

**ICC-ES Evaluation Report****ESR-2262**

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**DIVISION: 03 00 00—CONCRETE**  
**Section: 03 15 00—Concrete Accessories****REPORT HOLDER:****HILTI, INC.**  
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[HiltiTechEng@us.hilti.com](mailto:HiltiTechEng@us.hilti.com)**EVALUATION SUBJECT:****HILTI HIT-HY 150 MAX ADHESIVE ANCHORING SYSTEM  
IN 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)
- 2000 *International Building Code*® (2000 IBC)
- 2000 *International Residential Code*® (2000 IRC)

**Property evaluated:**

Structural

**2.0 USES**

The Hilti HIT-HY 150 MAX Adhesive Anchoring System is used to resist static, wind, or earthquake (Seismic Design Categories A and B only) tension and shear loads in uncracked normal-weight concrete having a specified compressive strength,  $f'_c$ , of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa). The anchor system is an alternative to anchors described in Sections 1911 and 1912 of the 2009 and 2006 IBC and Sections 1912 and 1913 of the 2003 and 2000 IBC. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the 2009, 2006 and 2003 IRC, or Section R301.1.2 of the 2000 IRC.

**3.0 DESCRIPTION****3.1 General:**

The Hilti HIT-HY 150 MAX Adhesive Anchoring System is comprised of the following components:

- Hilti HIT-HY 150 MAX adhesive packaged in foil packs.
- Adhesive mixing and dispensing equipment.
- Hole cleaning equipment.

The Hilti HIT-HY 150 MAX Adhesive Anchoring System may be used with continuously threaded rod, Hilti HIS-N and HIS-RN internally-threaded inserts or deformed reinforcing bar. The primary components of the Hilti Adhesive Anchoring System are shown in Figure 3 of this report.

Installation information and parameters, as included with each adhesive unit package, are shown in Figure 5 of this report.

**3.2 Materials:**

**3.2.1 Hilti HIT-HY 150 MAX Adhesive:** Hilti HIT-HY 150 MAX Adhesive is an injectable hybrid adhesive combining urethane methacrylate resin, hardener, cement and water. The resin and cement are kept separate from the hardener and water by means of a dual-cylinder foil pack attached to a manifold. The two components combine and react when dispensed through a static mixing nozzle attached to the manifold. Hilti HIT-HY 150 MAX is available in 11.1-ounce (330 ml), 16.9-ounce (500 ml), and 47.3-ounce (1400 ml) foil packs. The manifold attached to each foil pack is stamped with the adhesive expiration date. The shelf life, as indicated by the expiration date, applies to unopened foil packs that are stored in accordance with the Instructions for Use, as illustrated in Figure 5 of this report.

**3.2.2 Hole Cleaning Equipment:** Hole cleaning equipment comprised of steel wire brushes and air nozzles is illustrated in Figure 5 of this report.

**3.2.3 Dispensers:** Hilti HIT-HY 150 MAX must be dispensed with manual dispensers, pneumatic dispensers, or electric dispensers provided by Hilti.

**3.2.4 Anchor Elements:**

**3.2.4.1 Threaded Steel Rods:** The threaded steel rods must be clean, continuously threaded rods (all-thread) in diameters as described in Tables 2 and 3 of this report. Steel design information for common grades of threaded rod and associated nuts are provided in Tables 7 and 10, and instructions for use are shown in Figure 5. Carbon steel threaded rods must be furnished with a 0.0002-inch-thick (0.005 mm) zinc electroplate coating in accordance with ASTM B 633 SC 1; or must be hot-dipped galvanized in accordance with ASTM A 153, Class C or D. Threaded rods must be straight and free of indentations or other defects along their length. The ends may be stamped with identifying marks and the embedded end may be blunt cut or cut on the bias (chisel point).

**3.2.4.2 Steel Reinforcing Bars:** Steel reinforcing bars are deformed reinforcing bars. Table 19, Table 22 and Table 25, along with the instructions for use shown in Figure 5 of this report, summarize reinforcing bar size ranges. Table 6 provides properties of common reinforcing bar types and grades. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil, and other coatings that impair the bond with the adhesive. Reinforcing bars must not be bent after installation except as set forth in Section 7.3.2 of ACI 318, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

**3.2.4.3 HIS-N and HIS-RN Inserts:** Hilti HIS-N and HIS-RN inserts have a profile on the external surface and are internally threaded. Tensile properties for HIS-N and HIS-RN inserts are provided in Table 4 of this report. The inserts are available in diameters as shown in Table 13 and Table 16, and the instructions for use are shown in Figure 5 of this report. HIS-N inserts are produced from carbon steel and furnished either with a 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B 633 SC 1, or a hot-dipped galvanized coating complying with ASTM A 153, Class C or D. The stainless steel HIS-RN inserts are fabricated from X5CrNiMo17122 K700 steel complying with DIN 17440 (EN 10088). Specifications for common bolt types that may be used in conjunction with HIS-N and HIS-RN inserts are provided in Table 5. Bolt grade and material type (carbon, stainless) must be matched to the insert. Strength reduction factors,  $\phi$ , corresponding to brittle steel elements must be used for HIS-N and HIS-RN inserts.

**3.2.4.4 Ductility:** In accordance with ACI 318 Appendix D, in order for a steel element to be considered ductile, the tested elongation must be at least 14 percent and 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 various steel materials are provided in Tables 2 through 6 of this report. Where values are nonconforming or unstated, the steel must be considered brittle.

### 3.3 Concrete:

Normal-weight concrete must comply with Sections 1903 and 1905 of the IBC. The specified compressive strength of the concrete must be from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

## 4.0 DESIGN AND INSTALLATION

### 4.1 Strength Design:

**4.1.1 General:** The design strength of anchors under the 2009, 2003, and 2000 IBC, as well as Section 301.1.2 of the 2000 IRC and Section 301.1.3 of the 2009 and 2003 IRC, must be determined in accordance with ACI 318-08 Appendix D and this report.

The design strength of anchors under the 2006 IBC and 2006 IRC must be determined in accordance with ACI 318-05 Appendix D and this report.

A design example according to the 2006 IBC is given in Figure 4 of this report.

Design parameters are based on the 2009 IBC (ACI 318-08) unless noted otherwise in Sections 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.

Design parameters are provided in Table 7 through Table 27. Strength reduction factors,  $\phi$ , as given in ACI

318 D.4.4 must be used for load combinations calculated in accordance with Section 1605.2.1 of the IBC or ACI 318. Strength reduction factors,  $\phi$ , as given in ACI 318 D.4.5 must be used for load combinations calculated in accordance with ACI 318 Appendix C.

The following amendments to ACI 318 Appendix D must be used as required for the strength design of adhesive anchors. In conformance with ACI 318, all equations are expressed in inch-pound units.

Modify ACI 318 D.4.1.2 as follows:

*D.4.1.2—In Eq. (D-1) and (D-2),  $\phi N_n$  and  $\phi V_n$  are the lowest design strengths determined from all appropriate failure modes.  $\phi N_n$  is the lowest design strength in tension of an anchor or group of anchors as determined from consideration of  $\phi N_{sa}$ , either  $\phi N_a$  or  $\phi N_{ag}$  and either  $\phi N_{cb}$  or  $\phi N_{cbg}$ .  $\phi V_n$  is the lowest design strength in shear of an anchor or a group of anchors as determined from consideration of:  $\phi V_{sa}$ , either  $\phi V_{cb}$  or  $\phi V_{cbg}$ , and either  $\phi V_{cp}$  or  $\phi V_{cpg}$ . For adhesive anchors subjected to tension resulting from sustained loading, refer to D.4.1.4 for additional requirements.*

Add ACI 318 D.4.1.4 as follows:

*D.4.1.4—For adhesive anchors subjected to tension resulting from sustained loading, a supplementary check shall be performed using Eq. (D-1), whereby  $N_{ua}$  is determined from the sustained load alone, e.g., the dead load and that portion of the live load acting that may be considered as sustained and  $\phi N_n$  is determined as follows:*

*D.4.1.4.1—For single anchors,  $\phi N_n = 0.75\phi N_{a0}$ .*

*D.4.1.4.2—For anchor groups, Eq. (D-1) shall be satisfied by taking  $\phi N_n = 0.75\phi N_{a0}$  for that anchor in an anchor group that resists the highest tension load.*

*D.4.1.4.3—Where shear loads act concurrently with the sustained tension load, the interaction of tension and shear shall be analyzed in accordance with D.4.1.3.*

Modify ACI 318 D.4.2.2 in accordance with 2009 IBC Section 1908.1.10 as follows:

*D.4.2.2 – The concrete breakout strength requirements for anchors in tension shall be considered satisfied by the design procedure of D.5.2 provided Equation D-8 is not used for the anchor embedments exceeding 25 inches. The concrete breakout strength requirements for anchors in shear with diameters not exceeding 2 inches shall be considered satisfied by the design procedure of D.6.2. For anchors in shear with diameters exceeding 2 inches, shear anchor reinforcement shall be provided in accordance with the procedure of D.6.2.9.*

**4.1.2 Static Steel Strength in Tension:** The nominal static steel strength of a single anchor in tension,  $N_{sa}$ , in accordance with ACI 318 D.5.1.2 and strength reduction factor,  $\phi$ , in accordance with ACI D.4.4 are given in the tables outlined in Table 1a for the corresponding anchor steel.

**4.1.3 Static Concrete Breakout Strength in Tension:** The nominal static concrete breakout strength of a single anchor or group of anchors in tension,  $N_{cb}$  or  $N_{cbg}$ , must be calculated in accordance with ACI 318 D.5.2 with the following addition:

*D.5.2.10 (2009 IBC) or D.5.2.9 (2006 IBC) —The limiting concrete strength of adhesive anchors in tension shall be calculated in accordance with D.5.2.1 to D.5.2.9 under the 2009 IBC or D.5.2.1 to D.5.2.8 under the 2006 IBC where the value of  $k_c$  to be used in Eq. (D-7) shall be:*

$k_{c,uncr}$  where analysis indicates no cracking at service load levels in the anchor vicinity (uncracked concrete). The values of  $k_{c,uncr}$  are given in the tables of this report.

The basic concrete breakout strength of a single anchor in tension,  $N_b$ , must be calculated in accordance with ACI 318 D.5.2.2 using the values of  $h_{ef}$  and  $k_{c,uncr}$  as given in Tables 8, 9, 11, 12, 14, 15, 17, 18, 20, 21, 23, 24, 26, and 27, as applicable for the corresponding steel element, of this report. The modification factor “ $\lambda$ ” shall be taken as 1.0. Anchors shall not be installed in lightweight concrete. The value of  $f'_c$  must be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318 D.3.5.

Additional information for the determination of the nominal concrete breakout strength ( $N_{cb}$  or  $N_{cbg}$ ) is given in the tables outlined in Table 1a for the corresponding anchor steel.

**4.1.4 Static Pullout Strength in Tension:** In lieu of determining the nominal static pullout strength in accordance with ACI 318 D.5.3, nominal bond strength in tension must be calculated in accordance with the following sections added to ACI 318:

**D.5.3.7—The nominal bond strength of an adhesive anchor  $N_a$  or group of adhesive anchors,  $N_{ag}$ , in tension shall not exceed**

(a) for a single anchor

$$N_a = \frac{A_{Na}}{A_{Na0}} \cdot \psi_{ed,Na} \cdot \psi_{p,Na} \cdot N_{a0} \quad (D-16a)$$

(b) for a group of anchors

$$N_{ag} = \frac{A_{Na}}{A_{Na0}} \cdot \psi_{ed,Na} \cdot \psi_{g,Na} \cdot \psi_{ec,Na} \cdot \psi_{p,Na} \cdot N_{a0} \quad (D-16b)$$

where

$A_{Na}$  is the projected area of the failure surface for the single anchor or group of anchors that shall be approximated as the base of the rectilinear geometrical figure that results from projecting the failure surface outward a distance,  $c_{cr,Na}$ , from the centerline of the anchor, or in the case of a group of anchors, from a line through a row of adjacent anchors.  $A_{Na}$  shall not exceed  $nA_{Na0}$  where  $n$  is the number of anchors in tension in the group. In ACI 318 Figures RD.5.2.1a and RD.5.2.1b, the terms  $1.5h_{ef}$  and  $3.0h_{ef}$  shall be replaced with  $c_{cr,Na}$  and  $s_{cr,Na}$ , respectively.

$A_{Na0}$  is the projected area of the failure surface of a single anchor without the influence of proximate edges in accordance with Eq. (D-16c):

$$A_{Na0} = (s_{cr,Na})^2 \quad (D-16c)$$

with

$$s_{cr,Na} = \text{as given by Eq. (D-16d)}$$

**D.5.3.8—The critical spacing  $s_{cr,Na}$  and critical edge distance  $c_{cr,Na}$  shall be calculated as follows:**

$$s_{cr,Na} = 20 \cdot d \cdot \sqrt{\frac{\tau_{k,uncr}}{1,450}} \leq 3 \cdot h_{ef} \quad (D-16d)$$

$$c_{cr,Na} = \frac{s_{cr,Na}}{2} \quad (D-16e)$$

**D.5.3.9—The basic strength of a single adhesive anchor in tension in uncracked concrete shall not exceed:**

$$N_{a0} = \tau_{k,uncr} \cdot \pi \cdot d \cdot h_{ef} \quad (D-16f)$$

**D.5.3.10—The modification factor for the influence of the failure surface of a group of adhesive anchors is:**

$$\psi_{g,Na} = \psi_{g,Na0} + \left[ \left( \frac{S}{S_{cr,Na}} \right)^{0.5} \cdot (1 - \psi_{g,Na0}) \right] \quad (D-16g)$$

where

$$\psi_{g,Na0} = \sqrt{n} - \left[ (\sqrt{n} - 1) \cdot \left( \frac{\tau_{k,uncr}}{\tau_{k,max,uncr}} \right)^{1.5} \right] \geq 1.0 \quad (D-16h)$$

where

$n$  = the number of tension-loaded adhesive anchors in a group.

$$\tau_{k,max,uncr} = \frac{k_{c,uncr}}{\pi \cdot d} \cdot \sqrt{h_{ef} \cdot f'_c} \quad (D-16i)$$

The value of  $f'_c$  must be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318 D.3.5.

**D.5.3.11—The modification factor for eccentrically loaded adhesive anchor groups is:**

$$\psi_{ec,Na} = \frac{1}{1 + \frac{2e'_N}{S_{cr,Na}}} \leq 1.0 \quad (D-16j)$$

Eq. (D-16j) is valid for  $e'_N \leq \frac{S}{2}$

If the loading on an anchor group is such that only certain anchors are in tension, only those anchors that are in tension shall be considered when determining the eccentricity  $e'_N$  for use in Eq. (D-16j).

In the case where eccentric loading exists about two orthogonal axes, the modification factor  $\psi_{ec,Na}$  shall be computed for each axis individually and the product of these factors used as  $\psi_{ec,Na}$  in Eq. (D-16b).

**D.5.3.12—The modification factor for the edge effects for a single adhesive anchor or anchor groups loaded in tension is:**

$$\psi_{ed,Na} = 1.0 \text{ when } c_{a,min} \geq c_{cr,Na} \quad (D-16l)$$

or

$$\psi_{ed,Na} = \left( 0.7 + 0.3 \cdot \frac{c_{a,min}}{c_{cr,Na}} \right) \leq 1.0 \text{ when } c_{a,min} < c_{cr,Na} \quad (D-16m)$$

**D.5.3.14—When an adhesive anchor or a group of adhesive anchors is located in a region of a concrete member where analysis indicates no cracking at service load levels, the modification factor  $\psi_{p,Na}$  shall be taken as:**

$$\psi_{p,Na} = 1.0 \text{ when } c_{a,min} \geq c_{ac} \quad (D-16o)$$

$$\psi_{p,Na} = \frac{\max |c_{a,min} \cdot c_{cr,Na}|}{c_{ac}} \text{ when } c_{a,min} < c_{ac} \quad (D-16p)$$

where

$c_{ac}$  shall be determined in accordance with Section 4.1.10 of this report.

Additional information for the determination of nominal bond strength in tension is given in Section 4.1.8 of this report.

**4.1.5 Static Steel Strength in Shear:** The nominal static steel strength of a single anchor in shear as governed by the steel,  $V_{sa}$ , in accordance with ACI 318 D.6.1.2 and strength reduction factor,  $\phi$ , in accordance with ACI 318 D.4.4 are given in the tables outlined in Table 1a of this report for the corresponding anchor steel.



**4.1.6 Static Concrete Breakout Strength in Shear:** The nominal static concrete breakout strength of a single anchor or group of anchors in shear,  $V_{cb}$  or  $V_{cbg}$ , must be calculated in accordance with ACI 318 D.6.2 based on information given in the tables outlined in Table 1a of this report for the corresponding anchor steel. The basic concrete breakout strength of a single anchor in shear,  $V_b$ , must be calculated in accordance with ACI 318 D.6.2.2 using the values of  $d$  and  $h_{ef}$  given in the tables outlined in Table 1a for the corresponding anchor steel in lieu of  $d_a$  (2009 IBC) and  $d_o$  (2006 IBC). In addition,  $h_{ef}$  must be substituted for  $\ell_e$ . In no case must  $h_{ef}$  exceed  $8d$ . The value of  $f'_c$  must be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318 D.3.5.

**4.1.7 Static Concrete Pryout Strength in Shear:** In lieu of determining the nominal static pryout strength in accordance with ACI 318 D.6.3.1, the nominal pryout strength in shear must be calculated in accordance with the following sections added to ACI 318:

*D.6.3.2—The nominal pryout strength of an adhesive anchor or group of adhesive anchors shall not exceed:*

(a) for single anchors:

$$V_{cp} = \min | k_{cp} \cdot N_a; k_{cp} \cdot N_{cb} | \quad (D-30a)$$

(b) for groups:

$$V_{cpg} = \min | k_{cp} \cdot N_{ag}; k_{cp} \cdot N_{cbg} | \quad (D-30b)$$

where

$$k_{cp} = 1.0 \text{ for } h_{ef} < 2.5 \text{ inches (64 mm)}$$

$$k_{cp} = 2.0 \text{ for } h_{ef} \geq 2.5 \text{ inches (64 mm)}$$

$N_a$  shall be calculated in accordance with Eq. (D-16a)

$N_{ag}$  shall be calculated in accordance with Eq. (D-16b)

$N_{cb}$  and  $N_{cbg}$  shall be determined in accordance with D.5.2

**4.1.8 Bond Strength Determination:** Bond strength values are a function of installation conditions (dry, water-saturated concrete). The resulting characteristic bond strength must be multiplied by the associated strength reduction factor  $\phi_{nn}$  as follows:

CONCRETE TYPE	PERMISSIBLE INSTALLATION CONDITIONS	BOND STRENGTH	ASSOCIATED STRENGTH REDUCTION FACTOR
Uncracked	Dry concrete	$\tau_{k,uncr}$	$\phi_d$
	Water-saturated	$\tau_{k,uncr}$	$\phi_{ws}$

Figure 2 of this report presents a bond strength design selection flowchart.

Strength reduction factors for determination of the bond strength are given in the tables outlined in Table 1a of this report. Adjustments to the bond strength may also be taken for increased concrete compressive strength. These factors are given in the corresponding tables as well.

**4.1.9 Minimum Member Thickness,  $h_{min}$ , Anchor Spacing,  $s_{min}$ , and Edge Distance,  $c_{min}$ :** In lieu of ACI 318 D.8.3, values of  $c_{min}$  and  $s_{min}$  described in this report must be observed for anchor design and installation. Likewise, in lieu of ACI 318 D.8.5, the minimum member thicknesses,  $h_{min}$ , described in this report must be observed for anchor design and installation. In determining minimum edge distance,  $c_{min}$ , the following section must be added to ACI 318:

*D.8.8—For adhesive anchors that will remain untorqued, the minimum edge distance shall be based on minimum*

*cover requirements for reinforcement in 7.7. For adhesive anchors that will be torqued, the minimum edge distance and spacing are given in the Tables 8, 11, 14, 17, 20, 23, and 26 of this report.*

For the edge distance  $c_{ai}$  and anchor spacing,  $s_{ai}$ , and maximum torque,  $T'_{max}$  shall comply with the following requirements:

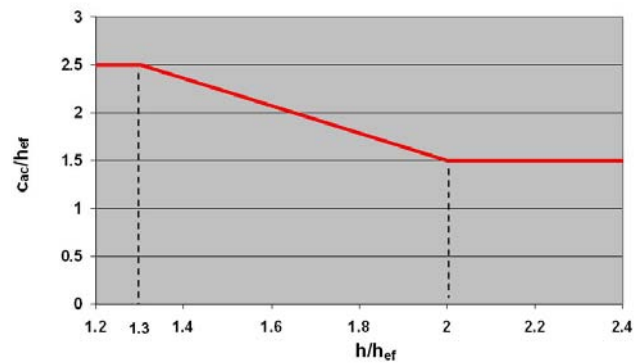
Reduced Installation Torque $T'_{max}$ for Edge Distances $c_{ai} < (5 \times d)$		
Edge Distance $c_{ai}$	Minimum Anchor Spacing, $s_{ai}$	=> Maximum Torque, $T'_{max}$
1.75 in. (45 mm) $\leq$ $c_{ai} < 5 \times d$	$5 \times d \leq s_{ai} < 16 \text{ in.}$	$0.3 \times T'_{max}$
	$s_{ai} \geq 16 \text{ in. (406 mm)}$	$0.5 \times T'_{max}$

**4.1.10 Critical Edge Distance,  $c_{ac}$ :** For the calculation of  $N_{cb}$ ,  $N_{cbg}$ ,  $N_a$  and  $N_{ag}$  in accordance with ACI 318 D.5.2.7 and Section 4.1.4 of this report, the critical edge distance,  $c_{ac}$ , must be taken as follows:

i.  $c_{ac} = 1.5 h_{ef}$  for  $h/h_{ef} \geq 2$

ii.  $c_{ac} = 2.5 h_{ef}$  for  $h/h_{ef} \leq 1.3$

For definition of  $h$  and  $h_{ef}$ , see Figure 1 of this report.



Linear interpolation is permitted to determine the ratio  $c_{ac}/h_{ef}$  for values of  $h/h_{ef}$  between 2 and 1.3 as illustrated in the preceding graph.

**4.1.11 Requirements for Seismic Design:** The anchors may be used to resist seismic loads for structures classified as Seismic Design Categories A and B under the IBC or IRC only.

**4.1.12 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 D.7.

## 4.2 Allowable Stress Design:

**4.2.1 General:** For anchors designed using load combinations in accordance with IBC Section 1605.3 (Allowable Stress Design) allowable loads must be established using Eq. (4-1) and Eq. (4-2):

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \quad \text{Eq. (4-1)}$$

and

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha} \quad \text{Eq. (4-2)}$$

where

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

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

$\phi N_n$  = Lowest design strength of an anchor or anchor group in tension as determined in

accordance with ACI 318 Appendix D with amendments in this report and either 2009 IBC Sections 1908.1.9 and 1908.1.10 or 2006 IBC Section 1908.1.16, as applicable.

- $\phi V_n$  = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 Appendix D with amendments in this report and either 2009 IBC Sections 1908.1.9 and 1908.1.10 or 2006 IBC Section 1908.1.16, as applicable.
- $\alpha$  = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition,  $\alpha$  must include all applicable factors to account for non-ductile failure modes and required over-strength.

Limits on edge distance, anchor spacing and member thickness described in this report must apply.

Example calculations for derivation of  $T_{allowable,ASD}$  are provided in Table 1b.

**4.2.2 Interaction of Tension and Shear Forces:** In lieu of ACI 318 D.7.1, D.7.2 and D.7.3, interaction must be calculated as follows:

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

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

For all other cases:

$$\frac{T}{T_{allowable,ASD}} + \frac{V}{V_{allowable,ASD}} \leq 1.2 \quad \text{Eq. (4-3)}$$

#### 4.3 Installation:

Installation parameters are illustrated in Figure 1 of this report. Anchor locations must comply with this report and the plans and specifications approved by the code official. Installation of the Hilti HIT-HY 150 MAX Adhesive Anchor System must conform to the manufacturer's published installation instructions (IFU) included in each unit package as provided in Figure 5 of this report.

#### 4.4 Special Inspection:

Periodic special inspection must be performed where required in accordance with Sections 1704.4 and 1704.15 of the 2009 IBC or Section 1704.13 of the 2006, 2003 and 2000 IBC, whereby periodic special inspection is defined in Section 1702.1 of the IBC and this report. The special inspector must be on the jobsite initially during anchor installation to verify anchor type, anchor dimensions, adhesive identification, and expiration date, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque and adherence to the manufacturer's printed installation instructions.

The special inspector must verify the initial installations of each type and size of adhesive anchor by construction personnel on the site. Subsequent installations of the same anchor type and size by the same construction personnel are permitted to be performed in the absence of the special inspector. Any change in the anchor product being installed or the personnel performing the installation requires an initial inspection. For ongoing installations over an extended period, the special inspector must make regular inspections to confirm correct handling and installation of the product.

Continuous special inspection is required for all cases where anchors installed overhead (vertical up) are designed to resist sustained tension loads.

Under the IBC, additional requirements as set forth in Sections 1705, 1706, or 1707 must be observed, where applicable.

### 5.0 CONDITIONS OF USE

The Hilti HIT-HY 150 MAX Adhesive Anchoring System described in this report is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1** The Hilti HIT-HY 150 MAX Adhesive Anchoring System must be installed in accordance with the manufacturer's published installation instructions as included in the adhesive packaging and illustrated in Figure 5 of this report.
- 5.2** Anchors are limited to installation in concrete that is uncracked and may be expected to remain uncracked for the service life of the anchor. The anchors must be installed in uncracked normal-weight concrete having a specified compressive strength  $f'_c = 2,500$  psi to 8,500 psi (17.2 MPa to 58.6 MPa).
- 5.3** The values of  $f'_c$  used for calculation purposes must not exceed 8,000 psi (55 MPa).
- 5.4** Anchors must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 5 of this report.
- 5.5** Loads applied to the anchors must be adjusted in accordance with Section 1605.2 of the IBC for strength design and in accordance with Section 1605.3 of the IBC for allowable stress design.
- 5.6** Hilti HIT-HY 150 MAX adhesive anchors are recognized for use to resist short- and long-term loads, including wind and earthquake (Seismic Design Categories A and B only), subject to the conditions of this report.
- 5.7** Strength design values must be established in accordance with Section 4.1 of this report.
- 5.8** Allowable stress design values must be established in accordance with Section 4.2.
- 5.9** Minimum anchor spacing and edge distance as well as minimum member thickness must comply with the values given in this report.
- 5.10** Prior to anchor installation, calculations and details demonstrating compliance with this report shall 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.
- 5.11** Where not otherwise prohibited by the code, the Hilti HIT-HY 150 MAX Adhesive Anchoring System is permitted for installation in fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:
  - Anchors are used to resist wind only, or,
  - Anchors that support fire-resistance-rated construction or 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, or,

- Anchors are used to support only nonstructural elements.

- 5.12** Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive 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.
- 5.13** Use of zinc-plated carbon steel threaded rods, zinc-plated HIS-N inserts, or steel reinforcing bars is limited to dry, interior locations.
- 5.14** Use of hot-dipped galvanized carbon steel rods, or hot-dipped galvanized carbon steel or stainless steel HIS-RN inserts, is permitted for exterior exposure or damp environments.
- 5.15** Steel anchoring materials in contact with preservative-treated and fire-retardant treated wood must be of zinc-coated carbon steel or stainless steel. The minimum coating weights for zinc-coated steel must comply with ASTM A 153.
- 5.16** Periodic special inspection must be provided in accordance with Section 4.4 of this report. Continuous special inspection for overhead installations (vertical up) that are designed to resist sustained tension loads must be provided in accordance with Section 4.4 of this report.
- 5.17** Hilti HIT-HY 150 MAX adhesive is manufactured by Hilti GmbH, Kaufering, Germany, with quality control

inspections by Underwriters Laboratories Inc. (AA-668).

- 5.18** Hilti HIS-N and HIS-RN inserts are manufactured by Hilti (China) Ltd., Guangdong, China, with quality control inspections by Underwriters Laboratories Inc. (AA-668).

## 6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Post-installed Adhesive Anchors in Concrete Elements (AC308), dated November 2009.

## 7.0 IDENTIFICATION

- 7.1** The adhesives are identified by packaging labeled with the manufacturer's name (Hilti, Inc.) and address, anchor name, anchor size, evaluation report number (ICC-ES ESR-2262), and the name of the inspection agency (Underwriters Laboratories Inc.).
- 7.2** HIS-N and HIS-RN inserts are identified by packaging labeled with the manufacturer's name (Hilti, Inc.) and address, anchor name, evaluation report number (ICC-ES ESR-2262), and the name of the inspection agency (Underwriters Laboratories Inc.).
- 7.3** Threaded rods, nuts, washers, bolts, cap screws, and deformed reinforcing bars are standard elements and must conform to applicable national or international specifications as set forth in Tables 2 through 6.

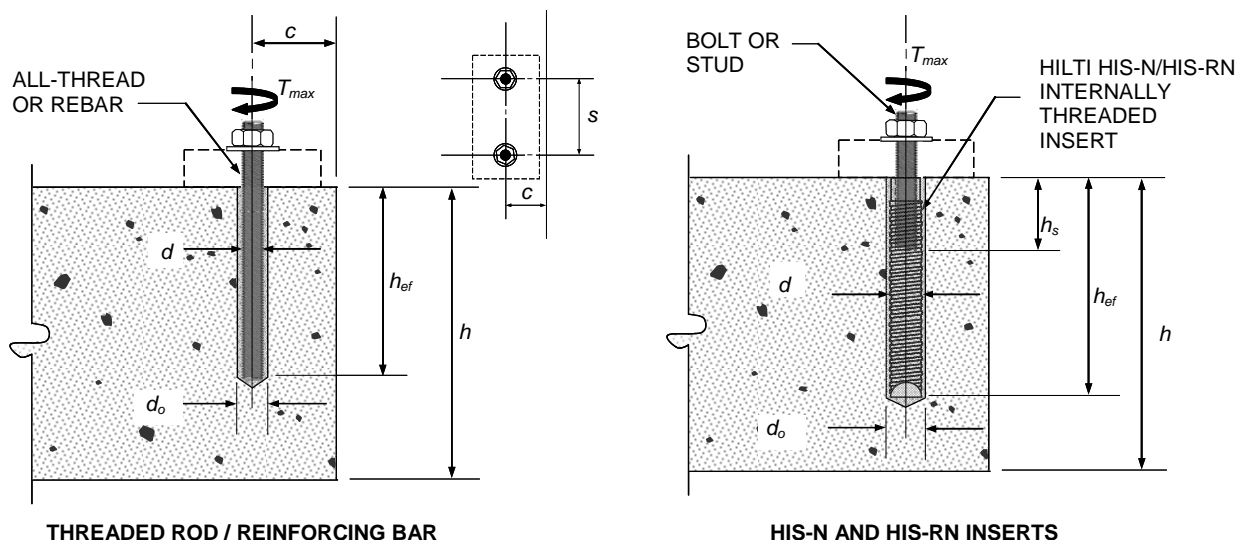


FIGURE 1—INSTALLATION PARAMETERS

TABLE 1a—DESIGN TABLE INDEX

DESIGN STRENGTH <sup>1</sup>		THREADED ROD		HILTI HIS INTERNALLY THREADED INSERT		DEFORMED REINFORCEMENT		
		Fractional	Metric	Fractional	Metric	USA	EU	Canadian
Steel	$N_{sa}, V_{sa}$	Table 7	Table 10	Table 13	Table 16	Table 19	Table 22	Table 25
Concrete	$N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}$	Table 8	Table 11	Table 14	Table 17	Table 20	Table 23	Table 26
Bond <sup>2</sup>	$N_b, N_{ag}$	Table 9	Table 12	Table 15	Table 18	Table 20	Table 24	Table 27

<sup>1</sup>Design strengths are as set forth in ACI 318 D.4.1.2.

<sup>2</sup>See Section 4.1 of this report for bond strength information.

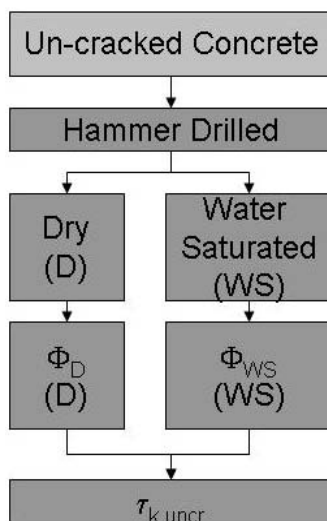


FIGURE 2—FLOWCHART FOR ESTABLISHMENT OF DESIGN BOND STRENGTH

TABLE 1b—EXAMPLE ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES

NOMINAL ANCHOR DIAMETER	EFFECTIVE EMBEDMENT DEPTH	$f'_c$	$k_{c,uncr}$	$\alpha$	$\phi$	$N_n$	ALLOWABLE TENSION LOAD $\phi N_n / \alpha$
$d_o$	$h_{ef}$	(psi)	(-)	(-)	(-)	(lb)	(lb)
$\frac{3}{8}$	$1\frac{1}{2}$	2,500	24	1.48	0.65	2,205	968
$\frac{1}{2}$	2	2,500	24	1.48	0.65	3,394	1,491
$\frac{5}{8}$	$2\frac{1}{2}$	2,500	24	1.48	0.65	4,750	2,086
$\frac{3}{4}$	3	2,500	24	1.48	0.65	6,235	2,739*
$\frac{7}{8}$	$3\frac{1}{2}$	2,500	27	1.48	0.65	8,840	3,882
1	4	2,500	27	1.48	0.65	10,800	4,743
$1\frac{1}{4}$	5	2,500	30	1.48	0.65	16,771	7,365

For SI: 1 lb = 4.45 kN, 1 psi = 0.00689 MPa, 1 in. = 25.4 mm, °C = [(°F) – 32]/1.8.

## Design Assumptions:

- Single anchor with static tension load only; ASTM A 193 Grade B7 threaded rod.
- Vertical downward installation direction.
- Inspection Regimen = Periodic.
- Installation temperature = 14 – 104 °F.
- Long term temperature = 80 °F.
- Short term temperature = 110 °F.
- Dry hole condition – carbide drilled hole.
- Embedment depth =  $h_{ef, min}$ .
- Concrete determined to remain uncracked for the life of the anchorage.
- Load combination from ACI 318 Section 9.2 (no seismic loading).
- 30 percent Dead Load (D) and 70 percent Live Load (L); Controlling load combination 1.2 D + 1.6 L.
- Calculation of  $\alpha$  based on weighted average:  $\alpha = 1.2 D + 1.6 L = 1.2 (0.30) + 1.6 (0.70) = 1.48$ .
- Normal weight concrete:  $f'_c = 2,500$  psi
- Edge distance:  $c_{a1} = c_{a2} > c_{ac}$
- Member thickness:  $h \geq h_{min}$ .

* Verify capacity					
Capacity	ACI 318 reference	Formula	Calculation	$\phi$	$\phi N_n$
Steel	D.5.1	$N_{sa} = n A_{se} f_{uta}$	$N_{sa} = 0.3345 \cdot 125,000$	0.75	31,360 lb
Concrete	D.5.2	$N_{cb} = k_{c,uncr} (f'_c)^{0.5} h_{ef}^{1.5}$	$N_{cb} = 24 \cdot (2,500)^{0.5} \cdot 3^{1.5}$	0.65	4,053 lb
Bond	D.5.3**	$N_b = \pi d h_{ef} \tau_{k,uncr}$	$N_b = \pi \cdot 3/4 \cdot 3 \cdot 1,710$	0.65	7,857 lb
→ concrete breakout is decisive; hence the ASD value will be calculated as $\frac{4,053 \text{ lb}}{1.48} = 2,739 \text{ lb}$					
** Design equation provided in Section 4.1.4 as new section ACI 318 D.5.3.9, Eq. (D-16f).					

TABLE 2—TENSILE PROPERTIES OF COMMON CARBON STEEL THREADED ROD MATERIALS<sup>1</sup>

THREADED ROD SPECIFICATION		MINIMUM SPECIFIED ULTIMATE STRENGTH $f_{UTA}$	MINIMUM SPECIFIED YIELD STRENGTH 0.2% OFFSET, $f_{YA}$	$f_{UTA}/f_{YA}$	MINIMUM ELONGATION, PERCENT <sup>5</sup>	MINIMUM REDUCTION OF AREA, PERCENT	SPECIFICATION FOR NUTS <sup>6</sup>
ASTM A 193 <sup>2</sup> Grade B7 ≤ 2-1/2 in. (≤ 64 mm)	psi (MPa)	125,000 (860)	105,000 (725)	1.19	16	50	ASTM A 563 Grade DH
ASTM F 568M <sup>3</sup> Class 5.8 M5 (1/4 in.) to M24 (1 in.) (equivalent to ISO 898-1)	MPa (psi)	500 (72,500)	400 (58,000)	1.25	10	35	DIN 934 (8-A2K) ASTM A 563 Grade DH <sup>7</sup>
ISO 898-1 <sup>4</sup> Class 5.8	MPa (psi)	500 (72,500)	400 (58,000)	1.25	22	-	DIN 934 (8-A2K)
ISO 898-1 <sup>4</sup> Class 8.8	MPa (psi)	800 (116,000)	640 (92,800)	1.25	12	52	DIN 934 (8-A2K)

<sup>1</sup>Hilti HIT-HY 150 MAX adhesive may be used in conjunction with all grades of continuously threaded carbon steel rod (all-thread) that comply with the code reference standards and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series or ANSI B1.13M M Profile Metric Thread Series. Values for threaded rod types and associated nuts supplied by Hilti are provided here.

<sup>2</sup>Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

<sup>3</sup>Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

<sup>4</sup>Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs

<sup>5</sup>Based on 2-in. (50 mm) gauge length except ASTM A 193, which are based on a gauge length of 4d and ISO 898 which is based on 5d.

<sup>6</sup>Nuts of other grades and styles having specified proof load stresses greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.

<sup>7</sup>Nuts for fractional rods.

TABLE 3—TENSILE PROPERTIES OF COMMON STAINLESS STEEL THREADED ROD MATERIALS<sup>1</sup>

THREADED ROD SPECIFICATION		MINIMUM SPECIFIED ULTIMATE STRENGTH $f_{UTA}$	MINIMUM SPECIFIED YIELD STRENGTH 0.2% OFFSET, $f_{YA}$	$f_{UTA}/f_{YA}$	MINIMUM ELONGATION, PERCENT	MINIMUM REDUCTION OF AREA, PERCENT	SPECIFICATION FOR NUTS <sup>4</sup>
ASTM F 593 <sup>2</sup> CW1 (316) 1/4 to 5/8 in.	psi (MPa)	100,000 (690)	65,000 (450)	1.54	20	—	F 594
ASTM F 593 <sup>2</sup> CW2 (316) 3/4 to 1-1/2 in.	psi (MPa)	85,000 (585)	45,000 (310)	1.89	25	—	F 594
ISO 3506-1 <sup>3</sup> A4-70 M8 – M24	MPa (psi)	700 (101,500)	450 (65,250)	1.56	40	—	ISO 4032
ISO 3506-1 <sup>3</sup> A4-50 M27 – M30	MPa (psi)	500 (72,500)	210 (30,450)	2.38	40	—	ISO 4032

<sup>1</sup>Hilti HIT-HY 150 MAX may be used in conjunction with all grades of continuously threaded stainless steel rod (all-thread) that comply with the code reference standards and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series or ANSI B1.13M M Profile Metric Thread Series. Values for threaded rod types and associated nuts supplied by Hilti are provided here.

<sup>2</sup>Standard Steel Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

<sup>3</sup>Mechanical properties of corrosion-resistant stainless steel fasteners – Part 1: Bolts, screws and studs

<sup>4</sup>Nuts of other grades and styles having specified proof load stresses greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.

TABLE 4—TENSILE PROPERTIES OF FRACTIONAL AND METRIC HIS-N AND HIS-RN INSERTS

HILTI HIS-N AND HIS-RN INSERTS		MINIMUM SPECIFIED ULTIMATE STRENGTH, $f_{Uta}$	MINIMUM SPECIFIED YIELD STRENGTH, $f_{ya}$
Carbon Steel DIN EN 10277-3 11SMnPb30+c or DIN 1561 9SMnPb28K 3/8 and M8 to M10	MPa	490	410
	(psi)	(71,050)	(59,450)
Carbon Steel DIN EN 10277-3 11SMnPb30+c or DIN 1561 9SMnPb28K 1/2 to 3/4 and M12 to M20	MPa	460	375
	(psi)	(66,700)	(54,375)
Stainless Steel DIN 17440 (EN 10088-3) X5CrNiMo 17-12-2	MPa	700	350
	(psi)	(101,500)	(50,750)



**TABLE 5—TENSILE PROPERTIES OF COMMON BOLTS, CAP SCREWS AND STUDS  
FOR USE WITH HIS-N AND HIS-RN INSERTS<sup>1,2</sup>**

BOLT, CAP SCREW OR STUD SPECIFICATION		MINIMUM SPECIFIED ULTIMATE STRENGTH, $f_{uta}$	MINIMUM SPECIFIED YIELD STRENGTH 0.2% OFFSET, $f_{ya}$	$f_{uta}/f_{ya}$	MINIMUM ELONGATION, PERCENT	MINIMUM REDUCTION OF AREA, PERCENT	SPECIFICATION FOR NUTS <sup>6</sup>
SAE J429 <sup>3</sup> Grade 5	psi (MPa)	120,000 (830)	92,000 (635)	1.30	14	35	SAE J995
ASTM A 325 <sup>4</sup> 1/2 to 1-in.	psi (MPa)	120,000 (830)	92,000 (635)	1.30	14	35	A 563 C, C3, D, DH, DH3 Heavy Hex
ASTM A193 <sup>5</sup> Grade B8M (AISI 316) for use with HIS-RN	psi (MPa)	110,000 (760)	95,000 (655)	1.16	15	45	F 594 <sup>7</sup>
ASTM A193 <sup>5</sup> Grade B8T (AISI 321) for use with HIS-RN	psi (MPa)	125,000 (860)	100,000 (690)	1.25	12	35	F 594 <sup>7</sup>

<sup>1</sup>Minimum Grade 5 bolts, cap screws or studs must be used with carbon steel HIS inserts.

<sup>2</sup>Only stainless steel bolts, cap screws or studs are permitted with HIS-RN inserts.

<sup>3</sup>*Mechanical and Material Requirements for Externally Threaded Fasteners*

<sup>4</sup>*Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength*

<sup>5</sup>*Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service*

<sup>6</sup>Nuts must have specified minimum proof load stresses equal to or greater than the specified minimum full-size tensile strength of the specified stud.

<sup>7</sup>Nuts for stainless steel studs must be of the same alloy group as the specified stud.

**TABLE 6—TENSILE PROPERTIES OF COMMON REINFORCING BARS**

REINFORCING BAR SPECIFICATION		MINIMUM SPECIFIED ULTIMATE STRENGTH, $f_{uta}$	MINIMUM SPECIFIED YIELD STRENGTH, $f_{ya}$
ASTM A 615 <sup>1</sup> Gr. 60	psi (MPa)	90,000 (620)	60,000 (415)
ASTM A 615 <sup>1</sup> Gr. 40	psi (MPa)	60,000 (415)	40,000 (275)
DIN 488 <sup>2</sup> BSt 500	MPa (psi)	550 (79,750)	500 (72,500)
CAN/CSA-G30.18 <sup>3</sup> Gr. 400	MPa (psi)	540 (78,300)	400 (58,000)

<sup>1</sup> *Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement*

<sup>2</sup> *Reinforcing steel; reinforcing steel bars; dimensions and masses*

<sup>3</sup> *Billet-Steel Bars for Concrete Reinforcement*

TABLE 7—STEEL DESIGN INFORMATION FOR FRACTIONAL THREADED ROD<sup>1</sup>

DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inches)					
				<sup>3</sup> / <sub>8</sub>	<sup>1</sup> / <sub>2</sub>	<sup>5</sup> / <sub>8</sub>	<sup>3</sup> / <sub>4</sub>	<sup>7</sup> / <sub>8</sub>	1
Rod O.D.		$d$	in. (mm)	0.375 (9.5)	0.5 (12.7)	0.625 (15.9)	0.75 (19.1)	0.875 (22.2)	1 (25.4)
Rod effective cross-sectional area		$A_{se}$	in. <sup>2</sup> (mm <sup>2</sup> )	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength	$N_{sa}$	lbf (kN)	5,620 (25.0)	10,290 (45.8)	16,385 (72.9)	24,250 (107.9)	33,470 (148.9)	43,910 (195.3)
		$V_{sa}$	lbf (kN)	2,810 (12.5)	6,175 (27.5)	9,830 (43.7)	14,550 (64.7)	20,085 (89.3)	26,345 (117.2)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65					
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60					
ASTM A 193 B7	Nominal strength as governed by steel strength	$N_{sa}$	lbf (kN)	9,690 (43.1)	17,740 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)
		$V_{sa}$	lbf (kN)	4,845 (21.5)	10,640 (47.3)	16,950 (75.4)	25,090 (111.6)	34,630 (154.0)	45,425 (202.1)
	Strength reduction factor $\phi$ for tension <sup>3</sup>	$\phi$	-	0.75					
	Strength reduction factor $\phi$ for shear <sup>3</sup>	$\phi$	-	0.65					
ASTM F 593, CW Stainless	Nominal strength as governed by steel strength	$N_{sa}$	lbf (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)
		$V_{sa}$	lb (kN)	3,875 (17.2)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65					
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60					

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup> Values provided for common rod material types based on published strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Other material specifications are admissible, subject to the approval of the code official. Nuts and washers must be appropriate for the rod strength.

<sup>2</sup> For use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5. Values correspond to a brittle steel element.

<sup>3</sup> For use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5. Values correspond to a ductile steel element.

**TABLE 8—CONCRETE BREAKOUT DESIGN INFORMATION FOR FRACTIONAL THREADED ROD  
IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>**

DESIGN INFORMATION	SYMBOL	UNITS	NOMINAL ROD DIAMETER (inches)						
			$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{4}$
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)	24 (10)	24 (10)	24 (10)	27 (11.3)	27 (12.6)	30 (12.6)
Min. anchor spacing	$s_{min}$	in. (mm)	$1\frac{7}{8}$ (48)	$2\frac{1}{2}$ (64)	$3\frac{3}{8}$ (79)	$3\frac{3}{4}$ (95)	$4\frac{3}{8}$ (111)	5 (127)	$6\frac{1}{4}$ (159)
Min. edge distance	$c_{min}$	in. (mm)	$1\frac{7}{8}$ (48)	$2\frac{1}{2}$ (64)	$3\frac{1}{8}$ (79)	$3\frac{3}{4}$ (95)	$4\frac{3}{8}$ (111)	5 (127)	$6\frac{1}{4}$ (159)
Minimum member thickness	$h_{min}$	in. (mm)	$h_{ef} + 1\frac{1}{4}$ ( $h_{ef} + 30$ )		$h_{ef} + 2d_o^{(3)}$				
Critical edge distance – splitting (for uncracked concrete)	$c_{ac}$	-	See Section 4.1.10 of this report.						
Strength reduction factor for tension, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.65						
Strength reduction factor for shear, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.70						

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>For additional setting information, see installation instructions in Figure 5.

<sup>2</sup>Values provided for post-installed anchors with category as determined from ACI 355.2 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318 D.4.4, while condition A requires supplemental reinforcement. Values are for use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5.

<sup>3</sup> $d_o$  = hole diameter.

**TABLE 9—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL THREADED ROD  
IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>**

DESIGN INFORMATION			SYMBOL	UNITS	NOMINAL ROD DIAMETER (IN.)					
					$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	$1\frac{1}{4}$
Temperature Range <sup>2</sup>	A	Characteristic bond strength	$\tau_{k,uncr}$	psi (MPa)	1,985 (13.7)	1,985 (13.7)	1,850 (12.7)	1,710 (11.8)	1,575 (10.9)	1,440 (9.9)
	B	Characteristic bond strength	$\tau_{k,uncr}$	psi (MPa)	1,610 (11.1)	1,610 (11.1)	1,495 (10.3)	1,385 (9.6)	1,275 (8.8)	1,170 (8.1)
	C	Characteristic bond strength	$\tau_{k,uncr}$	psi (MPa)	930 (6.4)	930 (6.4)	865 (6.0)	805 (5.5)	740 (5.1)	675 (4.7)
Minimum anchor embedment depth			$h_{ef,min}$	in.	$1\frac{1}{2}$	2	$2\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	4
				(mm)	(40)	(51)	(64)	(89)	(89)	(102)
Maximum anchor embedment depth			$h_{ef,max}$	in.	$7\frac{1}{2}$	10	$12\frac{1}{2}$	15	$17\frac{1}{2}$	20
				(mm)	(191)	(254)	(318)	(381)	(445)	(508)
Permissible Installation Conditions	Dry concrete & Water-saturated concrete		Anchor Category	-	1					2
			$\phi_t$ & $\phi_{ws}$		0.65					0.55

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>Bond strength values correspond to concrete compressive strength range  $2,500 \text{ psi} \leq f'_c \leq 4,500 \text{ psi}$ . For  $4,500 \text{ psi} < f'_c \leq 6,500 \text{ psi}$ , tabulated characteristic bond strengths may be increased by 6 percent. For  $6,500 \text{ psi} < f'_c \leq 8,000 \text{ psi}$ , tabulated characteristic bond strengths may be increased by 10 percent.

<sup>2</sup>Temperature range A: Maximum short term temperature = 104°F (40°C), maximum long term temperature = 75°F (24°C).

Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

Temperature range C: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 162°F (72°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

TABLE 10—STEEL DESIGN INFORMATION FOR METRIC THREADED ROD<sup>1</sup>

DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL ROD DIAMETER (mm)							
				8	10	12	16	20	24	27	30
Rod O.D.		$d$	mm (in.)	8 (0.31)	10 (0.39)	12 (0.47)	16 (0.63)	20 (0.79)	24 (0.94)	27 (1.06)	30 (1.18)
Rod effective cross-sectional area		$A_{se}$	mm <sup>2</sup> (in. <sup>2</sup> )	36.6 (0.057)	58 (0.090)	84.3 (0.131)	157 (0.243)	245 (0.380)	353 (0.547)	459 (0.711)	561 (0.870)
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength	$N_{sa}$	kN (lb)	18.3 (4,115)	29.0 (6,520)	42.2 (9,475)	78.5 (17,650)	122.5 (27,540)	176.5 (39,680)	229.5 (51,595)	280.5 (63,060)
		$V_{sa}$	kN (lb)	9.2 (2,060)	14.5 (3,260)	25.3 (5,685)	47.1 (10,590)	73.5 (16,525)	105.9 (23,810)	137.7 (30,955)	168.3 (37,835)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65							
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60							
ISO 898-1 Class. 8.8	Nominal strength as governed by steel strength	$N_{sa}$	kN (lb)	29.3 (6,580)	46.4 (10,430)	67.4 (15,160)	125.6 (28,235)	196.0 (44,065)	282.4 (63,485)	367.2 (82,550)	448.8 (100,895)
		$V_{sa}$	kN (lb)	14.6 (3,290)	23.2 (5,215)	40.5 (9,100)	75.4 (16,940)	117.6 (26,440)	169.4 (38,090)	220.3 (49,530)	269.3 (60,540)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65							
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60							
ISO 3506-1 Class A4 SS <sup>3</sup>	Nominal strength as governed by steel strength	$N_{sa}$	kN (lb)	25.6 (5,760)	40.6 (9,130)	59.0 (13,263)	109.9 (24,703)	171.5 (38,555)	247.1 (55,550)	183.1 (41,135)	223.8 (50,335)
		$V_{sa}$	kN (lb)	12.8 (2,880)	20.3 (4,565)	35.4 (7,960)	65.9 (14,825)	102.9 (23,135)	148.3 (33,330)	109.9 (24,680)	134.3 (30,200)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65							
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60							

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>Values provided for common rod material types based on published strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Other material specifications are admissible, subject to the approval of the code official. Nuts and washers must be appropriate for the rod strength.

<sup>2</sup>For use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5. Values correspond to a brittle steel element.

<sup>3</sup>A4-70 Stainless (M8 - M24 diameters); A4-502 Stainless (M27 - M30 diameters)



**TABLE 11—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC THREADED ROD  
IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>**

DESIGN INFORMATION	SYMBOL	UNITS	NOMINAL ROD DIAMETER (mm)							
			8	10	12	16	20	24	27	30
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)	10 (24)	10 (24)	10 (24)	10 (24)	11.3 (27)	11.3 (27)	12.6 (30)
Min. anchor spacing	$s_{min}$	mm (in.)	40 (1.6)	50 (2.0)	60 (2.4)	80 (3.2)	100 (3.9)	120 (4.7)	135 (5.3)	150 (5.9)
Min. edge distance	$c_{min}$	mm (in.)	40 (1.6)	50 (2.0)	60 (2.4)	80 (3.2)	100 (3.9)	120 (4.7)	135 (5.3)	150 (5.9)
Minimum member thickness	$h_{min}$	mm (in.)	$h_{ef} + 30$ ( $h_{ef} + 1\frac{1}{4}$ )		$h_{ef} + 2d_o^{(3)}$					
Critical edge distance – splitting (for uncracked concrete)	$c_{ac}$	-	See Section 4.1.10 of this report.							
Strength reduction factor for tension, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.70							

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>For additional setting information, see installation instructions in Figure 5.

<sup>2</sup>Values provided for post-installed anchors with category as determined from ACI 355.2 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318 D.4.4, while condition A requires supplemental reinforcement. Values are for use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5.

<sup>3</sup> $d_0$  = drill bit diameter.

**TABLE 12—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED ROD  
IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>**

DESIGN INFORMATION			SYMBOL	UNITS	NOMINAL ROD DIAMETER (mm)							
					8	10	12	16	20	24	27	30
Temperature Range <sup>2</sup>	A	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	13.7 (1,985)	13.7 (1,985)	13.7 (1,985)	12.7 (1,850)	11.8 (1,710)	10.9 (1,575)	9.9 (1,440)	8.1 (1,175)
	B	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	11.1 (1,610)	11.1 (1,610)	11.1 (1,610)	10.3 (1,500)	9.6 (1,390)	8.8 (1,275)	8.1 (1,170)	6.6 (950)
	C	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	6.4 (930)	6.4 (930)	6.4 (930)	6.0 (865)	5.5 (805)	5.1 (740)	4.7 (675)	3.8 (550)
Minimum anchor embedment depth			$h_{ef,min}$	mm (in.)	40 (1.6)	40 (1.6)	48 (1.9)	64 (2.5)	80 (3.1)	96 (3.8)	108 (4.3)	120 (4.7)
Maximum anchor embedment depth			$h_{ef,max}$	mm	160	200	240	320	400	480	540	600
				(in.)	(6.3)	(7.9)	(9.4)	(12.6)	(15.7)	(18.9)	(21.3)	(23.6)
Permissible Installation Conditions	Dry concrete & Water-saturated concrete		Anchor Category	-	1							2
			$\phi_d$ & $\phi_{ws}$	-	0.65							0.55

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup> Bond strength values correspond to concrete compressive strength range  $2,500 \text{ psi} \leq f'_c \leq 4,500 \text{ psi}$ . For  $4,500 \text{ psi} < f'_c \leq 6,500 \text{ psi}$ , tabulated characteristic bond strengths may be increased by 6 percent. For  $6,500 \text{ psi} < f'_c \leq 8,000 \text{ psi}$ , tabulated characteristic bond strengths may be increased by 10 percent.

<sup>2</sup> Temperature range A: Maximum short term temperature = 104°F (40°C), maximum long term temperature = 75°F (24°C).

Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

Temperature range C: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 162°F (72°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

TABLE 13—STEEL DESIGN INFORMATION FOR FRACTIONAL HILTI HIS-N AND HIS-RN INSERTS<sup>1</sup>

DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL BOLT/CAP SCREW DIAMETER (inch)			
				<sup>3</sup> / <sub>8</sub>	<sup>1</sup> / <sub>2</sub>	<sup>5</sup> / <sub>8</sub>	<sup>3</sup> / <sub>4</sub>
HIS insert O.D.		$d$	in. (mm)	0.65 (16.5)	0.81 (20.5)	1 (25.4)	1.09 (27.6)
Bolt effective cross-sectional area		$A_{se}$	in. <sup>2</sup> (mm <sup>2</sup> )	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)
HIS insert effective cross-sectional area		$A_{insert}$	in. <sup>2</sup> (mm <sup>2</sup> )	0.178 (115)	0.243 (157)	0.404 (260)	0.410 (265)
ASTM A 193 B7	Nominal strength as governed by steel strength – ASTM A193 B7 bolt/cap screw	$N_{sa}$	lb (kN)	9,295 (41.3)	17,020 (75.7)	27,110 (120.6)	40,120 (178.5)
		$V_{sa}$	lb (kN)	5,580 (24.8)	10,210 (45.4)	16,265 (72.3)	24,075 (107.1)
	Nominal strength as governed by steel strength – HIS-N insert	$N_{sa}$	lb (kN)	12,650 (56.3)	16,195 (72.0)	26,925 (119.8)	27,360 (121.7)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65			
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60			
ASTM A 193 Gr. B8M SS	Nominal strength as governed by steel strength – ASTM A193 Grade B8M SS bolt/cap screw	$N_{sa}$	lb (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)
		$V_{sa}$	lb (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)
	Nominal strength as governed by steel strength – HIS-RN insert	$N_{sa}$	lb (kN)	18,070 (80.4)	24,645 (109.6)	40,975 (182.3)	41,640 (185.2)
	Strength reduction factor $\phi$ for tension <sup>3</sup>	$\phi$	-	0.65			
	Strength reduction factor $\phi$ for shear <sup>3</sup>	$\phi$	-	0.60			

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup> Values provided for common rod material types based on published strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Other material specifications are admissible, subject to the approval of the code official. Nuts and washers must be appropriate for the rod strength.

<sup>2</sup> For use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5. Values correspond to a brittle steel element.

<sup>3</sup> For use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5. Values correspond to a brittle steel element.

TABLE 14—CONCRETE BREAKOUT DESIGN INFORMATION FOR FRACTIONAL HILTI HIS-N AND HIS-RN INSERTS<sup>1</sup>

DESIGN INFORMATION	SYMBOL	UNITS	NOMINAL BOLT/CAP SCREW DIAMETER (inch)			
			$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$
Effective embedment depth	$h_{ef}$	in. (mm)	$4\frac{3}{8}$ (110)	5 (125)	$6\frac{3}{4}$ (170)	$8\frac{1}{8}$ (205)
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)			
Min. anchor spacing	$s_{min}$	in. (mm)	$3\frac{1}{4}$ (83)	4 (102)	5 (127)	$5\frac{1}{2}$ (140)
Min. edge distance	$c_{min}$	in. (mm)	$3\frac{1}{4}$ (83)	4 (102)	5 (127)	$5\frac{1}{2}$ (140)
Minimum member thickness	$h_{min}$	in. (mm)	5.9 (150)	6.7 (170)	9.1 (230)	10.6 (270)
Critical edge distance – splitting (for uncracked concrete)	$c_{ac}$	-	See Section 4.1.10 of this report.			
Strength reduction factor for tension, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.65			
Strength reduction factor for shear, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.70			

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>For additional setting information, see installation instructions in Figure 5.

<sup>2</sup>Values provided for post-installed anchors with category as determined from ACI 355.2 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318 D.4.4, while condition A requires supplemental reinforcement. Values are for use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5.

TABLE 15—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL HILTI HIS-N AND HIS-RN INSERTS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>

DESIGN INFORMATION			SYMBOL	UNITS	NOMINAL BOLT/CAP SCREW DIAMETER (inch)			
					$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$
Effective embedment depth			$h_{ef}$	in. (mm)	$4\frac{3}{8}$ (110)	5 (125)	$6\frac{3}{4}$ (170)	$8\frac{1}{8}$ (205)
HIS insert O.D.			$d$	in. (mm)	0.65 (16.5)	0.81 (20.5)	1 (25.4)	1.09 (27.6)
Temperature range <sup>2</sup>	A	Characteristic bond strength	$\tau_{k,uncr}$	psi (MPa)	1,565 (10.8)	1,440 (9.9)	1,255 (8.7)	1,170 (8.1)
	B	Characteristic bond strength	$\tau_{k,uncr}$	psi (MPa)	1,270 (8.7)	1,170 (8.1)	1,020 (7.0)	950 (6.5)
	C	Characteristic bond strength	$\tau_{k,uncr}$	psi (MPa)	735 (5.1)	675 (4.7)	590 (4.1)	550 (3.8)
Permissible Installation Conditions	Dry concrete & Water-saturated concrete		Anchor Category	-	1			2
			$\phi_d$ & $\phi_{ws}$	-	0.65			0.55

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>Bond strength values correspond to concrete compressive strength range  $2,500 \text{ psi} \leq f'_c \leq 4,500 \text{ psi}$ . For  $4,500 \text{ psi} < f'_c \leq 6,500 \text{ psi}$ , tabulated characteristic bond strengths may be increased by 6 percent. For  $6,500 \text{ psi} < f'_c \leq 8,000 \text{ psi}$ , tabulated characteristic bond strengths may be increased by 10 percent.

<sup>2</sup>Temperature range A: Maximum short term temperature = 104°F (40°C), maximum long term temperature = 75°F (24°C).

Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

Temperature range C: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 162°F (72°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

TABLE 16—STEEL DESIGN INFORMATION FOR METRIC HILTI HIS-N AND HIS-RN INSERTS<sup>1</sup>

DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL BOLT/CAP SCREW DIAMETER (mm)				
				8	10	12	16	20
HIS insert O.D.		$d$	mm (in.)	12.5 (0.49)	16.5 (0.65)	20.5 (0.81)	25.4 (1.00)	27.6 (1.09)
Bolt effective cross-sectional area		$A_{se}$	mm <sup>2</sup> (in. <sup>2</sup> )	36.6 (0.057)	58 (0.090)	84.3 (0.131)	157 (0.243)	245 (0.380)
HIS insert effective cross-sectional area		$A_{insert}$	mm <sup>2</sup> (in. <sup>2</sup> )	51.5 (0.080)	108 (0.167)	169.1 (0.262)	256.1 (0.397)	237.6 (0.368)
ISO 898-1 Class 8.8	Nominal strength as governed by steel strength – ISO 898-1 Class 8.8 bolt/cap screw	$N_{sa}$	kN (lb)	29.3 (6,580)	46.4 (10,430)	67.4 (15,160)	125.6 (28,235)	196.0 (44,065)
		$V_{sa}$	kN (lb)	17.6 (3,950)	27.8 (6,260)	40.5 (9,100)	75.4 (16,940)	117.6 (26,440)
	Nominal strength as governed by steel strength – HIS-N insert	$N_{sa}$	kN (lb)	25.2 (5,670)	52.9 (11,895)	77.8 (17,490)	117.8 (26,485)	109.3 (24,575)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65				
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60				
ISO 3506-1 Class A4-70 Stainless	Nominal strength as governed by steel strength – ISO 3506-1 Class A4-70 Stainless bolt/cap screw	$N_{sa}$	kN (lb)	25.6 (5,760)	40.6 (9,130)	59.0 (13,265)	109.9 (24,705)	171.5 (38,555)
		$V_{sa}$	kN (lb)	15.4 (3,455)	24.4 (5,475)	35.4 (7,960)	65.9 (14,825)	102.9 (23,135)
	Nominal strength as governed by steel strength – HIS-RN insert	$N_{sa}$	kN (lb)	36.0 (8,100)	75.6 (16,990)	118.4 (26,610)	179.3 (40,300)	166.3 (37,395)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65				
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60				

For **SI**: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup> Values provided for common rod material types based on published strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Other material specifications are admissible, subject to the approval of the code official. Nuts and washers must be appropriate for the rod strength.

<sup>2</sup> For use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5. Values correspond to a brittle steel element.



TABLE 17—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC HILTI HIS-N AND HIS-RN INSERTS<sup>1</sup>

DESIGN INFORMATION	SYMBOL	UNITS	NOMINAL BOLT/CAP SCREW DIAMETER (inches)				
			8	10	12	16	20
Effective embedment depth	$h_{ef}$	mm (in.)	90 (3.5)	110 (4.3)	125 (4.9)	170 (6.7)	205 (8.1)
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)				
Min. anchor spacing	$s_{min}$	mm (in.)	63 (2.5)	83 (3.25)	102 (4.0)	127 (5.0)	140 (5.5)
Min. edge distance	$c_{min}$	mm (in.)	63 (2.5)	83 (3.25)	102 (4.0)	127 (5.0)	140 (5.5)
Minimum member thickness	$h_{min}$	mm (in.)	120 (4.7)	150 (5.9)	170 (6.7)	230 (9.1)	270 (10.6)
Critical edge distance – splitting (for uncracked concrete)	$c_{ac}$	-	See Section 4.1.10 of this report.				
Strength reduction factor for tension, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.65				
Strength reduction factor for shear, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.70				

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>For additional setting information, see installation instructions in Figure 5.

Values provided for post-installed anchors with category as determined from ACI 355.2 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318 D.4.4, while condition A requires supplemental reinforcement. Values are for use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5.

TABLE 18—BOND STRENGTH DESIGN INFORMATION FOR METRIC HILTI HIS-N AND HIS-RN INSERTS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>

DESIGN INFORMATION			SYMBOL	UNITS	NOMINAL BOLT/CAP SCREW DIAMETER (inches)				
					8	10	12	16	20
Effective embedment depth			$h_{ef}$	mm (in.)	90 (3.5)	110 (4.3)	125 (4.9)	170 (6.7)	205 (8.1)
HIS insert O.D.			$d$	mm (in.)	12.5 (0.49)	16.5 (0.65)	20.5 (0.81)	25.4 (1.00)	27.6 (1.09)
Temperature Range <sup>2</sup>	A	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	10.8 (1,565)	10.8 (1,565)	9.9 (1,440)	8.7 (1,255)	8.1 (1,170)
	B	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	8.7 (1,270)	8.7 (1,270)	8.1 (1,170)	7.0 (1,020)	6.5 (950)
	C	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	5.1 (735)	5.1 (735)	4.7 (675)	4.1 (590)	3.8 (550)
Permissible Installation Conditions	Dry concrete & Water-saturated concrete		Anchor Category	-	1				2
			$\phi_{ej}$ & $\phi_{ws}$	-	0.65				0.55

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>Bond strength values correspond to concrete compressive strength range  $2,500 \text{ psi} \leq f'_c \leq 4,500 \text{ psi}$ . For  $4,500 \text{ psi} < f'_c \leq 6,500 \text{ psi}$ , tabulated characteristic bond strengths may be increased by 6 percent. For  $6,500 \text{ psi} < f'_c \leq 8,000 \text{ psi}$ , tabulated characteristic bond strengths may be increased by 10 percent.

<sup>2</sup>Temperature range A: Maximum short term temperature = 104°F (40°C), maximum long term temperature = 75°F (24°C).

Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

Temperature range C: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 162°F (72°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

TABLE 19—STEEL DESIGN INFORMATION FOR USA REINFORCING BARS<sup>1</sup>

DESIGN INFORMATION		SYMBOL	UNITS	BAR SIZE							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Nominal bar diameter		$d$	in. (mm)	$\frac{3}{8}$ (9.5)	$\frac{1}{2}$ (12.7)	$\frac{5}{8}$ (15.9)	$\frac{3}{4}$ (19.1)	$\frac{7}{8}$ (22.2)	1 (25.4)	$1\frac{1}{8}$ (28.6)	$1\frac{1}{4}$ (31.8)
Bar effective cross-sectional area		$A_{se}$	in. <sup>2</sup> (mm <sup>2</sup> )	0.11 (71)	0.2 (129)	0.31 (200)	0.44 (284)	0.6 (387)	0.79 (510)	1.0 (645)	1.27 (819)
ASTM A 615 Gr. 40	Nominal strength as governed by steel strength	$N_{sa}$	lb (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	36,000 (160.1)	47,400 (210.9)	60,000 (266.9)	76,200 (339.0)
		$V_{sa}$	lb (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)	21,600 (96.1)	28,440 (126.5)	36,000 (160.1)	45,720 (203.4)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65							
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60							
ASTM A 615 Gr. 60	Nominal strength as governed by steel strength	$N_{sa}$	lb (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.2)	54,000 (240.2)	71,100 (316.3)	90,000 (400.4)	114,300 (508.5)
		$V_{sa}$	lb (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)	68,580 (305.1)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65							
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60							

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>Values provided for common rod material types based on published strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Other material specifications are admissible, subject to the approval of the code official. Nuts and washers must be appropriate for the rod strength.

<sup>2</sup>For use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5. Values correspond to a brittle steel element.

TABLE 20—CONCRETE BREAKOUT DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>

DESIGN INFORMATION	SYMBOL	UNITS	BAR SIZE								
			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)	24 (10)	24 (10)	24 (10)	24 (10)	24 (10)	27 (11.3)	30 (12.6)	
Min. bar spacing	$s_{min}$	in. (mm)	1 <sup>7</sup> / <sub>8</sub> (48)	2 <sup>1</sup> / <sub>2</sub> (64)	3 <sup>1</sup> / <sub>8</sub> (79)	3 <sup>3</sup> / <sub>4</sub> (95)	4 <sup>3</sup> / <sub>8</sub> (111)	5 (127)	5 <sup>5</sup> / <sub>8</sub> (143)	6 <sup>1</sup> / <sub>4</sub> (159)	
Min. edge distance	$c_{min}$	in. (mm)	1 <sup>7</sup> / <sub>8</sub> (48)	2 <sup>1</sup> / <sub>2</sub> (64)	3 <sup>1</sup> / <sub>8</sub> (79)	3 <sup>3</sup> / <sub>4</sub> (95)	4 <sup>3</sup> / <sub>8</sub> (111)	5 (127)	5 <sup>5</sup> / <sub>8</sub> (143)	6 <sup>1</sup> / <sub>4</sub> (159)	
Minimum member thickness	$h_{min}$	in. (mm)	$h_{ef} + 1\frac{1}{4}$ ( $h_{ef} + 30$ )		$h_{ef} + 2d_o^{(3)}$						
Critical edge distance – splitting (for uncracked concrete)	$c_{ac}$	-	See Section 4.1.10 of this report.								
Strength reduction factor for tension, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.65								
Strength reduction factor for shear, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.70								

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>For additional setting information, see installation instructions in Figure 5.

<sup>2</sup>Values provided for post-installed anchors with category as determined from ACI 355.2 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318 D.4.4, while condition A requires supplemental reinforcement. Values are for use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5.

<sup>3</sup> $d_o$  = drill bit diameter.

**TABLE 21—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS  
IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>**

DESIGN INFORMATION			SYMBOL	UNITS	BAR SIZE							
					No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Temperature Range <sup>2</sup>	A	Characteristic bond strength	$\tau_{k,uncr}$	psi MPa	1,290 (8.9)							
	B	Characteristic bond strength	$\tau_{k,uncr}$	psi MPa	1,045 (7.2)							
	C	Characteristic bond strength	$\tau_{k,uncr}$	psi MPa	605 (4.2)							
Minimum anchor embedment depth			$h_{ef,min}$	in. (mm)	1½ (40)	2 (51)	2½ (64)	3½ (89)	3½ (89)	4 (102)	4½ (114)	5 (127)
Maximum anchor embedment depth			$h_{ef,max}$	in. (mm)	7½ (191)	10 (254)	12½ (318)	15 (381)	17½ (445)	20 (508)	22½ (572)	25 (635)
Permissible Installation Conditions	Dry concrete & Water-saturated concrete		Anchor Category	-	1						2	
			$\phi_d$ & $\phi_{ws}$	-	0.65						0.55	

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>Bond strength values correspond to concrete compressive strength range 2,500 psi  $\leq f'_c \leq$  4,500 psi. For 4,500 psi  $< f'_c \leq$  6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For 6,500 psi  $< f'_c \leq$  8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.

<sup>2</sup>Temperature range A: Maximum short term temperature = 104°F (40°C), maximum long term temperature = 75°F (24°C).

Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

Temperature range C: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 162°F (72°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

**TABLE 22—STEEL DESIGN INFORMATION FOR EU METRIC REINFORCING BARS<sup>1</sup>**

DESIGN INFORMATION		SYMBOL	UNITS	BAR SIZE								
				8	10	12	14	16	20	25	28	32
Nominal bar diameter		$d$	mm (in.)	8.0 (0.315)	10.0 (0.394)	12.0 (0.472)	14.0 (0.551)	16.0 (0.630)	20.0 (0.787)	25.0 (0.984)	28.0 (1.102)	32.0 (1.260)
Bar effective cross-sectional area		$A_{se}$	mm <sup>2</sup> (in. <sup>2</sup> )	50.3 (0.078)	78.5 (0.122)	113.1 (0.175)	153.9 (0.239)	201.1 (0.312)	314.2 (0.487)	490.9 (0.761)	615.8 (0.954)	804.2 (1.247)
DIN 488 BSt 550/500	Nominal strength as governed by steel strength	$N_{sa}$	kN (lb)	27.6 (6,215)	43.2 (9,710)	62.2 (13,985)	84.7 (19,035)	110.6 (24,860)	172.8 (38,845)	270.0 (60,695)	338.7 (76,135)	442.3 (99,440)
		$V_{sa}$	kN (lb)	16.6 (3,730)	25.9 (5,830)	37.3 (8,390)	50.8 (11,420)	66.4 (14,915)	103.7 (23,310)	162.0 (36,415)	203.2 (45,680)	265.4 (59,665)
	Strength reduction factor $\phi$ for tension <sup>2</sup>		$\phi$	-	0.65							
	Strength reduction factor $\phi$ for shear <sup>2</sup>		$\phi$	-	0.60							

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>Values provided for common rod material types based on published strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Other material specifications are admissible, subject to the approval of the code official. Nuts and washers must be appropriate for the rod strength.

<sup>2</sup>For use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5. Values correspond to a brittle steel element.

**TABLE 23—CONCRETE BREAKOUT DESIGN INFORMATION FOR EU METRIC REINFORCING BARS  
IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>**

DESIGN INFORMATION	SYMBOL	UNITS	BAR SIZE								
			8	10	12	14	16	20	25	28	32
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)						12.6 (30)		
Min. bar spacing	$s_{min}$	mm (in.)	40 (1.6)	50 (2)	60 (2.4)	70 (2.8)	80 (3.1)	100 (3.9)	125 (4.9)	140 (5.5)	160 (6.3)
Min. edge distance	$c_{min}$	mm (in.)	40 (1.6)	50 (2)	60 (2.4)	70 (2.8)	80 (3.1)	100 (3.9)	125 (4.9)	140 (5.5)	160 (6.3)
Minimum member thickness	$h_{min}$	mm (in.)	$h_{ef} + 30$ ( $h_{ef} + 1\frac{1}{4}$ )		$h_{ef} + 2d_o^{(3)}$						
Critical edge distance – splitting (for uncracked concrete)	$c_{ac}$	-	See Section 4.1.10 of this report.								
Strength reduction factor for tension, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.65								
Strength reduction factor for shear, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.70								

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>For additional setting information, see installation instructions in Figure 5.

<sup>2</sup>Values provided for post-installed anchors with category as determined from ACI 355.2 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318 D.4.4, while condition A requires supplemental reinforcement. Values are for use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5.

<sup>3</sup> $d_o$  = drill bit diameter.

**TABLE 24—BOND STRENGTH DESIGN INFORMATION FOR EU METRIC REINFORCING BARS  
IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>**

DESIGN INFORMATION			SYMBOL	UNITS	BAR SIZE								
					8	10	12	14	16	20	25	28	32
Temperature Range <sup>2</sup>	A	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	8.9 (1,290)								
	B	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	7.2 (1,045)								
	C	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	4.2 (605)								
Minimum anchor embedment depth			$h_{ef,min}$	mm (in.)	40 (1.6)	40 (1.6)	48 (1.9)	64 (2.5)	80 (3.1)	88 (3.5)	100 (3.9)	112 (4.4)	128 (5.0)
Maximum anchor embedment depth			$h_{ef,max}$	mm (in.)	160 (6.3)	200 (7.9)	240 (9.4)	320 (12.6)	400 (15.7)	440 (17.3)	500 (19.7)	560 (22.0)	635 (25)
Permissible Installation Conditions	Dry concrete & Water-saturated concrete		Anchor Category	-	1							2	
			$\phi_d$ & $\phi_{ws}$	-	0.65							0.55	

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>Bond strength values correspond to concrete compressive strength range 2,500 psi  $\leq f'_c \leq$  4,500 psi. For 4,500 psi  $< f'_c \leq$  6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For 6,500 psi  $< f'_c \leq$  8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.

<sup>2</sup>Temperature range A: Maximum short term temperature = 104°F (40°C), maximum long term temperature = 75°F (24°C).

Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

Temperature range C: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 162°F (72°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.



TABLE 25—STEEL DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS<sup>1</sup>

DESIGN INFORMATION		SYMBOL	UNITS	BAR SIZE				
				10 M	15 M	20 M	25 M	30 M
Nominal bar diameter		$d$	mm (in.)	11.3 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)
Bar effective cross-sectional area		$A_{se}$	mm <sup>2</sup> (in. <sup>2</sup> )	100.3 (0.155)	201.1 (0.312)	298.6 (0.463)	498.8 (0.773)	702.2 (1.088)
G30CSA	Nominal strength as governed by steel strength	$N_{sa}$	kN (lb)	54.2 (12,175)	108.6 (24,410)	161.3 (36,255)	269.3 (60,550)	379.2 (85,240)
		$V_{sa}$	kN (lb)	32.5 (7,305)	65.1 (14,645)	96.8 (21,755)	161.6 (36,330)	227.5 (51,145)
	Strength reduction factor $\phi$ for tension <sup>2</sup>	$\phi$	-	0.65				
	Strength reduction factor $\phi$ for shear <sup>2</sup>	$\phi$	-	0.60				

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>Values provided for common rod material types based on published strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Other material specifications are admissible, subject to the approval of the code official. Nuts and washers must be appropriate for the rod strength.

<sup>2</sup>For use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5. Values correspond to a brittle steel element.

TABLE 26—CONCRETE BREAKOUT DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>

DESIGN INFORMATION	SYMBOL	UNITS	BAR SIZE				
			10 M	15 M	20 M	25 M	30 M
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)	10 (24)	10 (24)	11.3 (27)	12.6 (30)
Min. bar spacing	$s_{min}$	mm (in.)	57 (2.2)	80 (3.1)	98 (3.8)	126 (5.0)	150 (5.9)
Min. edge distance	$c_{min}$	mm (in.)	57 (2.2)	80 (3.1)	98 (3.8)	126 (5.0)	150 (5.9)
Minimum member thickness	$h_{min}$	mm (in.)	$h_{ef} + 30$ ( $h_{ef} + 1\frac{1}{4}$ )	$h_{ef} + 2d_o^{(3)}$			
Critical edge distance – splitting (for uncracked concrete)	$c_{ac}$	-	See Section 4.1.10 of this report.				
Strength reduction factor for tension, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.65				
Strength reduction factor for shear, concrete failure modes, Condition B <sup>2</sup>	$\phi$	-	0.70				

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>For additional setting information, see installation instructions in Figure 5.

<sup>2</sup>Values provided for post-installed anchors with category as determined from ACI 355.2 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318 D.4.4, while condition A requires supplemental reinforcement. Values are for use with the load combinations of IBC Section 1605.2.1 or ACI 318 Section 9.2 as set forth in ACI 318 D.4.4. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5.

<sup>3</sup> $d_o$  = drill bit diameter.

**TABLE 27—BOND STRENGTH DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS  
IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT<sup>1</sup>**

DESIGN INFORMATION			SYMBOL	UNITS	BAR SIZE				
					10 M	15 M	20 M	25 M	30 M
Temperature Range <sup>2</sup>	A	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	8.9 (1,290)				
	B	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	7.2 (1,045)				
	C	Characteristic bond strength	$\tau_{k,uncr}$	MPa (psi)	4.2 (605)				
Minimum anchor embedment depth			$h_{ef,min}$	mm (in.)	45 (1.8)	64 (2.5)	78 (3.1)	101 (4.0)	120 (4.7)
Maximum anchor embedment depth			$h_{ef,max}$	mm (in.)	226 (8.9)	320 (12.6)	390 (15.4)	504 (19.8)	598 (23.5)
Permissible Installation Conditions	Dry concrete & Water-saturated concrete	Anchor Category	-	-	1				2
		$\phi_d$ & $\phi_{ws}$	-	-	0.65				0.55

For SI: 1 inch  $\equiv$  25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

<sup>1</sup>Bond strength values correspond to concrete compressive strength range  $2,500 \text{ psi} \leq f_c \leq 4,500 \text{ psi}$ . For  $4,500 \text{ psi} < f_c \leq 6,500 \text{ psi}$ , tabulated characteristic bond strengths may be increased by 6 percent. For  $6,500 \text{ psi} < f_c \leq 8,000 \text{ psi}$ , tabulated characteristic bond strengths may be increased by 10 percent.

<sup>2</sup>Temperature range A: Maximum short term temperature = 104°F (40°C), maximum long term temperature = 75°F (24°C).

Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

Temperature range C: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 162°F (72°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.



**FIGURE 3—HILTI HIT-HY 150 MAX ANCHORING SYSTEM AND ANCHOR ELEMENTS**

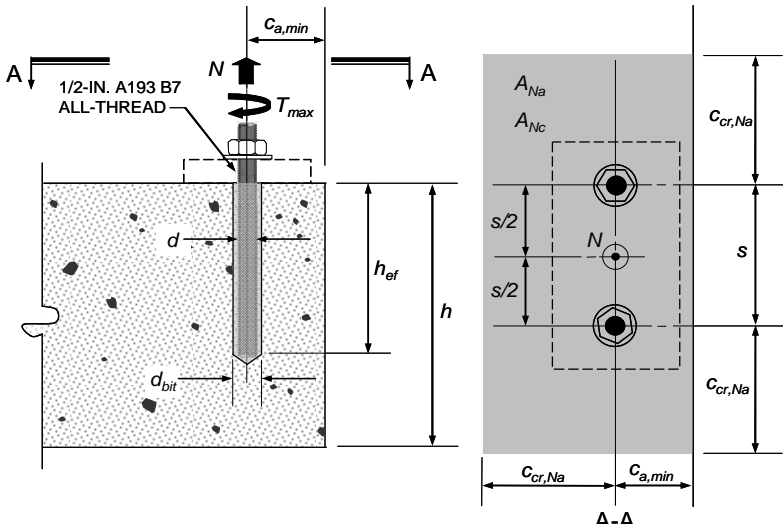
<p><b>Given:</b></p> <p>(2) 1/2 inch diameter HIT-HY 150 MAX adhesive anchors subjected to a tension load as shown.</p> <p>Design objective:</p> <p>Calculate the design tension resistance for this configuration in accordance with the 2006 IBC.</p>			
<p><b>Dimensional Parameters:</b></p> <p><math>h_{ef}</math> = 9 in.</p> <p><math>s</math> = 4 in.</p> <p><math>c_{a,min}</math> = 2.5 in.</p> <p><math>h</math> = 12 in.</p> <p><math>d</math> = 1/2 in.</p>	<p><b>Specifications / Assumptions:</b></p> <p>ASTM A 193 B7 all-thread rods, UNC thread, A 563 Grade HD hex nuts; <math>n = 2</math></p> <p>Normal weight concrete, <math>f'_c = 4,000</math> psi</p> <p>Seismic Design Category (SDC) B</p> <p>No supplementary reinforcing in accordance with ACI 318-05 D.1</p> <p>Assume maximum short term (diurnal) base material temperature <math>\leq 100</math> °F</p> <p>Assume maximum long term base material temperature <math>\leq 75</math> °F</p> <p>Assume installation in dry concrete and hammer-drilled holes</p> <p>Assume concrete will remain uncracked for service life of anchorage</p>		
<p><b>Calculation per ACI 318 Appendix D and this report</b></p>		<p><b>ACI 318 Code Ref.</b></p>	<p><b>Report Ref.</b></p>
<p><b>Step 1.</b> Check minimum edge distance, anchor spacing and member thickness:</p>		-	-
<p><math>c_{min} = 2.5 \text{ in.} \leq c_{a,min} = 2.5 \text{ in.}</math></p>	ok	-	<b>Table 8</b>
<p><math>s_{min} = 2.5 \text{ in.} \leq s = 4 \text{ in.}</math></p>	ok	-	<b>Table 8</b>
<p><math>h_{min} = h_{ef} + 1.25 \text{ in.} = 9 \text{ in.} + 1.25 \text{ in.} = 10.25 \text{ in.} \leq h = 12 \text{ in.}</math></p>	ok	-	<b>Table 8</b>
<p><math>h_{ef,min} \leq h_{ef} \leq h_{ef,max} \rightarrow 2 \text{ in.} \leq 9 \text{ in.} \leq 10 \text{ in.}</math></p>	ok	-	<b>Table 9</b>
<p><b>Step 2.</b> Calculate steel strength: <math>N_{sa} = n \cdot A_{se} \cdot f_{uta}</math></p>		D.5.1.2 Eq. (D-3)	
<p>A193 B7 rods are considered ductile in accordance with ACI 318-05 D.1. <math>\therefore \phi = 0.75</math></p> <p><math>\therefore \phi N_{sa} = \phi n A_{se} f_{uta}</math></p> <p><math>= 0.75 \cdot 2 \cdot 0.1419 \text{ in}^2 \cdot 125,000 \text{ psi} = 26,606 \text{ lb}</math></p> <p>or, using Table 7, <math>\therefore \phi N_{sa} = 0.75 \cdot 2 \cdot 17,740 \text{ lb} = 26,610 \text{ lb}</math></p>		Eq. (D-3)	<b>Table 2</b> <b>Table 7</b>
<p><b>Step 3.</b> Determine concrete breakout strength:</p> <p><math>N_{cbg} = \frac{A_{Nc}}{A_{Nco}} \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b</math></p>		D.5.2.1 Eq. (D-5)	-
<p><math>A_{Nc} = (3 h_{ef} + s) (1.5 h_{ef} + c_{a,min})</math></p> <p><math>= (27 \text{ in.} + 4 \text{ in.}) (13.5 \text{ in.} + 2.5 \text{ in.}) = 496 \text{ in}^2</math></p>		-	-

FIGURE 4—SAMPLE CALCULATION

Calculation in accordance with ACI 318 Appendix D and this report	ACI 318 Code Ref.	Report Ref.
$A_{Nco} = 9 (h_{ef})^2 = 9 (9 \text{ in})^2 = 729 \text{ in}^2$	Eq. (D-6)	-
$\psi_{ec,N} = 1.0$ no eccentricity with respect to tension-loaded anchors	D.5.2.4	-
$c_{a,min} \leq 1.5 h_{ef}$ $c_{a,min} = 2.5 < 1.5 (9 \text{ in}) = 13.5 \text{ in.}$ $\psi_{ed,N} = 0.7 + 0.3 \frac{c_{a,min}}{1.5 h_{ef}} = 0.7 + 0.3 \frac{2.5 \text{ in.}}{1.5 (9 \text{ in.})} = 0.756$	D.5.2.5 Eq. (D-11)	-
$\psi_{c,N} = 1.0$ uncracked concrete assumed, ( $k_{c,uncr} = 24$ )	D.5.2.6	Table 8
Determine $c_{ac}$ : $\frac{h}{h_{ef}} = \frac{12 \text{ in.}}{9 \text{ in.}} = 1.33$ Interpolate between 1.3 and 2.0 to get value of multiplier = 2.45. $c_{ac} = 2.45 \cdot h_{ef} = 2.45 \cdot 9 \text{ in.} = 22.1 \text{ in.}$		Section 4.1.9
For $c_{a,min} < c_{ac}$ $\psi_{cp,N} = \frac{\max[c_{a,min}; 1.5 h_{ef}]}{c_{ac}} = \frac{\max[2.5 \text{ in.}; 1.5 (9 \text{ in.})]}{22.1 \text{ in.}} = 0.61$	D.5.2.7 Eq. (D-13)	-
$N_b = k_{c,uncr} \sqrt{f'_c} (h_{ef})^{1.5}$ $= 24 \sqrt{4,000 \text{ psi}} (9 \text{ in.})^{1.5} = 40,983 \text{ lb}$	D.5.2.2 Eq. (D-7)	Table 8
$N_{cbg} = \frac{496 \text{ in}^2}{729 \text{ in}^2} 1.0 0.756 1.0 0.611 40,983 \text{ lb} = 12,880 \text{ lb}$	D.5.2.1 Eq. (D-5)	-
$\phi N_{cbg} = 0.65 12,880 \text{ lb} = 8,372 \text{ lb}$	D.4.4(c)	-
<b>Step 4. Determine bond strength:</b> $N_{ag} = \frac{A_{Na}}{A_{Na0}} \psi_{ed,Na} \psi_{g,Na} \psi_{ec,Na} \psi_{p,Na} N_{ao}$	-	Section 4.1.4 Eq. (D-16b)
$S_{cr,Na} = \min 20 d \sqrt{\frac{T_{k,uncr}}{1,450 \text{ psi}}}; 3 h_{ef}$ $= 20 (0.5 \text{ in.}) \sqrt{\frac{1,985 \text{ psi}}{1,450 \text{ psi}}} = 11.7 \text{ in.}$ $3 h_{ef} = 27 \text{ in.} \geq 11.7 \text{ in.}$ $\therefore S_{cr,Na} = 11.7 \text{ in.}$	-	D.5.3.8 Eq. (D-16d) Table 9
$c_{cr,Na} = \frac{S_{cr,Na}}{2} = \frac{11.7 \text{ in.}}{2} = 5.85 \text{ in.}$	-	Section 4.1 D.5.3.8 Eq. (D-16e)
$A_{Na} = (2 c_{cr,Na} + s) (c_{cr,Na} + c_{a,min})$ $= (2 (5.85 \text{ in.}) + 4 \text{ in.}) (5.85 \text{ in.} + 2.5 \text{ in.}) = 131.1 \text{ in}^2$	-	D.5.3.7
$A_{Na0} = (S_{cr,Na})^2 = (11.7 \text{ in.})^2 = 136.9 \text{ in}^2$	-	D.5.3.7 Eq. (D-16c)

FIGURE 4—SAMPLE CALCULATION (Continued)



Calculation in accordance with ACI 318 Appendix D and this report	ACI 318 Code Ref.	Report Ref.
For $c_{a,min} < c_{cr,Na}$ $\psi_{ed,Na} = 0.7 + 0.3 \frac{c_{a,min}}{c_{cr,Na}} = 0.7 + 0.3 \frac{2.5 \text{ in.}}{5.85 \text{ in.}} = 0.828$	-	D.5.3.12 Eq. (D-16m)
$T_{k,max,uncr} = \frac{k_{c,uncr}}{\pi} \frac{d}{\sqrt{h_{ef}}} \sqrt{f'_c}$ $= \frac{24}{\pi} \frac{1}{0.5 \text{ in.}} \sqrt{9 \text{ in.}} \sqrt{4,000 \text{ psi}} = 2,899 \text{ psi}$	-	D.5.3.10 Eq. (D-16i) Table 8
$\psi_{g,Na0} = \sqrt{n} \left( \sqrt{n} - 1 \right) \frac{T_{k,uncr}^{1.5}}{T_{k,max,uncr}^{1.5}}$ $= \sqrt{2} \left( \sqrt{2} - 1 \right) \frac{1,985 \text{ psi}^{1.5}}{2,899 \text{ psi}^{1.5}} = 1.18$	-	D.5.3.10 Eq. (D-16h) Table 9
$\psi_{g,Na} = \psi_{g,Na0} + \frac{s}{s_{cr,Na}}^{0.5} \left( 1 - \psi_{g,Na0} \right)$ $= 1.18 + \frac{4 \text{ in.}}{11.7 \text{ in.}}^{0.5} (1 - 1.18) = 1.075$	-	D.5.3.10 Eq. (D-16g)
$\psi_{ec,Na} = 1.0$ no eccentricity - loading is concentric	-	D.5.3.11 Eq. (D-16j)
$\psi_{p,Na} = \frac{\max c_{a,min}; c_{cr,Na} }{c_{ac}} = \frac{\max 2.5 \text{ in.}; 5.85 \text{ in.} }{22.1 \text{ in.}} = 0.265$	-	D.5.3.14 Eq. (D-16p)
$N_{ao} = T_{k,uncr} \pi d h_{ef} = 1,985 \text{ psi} \pi 0.5 \text{ in.} 9 \text{ in.} = 28,062 \text{ lb}$	-	D.5.3.9 Eq. (D-16f)
$N_{ag} = \frac{A_{Na}}{A_{Na0}} \psi_{ed,Na} \psi_{g,Na} \psi_{ec,Na} \psi_{p,Na} N_{ao}$ $N_{ag} = \frac{131.1 \text{ in}^2}{136.9 \text{ in}^2} 0.828 1.075 1.0 0.265 28,062 \text{ lb} = 6,339 \text{ lb}$	-	Eq. (D-16b)
$\phi = 0.65$	-	Table 7
$\phi N_{ag} = 0.65 6,339 \text{ lb} = 4,120 \text{ lb}$	-	-
<b>Step 5. Determine controlling strength:</b>	D.4.1.2	-
Steel Strength in Tension $\phi \cdot N_{sa}$	= 26,610 lb	
Concrete Breakout Strength in Tension $\phi \cdot N_{cbg}$	= 8,372 lb	
Bond Strength in Tension $\phi \cdot N_{ag}$	= 4,120 lb	Controls = $\phi N_n$
<b>Step 6. Convert strength to ASD using factor provided in Section 4.2:</b>	-	Section 4.2
$N_{allow,ASD} = \frac{\phi N_n}{\alpha} = \frac{4,120 \text{ lb}}{1.48} = 2,784 \text{ lb}$	-	Eq. (21)

FIGURE 4—SAMPLE CALCULATION (Continued)

### Hilti HIT-HY 150 MAX

Instructions for use en  
Mode d'emploi fr  
Instrucciones de uso es

**Hilti HIT-HY 150 MAX**  
For industrial use only. Keep out of the reach of children.  
See the Material Safety Data Sheet for this product before handling.  
Caution: Irritating to eyes and skin. May cause sensitization in susceptible individuals.  
Contents: 1000 g (2.2 lb) net weight.  
Precautions: Avoid contact with skin/eyes. Always wear appropriate gloves and eye protection when using product. Store in a cool, dry area. Keep from freezing. Do not store in direct sunlight.  
First Aid - Eyes: Immediately flush with water for 15 minutes. Contact a physician.  
Skin: Wash with soap and water. Launder contaminated clothing before reuse. If irritation occurs, contact a physician. Ingestion: Do not induce vomiting unless directed by a physician. Contact a physician immediately. Inhalation: Move to fresh air. Give oxygen if breathing is difficult. Contact a physician if symptoms persist.

**Hilti HIT-HY 150 MAX**  
Pour usage industriel et seulement. Tenir hors de la portée des enfants.  
Se reporter à la Fiche de données de sécurité du produit (FDS) à l'usage.  
Attention: Irritant pour les yeux et la peau. Peut entraîner une sensibilité chez les individus à risque.  
Contient de: 1000 g (2.2 lb) de produit net.  
Précautions: Éviter le contact avec la peau et les yeux. Toujours porter des gants imperméables et une protection de protection des yeux lors de l'utilisation de ce produit. Conserver dans un endroit frais et au sec. Conserver à l'abri du gel. Conserver à l'abri de l'exposition directe.  
Premiers soins: Yeux: Rincer immédiatement à l'eau pendant 15 minutes et appeler un médecin.  
Peau: Se laver immédiatement avec de l'eau et du savon. Laver les vêtements contaminés avant de les réutiliser. En cas d'irritation, consulter un médecin. Ingestion: Ne pas faire vomir à moins que cela n'ait été ordonné par un médecin. Appeler immédiatement un médecin. Inhalation: Aller à l'air frais. Donner de l'oxygène en cas de difficultés respiratoires. Consulter un médecin en cas de persistance des symptômes.

**Hilti HIT-HY 150 MAX**  
Solo Para Uso Industrial. Mantener alejado de los niños.  
Consulte con las Hojas de datos de seguridad para este producto antes de usarlo.  
Precaución: Es irritante para los ojos y la piel. Puede provocar sensibilidad en algunas personas.  
Contenido: 1000 g (2.2 lb) de producto neto.  
Precauciones: Evite el contacto con la piel y los ojos. Utilice siempre guantes impermeables y protección para los ojos cuando utilice este producto. Conserve en un lugar fresco y seco. Evite que el producto se congele. No lo exponga a la luz directa del sol.  
Primeros auxilios: Ojos: Enjuague inmediatamente con agua durante 15 minutos. Busque ayuda médica. Piel: Lave con agua y jabón. Lave bien la ropa contaminada antes de volver a utilizarla. En caso de ingestión, busque ayuda médica. Ingestión: No induce al vómito a menos que así lo indique un médico. Busque ayuda médica de inmediato. Inhalación: Lleve a la persona al aire libre. Déle oxígeno si tiene dificultades para respirar. Si los síntomas persisten, busque ayuda médica.

NSF  
Certified to  
ANSI NSF 61

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ICC ESR - 1967  
ICC ESR - 2262

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### Hilti HIT-HY 150 MAX

Compressed Air Cleaning

Manual Cleaning

$d_0 \leq 3/4$  inch (20 mm)  
 $h_0 \text{ max} < 10 \times d$

or / ou / o







\*) Please refer to technical literature (approvals, setting instructions) for detail  
\*) Voir littérature technique (agrément, manuels d'utilisation produits) pour plus de détail  
\*) Por favor vea la referencia técnica (normativa y manuales de uso) para mas detalle

12	F	C	t <sub>gel</sub>
14	-10	-10	3 h
23	-5	-5	40 min
32	0	0	20 min
41	5	5	6 min
68	20	20	5 min
86	30	30	3 min
104	40	40	2 min

13	F	C	t <sub>reue</sub>
14	-10	-10	12 h
23	-5	-5	4 h
32	0	0	2 h
41	5	5	1 h
68	20	20	30 min
86	30	30	30 min
104	40	40	30 min

FIGURE 5—INSTRUCTIONS FOR USE (IFU) AS PROVIDED WITH PRODUCT PACKAGING

## Hilti HIT-HY 150 MAX

	HAS	HIS	Rebar	HIT-RB		HIT-SZ (IP)		HIT-DL		
										
	Ø[mm]	Ø[mm]	Ø[mm]	Ø[mm]	HIT-RB	Item no.	HIT-SZ	Item no.	HIT-DL	Item no.
10	8			10		380917				
12	10		8	12		336548	12	335022	12	371715
14	12	8	10	14		336549	14	335023	14	371716
16			12	16		336550	16	335024	16	371717
18	16	10	14	18		336551	18	335025	18	371718
20			16	20		336552	20	335026	20	371719
22		12	18	22		370774	22	380922	20	371720
24	20			24		380918	24	380923	20	371719
25			20	25		336553	25	335027	25	371720
28	24	16	22	28		380919	28	380924	25	371720
30	27			30		380920	30	380925	25	371720
32		20	25	32		336554	32	335028	32	371721
35	30		28	35		380921	35	380926	32	371721
37	33		30	37		382260	37	382267	32	371721
40	36		32	40		382260	40	380927	32	371721

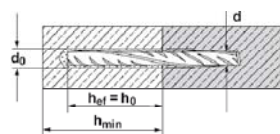
Ø[inch]	Ø[inch]	Ø[inch]	Size	HIT-RB	Item no.	HIT-IP	Item no.	HIT-DL	Item no.	
7/16	3/8		#3	1/2"	273203	1/2"	274019	1/2"	38237	
1/2			10M	9/16"	273205	9/16"	274020	9/16"	38238	
9/16	1/2		#4	5/8"	273207	5/8"	274021	9/16"	38238	
5/8				1 1/16"	273209	1 1/16"	274022	1 1/16"	38239	
11/16		3/8		3/4"	273210	3/4"	274023	3/4"	38240	
3/4	5/8		#51	15M	273211	1 1/4"	274024	7/8"	38241	
7/8	3/4	1/2		7/8"	273211	7/8"	274024	7/8"	38241	
1	7/8		#71	20M	1"	273212	1"	274025	1"	38242
1 1/8	1	5/8		1 1/8"	273214	1 1/8"	274026	1"	38242	
1 1/4	1 1/4	3/4	25M	1 1/4"	273216	1 1/4"	274027	1"	38242	
1 3/8	1 1/4		#9	13M"	273217	1 3/8"	274028	1 3/8"	38243	
1 1/2			#10	30M	1 1/2"	273218	1 1/2"	274029	1 3/8"	38243

Drill bits must conform to ANSI B212-1994

Les mèches de forage doivent être conformes à ANSI B212-1994.

Brocas deben cumplir con el estándar ANSI B212-1994.

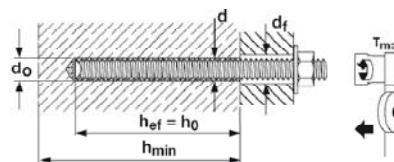
## Setting Details of Hilti HIT-HY 150 MAX with reinforcement bars



d	d <sub>0</sub>	h <sub>ef</sub> min-max	h <sub>min</sub>
US rebar	(inch)	(inch) (mm)	(inch)
#3	1/2	1 1/2 - 7 1/2	40 - 191
#4	5/8	2 - 10	51 - 254
#5	3/4	2 1/2 - 12 1/2	64 - 318
#6	7/8	3 - 15	76 - 381
#7	1	3 1/2 - 17 1/2	89 - 445
#8	1 1/8	4 - 20	102 - 508
#9	1 3/8	4 1/2 - 22 1/2	114 - 572
#10	1 1/2	5 - 25	127 - 635
Rebar	(mm)	(mm)	(mm)
8	12	40 - 160	
10	14	41 - 200	
12	16	48 - 240	
14	18	56 - 280	
16	20	64 - 320	
20	25	80 - 400	
25	32	100 - 500	
28	35	112 - 560	
32	40	128 - 640	
CA rebar	(inch)	(mm)	(inch)
10 M	3/16	45 - 226	
15 M	3/4	64 - 320	
20 M	1	78 - 390	
25 M	1 1/4	101 - 504	
30 M	1 1/2	120 - 598	

## Hilti HIT-HY 150 MAX

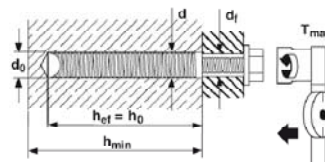
## Setting Details of Hilti HIT-HY 150 MAX with threaded rod



d	d <sub>0</sub>	h <sub>ef</sub> min-max	T <sub>max</sub>	d <sub>f</sub>	h <sub>min</sub>
(inch)	(mm)	(inch) (mm)	(ft-lb) (Nm)	(inch)	(inch)
3/8	9.5	7/16 1 1/2 - 7 1/2	40 - 191	15	20
1/2	12.7	9/16 2 - 10	51 - 254	30	41
5/8	15.9	3/4 2 1/2 - 12 1/2	64 - 318	60	81
3/4	19.1	7/8 3 - 15	76 - 381	100	136
7/8	22.2	1 3 1/2 - 17 1/2	89 - 445	125	169
1	25.4	1 1/8 4 - 20	102 - 508	150	203
1 1/4	31.8	1 3/8 5 - 25	127 - 635	200	271
(mm)	(mm)	(mm)	(Nm)	(mm)	(mm)
M8	10	40 - 160	10	9	
M10	12	40 - 200	20	12	
M12	14	48 - 240	40	14	
M16	18	64 - 320	80	18	
M20	24	80 - 400	150	22	
M24	28	96 - 480	200	26	
M27	30	108 - 540	270	30	
M30	35	120 - 600	300	33	

Edge distance, c <sub>ef</sub>	Element spacing s	T <sub>max</sub>
(inch)	(mm)	(inch) (mm)
1.75	45	5 x Ø
1.75	45	16.0 406

## Setting Details of Hilti HIT-HY 150 MAX with HIS-N and HIS-RN Inserts



d	d <sub>0</sub>	h <sub>ef</sub>	T <sub>max</sub>	d <sub>f</sub>	h <sub>min</sub>
(inch)	(mm)	(inch) (mm)	(ft-lb) (Nm)	(inch)	(inch) (mm)
3/8	9.5	11/16 4 3/8	110	15	20
1/2	12.7	7/8 5	125	30	41
5/8	15.9	1 1/8 6 3/4	170	60	81
3/4	19.1	1 1/4 8 1/8	205	100	136
(mm)	(mm)	(mm)	(Nm)	(mm)	(mm)
M8	12.5	14	90	10	120
M10	16.5	18	110	20	150
M12	20.5	22	125	40	170
M16	25.4	28	170	80	230
M20	27.6	32	205	160	270

FIGURE 5—INSTRUCTIONS FOR USE (IFU) AS PROVIDED WITH PRODUCT PACKAGING (Continued)



**Hilti HIT-HY 150 MAX****Adhesive anchoring system for fastenings in concrete**

**Prior to use of product, follow instructions for use and recommended safety precautions.**  
**Check expiration date:** See expiration date imprint on foil pack manifold. (Month/Year). Do not use an expired product.

**Foil pack temperature:** Must be between 32 °F and 104 °F (0 °C and 40 °C) when in use.  
**Base material temperature at time of installation:** Must be between 14 °F and 104 °F (-10 °C and 40 °C).

**Instructions for transport and storage:** Keep in a cool, dry and dark place between 41 °F to 77 °F (5 °C to 25 °C).

**Material Safety Data Sheet:** Review the MSDS before use.

**Installation instructions:** Follow the illustrations on page 1 for the sequence of operations and refer to tables on page 2-3 for setting details. For any application not covered by this document, contact Hilti.

- 1** Drill hole to the required depth  $h_0$  with a hammer-drill set in rotation hammer mode using an appropriately sized carbide drill bit. For holes drilled with other drill types contact a Hilti representative.
- 2 – 4** Clean hole: Cleaning method has to be decided based on borehole condition. Just before setting an anchor/rebar, the borehole must be free of dust and debris by one of the following methods:  
**Method 1 – for dry or water saturated concrete (refer to pictograms):**  
 Compressed air cleaning is permissible for all diameters and embedment depths.  
 • **Blow** from the back of the borehole with oil-free compressed air (min. 90psi at 3.5 CFM (6 bar at 6 m<sup>3</sup>/h)) fully retracting the air extension 2 times until return air stream is free of noticeable dust.  
 • **Brush 2 times** with the specified Hilti HIT-RB brush size (brush  $\varnothing \geq$  bore hole  $\varnothing$ ) by inserting the round steel brush to the back of the borehole in a twisting motion and removing it. The brush should resist insertion into the borehole - if not, the brush is too small and must be replaced with a brush of appropriate brush diameter.  
 • **Blow** again with compressed air 2 times until return air stream is free of noticeable dust.  
**If required use extensions for air nozzle and brushes to reach back of deep hole.**  
**Manual cleaning method** is limited to < 3/4 inch (20 mm) borehole diameter and a max. borehole depth of 10 x element.  
 • **Blow** - 4 strokes with Hilti blow-out pump with the nozzle extended to the back of the hole until return air stream is free of noticeable dust.  
 • **Brush** - 4 times with the specified Hilti HIT-RB brush size (brush  $\varnothing \geq$  borehole  $\varnothing$ ) by inserting the round steel brush to the back of the hole with a twisting motion.  
 • **Blow** - 4 strokes with Hilti blow-out pump with the nozzle extended to the back of the hole until return air stream is free of noticeable dust.  
**Method 2 – for standing water (e.g. water flows into cleaned borehole):**  
 • **Flush hole 2 times** by inserting a water hose (water-line pressure) to the back of the borehole until water runs clear.  
 • **Brush 2 times** with the specified Hilti HIT-RB brush size (brush  $\varnothing \geq$  borehole  $\varnothing$ ) by inserting the round steel brush to the back of the borehole with a twisting motion and removing it. The brush should resist insertion into the borehole - if not, the brush is too small and must be replaced with a brush of appropriate brush diameter.  
 • **Flush again 2 times** until water runs clear. Remove all standing water completely (i.e. vacuum, compressed air or other appropriate procedure). To attain a dried borehole, a Hilti HIT-DL air nozzle attachment is recommended for borehole depth  $\leq$  10 inch (250 mm) and required for borehole depth > 10 inch (250 mm).  
 • **Continue** with borehole cleaning as described in **Method 1**.
- 5** Insert foil pack in foil pack holder. Never use damaged foil packs and/or damaged or unclear foil pack holders. Attach new mixer prior to dispensing a new foil pack (snug fit).
- 6** Tightly attach Hilti HIT-RE-M mixer to foil pack manifold. Do not modify the mixer in any way. Make sure the mixing element is in the mixer. Use only the mixer supplied with the anchor adhesive.
- 7** Insert foil pack holder with foil pack into HIT-dispenser. Push release trigger, retract plunger and insert foil pack holder into the appropriate Hilti dispenser.
- 8** Discard initial anchor adhesive. The foil pack opens automatically as dispensing is initiated. Do not pierce the foil pack manually (can cause system failure). Depending on the size of the foil pack an initial amount of anchor adhesive has to be discarded. See pictogram 8 for discard quantities. Dispose discarded anchor adhesive into the empty outer packaging. If a new mixer is installed onto a previously-opened foil pack, the first trigger pulls must also be discarded as described above. For each new foil pack a new mixer must be used.
- 9 – 11** Inject anchor adhesive from the back of the borehole without forming air voids:  
 • **Injection method – for borehole with depth  $\leq$  10 inch/250 mm:**  
 Inject the anchor adhesive starting at the back of the hole (use the extension for deep holes), slowly withdraw the mixer with each trigger pull. Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the anchor/rebar and the concrete is completely filled with anchor adhesive along the embedment length. After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further anchor adhesive discharge from the mixer.  
 • **Piston plug injection – is recommended for and borehole depth > 10 inch/250 mm. The installation overhead is only possible with the aid of piston plugs.**  
 Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug. Insert piston plug HIT-SZ to back of the hole, and inject anchor adhesive as described in the injection method above. During injection the piston plug will be naturally extruded out of the bore hole by the anchor adhesive pressure.
- 12** Insert anchor/rebar into bore hole. Mark and set anchor/rebar to the required embedment depth. Before use, verify that the anchor/rebar is dry and free of oil and other contaminants. To ease installation, anchor/rebar may be slowly twisted as they are inserted. **Use only Hilti anchor rods or equivalent.** After installing an anchor/rebar, the annular gap must be completely filled with anchor adhesive.  
**Attention!** For overhead applications take special care when inserting the anchor/rebar. Excess adhesive will be forced out of the borehole - take appropriate steps to prevent it from falling onto the installer. Position the anchor/rebar and secure it from moving/falling during the curing time (e.g. wedges).

**Hilti HIT-HY 150 MAX**

- 13** Observe the gel time "**t<sub>gel</sub>**", which varies according to temperature of base material. Minor adjustments to the anchor/rebar position may be performed during the gel time. See table 12. Once the gel time has elapsed, do not disturb the anchor/rebar until the curing time "**t<sub>cure</sub>**" has elapsed.
- 14** Apply designed load/torque after "**t<sub>cure</sub>**" has passed, and the fixture to be attached has been positioned. See table 13.

Partly used foil packs must be used up within **four weeks**. Leave the mixer attached on the foil pack manifold and store under the recommended storage conditions. If reused, attach a new mixer and discard the initial quantity of anchor adhesive as described by point 8.

**Safety instructions:**

For industrial use only. Keep out of the reach of children. See the Material Safety Data Sheet for this product before handling.

**Caution:** Irritating to eyes and skin. May cause sensitization in susceptible individuals.

Contains: dibenzoyl peroxide.

**Precautions:** Avoid contact with skin/eyes. Always wear impermeable gloves and eye protection when using product. Store in a cool, dry area. Keep from freezing. Do not store in direct sunlight.

**First Aid: Eyes** - Immediately flush with water for 15 minutes, contact a physician. **Skin** - Wash with soap and water, launder contaminated clothing before reuse. If irritations occurs, contact physician.

**Ingestion** - Do not induce vomiting unless directed by a physician. Contact a physician immediately.

**Inhalation** - Move to fresh air, give oxygen if breathing is difficult. Contact a physician if symptoms persist.



Ingredient	CAS Number	Ingredient	CAS Number
<b>Part A: (Large side)</b>		<b>Part B: (Small side)</b>	
NJ Trade Secret Registry	No. 19136100-5001	Quartz Sand	14808-60-7
Quartz Sand	14808-60-7	Water	07732-18-5
NJ Trade Secret Registry	No. 19136100-5003	Dibenzoyl peroxide	00094-36-0
NJ Trade Secret Registry	No. 19136100-5004	Aluminum oxide	01344-28-1
NJ Trade Secret Registry	No. 19136100-5005	Amorphous silica	07631-86-9
Amorphous silica	67762-90-7	1,2,3-Propantriol	00056-81-5
NJ Trade Secret Registry	No. 19136100-5002		
NJ Trade Secret Registry	No. 19136100-5017		
NJ Trade Secret Registry	No. 19136100-5019		

\* NJ TSNR = New Jersey Trade Secret Registry Number

In Case of Emergency, call Chem-Trec: 1-800-424-0300 (USA, P.R., Virgin Islands, Canada)  
 En cas d'urgence, téléphoner Chem-Trec: 1-800-424-0300 (USA, P.R., Virgin Islands, Canada)  
 En Caso de Emergencia, llame Chem-Trec: 001-763-527-3887 (other countries/autres pays/otros países)

Made in Germany

Net contents: 11.1 fl. oz (330 ml) / 16.9 fl. oz (500 ml) Net weight: 20.3 oz (575 g) / 31.0 oz (880 g)

Warranty: Refer to standard Hilti terms and conditions of sale for warranty information.

Failure to observe these installation instructions, use of non-Hilti anchors, poor or questionable concrete conditions, or unique applications may affect the reliability or performance of the fastenings.

FIGURE 5—INSTRUCTIONS FOR USE (IFU) AS PROVIDED WITH PRODUCT PACKAGING (Continued)

**ICC-ES Evaluation Report****ESR-2262 Supplement***Reissued August 1, 2010**This report is subject to re-examination in two years.*[www.icc-es.org](http://www.icc-es.org) | (800) 423-6587 | (562) 699-0543*A Subsidiary of the International Code Council®*

**DIVISION: 03 00 00—CONCRETE**  
**Section: 03 15 00—Concrete Accessories**

**REPORT HOLDER:**

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**EVALUATION SUBJECT:****HILTI HIT HY 150 MAX ADHESIVE ANCHOR SYSTEM IN UNCRACKED CONCRETE****1.0 EVALUATION SCOPE****Compliance with the following codes:**

- 2007 *Florida Building Code—Building*
- 2007 *Florida Building Code—Residential*

**Property Evaluated:**

Structural

**2.0 PURPOSE OF THIS SUPPLEMENT**

This supplement is issued to indicate that the Hilti HIT HY 150 Max Adhesive Anchor System in Uncracked Concrete described in the master report comply with the 2007 *Florida Building Code—Building* and the 2007 *Florida Building Code—Residential*, when designed and installed in accordance with the master evaluation report.

Use of the Hilti HIT HY 150 Max Adhesive Anchor System in Uncracked Concrete as described in the master evaluation report to comply with the High Velocity Hurricane Zone Provisions of the 2007 *Florida Building Code—Building* has not been evaluated, and is outside the scope of this supplement.

For products falling under Florida Rule 9B-72, 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 master report reissued on August 1, 2010.