Hilti. Outperform. Outlast.

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Tulsa, OK 74146

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T 1-800-879-8000 I F 1-800-879-7000
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Date:________________

Project Name:____

Location:____

PRODUCT

☐ Submittal

☐ Substitution

To:____ T________________________

Firm:____ F________________________

Address:____ E________________________

____

Submitted By:____ T________________________

Firm:____ F________________________

Address:____ E________________________

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Submitted Product(s) HILTI KWIK HUS-EZ **(KH-EZ) SCREW ANCHOR**

Original Product Specified:____

Specification Location:____

For Architect / Engineer Use:

☐ Accepted, no exceptions ☐ Revise and resubmit

☐ Accepted, make corrections noted ☐ Rejected, see notes below

Attached information includes product description, installation instructions and technical data needed for review and evaluation of the submittal request.

Notes:____

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HILTI

KWIK HUS-EZ (KH-EZ)

Carbon Steel Screw Anchor

Drill. Drive. Done.

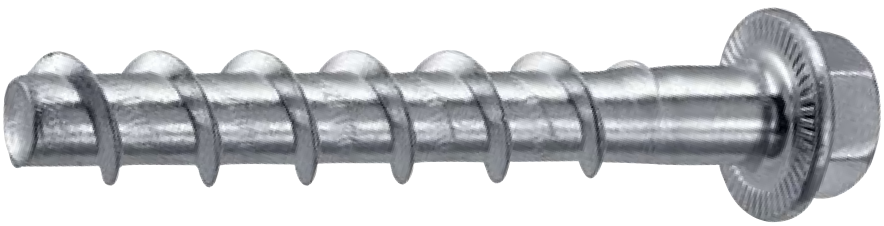
Hilti. Outperform. Outlast.

Drill. Drive. Done.

KWIK HUS-EZ Screw Anchors

KWIK HUS-EZ takes screw anchor technology to the next level. Experience the ease and speed of setting, superior load values, and comprehensive approvals that are unique to Hilti.

The KWIK HUS anchor line is the direct result of decades of jobsite experience combined with the most sophisticated research and development in the industry.



KWIK HUS-EZ

KWIK HUS-EZ (every zone) offers one solution for every zone: cracked concrete, uncracked concrete, concrete over metal deck and grout-filled CMU blocks in seismic and non-seismic zones.

KWIK HUS-EZ is a reliable, easy-to-set and fully-removable fastening solution developed to fulfill all your needs with a comprehensive cracked concrete and seismic ICC-ES approved portfolio from 1/4" to 3/4" and an ICC-ES approval pending for grout filled CMU blocks.

With the launch of the KWIK HUS-EZ, Hilti introduces the only 1/4" anchor with an ICC-ES approval in cracked concrete thanks to Hilti's unique cutting edge technology.

Applications

- Glazing, windows and storefronts
- Racking and shelving
- Ledgers
- Inside railing
- Seismic braces
- Formwork and tilt-up braces
- Sill plates
- Perimeter walls

Outperform and Outlast

- Quick and easy to install, no high-accuracy torque wrench required
- Optimized thread design for best-in-class setting performance and superior load values
- For use with standard ANSI-tolerance drill bit; no matched tolerance drill bits are required; same drill bit diameter as anchor diameter
- Fully-removable anchoring solution
- Suitable for reduced edge distances and spacing
- Hex head with integrated washer and clear indication of length and size

Listings/Approvals

- KWIK HUS-EZ 1/4" to 3/4": ICC-ES ESR-3027 for cracked and uncracked concrete, lightweight concrete over metal deck, and seismic conditions; all category 1 anchors
- ICC-ES report for grouted CMU blocks is pending; Hilti's testing data according to AC 106 is available in this technical document
- Compliant with 2009 IBC, 2006 IBC and 2003 IBC

2003 IBC® Compliant Anchor

2006 IBC® Compliant Anchor

2009 IBC® Compliant Anchor

Order Information

Description	Hole Diameter	Total Length without Anchor Head	Minimum Embedment Depth	Qty (pcs) Box	Item No.
KH-EZ 1/4"x2 5/8"	1/4"	2-5/8"	2-1/2"	100	00418045
KH-EZ 1/4"x3"	1/4"	3"	2-1/2"	100	00418046
KH-EZ 1/4"x3 1/2"	1/4"	3-1/2"	2-1/2"	100	00418047
KH-EZ 1/4"x4"	1/4"	4"	2-1/2"	100	00418048
KH-EZ 3/8"x1 7/8"	3/8"	1-7/8"	1-5/8"	50	00418055
KH-EZ 3/8"x2 1/8"	3/8"	2-1/8"	1-5/8"	50	00418056
KH-EZ 3/8"x3"	3/8"	3"	2-1/2"	50	00418057
KH-EZ 3/8"x3 1/2"	3/8"	3-1/2"	2-1/2"	50	00418058
KH-EZ 3/8"x4"	3/8"	4"	3-1/4"	50	00418059
KH-EZ 3/8"x5"	3/8"	5"	3-1/4"	30	00418061
KH-EZ 1/2"x2 1/2"	1/2"	2-1/2"	2-1/4"	30	00418070
KH-EZ 1/2"x3"	1/2"	3"	2-1/4"	30	00418071
KH-EZ 1/2"x3 1/2"	1/2"	3-1/2"	3"	25	00418072
KH-EZ 1/2"x4"	1/2"	4"	3"	25	00418073
KH-EZ 1/2"x4 1/2"	1/2"	4-1/2"	4 1/4"	25	00418075
KH-EZ 1/2"x5"	1/2"	5"	4 1/4"	25	00418076
KH-EZ 1/2"x6"	1/2"	6"	4-1/4"	25	00418077
KH-EZ 5/8"x3 1/2"	5/8"	3-1/2"	3-1/4"	15	00418078
KH-EZ 5/8"x4"	5/8"	4"	3-1/4"	15	00418079
KH-EZ 5/8"x5 1/2"	5/8"	5-1/2"	5"	15	00418080
KH-EZ 5/8"x6 1/2"	5/8"	6-1/2"	5"	15	00418081
KH-EZ 5/8"x8"	5/8"	8"	5"	15	00418082
KH-EZ 3/4"x4 1/2"	3/4"	4-1/2"	4"	10	00418083
KH-EZ 3/4"x5 1/2"	3/4"	5-1/2"	4"	10	00418084
KH-EZ 3/4"x7"	3/4"	7"	6 1/4"	10	00418085
KH-EZ 3/4"x8"	3/4"	8"	6-1/4"	10	00418086
KH-EZ 3/4"x9"	3/4"	9"	6-1/4"	10	00418087

Hilti has everything you need to properly set your KWIK HUS-EZ anchors:
TE 4-A18 Cordless Rotary Hammer Drill, TE-CX Drill Bits, SIW 18T-A Cordless High Torque Impact Wrench, and sockets

Hilti. Outperform. Outlast.

The following, through page 9, represent a reprint of ICC-ESR 3027.

HILTI KWIK HUS-EZ (KH-EZ) CARBON STEEL SCREW ANCHORS FOR USE IN CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2009 International Building Code® (2009 IBC)
- 2009 International Residential Code® (2009 IRC)
- 2006 International Building Code® (2006 IBC)
- 2006 International Residential Code® (2006 IRC)
- 2003 International Building Code® (2003 IBC)
- 2003 International Residential Code® (2003 IRC)

Properties evaluated:

Structural

2.0 USES

The Hilti KWIK HUS-EZ (KH-EZ) screw anchors are used to resist static, wind and seismic tension and shear loads in cracked and uncracked normal-weight and sand lightweight concrete having a specified strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa); and cracked and uncracked normal-weight or sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c of 3,000 psi (20.7 MPa).

The Hilti Kwik HUS EZ screw anchors are an alternative to anchors described in Sections 1911 and 1912 of the 2009 and 2006 IBC and Sections 1912 and 1913 of the 2003 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 KWIK HUS-EZ:

Hilti KWIK HUS-EZ (KH-EZ) anchors are comprised of a body with hex washer head. The anchor is manufactured from carbon steel and is heat treated. It has a minimum 0.0003 inch (8 μm) zinc coating in accordance with DIN EN ISO 4042. The anchoring system is available in a variety of lengths with diameters of 1/4 inch, 3/8 inch, 1/2 inch, 5/8 inch and 3/4 inch (6.4mm, 9.5mm, 12.7mm, 15.9mm and 19.1mm). The KWIK HUS-EZ is illustrated in Figure 1.

The hex head is larger than the diameter of the anchor and is formed with serrations on the underside. The anchor body is formed with threads running most of the length of the anchor body. The anchor is installed in a predrilled hole with a powered impact wrench or torque wrench. The anchor threads cut into the concrete on the sides of the hole and interlock with the base material during installation.

3.2 Concrete:

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

3.3 Steel Deck Panels:

Steel deck panels must comply with the configurations in Figure 3 and have a minimum base steel thickness of 0.035 in. (.889 mm). Steel must comply with ASTM A 653/A 653M SS Grade 33 and have a minimum yield strength of 33,000 psi (228 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with the 2009 and 2003 IBC and Section R301.1.3 of the 2009 and 2003 IRC must be determined in accordance with ACI 318-08 Appendix D and this report. Design strength of anchors complying with the 2006 IBC and 2006 IRC must be in accordance with ACI 318-05 Appendix D and this report. Design parameters provided in Table 2 through Table 5 of this report are based on the 2009 IBC (ACI 318-08) unless noted otherwise in Section 4.1.1 through 4.1.12 of this report.

The strength design of anchors must comply with ACI 318 D.4.1, except as required in ACI 318 D.3.3. Strength reduction factors, Φ, as given in ACI 318 D.4.4, and noted in Tables 3 and 4 of this report, must be used for load combinations calculated in accordance with Section 1605.2.1 of the IBC and Section 9.2 of ACI 318. Strength reduction factors, Φ, as given in ACI 318 D.4.5 must be used for load combinations calculated in accordance with ACI 318 Appendix C. The value of f'_c used in the calculation must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318 D.3.5. An example calculation is provided in Figure 4.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal static steel strength, N_{sa}, of a single anchor in tension calculated in accordance with ACI 318 D.5.1.2, N_{sa}, is given in Table 3 of this report. Strength reduction factors, Φ, corresponding to brittle steel elements must be used.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal concrete breakout strength of a single anchor or a group of anchors in tension, N_{cb} and N_{cbg} respectively, must be calculated in accordance with ACI 318 D.5.2.2, with modifications as described in this section. The basic concrete breakout strength in tension, N_b, must be calculated in accordance with ACI 318 D.5.2, using the values of h_{ef} and k_{cr} as given in Table 3 of this report. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318 D.5.2.6 must be calculated with the value of k_{uncr} as given in Table 3 and with $\psi_{c,N}$ = 1.0.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 3, calculation of the concrete breakout strength in accordance with ACI 318 D.5.2 is not required.

4.1.4 Requirements for Static Pullout Strength in Tension, N_p: The nominal pullout strength of a single anchor in accordance with ACI D.5.3.1 and D.5.3.2 in cracked and uncracked concrete, $N_{p,cr}$, and $N_{p,uncr}$, respectively, is given in Table 3. In lieu of ACI 318 D.5.3.6, $\psi_{c,P}$ = 1.0 for all design cases. In accordance with ACI 318 D.5.3, the nominal pullout strength in cracked concrete may be adjusted according to Eq.-1:

$$N_{p,f'c} = N_{p,cr}\sqrt{\frac{f'_c}{2{,}500}} \text{ (lb,psi)} \qquad \text{(Eq-1)}$$

$$N_{p,f'c} = N_{p,cr}\sqrt{\frac{f'_c}{17.2}} \text{ (N, MPa)}$$

where f'_c is the specified concrete compressive strength.

In regions where analysis indicates no cracking in accordance with ACI 318 Section D.5.3.6, the nominal pullout strength in tension may be adjusted according to Eq-2:

$$N_{p,f'c} = N_{p,uncr}\sqrt{\frac{f'_c}{2{,}500}} \text{ (lb,psi)} \qquad \text{(Eq-2)}$$

$$N_{p,f'c} = N_{p,uncr}\sqrt{\frac{f'_c}{17.2}} \text{ (N, MPa)}$$

where f'_c is the specified concrete compressive strength.

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Table 3 of this report, the pullout strength in tension need not be considered.

The nominal pullout strength in tension of the anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figure 3, is provided in Table 5. In accordance with ACI Section D.5.3.2, the nominal pullout strength in cracked concrete must be calculated according to Eq-1, whereby the value of $N_{p,deck,cr}$ must be substituted for $N_{p,cr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator. In regions where analysis indicates no cracking in accordance with ACI 318 Section 5.3.6, the nominal strength in uncracked concrete must be calculated according to Eq-2, whereby the value of $N_{p,deck,uncr}$ must be substituted for $N_{p,uncr}$ and the value of 3,000 psi (20.7) MPa must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator.

4.1.5 Requirements for Static Steel Shear Capacity, V_{sa}: The nominal steel strength in shear, V_{sa}, of a single anchor in accordance with ACI 318 D.6.1.2 is given in Table 4 of this report and must be used in lieu of the values derived by calculation from ACI 318, Eq. D-20. The strength reduction factor, Φ, corresponding to brittle steel elements must be used. The nominal shear strength of $V_{sa,deck}$ of anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figure 3, is given in Table 5.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: The nominal 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 D.6.2, with modifications as described in this section. The basic concrete breakout strength in shear, V_b, must be calculated in accordance with ACI 318 D.6.2.2 using the values of ℓ_e and d_a given in Table 4.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 3, calculation of the concrete breakout strength in accordance with ACI 318 D.6.2 is not required.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear, V_{cp} or V_{cpg}: 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 D.6.3, modified by using the value of k_{cp} provided in Table 4 and the value of N_{cb} or N_{cbg} as calculated in Section 4.1.3 of this report.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 3, calculation of the concrete pryout strength in accordance with ACI 318 D.6.3 is not required.

4.1.8 Requirements for Seismic Design

4.1.8.1 General: For load combinations including seismic, the design must be in accordance with ACI 318 Section D.3.3, as modified by Section 1908.1.9 of the 2009 IBC or Section 1908.1.16 of the 2006 IBC, as applicable, or the following:

CODE	ACI 318 SECTION D.3.3 SEISMIC REGION	CODE EQUIVALENT DESIGNATION
2003 IBC and 2003 IRC	Moderate or high seismic risk	Seismic Design Categories C, D, E and F

The nominal steel strength and nominal concrete breakout strength for anchors in tension, and the nominal concrete breakout strength and pryout strength for anchors in shear, must be calculated according to ACI 318 Sections D.5 and D.6, respectively, taking into account the corresponding values in Tables 2 through 5 of this report. The anchors comply with ACI 318 Section D.1 as brittle steel elements and must be designed in accordance with ACI 318-08 Section D.3.3.5 or D.3.3.6 or ACI 318-05 D.3.3.5, as applicable.

4.1.8.2 Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated according to ACI 318 Section D.5.1 and D.5.2, as described in Sections 4.1.2 and 4.1.3 of this report. In accordance with ACI 318 Section D.5.3.2, the appropriate value for pullout strength in tension for seismic loads, N_{eq} or $N_{p,deck,cr}$ described in Table 3 and 5, respectively, of this report must be used in lieu of N_p. N_{eq} or $N_{p,deck,cr}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report in addition for concrete-filled steel deck floor and roof assemblies the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator.

Where values for N_{eq} are not provided in Table 3 of this report, the pullout strength in tension for seismic loads need not be evaluated.

4.1.8.3 Seismic Shear: The nominal concrete breakout strength and pryout strength in shear must be calculated according to ACI 318 Sections D.6.2 and D.6.3, as described in Sections 4.1.6 and 4.1.7 of this report; and, in accordance with ACI 318 Section D.6.1.2, the appropriate value for nominal steel strength for seismic loads, $V_{sa,eq}$ or $V_{sa,deck,eq}$ described in Table 4 and 5, respectively, of this report, must be used in lieu of V_{sa}.

4.1.9 Requirements for Interaction of Tensile and Shear Forces: The effects of combined tensile and shear forces must be determined in accordance with ACI 318, D.7.

4.1.10 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: In lieu of ACI 318 D.8.1 and D.8.3, values of c_{min} and s_{min} as given in Table 2 of this report must be used. In lieu of ACI 318 Section D.8.5, minimum member thicknesses, h_{min} as given in Table 3 of this report must be used.

For anchors installed through the soffit of steel deck assemblies, the anchors must be installed in accordance with Figure 3 and shall have an axial spacing along the flute equal to the greater of 3 h_{ef} or 1.5 times the flute width.

4.1.11 Requirements for Critical Edge Distance, c_{ac}: In applications where $c<c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318 Section D.5.2, must be further multiplied by the factor $\psi_{cp,N}$ as given by Eq-3:

$$\psi_{cp,N} = \frac{c}{c_{ac}} \qquad \text{(Eq-3)}$$

where the factor $\psi_{cp,N}$ need not be taken as less than

$$\frac{1.5\,h_{ef}}{c_{ac}}$$

For all other cases, $\psi_{cp,N}$ = 1.0. In lieu of using ACI 318 D.8.6, values of c_{ac} must comply with Table 3.

4.1.12 Sand-lightweight Concrete: For ACI 318-08, when anchors are used in sand-lightweight concrete, the modification factor for concrete breakout, λ, must be taken as 0.6. In addition, the pullout strength $N_{p,uncr}$, $N_{p,cr}$, and N_{eq} must be multiplied by 0.6, as applicable.

For ACI 318-05 the values N_b, $N_{p,uncr}$, $N_{p,cr}$, N_{eq}, and V_b determined in accordance with this report must be multiplied by 0.60, in lieu of ACI 318 D.3.4.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight concrete-filled steel deck and floor and roof assemblies, this reduction is not required.

4.2 Allowable Stress Design (ASD):

4.2.1 General: Design values for use with allowable stress design load combinations calculated in accordance with Section 1605.3 of the IBC must be established using the following equations:

$$T_{allowable,ASD} = \frac{\Phi N_n}{\alpha} \qquad \text{(Eq-4)}$$

$$V_{allowable,ASD} = \frac{\Phi V_n}{\alpha} \qquad \text{(Eq-5)}$$

where:

$T_{allowable,ASD}$ = Allowable tension load (lb, N)

$V_{allowable\ ASD}$ = Allowable shear load (lb, N)

ΦN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 Appendix D, Section 4.1 of this report and the 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16, as applicable.

ΦV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 Appendix D, Section 4.1 of this report and the 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16, as applicable.

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 e.g. to account for nonductile failure modes and required over-strength.

Limits on edge distance, anchor spacing and member thickness as given in Table 2 of this report must apply. An example of Allowable Stress Design tension values is given in Table 6 and Figure 4.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318 D.7, as follows:

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

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

For all other cases:

$$\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2$$

4.3 Installation:

Installation parameters are provided in Tables 1 and 2 and Figures 1, 3 and 5. Anchor locations must comply with this report and plans and specifications approved by the code official. The Hilti KWIK HUS-EZ (KH-EZ) must be installed according to manufacturer's published instructions and this report. In case of conflict this report governs. Anchors must be installed in holes drilled into concrete perpendicular to the surface using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The nominal drill bit diameter must be equal to that of the anchor. The minimum drilled hole depth is given in Table 2. Prior to installation, dust and debris must be removed from the drilled hole using a hand pump, compressed air or a vacuum. The anchor must be installed into the predrilled hole using a powered impact wrench or installed with a torque wrench until the proper nominal embedment depth is obtained. The maximum impact wrench torque, $T_{impact,max}$ and maximum installation torque, $T_{inst,max}$ for the manual torque wrench must be in accordance with Table 2. The KWIK HUS-EZ (KH-EZ) may be loosened by a maximum of one turn and reinstalled with a socket wrench or powered impact wrench to facilitate fixture attachment or realignment.

For installation in the soffit of concrete on steel deck assemblies, the hole diameter in the steel deck must not exceed the diameter of the hole in the concrete by more the 1/8 inch (3.2mm). For member thickness and edge distance restrictions for installations into the soffit of concrete on steel deck assemblies, see Figure 3.

4.4 Special Inspection:

Periodic special inspection is required, in accordance with Section 1704.15 of the 2009 IBC or Section 1704.13 of the 2006 or 2003 IBC. The special inspector must be on the site periodically during anchor installation to verify anchor type, anchor dimensions, hole dimensions, concrete type, concrete compressive strength, drill bit type and size, hole dimensions, hole cleaning procedures, anchor spacing(s), edge distance(s), concrete member thickness, anchor embedment, installation torque, impact wrench power and adherence to the manufacturer's printed installation instructions and the conditions of this report, in case of conflict this report governs. 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 and 1706 must be observed, where applicable.

5.0 CONDITIONS OF USE

The Hilti KWIK HUS-EZ (KH-EZ) concrete anchors described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The anchors must be installed in accordance with the manufacturer's published installation instructions and this report. In case of conflict, this report governs.

5.2 Anchor sizes, dimensions, and minimum embedment depths are as set forth in this report.

5.3 Anchors must be installed in accordance with section 4.3 of this report in uncracked or cracked normal-weight concrete and sand lightweight concrete having a specified compressive strength of f'_c of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) and cracked and uncracked normal-weight or sand lightweight concrete over metal deck having a minimum specified compressive strength f'_c of 3,000 psi (20.7 MPa).

5.4 The values of f'c used for calculation purposes must not exceed 8,000 psi (55.2 MPa).

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

5.7 Allowable stress design values must be established in accordance with Section 4.2 of this report.

5.8 Anchor spacing(s) and edge distance(s), and minimum member thickness must comply with Table 2 and Figure 3 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 anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

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

5.12 Anchors may be used to resist short-term loading due to wind or seismic forces, subject to the conditions of this report.

- Anchors are not permitted to support fire-resistance-rated construction. Where not otherwise prohibited in the code, anchors are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:
- Anchors are used to resist wind or seismic forces only.
- Anchors that support gravity load-bearing structural elements are within 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.
- Anchors are used to support nonstructural elements.

5.13 Anchors have been evaluated for reliability against brittle failure and found to be not significantly sensitive to stress-induced hydrogen embrittlement.

5.14 Use of carbon steel anchors is limited to dry, interior locations.

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

5.16 KWIK HUS EZ (KH-EZ) anchors are manufactured by Hilti AG, under a quality control program with inspections by Underwriters Laboratories Inc. (AA-668).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated November 2010; and quality control documentation.

7.0 IDENTIFICATION

The HILTI KWIK HUS-EZ (KH-EZ) anchors are identified by packaging with the manufacturer's name (Hilti, Inc.) and contact information, anchor name, anchor size, evaluation report number (ICC-ES ESR-3027), and the name of the inspection agency (Underwriters Laboratories, Inc.). The anchors with hex washer head have the letters KH-EZ, HILTI and anchor size and anchor length embossed on the anchor head. Identifications are visible after installation for verification.

KWIK HUS-EZ Screw Anchor System

Figure 1 — KWIK HUS-EZ anchor installation details

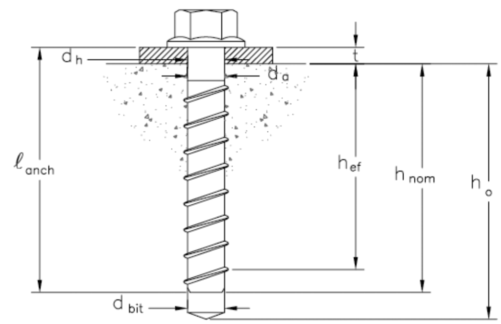


Figure 2 — Hilti KWIK HUS-EZ concrete screw anchor

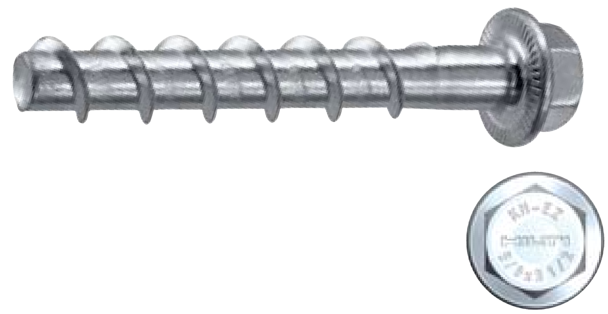


Table 1 — KWIK HUS-EZ (KH-EZ) product information

Name and Size	Diameter	Total length without anchor head
KH-EZ 1/4" x 2-5/8"	1/4"	2-5/8"
KH-EZ 1/4" x 3"	1/4"	3"
KH-EZ 1/4" x 3-1/2"	1/4"	3-1/2"
KH-EZ 1/4" x 4"	1/4"	4"
KH-EZ 3/8" x 1-7/8"	3/8"	1-7/8"
KH-EZ 3/8" x 2-1/8"	3/8"	2-1/8"
KH-EZ 3/8" x 3"	3/8"	3"
KH-EZ 3/8" x 3-1/2"	3/8"	3-1/2"
KH-EZ 3/8" x 4"	3/8"	4"
KH-EZ 3/8" x 5"	3/8"	5"
KH-EZ 1/2" x 2-1/2"	1/2"	2-1/2"
KH-EZ 1/2" x 3"	1/2"	3"
KH-EZ 1/2" x 3-1/2"	1/2"	3-1/2"
KH-EZ 1/2" x 4"	1/2"	4"
KH-EZ 1/2" x 4-1/2"	1/2"	4-1/2"
KH-EZ 1/2" x 5"	1/2"	5"
KH-EZ 1/2" x 6"	1/2"	6"
KH-EZ 5/8" x 3-1/2"	5/8"	3-1/2"
KH-EZ 5/8" x 4"	5/8"	4"
KH-EZ 5/8" x 5-1/2"	5/8"	5-1/2"
KH-EZ 5/8" x 6-1/2"	5/8"	6-1/2"
KH-EZ 5/8" x 8"	5/8"	8"
KH-EZ 3/4" x 4-1/2"	3/4"	4-1/2"
KH-EZ 3/4" x 5-1/2"	3/4"	5-1/2"
KH-EZ 3/4" x 7"	3/4"	7"
KH-EZ 3/4" x 8"	3/4"	8"
KH-EZ 3/4" x 9"	3/4"	9"

Table 2 — KWIK HUS-EZ (KH-EZ) installation information and anchor specification[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)										
			1/4	3/8			1/2			5/8		3/4	
Nominal Diameter	d_a $(d_o)^5$	in.	1/4	3/8			1/2			5/8		3/4	
Drill Bit Diameter	d_{bit}	in.	1/4	3/8			1/2			5/8		3/4	
Minimum Baseplate Clearance Hole Diameter	d_h	in.	3/8	1/2			5/8			3/4		7/8	
Maximum Installation Torque	$T_{inst,max}{}^4$	ft-lbf	18	40			45			85		115	
Maximum Impact Wrench Torque Rating[3]	$T_{impact,max}$	ft-lbf	137	114	450		137	450		450		450	
Minimum Nominal Embedment depth	h_{nom}	in.	2-1/2	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	6-1/4
Effective Embedment Depth	h_{ef}	in.	1.90	1.10	1.90	2.50	1.50	2.20	3.20	2.40	3.90	2.90	4.80
Minimum Hole Depth	h_o	in.	2-7/8	1-7/8	2-3/4	3-1/2	2-5/8	3-3/8	4-5/8	3-5/8	5-3/8	4-3/8	6-5/8
Critical Edge Distance[2]	c_{ac}	in.	2.78	2.10	2.92	3.75	2.75	3.67	5.25	3.63	5.81	4.41	7.28
Minimum Edge Distance[2]	c_{min}	in.	1.50				1.75						
Minimum Spacing Distance[2]	s_{min}	in.	3							4			
Minimum ConcreteThickness	h_{min}	in.	4	3.25	4	4.75	4.5	5.5	6.75	5	7	6	8
Wrench socket size	-	in.	7/16	9/16			3/4			15/16		1-1/8	
Max. Head height	-	in.	0.24	0.35			0.49			0.57		0.70	
Effective tensile stress area	A_{se} $(A_{se,N})^5$	in.^{2}	0.045	0.086			0.161			0.268		0.392	
Minimum specified ultimate strength	f_{uta} $(f_{ut})^6$	psi	134,000	106,225	120,300		112,540			90,180		81,600	

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

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

2 For installations through the soffit of steel deck into concrete (see Figure 3) anchors installed in the lower flute may be installed with a maximum 1 inch offset in either direction from the center of the flute.

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

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

5 The notation in parenthesis is for the 2006 IBC.

6 The notation in parenthesis is for the 2003 IBC.

* Values courtesy of ICC evaluation report.

KWIK HUS-EZ Screw Anchor System

Table 3 — Hilti KWIK HUS EZ (KH EZ) Tension Strength Design Data[1,2,3,4,5,6]

Characteristic	Symbol	Units	Nominal Anchor Diameter(inches)										
			1/4	3/8			1/2			5/8		3/4	
Anchor Category 1,2 or 3			1										
Nominal Embedment Depth	h_{nom}	in.	2-1/2	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	6-1/4
Steel Strength in Tension (ACI 318 D 5.1)[6]													
Tension Resistance of Steel	N_{sa}	lb.	6,070	9,125	10,335		18,120			24,210		32013	
Reduction Factor for Steel Strength[2]	Φ_{sa}	-	0.65										
Concrete Breakout Strength in Tension (ACI 318 D.5.2)													
Effective Embedment Depth	h_{ef}	in.	1.92	1.11	1.86	2.50	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Critical Edge Distance	c_{ac}	in.	2.78	2.10	2.92	3.74	2.75	3.67	5.25	3.63	5.82	4.81	7.28
Effectiveness Factor — Uncracked Concrete	k_{uncr}	-	24	24	24	24	27	27	27	27	27	27	27
Effectiveness Factor — Cracked Concrete	k_{cr}	-	17	17	17	17	17	17	17	17	17	17	17
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Reduction Factor for Concrete Breakout Strength[2]	Φ_{cb}	-	0.65 (Condition B)										
Pullout Strength in Tension (Non Seismic Applications) (ACI318 D.5.3)													
Characteristic pullout strength, uncracked concrete (2,500psi)	$N_{p,uncr}$	lb.	2348[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Characteristic pullout strength, cracked concrete (2500 psi)	$N_{p,cr}$	lb.	1166[4]	728[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reduction factor for pullout strength[2]	Φ_p	-	0.65 (Condition B)										
Pullout Strength in Tension (Seismic Applications) (ACI 318 D.5.3)													
Characteristic Pullout Strength, Seismic (2,500 psi)	N_{eq}	lb.	1166[4]	728[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reduction Factor for Pullout Strength[2] (2,500 psi)	Φ_{eq}	-	0.65 (Condition B)										
Axial Stiffness in Service Load Range													
Uncracked Concrete	β_{uncr}	lb/in.	760,000										
Cracked Concrete	β_{cr}	lb/in.	293,000										

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

1 The data in this table is intended for use with the design provisions of ACI 318 Appendix D; for anchors resisting seismic load combinations the additional requirements of D.3.3 shall apply.

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

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

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

5 For sand-lightweight concrete, calculate values according to Section 4.1.12 of this report.

Table 4 — Hilti KWIK HUS EZ (KH EZ) Shear Strength Design Data[1,2]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)										
			1/4	3/8			1/2			5/8		3/4	
Anchor Category	1,2 or 3		1										
Embedment Depth	h_{nom}	in.	2-1/2	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	6-1/4
Steel Strength in Shear (ACI 318 D 6.1)[4, 5]													
Shear Resistance of Steel — Static	V_{sa} [3]	lb.	1548	4057	5185		9245			11221		16662	
Shear Resistance of Steel — Seismic	V_{eq} [3]	lb.	1393	2524	3111		5547			6733		11556	
Reduction Factor for Steel Strength	Φ_{sa}	-	0.60										
Concrete Breakout Strength in Shear (ACI 318 D.6.2)													
Nominal Diameter	d_o (d_o)[6]	in.	0.250	0.375			0.500			0.625		0.750	
Load Bearing Length of Anchor	l_e [3]	in.	1.92	1.11	1.86	2.50	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Reduction Factor for Concrete Breakout Strength	Φ_{cb}	-	0.70										
Concrete Pryout Strength in Shear (ACI 318 D.6.3)													
Coefficient for Pryout Strength	k_{cp}	-	1.0	1.0	1.0	2.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0
Reduction Factor for Pryout Strength	Φ_{cp}	-	0.70										

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

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

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

3 For 2003 IBC code basis replace ℓ_e with ℓ , V_{sa} with V_s, and V_{eq} with $V_{sa,seis}$.

4 Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of calculated results using equation D-20 of ACI 318.

5 The KWIK HUS-EZ (KH-EZ) is considered a brittle steel element as defined by ACI 318 D.1.

6 The notation in brackets is for the 2006 IBC.

KWIK HUS-EZ Screw Anchor System

Table 5 — Hilti KWIK HUS-EZ (KH-EZ) tension and shear design data for installation in the underside of concrete-filled profile steel deck assemblies[1,6]

Characteristic	Symbol	Units	Lower Flute								Upper Flute		
			Anchor Diameter										
			1/4	3/8		1/2		5/8		3/4	1/4	3/8	1/2
Embedment	h_{nom}	in.	2-1/2	1-5/8	3-1/4	2-1/4	4-1/4	3-1/4	5	4	2-1/2	1-5/8	2-1/4
Minimum Hole Depth	h_{hole}	in.	2-7/8	1-7/8	3-1/2	2-5/8	4-5/8	3-5/8	5-3/8	4-3/8	2-7/8	1-7/8	2-5/8
Effective Embedment Depth	h_{ef}	in.	1.92	1.11	2.50	1.52	3.22	2.39	3.88	2.92	1.92	1.11	1.52
Pullout Resistance, (uncracked concrete)[2]	$N_{p,deck,uncr}$	lb.	1,875	1,285	3,920	1,305	5,360	4,180	9,495	4,180	1,960	1,015	1,395
Pullout Resistance (cracked concrete and seismic loads)[3]	$N_{p,deck,cr}$	lb.	1,330	1,120	3,430	925	3,795	3,070	7,385	2,630	1,390	885	985
Steel Strength in Shear[4]	$V_{sa,deck}$[8]	lb.	2,210	1,670	3,605	1,605	3,590	3,470	4,190	3,762	3,265	3,935	7,850
Steel Strength in Shear, Seismic	$V_{sa,deck,eq}$	lb.	1,988	935	2,163	963	2,154	2,082	2,514	2,609	2,937	2,203	4,710

1 Installation must comply with Sections 4.1.10 and 4.3 and Figure 3 of this report.

2 The values listed must be used in accordance with Section 4.1.4 of this report.

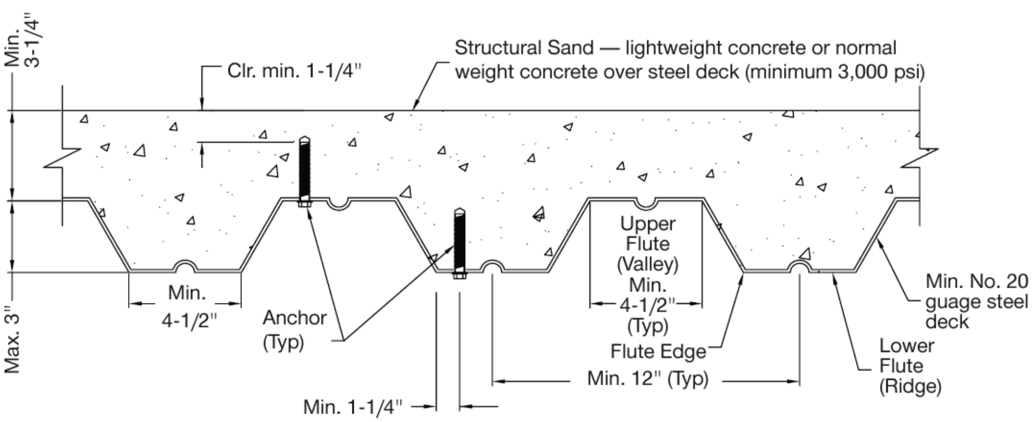
3 The values listed must be used in accordance with Section 4.1.4 and 4.1.8.2 of this report.

4 The values listed must be used in accordance with Section 4.1.5 and 4.1.8.3 of this report.

5 The values for ϕ_p in tension can be found in Table 3 of this report and the values for ϕ_{sa} in shear can be found in Table 4 of this report.

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

Figure 3 — Installation of KWIK HUS-EZ (KH-EZ) in Soffit of Concrete Over Steel Deck Floor and Roof Assemblies[1]



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

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

Nominal Anchor Diameter [in.]	Embedment Depth, h_{nom} [in.]	Effective Embedment Depth, h_{ef} [in.]	Allowable Tension Load [lbs]
1/4	2-1/2	1.92	1031
3/8	1-5/8	1.11	620
	2-1/2	1.86	1334
	3-1/4	2.50	2077
1/2	2-1/4	1.52	1111
	3	2.16	1882
	4-1/4	3.22	3426
5/8	3-1/4	2.39	2192
	5	3.88	4530
3/4	4	2.92	2963
	6-1/4	4.84	6305

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

1 Single anchor with static tension load only.

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

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

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

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

6 f'_c = 2,500 psi (normal weight concrete).

7 $c_{a1} = c_{a2} \geq c_{ac}$.

8 $h \geq h_{min}$.

9 Values are for Condition B where supplementary reinforcement in accordance with ACI 318 D.4.4 is not provided.

KWIK HUS-EZ Screw Anchor System

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

Table 7 — KWIK HUS-EZ Design Information (For use with CSA A23.3-04)

Characteristic	**Symbol**	**Units**	**Nominal Anchor Diameter(inches)**											**Code Ref.**
			1/4	3/8			1/2			5/8		3/4		
Anchor Category 1,2 or 3			1											
Nominal Embedment Depth	h_{nom}	mm	64	41	64	83	57	76	108	83	127	102	159	
Concrete material resistance factor for concrete	ϕ_c	-	0.65											8.4.2
Steel material resistance factor	ϕ_s	-	0.85											8.4.3
Ultimate strength of anchor steel	f_{ut}	MPa	924	732	829		776			622		563		
Effective cross-sectional area of anchor	A_{se}	mm^2	29.0	55.5			103.9			172.9		252.9		
Minimum Edge Distance	c_{min}	mm	38				44							
Minimum Spacing	s_{min}	mm	76							102				
Minimum Concrete Thickness	h_{min}	mm	102	83	102	121	114	140	171	127	178	152	203	
Steel Strength in Tension (CSA A23.3 D.6.1)[2]														
Factored Steel Resistance in tension	N_{sr}	kN	14.9	24.2	27.4		48.0			64.0		84.7		D.6.1.2
Reduction Factor for Steel Strength	R	-	0.70											D.5.4b
Concrete Breakout Strength in Tension (CSA A23.3 D.6.2)														
Effective Embedment Depth	h_{ef}	mm	49	28	47	64	39	55	82	61	99	74	123	
Critical Edge Distance	c_{ac}	mm	71	53	74	95	70	93	133	92	148	112	185	
Effectiveness Factor — Uncracked Concrete	k_{uncr}	-	10	10	10	10	10	10	10	10	10	10	10	D.6.2.2
Effectiveness Factor — Cracked Concrete	k_{cr}	-	7	7	7	7	7	7	7	7	7	7	7	
Modification factor for resistance in tension to account for uncracked concrete	$\Psi_{c,N}$	-	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	D.6.2.6
Reduction Factor for Concrete Breakout Strength	R	-	1.15 (Condition A), 1.00 (Condition B)											D.5.4c

Characteristic	Symbol	Units	Nominal Anchor Diameter(inches)											Code Ref.
			1/4	3/8			1/2			5/8		3/4		
Pullout Strength in Tension — Non Seismic Applications (CSA A23.3 D.6.3)[1]														
Factored Pullout Resistance, uncracked concrete (20 MPa)	$N_{pr,uncr}$	kN	7.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D.6.3.2
Factored Pullout Resistance, cracked concrete (20 MPa)	$N_{pr,cr}$	kN	3.6	2.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D.6.3.2
Reduction Factor for pullout strength	R	-	1.15 (Condition A), 1.00 (Condition B)											
Pullout Strength in Tension — Seismic Applications (CSA A23.3 D.6.3)[1]														
Factored Pullout Resistance, Seismic (20 MPa)	$N_{pr,seis}$	kN	3.6	2.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D.6.3.2
Reduction Factor for pullout strength	R	-	1.15 (Condition A), 1.00 (Condition B)											
Axial Stiffness in Service Load Range														
Uncracked Concrete	β_{uncr}	lb/in.	760000											
Cracked Concrete	β_{cr}	lb/in.	293000											
Steel Strength in Shear (CSA A23.3 D.7.1)[2]														
Factored Shear Resistance of Steel — Static	V_{sr}	kN	3.8	11.1	12.7		22.7			27.6		40.9		D.7.1.2c
Factored Shear Resistance of Steel — Seismic	$V_{sr,seis}$	kN	3.4	6.2	7.6		13.6			16.5		28.4		D.7.1.2c
Reduction Factor for Steel Strength	R	-	0.65											D.5.4b
Concrete Breakout Strength in Shear (CSA A23.3 D.7.2)														
Nominal Diameter	d_o	mm	6.4	9.5			12.7			15.9		19.1		
Load Bearing Length of Anchor	l_e	mm	49	28	47	64	39	55	82	61	99	74	123	
Reduction Factor for Concrete Breakout Strength	R		1.15 (Condition A), 1.00 (Condition B)											
Concrete Pryout Strength in Shear (CSA A23.3 D.7.3)														
Coefficient for Pryout Strength	k_{cp}		1.0	1.0	1.0	2.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0	
Reduction Factor for Pryout Strength	R		1.15 (Condition A), 1.00 (Condition B)											

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

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

This table replaces Table 3 and Table 4 of this Supplement (and Table 3 and Table 4 of ESR-3027) for anchorage design in normal weight concrete in accordance with CSA A23.3-04.

KWIK HUS-EZ Screw Anchor System

Figure 4 — Example calculation

Given:

Two 1/2” diameter KH-EZ with static tension load

h_{nom} = 4.25 inches

h_{ef} = 3.22 inches

Normal Weight Concrete – f’c = 3,000 psi

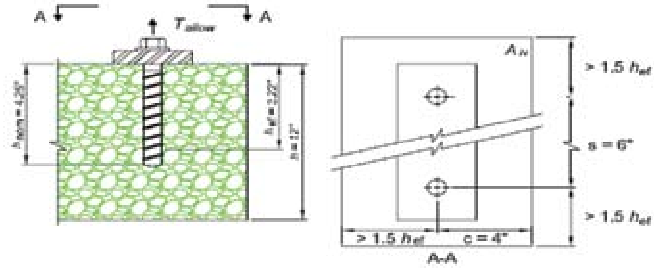
No supplementary reinforcement (Cond. B)

Assume cracked concrete since no other information is available.

h_{min} = 6.375 in

c_{min} = 1.75 in

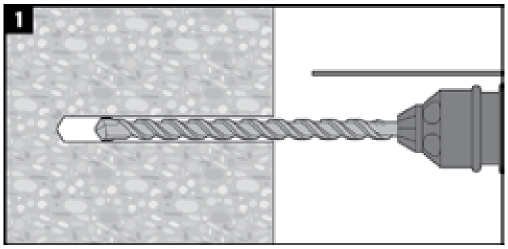
s_{min} = 3 in



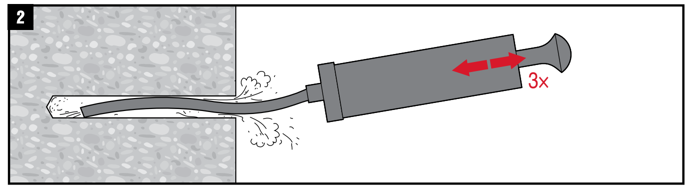
Needed: Allowable stress design (ASD) tension capacity

Calculation per ACI 318-08 and this report	**Code Reference**	**ESR Reference**
Step 1: Calculate steel capacity: $\Phi N_s = n\Phi N_{sa}$ = 2(0.65)(18,120) = 23,556 lbs.	D.5.1.2	Table 3
Step 2: Verify minimum member thickness, spacing and edge distance: h_{min} = 6.375 in. ≤ 8 in → ok c_{min} = 1.75 in. ≤ 4 in. → ok s_{min} = 3 in. ≤ 6 in. → ok	D.8	Table 2
Step 3: Calculate concrete breakout strength of anchor group in tension: $N = \frac{A_{Nc}}{A_{Nco}} \psi_{ec,N}\, \psi_{ed,N}\, \psi_{c,N}\, \psi_{cp,N}\, N_b$	D.5.2.1	4.1.3
Step 3a: Calculate A_{NC} and A_{Nco}: $A_{Nc} = (1.5\, h_{ef} + 4)\,(3\, h_{ef} + 6)$ =,(8.83) (15.66) = 138.3 in^2 $A_{Nco} = (9)\,(h_{ef})^2 = 9\,(3.22)^2 = 93.32$ in^2	D.5.2.1	Table 3
Step 3b: Determine $\psi_{ed,N} \rightarrow e'_N = 0 \rightarrow \psi_{ec,N} = 1.0$	D.5.2.4	-
Step 3c: Calculate $\psi_{ed,N} \rightarrow \psi_{ed,N} = 0.7 + 0.3 \left(\frac{4}{4.83}\right)$ =0.948	D.5.2.5	Table 3
Step 3d: $\psi_{cp,N} \rightarrow \psi_{cp,N}$ = 1.0 because concrete is cracked.	D.5.3.6	-
Step 3e: Calculate N_b: $N_b = k_{cr} \sqrt{f'_c}\, (h_{ef})^{1.5} = 17\,(1.0) \sqrt{3000}\, (3.22)^{1.5}$ = 5380 lbs.	D.5.2.2	Table 3
Step 3f: Calculate ΦN_{cbg}: $\Phi N_{cbg} = (0.65) \left(\frac{138.3}{93.32}\right) (1.0)\,(0.948)\,(1.0)\,(1.0)\,(5380)$ = 4914 lbs.	D.5.2.1 D.4.4 (c)	4.1.3 Table 3
Step 4: Check Pullout Strength → per Table 3 does not control	-	Table 3
Step 5: Controlling Strength: Lessor of $n\Phi N_{sa}$ and ΦN_{cbg} : → 4914 lbs.	D.4.1.2	Table 3
Step 6: Convert to ASD: $T_{allow} = \frac{4914}{1.44}$ = 3,412 lbs.	-	4.2.1

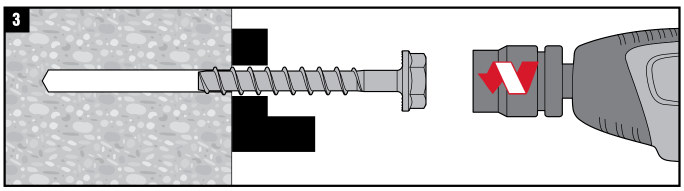
Figure 5 — Installation instructions



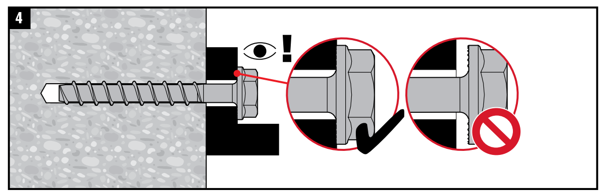
Drill hole in base material using proper diameter drill bit.



Clean dilled hole to remove debris.



Install anchor using proper impact tool or torque wrench.



Fasten anchor tightly against fastened part.

ICC-ES Evaluation Report

ESR-3027

Issued December 1, 2010

This report is subject to re-examination in one year.

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

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EVALUATION SUBJECT:

HILTI KWIK HUS-EZ (KH-EZ) CARBON STEEL SCREW ANCHORS FOR USE IN CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2009 *International Building Code®* (2009 IBC)
- 2009 *International Residential Code®* (2009 IRC)
- 2006 *International Building Code®* (2006 IBC)
- 2006 *International Residential Code®* (2006 IRC)
- 2003 *International Building Code®* (2003 IBC)
- 2003 *International Residential Code®* (2003 IRC)

Property evaluated:

Structural

2.0 USES

The Hilti KWIK HUS-EZ (KH-EZ) screw anchors are used to resist static, wind and seismic tension and shear loads in cracked and uncracked normal-weight and sand-lightweight concrete having a specified strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa); and cracked and uncracked normal-weight or sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

The Hilti KWIK HUS-EZ (KH-EZ) screw anchors are an alternative to anchors described in Sections 1911 and 1912 of the 2009 and 2006 IBC and Sections 1912 and 1913 of the 2003 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 KWIK HUS-EZ (KH-EZ):

Hilti KWIK HUS-EZ (KH-EZ) anchors are comprised of a body with hex washer head. The anchor is manufactured from carbon steel and is heat treated. It has a minimum 0.0003-inch (8 µm) zinc coating in accordance with DIN EN ISO 4042. The anchoring system is available in a variety of lengths with diameters of $^1/_4$ inch, $^3/_8$ inch, $^1/_2$ inch, $^5/_8$ inch and $^3/_4$ inch (6.4 mm, 9.5 mm, 12.7 mm, 15.9 mm and 19.1 mm). The KWIK HUS-EZ (KH-EZ) is illustrated in Figure 1.

The hex head is larger than the diameter of the anchor and is formed with serrations on the underside. The anchor body is formed with threads running most of the length of the anchor body. The anchor is installed in a predrilled hole with a powered impact wrench or torque wrench. The anchor threads cut into the concrete on the sides of the hole and interlock with the base material during installation.

3.2 Concrete:

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

3.3 Steel Deck Panels:

Steel deck panels must comply with the configurations in Figure 3 and have a minimum base steel thickness of 0.035 inch (0.889 mm). Steel must comply with ASTM A 653/A 653M SS Grade 33 and have a minimum yield strength of 33,000 psi (228 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with the 2009 and 2003 IBC and Section R301.1.3 of the 2009 and 2003 IRC must be determined in accordance with ACI 318-08 Appendix D and this report. Design strength of anchors complying with the 2006 IBC and 2006 IRC must be in accordance with ACI 318-05 Appendix D and this report. Design parameters provided in Table 2 through Table 5 of this report are based on the 2009 IBC (ACI 318-08) unless noted otherwise in Sections 4.1.1 through 4.1.12.

The strength design of anchors must comply with ACI 318 D.4.1, except as required in ACI 318 D.3.3. Strength reduction factors, ϕ, as given in ACI 318 D.4.4, and noted in Tables 3 and 4 of this report, must be used for load combinations calculated in accordance with Section 1605.2.1 of the IBC and Section 9.2 of ACI 318. Strength reduction factors, ϕ, as given in ACI 318 D.4.5 must be used for load combinations calculated in accordance with ACI 318 Appendix C.

The value of $f'c$ used in the calculation must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318 D.3.5. An example calculation is provided in Figure 4.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal static steel strength, N_{sa}, of a single anchor in tension calculated in accordance with ACI 318 D.5.1.2, N_{sa}, is given in Table 3 of this report. Strength reduction factors, ϕ, corresponding to brittle steel elements must be used.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal concrete breakout strength of a single anchor or a group of anchors in tension, N_{cb} and N_{cbg}, respectively, must be calculated in accordance with ACI 318 D.5.2, with modifications as described in this section. The basic concrete breakout strength in tension, N_b, must be calculated in accordance with ACI 318 D.5.2.2, using the values of h_{ef} and k_{cr} as given in Table 3 of this report. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318 D.5.2.6 must be calculated with the value of k_{uncr} as given in Table 3 and with $\psi_{c,N}$ = 1.0.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 3, calculation of the concrete breakout strength in accordance with ACI 318 D.5.2 is not required.

4.1.4 Requirements for Static Pullout Strength in Tension, N_p: The nominal pullout strength of a single anchor in accordance with ACI 318 D.5.3.1 and D.5.3.2 in cracked and uncracked concrete, $N_{p,cr}$, and $N_{p,uncr}$, respectively, is given in Table 3. In lieu of ACI 318 D.5.3.6, $\psi_{c,P}$ = 1.0 for all design cases. In accordance with ACI 318 D.5.3, the nominal pullout strength in cracked concrete may be adjusted according to Eq.-1:

$$N_{p,f_c'} = N_{p,cr}\sqrt{\frac{f_c'}{2{,}500}} \qquad \text{(lb, psi)} \qquad \text{(Eq-1)}$$

$$N_{p,f_c'} = N_{p,cr}\sqrt{\frac{f_c'}{17.2}} \qquad \text{(N, MPa)}$$

where f'_c is the specified concrete compressive strength.

In regions where analysis indicates no cracking in accordance with ACI 318 D.5.3.6, the nominal pullout strength in tension may be adjusted according to Eq-2:

$$N_{p,f_c'} = N_{p,uncr}\sqrt{\frac{f_c'}{2{,}500}} \qquad \text{(lb, psi)} \qquad \text{(Eq-2)}$$

$$N_{p,f_c'} = N_{p,uncr}\sqrt{\frac{f_c'}{17.2}} \qquad \text{(N, MPa)}$$

where f'_c is the specified concrete compressive strength.

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Table 3 of this report, the pullout strength in tension need not be considered.

The nominal pullout strength in tension of the anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figure 3, is provided in Table 5. In accordance with ACI Section D.5.3.2, the nominal pullout strength in cracked concrete must be calculated according to Eq-1, whereby the value of $N_{p,deck,cr}$ must be substituted for $N_{p,cr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator. In regions where analysis indicates no cracking in accordance with ACI 318 5.3.6, the nominal strength in uncracked concrete must be calculated according to Eq-2, whereby the value of $N_{p,deck,uncr}$ must be substituted for $N_{p,uncr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator.

4.1.5 Requirements for Static Steel Shear Capacity, V_{sa}: The nominal steel strength in shear, V_{sa}, of a single anchor in accordance with ACI 318 D.6.1.2 is given in Table 4 of this report and must be used in lieu of the values derived by calculation from ACI 318, Eq. D-20. The strength reduction factor, ϕ, corresponding to brittle steel elements must be used. The nominal shear strength $V_{sa,deck}$, of anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figure 3, is given in Table 5.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: The nominal 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 D.6.2, with modifications as described in this section. The basic concrete breakout strength in shear, V_b, must be calculated in accordance with ACI 318 D.6.2.2 using the values of ℓ_e and d_a given in Table 4.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 3, calculation of the concrete breakout strength in accordance with ACI 318 D.6.2 is not required.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear, V_{cp} or V_{cpg}: 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 D.6.3, modified by using the value of k_{cp} provided in Table 4 and the value of N_{cb} or N_{cbg} as calculated in Section 4.1.3 of this report.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 3, calculation of the concrete pryout strength in accordance with ACI 318 D.6.3 is not required.

4.1.8 Requirements for Seismic Design:

4.1.8.1 General: For load combinations including seismic, the design must be in accordance with ACI 318 D.3.3, as modified by Section 1908.1.9 of the 2009 IBC or Section 1908.1.16 of the 2006 IBC, as applicable, or the following:

CODE	ACI 318 SECTION D.3.3 SEISMIC REGION	CODE EQUIVALENT DESIGNATION
2003 IBC and 2003 IRC	Moderate or high seismic risk	Seismic Design Categories C, D, E and F

The nominal steel strength and nominal concrete breakout strength for anchors in tension, and the nominal concrete breakout strength and pryout strength for anchors in shear, must be calculated according to ACI 318 D.5 and D.6, respectively, taking into account the corresponding values in Tables 2 through 5 of this report. The anchors comply with ACI 318 D.1 as brittle steel elements and must be designed in accordance with ACI 318-08 D.3.3.5 or D.3.3.6 or ACI 318-05 D.3.3.5, as applicable.

4.1.8.2 Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated according to ACI 318 D.5.1 and D.5.2, as described in Sections 4.1.2 and 4.1.3 of this report. In accordance with ACI 318 D.5.3.2, the appropriate value for pullout strength in tension for seismic loads, N_{eq} or $N_{p,deck,cr}$ described in Table 3 and 5, respectively, of this report must be used in lieu of N_p. N_{eq} or $N_{p,deck,cr}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report in addition for concrete-filled steel deck floor and roof assemblies the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator. Where values for N_{eq} are not provided in Table 3 of this report, the pullout strength in tension for seismic loads need not be evaluated.

4.1.8.3 Seismic Shear: The nominal concrete breakout strength and pryout strength in shear must be calculated according to ACI 318 D.6.2 and D.6.3, as described in Sections 4.1.6 and 4.1.7 of this report. In accordance with ACI 318 D.6.1.2, the appropriate value for nominal steel strength for seismic loads, V_{eq} or $V_{sa,deck,eq}$ described in Table 4 and 5, respectively, of this report, must be used in lieu of V_{sa}.

4.1.9 Requirements for Interaction of Tensile and Shear Forces: The effects of combined tensile and shear forces must be determined in accordance with ACI 318 D.7.

4.1.10 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: In lieu of ACI 318 D.8.1 and D.8.3, values of c_{min} and s_{min}, respectively, as given in Table 2 of this report must be used. In lieu of ACI 318 D.8.5, minimum member thicknesses, h_{min} as given in Table 2 must be used.

For anchors installed through the soffit of steel deck assemblies, the anchors must be installed in accordance with Figure 3 and shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

4.1.11 Requirements for Critical Edge Distance, c_{ac}: In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318 D.5.2, must be further multiplied by the factor $\Psi_{cp,N}$ as given by Eq-3:

$$\Psi_{cp,N} = \frac{c}{c_{ac}} \qquad \text{(Eq-3)}$$

where the factor $\Psi_{cp,N}$ need not be taken as less than $\frac{1.5h_{ef}}{c_{ac}}$. For all other cases, $\Psi_{cp,N}$ = 1.0. In lieu of using ACI 318 D.8.6, values of c_{ac} must comply with Table 3.

4.1.12 Sand-lightweight Concrete: For ACI 318-08, when anchors are used in sand-lightweight concrete, the modification factor for concrete breakout, λ, must be taken as 0.6. In addition, the pullout strength $N_{p,uncr}$, $N_{p,cr}$, and N_{eq} must be multiplied by 0.6, as applicable.

For ACI 318-05 the values N_b, $N_{p,uncr}$, $N_{p,cr}$, N_{eq}, and V_b determined in accordance with this report must be multiplied by 0.60, in lieu of ACI 318 D.3.4.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight concrete-filled steel deck and floor and roof assemblies, this reduction is not required.

4.2 Allowable Stress Design (ASD):

4.2.1 General: Design values for use with allowable stress design load combinations calculated in accordance with Section 1605.3 of the IBC must be established using the following equations:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \qquad \text{(Eq-4)}$$

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha} \qquad \text{(Eq-5)}$$

where:

$T_{allowable,ASD}$	=	Allowable tension load (lb, N)
$V_{allowable\ ASD}$	=	Allowable shear load (lb, N)
ϕN_n	=	Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 Appendix D, Section 4.1 of this report and 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16, as applicable.
ϕV_n	=	Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 Appendix D, Section 4.1 of this report and 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16, as applicable.
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 nonductile failure modes and required over-strength.

Limits on edge distance, anchor spacing and member thickness as given in Table 2 of this report must apply. An example of Allowable Stress Design tension values is given in Table 6 and Figure 4.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318 D.7, as follows:

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

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

For all other cases:

$$\frac{T_{applied}}{T_{allowable}} + \frac{V_{applied}}{V_{allowable}} \leq 1.2 \qquad \text{(Eq-6)}$$

4.3 Installation:

Installation parameters are provided in Tables 1 and 2 and Figures 1, 3 and 5. Anchor locations must comply with this report and plans and specifications approved by the code official. The Hilti KWIK HUS-EZ (KH-EZ) must be installed according to manufacturer's published instructions and this report. In case of conflict, this report governs. Anchors must be installed in holes drilled into concrete perpendicular to the surface using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The nominal drill bit diameter must be equal to that of the anchor. The minimum drilled hole depth is given in Table 2. Prior to installation, dust and debris must be removed from the drilled hole using a hand pump, compressed air or a vacuum. The anchor must be installed into the predrilled hole using a powered impact wrench or installed with a torque wrench until the proper nominal embedment depth is obtained. The maximum impact wrench torque, $T_{impact,max}$ and maximum installation torque, $T_{inst,max}$ for the manual torque wrench must be in accordance with Table 2. The KWIK HUS-EZ (KH-EZ) may be loosened by a maximum of one turn and reinstalled with a socket wrench or powered impact wrench to facilitate fixture attachment or realignment.

For installation in the soffit of concrete on steel deck assemblies, the hole diameter in the steel deck must not exceed the diameter of the hole in the concrete by more the $^1/_8$ inch (3.2mm). For member thickness and edge distance restrictions for installations into the soffit of concrete on steel deck assemblies, see Figure 3.

4.4 Special Inspection:

Periodic special inspection is required, in accordance with Section 1704.15 of the 2009 IBC or Section 1704.13 of the 2006 or 2003 IBC. The special inspector must be on the site periodically during anchor installation to verify anchor type, anchor dimensions, hole dimensions, concrete type, concrete compressive strength, drill bit type and size, hole dimensions, hole cleaning procedures, anchor spacing(s), edge distance(s), concrete member thickness, anchor embedment, installation torque, impact wrench power and adherence to the manufacturer's printed installation instructions and the conditions of this report (in case of conflict, this report governs). 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 and 1706 must be observed, where applicable.

5.0 CONDITIONS OF USE

The Hilti KWIK HUS-EZ (KH-EZ) concrete anchors described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The anchors must be installed in accordance with the manufacturer's published installation instructions and this report. In case of conflict, this report governs.

5.2 Anchor sizes, dimensions, and minimum embedment depths are as set forth in this report.

5.3 Anchors must be installed in accordance with Section 4.3 of this report in uncracked or cracked normal-weight concrete and sand-lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa), and cracked and uncracked normal-weight or sand-lightweight concrete over metal deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

5.4 The value of f'_c used for calculation purposes must not exceed 8,000 psi (55.2 MPa).

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

5.6 Allowable stress design values must be established in accordance with Section 4.2 of this report.

5.7 Anchor spacing(s) and edge distance(s), and minimum member thickness, must comply with Table 2 and Figure 3 of this report.

5.8 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.

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

5.10 Anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ($f_t>f_r$), subject to the conditions of this report.

5.11 Anchors may be used to resist short-term loading due to wind or seismic forces, subject to the conditions of this report.

5.12 Anchors are not permitted to support fire-resistance-rated construction. Where not otherwise prohibited in the code, anchors are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support gravity load–bearing structural elements are within 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.
- Anchors are used to support nonstructural elements.

5.13 Anchors have been evaluated for reliability against brittle failure and found to be not significantly sensitive to stress-induced hydrogen embrittlement.

5.14 Use of carbon steel anchors is limited to dry, interior locations.

5.15 Special inspection must be provided in accordance with Sections 4.4.

5.16 KWIK HUS-EZ (KH-EZ) anchors are manufactured by Hilti AG, under a quality control program with inspections by Underwriters Laboratories Inc. (AA-668).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated November 2010; and quality control documentation.

7.0 IDENTIFICATION

The HILTI KWIK HUS-EZ (KH-EZ) anchors are identified by packaging with the manufacturer's name (Hilti, Inc.) and contact information, anchor name, anchor size, evaluation report number (ICC-ES ESR-3027), and the name of the inspection agency (Underwriters Laboratories Inc.). The anchors with hex washer head have KH-EZ, HILTI, and anchor size and anchor length embossed on the anchor head. Identifications are visible after installation, for verification.

TABLE 1—KWIK HUS-EZ (KH-EZ) PRODUCT INFORMATION

Description	Name and Size	Diameter	Total Length - under the anchor head (l_{anch})
Screw Anchor with Hex-Head	KH-EZ $^1/_4$″x2$^5/_8$″	$^1/_4$″	2$^5/_8$″
	KH-EZ $^1/_4$″x3″	$^1/_4$″	3″
	KH-EZ $^1/_4$″x3$^1/_2$″	$^1/_4$″	3$^1/_2$″
	KH-EZ $^1/_4$″x4″	$^1/_4$″	4″
	KH-EZ $^3/_8$″x1$^7/_8$″	$^3/_8$″	1$^7/_8$″
	KH-EZ $^3/_8$″x2$^1/_8$″	$^3/_8$″	2$^1/_8$″
	KH-EZ $^3/_8$″x3″	$^3/_8$″	3″
	KH-EZ $^3/_8$″x3$^1/_2$″	$^3/_8$″	3$^1/_2$″
	KH-EZ $^3/_8$″x4″	$^3/_8$″	4″
	KH-EZ $^3/_8$″x5″	$^3/_8$″	5″
	KH-EZ $^1/_2$″x2$^1/_2$″	$^1/_2$″	2$^1/_2$″
	KH-EZ $^1/_2$″x3″	$^1/_2$″	3″
	KH-EZ $^1/_2$″x3$^1/_2$″	$^1/_2$″	3$^1/_2$″
	KH-EZ $^1/_2$″x4″	$^1/_2$″	4″
	KH-EZ $^1/_2$″x4$^1/_2$″	$^1/_2$″	4$^1/_2$″
	KH-EZ $^1/_2$″x5″	$^1/_2$″	5″
	KH-EZ $^1/_2$″x6″	$^1/_2$″	6″
	KH-EZ $^5/_8$″x3$^1/_2$″	$^5/_8$″	3$^1/_2$″
	KH-EZ $^5/_8$″x4″	$^5/_8$″	4″
	KH-EZ $^5/_8$″x5$^1/_2$″	$^5/_8$″	5$^1/_2$″
	KH-EZ $^5/_8$″x6$^1/_2$″	$^5/_8$″	6$^1/_2$″
	KH-EZ $^5/_8$″x8″	$^5/_8$″	8″
	KH-EZ $^3/_4$″x4$^1/_2$″	$^3/_4$″	4$^1/_2$″
	KH-EZ $^3/_4$″x5$^1/_2$″	$^3/_4$″	5$^1/_2$″
	KH-EZ $^3/_4$″x7″	$^3/_4$″	7″
	KH-EZ $^3/_4$″x8″	$^3/_4$″	8″
	KH-EZ $^3/_4$″x9″	$^3/_4$″	9″

For SI: 1 inch = 25.4 mm.

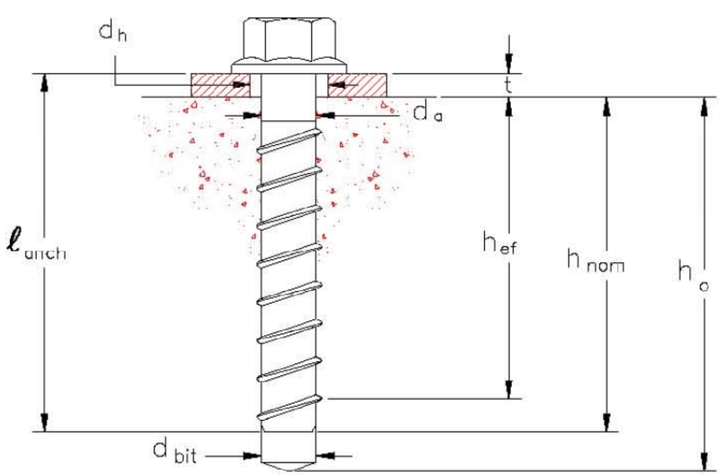


FIGURE 1—KWIK HUS EZ ANCHOR

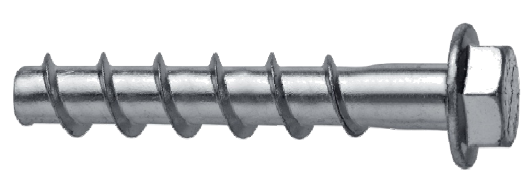


FIGURE 2—HILTI KWIK HUS EZ CONCRETE SCREW ANCHOR

TABLE 2—KWIK HUS-EZ (KH-EZ) INSTALLATION INFORMATION AND ANCHOR SPECIFICATION[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)										
			1/4	3/8			1/2			5/8		3/4	
Nominal Diameter	d_a (d_o)[5]	in.	1/4	3/8			1/2			5/8		3/4	
Drill Bit Diameter	d_{bit}	in.	1/4	3/8			1/2			5/8		3/4	
Minimum Baseplate Clearance Hole Diameter	d_h	in.	3/8	1/2			5/8			3/4		7/8	
Maximum Installation Torque	$T_{inst,max}$[4]	ft-lbf	18	40			45			85		115	
Maximum Impact Wrench Torque Rating[3]	$T_{impact,max}$	ft-lbf	137	114	450		137	450		450		450	
Minimum Nominal Embedment depth	h_{nom}	in.	2 1/2	1 5/8	2 1/2	3 1/4	2 1/4	3	4 1/4	3 1/4	5	4	6 1/4
Effective Embedment Depth	h_{ef}	in.	1.92	1.11	1.86	2.50	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Minimum Hole Depth	h_o	in.	2 7/8	1 7/8	2 3/4	3 1/2	2 5/8	3 3/8	4 5/8	3 5/8	5 3/8	4 3/8	6 5/8
Critical Edge Distance[2]	c_{ac}	in.	2.78	2.10	2.92	3.75	2.75	3.67	5.25	3.63	5.81	4.41	7.28
Minimum Edge Distance[2]	c_{min}	in.	1.50				1.75						
Minimum Spacing Distance[2]	s_{min}	in.	3							4			
Minimum Concrete Thickness	h_{min}	in.	4	3.25	4	4.75	4.5	5.5	6.75	5	7	6	8
Wrench socket size	-	in.	7/16	9/16			3/4			15/16		1 1/8	
Max. Head height	-	in.	0.24	0.35			0.49			0.57		0.70	
Effective tensile stress area	A_{se} $(A_{se,N})$[5]	$in.^2$	0.045	0.086			0.161			0.268		0.392	
Minimum specified ultimate strength	f_{uta} (f_{ut})[6]	psi	134,000	106,225	120,300		112,540			90,180		81,600	

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

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

[2]For installations through the soffit of steel deck into concrete (see Figure 3) anchors installed in the lower flute may be installed with a maximum 1 inch offset in either direction from the center of the flute.

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

[4]$T_{inst,max}$ applies to installations using a calibrated torque wrench.

[5]The notation in parenthesis is for the 2006 IBC.

[6]The notation in parenthesis is for the 2003 IBC.

TABLE 3—HILTI KWIK HUS-EZ (KH-EZ) TENSION STRENGTH DESIGN DATA[1,2,3,5]

Characteristic	Symbol	Units	Nominal Anchor Diameter(inches)										
			$\frac{1}{4}$	$\frac{3}{8}$			$\frac{1}{2}$			$\frac{5}{8}$		$\frac{3}{4}$	
Anchor Category 1,2 or 3			1										
Nominal Embedment Depth	h_{nom}	in.	$2\frac{1}{2}$	$1\frac{5}{8}$	$2\frac{1}{2}$	$3\frac{1}{4}$	$2\frac{1}{4}$	3	$4\frac{1}{4}$	$3\frac{1}{4}$	5	4	$6\frac{1}{4}$
Steel Strength in Tension (ACI 318 D.5.1)[6]													
Tension Resistance of Steel	N_{sa}	lb.	6,070	9,125	10,335		18,120			24,210		32,013	
Reduction Factor for Steel Strength[2]	ϕ_{sa}	-	0.65										
Concrete Breakout Strength in Tension (ACI 318 D.5.2)													
Effective Embedment Depth	h_{ef}	in.	1.92	1.11	1.86	2.50	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Critical Edge Distance	c_{ac}	in.	2.78	2.10	2.92	3.74	2.75	3.67	5.25	3.63	5.82	4.41	7.28
Effectiveness Factor – Uncracked Concrete	k_{uncr}	-	24	24	24	24	27	27	27	27	27	27	27
Effectiveness Factor – Cracked Concrete	k_{cr}	-	17	17	17	17	17	17	17	17	17	17	17
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Reduction Factor for Concrete Breakout Strength[2]	ϕ_{cb}	-	0.65 (Condition B)										
Pullout Strength in Tension (Non Seismic Applications) (ACI318 D.5.3)													
Characteristic pullout strength, uncracked concrete (2,500psi)	$N_{p,uncr}$	lb.	2,348[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Characteristic pullout strength, cracked concrete (2500 psi)	$N_{p,cr}$	lb.	1,166[4]	728[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reduction factor for pullout strength[2]	ϕ_p	-	0.65 (Condition B)										
Pullout Strength in Tension (Seismic Applications) (ACI 318 D.5.3)													
Characteristic Pullout Strength, Seismic (2,500 psi)	N_{eq}	lb.	1,166[4]	728[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reduction Factor for Pullout Strength[2] (2,500 psi)	ϕ_{eq}	-	0.65 (Condition B)										
Axial Stiffness in Service Load Range													
Uncracked Concrete	β_{uncr}	lb/in.	760,000										
Cracked Concrete	β_{cr}		293,000										

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

[1]The data in this table is intended for use with the design provisions of ACI 318 Appendix D; for anchors resisting seismic load combinations the additional requirements of ACI D.3.3 shall apply.

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

[3]In this report, N/A denotes that pullout resistance does not govern and does not need to be considered.

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

[5] For sand-lightweight concrete, calculate values according to Section 4.1.12 of this report.

[6]The KWIK HUS-EZ (KH-EZ) is considered a brittle steel element as defined by ACI 318 D.1.

TABLE 4—HILTI KWIK HUS-EZ (KH-EZ) SHEAR STRENGTH DESIGN DATA[1,2]

Characteristic	Symbol	Units	Nominal Anchor Diameter(inches)										
			$^1/_4$	$^3/_8$			$^1/_2$			$^5/_8$		$^3/_4$	
Anchor Category	1,2 or 3		1										
Embedment Depth	h_{nom}	in.	$2^1/_2$	$1^5/_8$	$2^1/_2$	$3^1/_4$	$2^1/_4$	3	$4^1/_4$	$3^1/_4$	5	4	$6^1/_4$
Steel Strength in Shear (ACI 318 D.6.1)[4,5]													
Shear Resistance of Steel - Static	V_{sa}[3]	lb.	1,548	4,507	5,185		9,245			11,221		16,662	
Shear Resistance of Steel - Seismic	V_{eq}[3]	lb.	1,393	2,524	3,111		5,547			6,733		11,556	
Reduction Factor for Steel Strength	ϕ_{sa}	-	0.60										
Concrete Breakout Strength in Shear (ACI 318 D.6.2)													
Nominal Diameter	$d_a(d_o)$[6]	in.	0.250	0.375			0.500			0.625		0.750	
Load Bearing Length of Anchor	ℓ_e[3]	in.	1.92	1.11	1.86	2.50	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Reduction Factor for Concrete Breakout Strength	ϕ_{cb}	-	0.70										
Concrete Pryout Strength in Shear (ACI 318 D.6.3)													
Coefficient for Pryout Strength	k_{cp}	-	1.0	1.0	1.0	2.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0
Reduction Factor for Pryout Strength	ϕ_{cp}	-	0.70										

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

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

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

[3]For 2003 IBC code basis replace ℓ_e with ℓ, V_{sa} with V_s, and V_{eq} with $V_{sa,seis}$.

[4]Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of calculated results using equation D-20 of ACI 318.

[5]The KWIK HUS-EZ (KH-EZ) is considered a brittle steel element as defined by ACI 318 D.1.

[6]The notation in brackets is for the 2006 IBC.

TABLE 5—HILTI KWIK HUS-EZ (KH-EZ) TENSION AND SHEAR DESIGN DATA FOR INSTALLATION IN THE UNDERSIDE OF CONCRETE-FILLED PROFILE STEEL DECK ASSEMBLIES[1,6]

Characteristic	Symbol	Units	Lower Flute								Upper Flute		
			Anchor Diameter										
			$^1/_4$	$^3/_8$		$^1/_2$		$^5/_8$		$^3/_4$	$^1/_4$	$^3/_8$	$^1/_2$
Embedment	h_{nom}	in.	$2^1/_2$	$1^5/_8$	$3^1/_4$	$2^1/_4$	$4^1/_4$	$3^1/_4$	5	4	$2^1/_2$	$1^5/_8$	$2^1/_4$
Minimum Hole Depth	h_{hole}	in.	$2^7/_8$	$1^7/_8$	$3^1/_2$	$2^5/_8$	$4^5/_8$	$3^5/_8$	$5^3/_8$	$4^3/_8$	$2^7/_8$	$1^7/_8$	$2^5/_8$
Effective Embedment Depth	h_{ef}	in.	1.92	1.11	2.50	1.52	3.22	2.39	3.88	2.92	1.92	1.11	1.52
Pullout Resistance, (uncracked concrete)[2]	$N_{p,deck,uncr}$	lb.	1,875	1,285	3,920	1,305	5,360	4,180	9,495	4,180	1,960	1,015	1,395
Pullout Resistance (cracked concrete and seismic loads)[3]	$N_{p,deck,cr}$	lb.	1,330	1,120	3,430	925	3,795	3,070	7,385	2,630	1,390	885	985
Steel Strength in Shear[4]	$V_{sa,deck}$[8]	lb.	2,210	1,670	3,605	1,605	3,590	3,470	4,190	3,762	3,265	3,935	7,850
Steel Strength in Shear, Seismic	$V_{sa,deck,eq}$	lb.	1,988	935	2,163	963	2,154	2,082	2,514	2,609	2,937	2,203	4,710

[1]Installation must comply with Sections 4.1.10 and 4.3 and Figure 3 of this report.

[2]The values listed must be used in accordance with Section 4.1.4 of this report.

[3]The values listed must be used in accordance with Section 4.1.4 and 4.1.8.2 of this report.

[4]The values listed must be used in accordance with Section 4.1.5 and 4.1.8.3 of this report.

[5]The values for ϕ_p in tension can be found in Table 3 of this report and the values for ϕ_{sa} in shear can be found in Table 4 of this report.

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

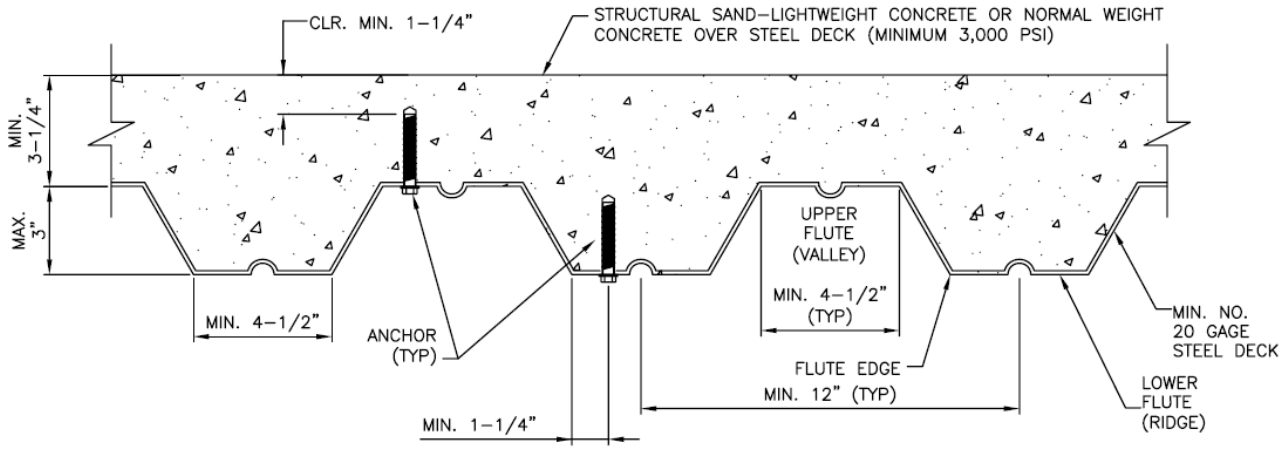


FIGURE 3—INSTALLATION OF KWIK HUS-EZ (KH-EZ) IN SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES[1]

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

TABLE 6—HILTI KWIK HUS-EZ (KH-EZ) ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES[1, 2, 3, 4, 5, 6, 7, 8, 9]

Nominal Anchor Diameter	Embedment Depth, h_{nom}	Effective Embedment Depth, h_{ef}	Allowable Tension Load
[in.]	[in.]	[in.]	[lbs]
1/4	$2^1/_2$	1.92	1,031
3/8	$1^5/_8$	1.11	620
	$2^1/_2$	1.86	1,334
	$3^1/_4$	2.5	2,077
1/2	$2^1/_4$	1.52	1,111
	3	2.16	1,882
	$4^1/_4$	3.22	3,426
5/8	$3^1/_4$	2.39	2,192
	5	3.88	4,530
3/4	4	2.92	2,963
	$6^1/_4$	4.84	6,305

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

[1]Single anchor with static tension load only.
[2]Concrete determined to remain uncracked for the life of the anchorage.
[3]Load combinations are taken from ACI 318 Section 9.2 (no seismic loading).
[4]40% dead load and 60% live load, controlling load combination $1.2D + 1.6L$.
[5]Calculation of weighted average for conversion factor $\alpha = 1.2(0.4) + 1.6(0.6) = 1.44$.
[6] f'_c = 2,500 psi (normal weight concrete).
[7] $c_{a1} = c_{a2} \geq c_{ac}$.
[8] $h \geq h_{min}$.
[9]Values are for Condition B where supplementary reinforcement in accordance with ACI 318 D.4.4 is not provided.

Given: Two 1/2” diameter KH-EZ with static tension load

h_{nom} = 4.25 inches

h_{ef} = 3.22 inches

Normal Weight Concrete: f'_c = 3,000 psi

No supplementary reinforcement (Cond. B)

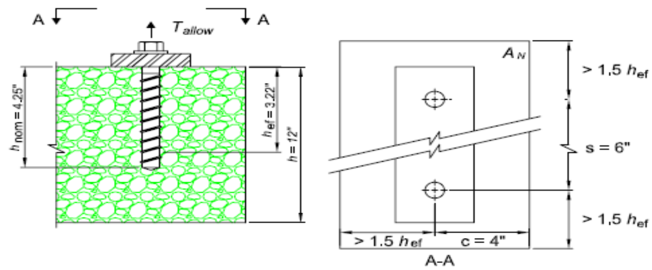
Assume cracked concrete since no other information is available.

h_{min}=6.375 in.

c_{min}=1.75 in.

s_{min}=3 in.

Needed: Allowable stress design (ASD) tension capacity



Calculation per ACI 318-08 and this report	Code Reference	ESR Reference
Step 1: Calculate steel capacity: $\phi N_s = n\phi N_{sa} = 2(0.65)(18{,}120) = 23{,}556$ lbs.	D.5.1.2	Table 3
Step 2: Verify minimum member thickness, spacing and edge distance: h_{min}=6.375 in. ≤8 in. →ok c_{min}=1.75 in. ≤4 in. →ok s_{min}=3 in. ≤6 in. →ok	D.8	Table 2
Step 3: Calculate concrete breakout strength of anchor group in tension: $N_{cbg} = \frac{A_{Nc}}{A_{Nco}} \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$	D.5.2.1	4.1.3
Step 3a: Calculate A_{Nc} and A_{Nco}: $A_{Nc} = (1.5h_{ef}+4)(3h_{ef}+6) = (8.83)(15.66) = 138.3$ in.^{2} $A_{Nco} = 9(h_{ef})^2 = 9(3.22)^2 = 93.32$ in.^{2}	D.5.2.1	Table 3
Step 3b: Determine $\Psi_{ec,N} \rightarrow e'_n = 0 \rightarrow \Psi_{ec,N} = 1.0$	D.5.2.4	----
Step 3c: Calculate $\Psi_{ed,N} \rightarrow \Psi_{ed,N} = 0.7 + 0.3\left(\frac{4}{4.83}\right) = 0.948$	D.5.2.5	Table 3
Step 3d: Determine $\Psi_{cp,N} \rightarrow \Psi_{cp,N} = 1.0$ because concrete is cracked.	D.5.3.6	----
Step 3e: Calculate N_b: $N_b = k_{cr}\lambda\sqrt{f'_c}(h_{ef})^{1.5} = 17(1.0)\sqrt{3{,}000}(3.22)^{1.5} = 5{,}380$ lbs (λ=1.0 for normal weight concrete)	D.5.2.2	Table 3
Step 3f: Calculate ϕN_{cbg}: $\phi N_{cbg} = (0.65)\left(\frac{138.3}{93.32}\right)(1.0)(0.948)(1.0)(1.0)(5{,}380) = 4{,}914$ lbs	D.5.2.1 D.4.4 (c)	4.1.3 Table 3
Step 4: Check Pullout Strength → per Table 3 does not control	----	Table 3
Step 5: Controlling Strength: Lesser of $n\phi N_{sa}$ and ϕN_{cbg} → 4,914 lbs	D.4.1.2	Table 3
Step 6: Convert to ASD based on 1.6 (0.60)+1.2(0.40)=1.44 60% Live Load and 40% Dead Load: $T_{allowable,ASD} = \frac{4{,}914}{1.44} = 3{,}412$ lbs	---	4.2.1

FIGURE 4—EXAMPLE CALCULATION

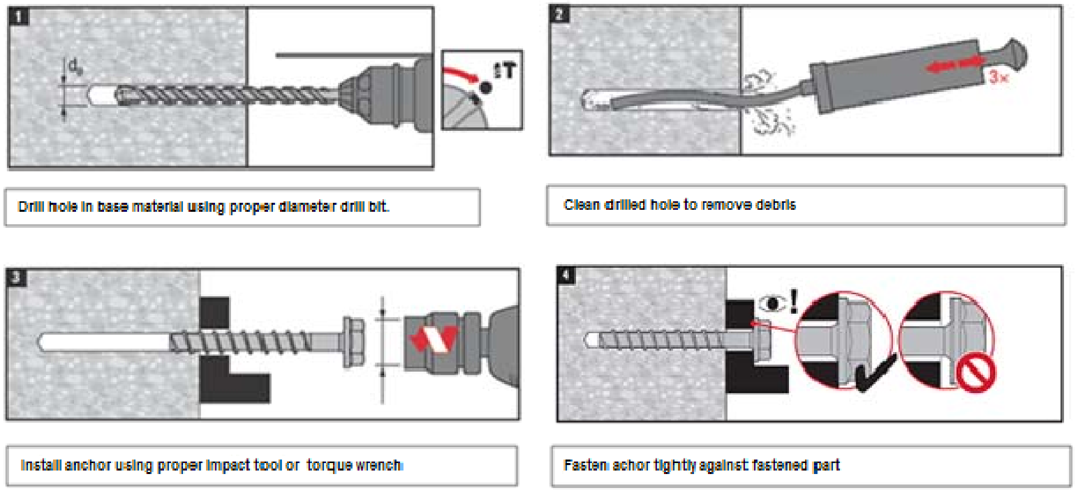


FIGURE 5—INSTALLATION INSTRUCTIONS