert | \( V_{\text{sa,deck}} \) | lb (kN) | 1,525                         | (6.8)          | 1,525          | (6.8)          | 1,880          |
| Nominal seismic steel strength in shear as governed by the insert | \( V_{\text{sa,deck,eq}} \) | lb (kN) | 1,525                         | (6.8)          | 1,525          | (6.8)          | 1,880          |

**Installations in lower flute of 3-inch minimum flute height (i.e. W-deck with 3-\( \frac{7}{8} \) inch lower flute width) according to Figure 4**

| Nominal pullout resistance, cracked                     | \( N_{\text{pn,deck}} \) | lb (kN) | 1,615                         | (7.2)          | 1,615          | (7.2)          | 1,615          |
| Nominal steel strength in shear as governed by the insert | \( V_{\text{sa,deck}} \) | lb (kN) | 1,525                         | (6.8)          | 1,525          | (6.8)          | 1,530          |
| Nominal seismic steel strength in shear as governed by the insert | \( V_{\text{sa,deck,eq}} \) | lb (kN) | 1,525                         | (6.8)          | 1,525          | (6.8)          | 1,530          |

**Installations in lower flute of 1\( \frac{1}{2} \)-inch minimum flute height (i.e. B -deck) according to Figure 5**

| Nominal pullout resistance, cracked                     | \( N_{\text{pn,deck}} \) | lb (kN) | 700                           | (3.1)          | 700            | (3.1)          | 700            |
| Nominal steel strength in shear as governed by the insert | \( V_{\text{sa,deck}} \) | lb (kN) | 1,125                         | (5.0)          | 1,125          | (5.0)          | 1,125          |
| Nominal seismic steel strength in shear as governed by the insert | \( V_{\text{sa,deck,eq}} \) | lb (kN) | 1,125                         | (5.0)          | 1,125          | (5.0)          | 1,125          |

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

1 Inserts may be placed in the upper flute or lower flute of the steel deck assembly. Inserts in the lower flute require a minimum 1\( \frac{1}{2} \) of concrete topping thickness from the top of the upper flute. Upper flute installations require a minimum 2\( \frac{1}{2} \) of concrete topping thickness from the top of the upper flute. Inserts in upper flute may be installed anywhere across upper flute.

2 Axial spacing for KCS-MD inserts along the lower flute length shall be minimum 3\( h_{ef} \).

3 Installation must comply with Section 4.3 and Figure 2 or 7 of this report.

4 The design strength must be in accordance with ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable, and Section 4.1 of this report. 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.

5 The characteristic pullout resistance for concrete compressive strengths greater than 3,000 psi may be increased by multiplying the value in the table by (f\( c^{0.04} \))^2 for psi or (f\( c^{0.20} \))^2 for MPa. Pullout resistance is for normal weight or sand light weight concrete.

6 Evaluation of concrete breakout capacity in accordance with ACI 318-14 17.4.2, 17.5.2, and 17.5.3 or ACI 318-11 D.5.2, D.6.2, and D.6.3, as applicable, is not required for anchors installed in the deck soffit.

7 See ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable.

8 For use with load combinations of ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 as applicable. Condition B applies where supplementary reinforcement in conformance with 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.
FIGURE 3—INSTALLATION IN THE SOFFIT OF CONCRETE FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES—W DECK
WITH 4-1/2 INCH FLUTE WIDTH¹²

¹Anchors may be placed in the upper or lower flute of the steel deck profile provided the minimum clearance is satisfied. Anchors in the lower flute may be installed with a min 1-1/8" offset from the edge of the flute.
²Axial spacing along the flute length shall be minimum 3hAx.

FIGURE 4—INSTALLATION IN THE SOFFIT OF CONCRETE FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES—W DECK
WITH 3-7/8 INCH FLUTE WIDTH¹²

¹Anchors may be placed in the upper or lower flute of the steel deck profile provided the minimum clearance is satisfied. Anchors in the lower flute may be installed with a min 1" offset from the edge of the flute.
²Axial spacing along the flute length shall be minimum 3hAx.

FIGURE 5—INSTALLATION IN THE SOFFIT OF CONCRETE FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES—B DECK¹²

¹Anchors may be placed in the upper or lower flute of the steel deck profile provided the minimum clearance is satisfied.
²Axial spacing along the flute length shall be minimum 3hAx.
TABLE 5—STEEL DESIGN INFORMATION FOR COMMON THREADED ROD ELEMENTS USED WITH
HILTI KWIK CAST KCS CONCRETE INSERTS

<table>
<thead>
<tr>
<th>DESIGN INFORMATION</th>
<th>SYMBOL</th>
<th>UNITS</th>
<th>1/4-inch</th>
<th>1/2-inch</th>
<th>1/2-inch</th>
<th>3/4-inch</th>
<th>1-inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threaded rod nominal outside diameter</td>
<td>(d_{	ext{rod}})</td>
<td>in. (mm)</td>
<td>(0.250 (6.4))</td>
<td>(0.375 (9.5))</td>
<td>(0.500 (12.7))</td>
<td>(0.625 (15.9))</td>
<td>(0.750 (19.1))</td>
</tr>
<tr>
<td>Threaded rod effective cross-sectional area</td>
<td>(A_{	ext{rod}})</td>
<td>in(^2) (mm(^2))</td>
<td>(0.032 (21))</td>
<td>(0.078 (50))</td>
<td>(0.142 (92))</td>
<td>(0.226 (146))</td>
<td>(0.335 (216))</td>
</tr>
<tr>
<td>Nominal tension strength of ASTM A36 threaded rod in tension as governed by steel strength for static or seismic loading</td>
<td>(N_{	ext{sa,rod,A36}}) &amp; (N_{	ext{sa,rod,eq,A36}})</td>
<td>lb (kN)</td>
<td>(1,855 (8.2))</td>
<td>(4,525 (20.0))</td>
<td>(8,235 (36.6))</td>
<td>(13,110 (58.3))</td>
<td>(19,400 (86.3))</td>
</tr>
<tr>
<td>Nominal tension strength of ASTM F1554, Gr. 105 threaded rod in tension as governed by steel strength for static or seismic loading</td>
<td>(N_{	ext{sa,rod,F1554}}) &amp; (N_{	ext{sa,rod,eq,F1554}})</td>
<td>lb (kN)</td>
<td>(4,000 (17.7))</td>
<td>(9,750 (43.1))</td>
<td>(17,750 (78.9))</td>
<td>(28,250 (125.7))</td>
<td>(41,875 (186.0))</td>
</tr>
<tr>
<td>Nominal tension strength of ASTM A193 threaded rod in tension as governed by steel strength for static or seismic loading</td>
<td>(N_{	ext{sa,rod,A193}}) &amp; (N_{	ext{sa,rod,eq,A193}})</td>
<td>lb (kN)</td>
<td>(4,000 (17.7))</td>
<td>(9,750 (43.1))</td>
<td>(17,750 (78.9))</td>
<td>(28,250 (125.7))</td>
<td>(41,875 (186.0))</td>
</tr>
<tr>
<td>Nominal shear strength of ASTM A36 threaded rod in shear as governed by steel strength for static loading</td>
<td>(V_{	ext{sa,rod,A36}})</td>
<td>lb (kN)</td>
<td>(1,105 (4.9))</td>
<td>(2,695 (12.0))</td>
<td>(4,940 (22.0))</td>
<td>(7,860 (35.0))</td>
<td>(11,640 (51.8))</td>
</tr>
<tr>
<td>Nominal shear strength of ASTM A36 threaded rod in shear as governed by steel strength for static or seismic loading</td>
<td>(V_{	ext{sa,rod,eq,A36}})</td>
<td>lb (kN)</td>
<td>(780 (3.5))</td>
<td>(1,900 (8.4))</td>
<td>(3,460 (15.4))</td>
<td>(5,505 (24.5))</td>
<td>(8,160 (36.3))</td>
</tr>
<tr>
<td>Nominal shear strength of ASTM F1554, Gr. 105 threaded rod in shear as governed by steel strength for static or seismic loading</td>
<td>(V_{	ext{sa,rod,F1554}})</td>
<td>lb (kN)</td>
<td>(2,385 (10.6))</td>
<td>(5,815 (25.9))</td>
<td>(10,640 (47.9))</td>
<td>(16,950 (75.4))</td>
<td>(25,085 (111.6))</td>
</tr>
<tr>
<td>Nominal shear strength of ASTM A193 threaded rod in shear as governed by steel strength for static or seismic loading</td>
<td>(V_{	ext{sa,rod,A193}})</td>
<td>lb (kN)</td>
<td>(1,680 (7.5))</td>
<td>(4,095 (18.2))</td>
<td>(7,455 (34.2))</td>
<td>(11,865 (52.8))</td>
<td>(17,590 (78.2))</td>
</tr>
</tbody>
</table>

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.

1Values provided for steel element material types, or equivalent, based on minimum specified strength; \(N_{	ext{sa,rod}}\) and \(V_{	ext{sa,rod}}\) calculated in accordance with 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. \(V_{	ext{sa,rod,eq}}\) must be taken as 0.7\(V_{	ext{sa,rod}}\). Materials of other strengths may be used and calculated in similar manner.
2Nominal shear \(\phi N_{sa}\) shall be the lower of the \(\phi N_{sa,rod}\) or \(\phi N_{sa,insert}\) for static steel strength in tension; for seismic loading \(\phi N_{sa}\) shall be the lower of the \(\phi N_{sa,rod}\) or \(\phi N_{sa,insert}\), or \(\phi V_{sa,rod}\) or \(\phi V_{sa,insert}\) for seismic loading.
3Nominal shear \(\phi V_{sa}\) shall be the lower of the \(\phi V_{sa,rod}\) or \(\phi V_{sa,insert}\) for static steel strength in tension; for seismic loading \(\phi V_{sa}\) shall be the lower of the \(\phi V_{sa,rod}\) or \(\phi V_{sa,insert}\), or \(\phi V_{sa,deck}\) for seismic loading.
4Strength 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 318-14 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 \(\phi\) applies when the load combinations of Section 1605.2 of the 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 \(\phi\) must be determined in accordance with ACI 318-11 D.4.4.

TABLE 6—EXAMPLE ASD ALLOWABLE TENSION AND SHEAR DESIGN VALUES FOR ILLUSTRATIVE PURPOSES FOR KCS-WF INSTALLED IN NORMAL WEIGHT CONCRETE AND KCS-MD INSTALLED IN LIGHTWEIGHT CONCRETE OVER METAL DECK FLOOR AND ROOF ASSEMBLIES

<table>
<thead>
<tr>
<th>Nominal Insert Diameter (inches)</th>
<th>KCS-WF</th>
<th>KCS-MD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B-Deck Installation</td>
<td>W-Deck Installation</td>
</tr>
<tr>
<td></td>
<td>Upper Flute</td>
<td>Lower Flute</td>
</tr>
<tr>
<td>3/4-inch</td>
<td>1.480</td>
<td>1.480</td>
</tr>
<tr>
<td>3/4-inch</td>
<td>1.860</td>
<td>1.860</td>
</tr>
</tbody>
</table>

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.

1Concrete strength \(f_c\) = 2500 psi for KCS-WF; \(f_c\) = 3000 psi sand-lightweight for KCS-MD.
2Values are for single anchors with static tension or shear with no nearby edge impact. Installation must be in accordance with applicable Figure 1, 2, 3, 4 and 5.
3Values are for uncracked concrete.
4Load combinations as given in ACI 318-14 5.4 or ACI 318 9.2, as applicable.
530% dead load and 70% live load, controlling load combination 1.2D + 1.6L.
6Calculation of ASD conversion \(\alpha\) = 0.3\*1.2 + 0.7\*1.6 = 1.48
7Values assume no side-face blowout in tension for KCS-WF or for KCS-MD installed in upper flute.
8Values are for Condition B where supplementary reinforcement in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided.
The allowable loads shown are for the applicable insert only. Design professional is responsible for checking capacity of threaded rod, including tension, shear, and influence of bending on tension capacity when loaded in shear, or other material placed in insert.

FIGURE 6—KWIK CAST KCS-WF CONCRETE INSERTS MANUFACTURER PRINTED INSTALLATION INSTRUCTIONS (MPII)

FIGURE 7—KWIK CAST KCS-MD CONCRETE INSERTS MANUFACTURER PRINTED INSTALLATION INSTRUCTIONS (MPII)
Given:
Two ¾ ϕ KCS-WF anchor (un-torqued) with an edge distance of 2 in. and spacing of 12 in. loaded in tension, N, and shear, V.

- Condition B per ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3 (c), as applicable
- Assume normal weight concrete, f'c= 3,000 psi
- Assume cracked concrete
- ASTM A36 attached steel rod insert element

Needed:
Using strength design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, calculate the design shear and tensile strength capacity for this configuration.

Calculations per ACI 318-14 Chapter 17 or ACI 318-11 Appendix D and this report.

Step 1. Calculate steel tensile capacity.

\[ N_{sa,insert} = A_{se,N} f_{uta} \]
\[ N_{sa,insert} = 14,000 \text{ lb.} \]
\[ \phi N_{sa,insert} = \phi (14,000) \times 2 \]
\[ \phi N_{sa,insert} = 18,200 \text{ lb.} \]
\[ N_{sa,rod,A36} = A_{se,N} f_{uta} \]
\[ N_{sa,rod,A36} = 19,400 \text{ lb.} \]
\[ \phi N_{sa,rod,A36} = \phi (19,400) \times 2 \]
\[ \phi N_{sa,rod,A36} = 29,100 \text{ lb.} \]

Step 2. Calculate concrete breakout of anchor in tension.

\[ N_b = 2 \lambda \left( f'c \right)^{1.5} \]
\[ N_b = 2 \times 1.0 \times 3,000^{1.5} \]
\[ N_b = 3,254 \text{ lb} \]

Step 2a. Check spacing and edge distance requirements.

- Given in Table 1
- c_{a,min} = 2 in > cover requirement for reinforcing bar per ACI
- s_{anchor} = 12 in > 4.0 in
- okay spacing and edge distance

Step 2b. Determine λ.

- normal weight concrete
- \[ \lambda = 1.0 \]

Step 2c. Calculate basic concrete breakout strength in tension.

\[ N_b = 2 \lambda \left( f'c \right)^{1.5} \]
\[ N_b = 2 \times 1.0 \times 3,000^{1.5} \]
\[ N_b = 3,254 \text{ lb} \]

Step 2d. Determine effective projected concrete breakout area.

\[ A_{oe} = \left( c_{a,min} + 1.5 \text{hef} \right) \left( 2 \times 1.5 \text{hef} \right) \]
\[ A_{oe} = \left( 2 + 1.5 \times 1.83 \right) \left( 2 \times 1.5 \times 1.83 \right) \]
\[ A_{oe} = 26.05 \text{ in}^2 \]

Step 2e. Determine idealized projected concrete breakout area.

\[ A_{oe} = 9 \left( \text{hef} \right)^2 = 30.14 \text{ in}^2 \]

Step 2f. Determine \( \psi_{ed,N} \).

- cracked concrete
- \( \psi_{ed,N} = 0.7 \times 3,254 \times 0.919 \times 1.0 = 1.0 \)

Step 2g. Determine \( \psi_{c,N} \).

- cracked concrete
- \( \psi_{c,N} = 1.0 \)

Step 2h. Determine \( \psi_{cp,N} \).

- cast-in anchor with cracked concrete
- \( \psi_{cp,N} = 1.0 \)

Step 2i. Calculate \( \phi N_{bc} \).

- \( \phi N_{bc} = 0.7 \times 2 \times \frac{26.05}{30.14} \times 3,254 \times 0.919 \times 1.0 = 1.0 \)
- \( \phi N_{bc} = 3,618 \text{ lb} \)

Step 3. Check pullout strength of concrete in tension.

\[ N_p = N_{bc} \times \psi_{cp,N} \]
\[ N_p = 3,618 \times 1.0 \]
\[ N_p = 3,618 \text{ lb} \]

Step 3a. Determine \( \psi_{cp} \).

- cracked concrete
- \( \psi_{cp} = 1.0 \)

Step 3b. Calculate basic concrete pullout in tension.

\[ N_p = 8 \left( f'c \right)^{0.5} \]
\[ N_p = 8 \times 2 \times 0.993 \times 3,000 \]
\[ N_p = 47,664 \text{ lb} \]

Step 3c. Calculate \( \phi N_{pb} \).

- \( \phi N_{pb} = 0.7 \times 47,664 \)

FIGURE 8—DESIGN EXAMPLE FOR KWIK CAST KCS-WF
\[ \phi N_{\text{N}} = 33,365 \text{ lb} \]

**Step 4. Calculate concrete side face blowout.**

\[ h_{ef} < 2.5ca \rightarrow \text{not applicable} \]

**Step 5. Determine the controlling tensile strength.**

- **Steel anchor insert strength** \[ \phi N_{\text{sa,insert}} = 18,200 \text{ lb} \]
- **Steel insert element strength** \[ \phi N_{\text{sa,rod,A}} = 29,100 \text{ lb} \]
- **Concrete pullout strength** \[ \phi N_{\text{p,N}} = 33,365 \text{ lb} \]
- **Concrete breakout strength** \[ \phi N_{\text{cb}} = 3,618 \text{ lb} \]

**Step 6. Calculate steel anchor capacity.**

\[ V_{\text{sa,insert}} = A_{\text{se,N}} f_{\text{uta}} \rightarrow \text{Given in Table 3} \]

\[ V_{\text{sa,insert}} = 9,070 \text{ lb} \]

\[ \phi V_{\text{sa,insert}} = (0.60) \times 2 \times 9,070 \text{ lb/anchor} \]

\[ \phi V_{\text{sa,insert}} = 10,884 \text{ lb} \]

\[ V_{\text{sa,rod,A}} = A_{\text{se,N}} f_{\text{uta}} \rightarrow \text{Given in Table 5} \]

\[ V_{\text{sa,rod,A}} = 11,640 \text{ lb} \]

\[ \phi V_{\text{sa,rod,A}} = (0.65) \times 2 \times 11,640 \text{ lb/anchor} \]

\[ \phi V_{\text{sa,rod,A}} = 15,130 \text{ lb} \]

**Step 7. Calculate concrete breakout of anchor in shear.**

\[ V_{\text{cb}} = \frac{A_{\text{se,N}}}{A_{\text{cr,v}}} \psi_{\text{v,c},V} \psi_{\text{h},V} \]

\[ V_{\text{cb}} = \frac{1,224}{1,394} \]

\[ V_{\text{cb}} = 0.8 \text{ lb} \]

**Step 8. Calculate pryout strength of concrete in shear.**

\[ V_{\text{cp}} = k_{\text{cp}} N_{\text{cb}} \]

**Step 8a. Determine \( k_{\text{cp}} \).**

\[ h_{ef} = 1.83 \text{ in} < 2.5 \text{ in} \]

\[ k_{\text{cp}} = 1.0 \]

**Step 9. Determine the controlling shear strength.**

- **Steel anchor strength** \[ \phi V_{\text{sa,insert}} = 10,884 \text{ lb} \]
- **Steel insert element strength** \[ \phi V_{\text{sa,insert}} = 15,130 \text{ lb} \]
- **Concrete pryout strength** \[ \phi V_{\text{cp}} = 3,618 \text{ lb} \]
- **Concrete breakout strength** \[ \phi V_{\text{cb}} = 1,713 \text{ lb} \]

\[ \phi V_{\text{cb}} = 3,618 \text{ lb} \]

\[ (2 \text{ ANCHORS}) \]

**FIGURE 8—DESIGN EXAMPLE FOR KWIK CAST KCS-WF (Continued)**
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 AND KCS-MD 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 and KCS-MD 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 and KCS-MD 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 and KCS-MD 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 and KCS-MD Headed Cast-in Specialty Inserts in Cracked and Uncracked Concrete are in accordance with the 2018 International Building Code® (2018 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 2019 and revised January 2020.
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 AND KCS-MD 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 and KCS-MD Headed Cast-In Specialty Inserts in Cracked and Uncracked Concrete, recognized in ICC-ES master evaluation report ESR-4006, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2017 Florida Building Code—Building
- 2017 Florida Building Code—Residential

2.0 CONCLUSIONS

The HILTI Kwik Cast KCS-WF and KCS-MD Headed Cast-In Specialty Inserts in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-4006, comply with the Florida Building Code—Building and the Florida Building Code—Residential, when designed and installed in accordance with the 2015 International Building Code® provisions noted in the master report.

Use of the HILTI Kwik Cast KCS-WF and KCS-MD Headed Cast-In Specialty Inserts in Cracked and Uncracked Concrete for use in dry, interior locations has 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.

For products falling under Florida Rule 9N-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 2019 and revised January 2020.