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

REPORT HOLDER:

HILTI, INC.
5400 SOUTH 122ND EAST AVENUE
TULSA, OKLAHOMA 74146
(800) 879-8000
www.us.hilti.com
HiltiTechEng@us.hilti.com

EVALUATION SUBJECT:

HILTI HIT-RE 500-SD ADHESIVE ANCHORS IN 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-RE 500-SD Adhesive Anchoring System is used to resist static, wind and seismic tension and shear loads in cracked and 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 cast-in-place and post-installed anchors described in Sections 1911 and 1912 of the 2009 and 2006 IBC, or Sections 1912 and 1913 of the 2000 or 2003 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, Section R301.1.3 of the 2003 IRC, or Section R301.1.2 of the 2000 IRC.

3.0 DESCRIPTION

3.1 General:

The Hilti HIT-RE 500-SD Adhesive Anchoring System is comprised of the following components:

- Hilti HIT-RE 500-SD adhesive packaged in foil packs
- Adhesive mixing and dispensing equipment
- Equipment for hole cleaning and adhesive injection

The Hilti HIT-RE 500-SD Adhesive Anchoring System may be used with continuously threaded rod, Hilti HIS-(R)N and HIS-RN internally threaded inserts or deformed steel reinforcing bars. The primary components of the Hilti Adhesive Anchoring System, including the Hilti HIT-RE 500-SD Adhesive, HIT-RE-M static mixing nozzle and steel anchoring elements, are shown in Figure 2 of this report.

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

3.2 Materials:

3.2.1 Hilti HIT-RE 500-SD Adhesive: Hilti HIT-RE 500-SD Adhesive is an injectable two-component epoxy adhesive. The two components are separated 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-RE 500-SD 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, corresponds to an unopened foil pack stored in a dry, dark environment.

3.2.2 Hole Cleaning Equipment: Hole cleaning equipment must be in accordance with Figure 5 of this report.

3.2.3 Dispensers: Hilti HIT-RE 500-SD 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: Threaded steel rods must be clean, continuously threaded rods (all-thread) in diameters as described in Tables 7 and 11 and Figure 5 of this report. Steel design information for common grades of threaded rods are provided in Table 2 and Table 3. Carbon steel threaded rods must be furnished with a 0.005-millimeter-thick (5 μm) zinc electroplated coating complying with ASTM B 633 SC 1 or must be hot-dipped galvanized complying with ASTM A 153, Class C or D. Threaded steel 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 bars (rebar). Tables 23, 27 and 31 and Figure 5 summarize reinforcing bar size ranges. See Table 6 for specifications of common reinforcing bar types and grades. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust and other coatings that may 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. Mechanical properties for HIS-N and HIS-RN inserts are provided in Table 4. The inserts are available in diameters and lengths as shown in Tables 15 and 19 and Figure 5. HIS-N inserts are produced from carbon steel and furnished either with a 0.005-millimeter-thick (5 µm) 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 conforming to DIN 17440. 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, φ, 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 less than 14 percent or a reduction of area less than 30 percent, or both, are considered brittle. Values for various common steel materials are provided in Tables 2, 3 and 5 of this report.

3.3 Concrete:

Normal-weight concrete must comply with Section 1903 and 1095 of the IBC. The specified compressive strength of 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: Anchor design strengths, ϕN_n and ϕV_n, must be determined in accordance with ACI 318-08 (2009 IBC) or ACI 318-05 Appendix D and this report. A design example is given in Figure 4 of this report. Design parameters are provided in Tables 5 through 10 of this report. Design strengths must be determined in accordance with ACI 318-08, as an alternative to the 2000 and 2003 IBC, and Section R301.1 of the IRC. Design parameters are based on the 2009 IBC (ACI 318-08) unless noted otherwise in Sections D.4.1.1 through 4.1.11 of this report. The anchor design must satisfy the requirements of ACI 318 Sections D.4.1.1 and D.4.1.2. Strength reduction factors, ϕ, described in ACI 318 Section D.4.4, and noted in Tables 5 through 10 of this report, must be used for load combinations calculated in accordance with Section 1605.2.1 of the IBC and ACI 318 Section 9.2. Strength reductions factors, ϕ, described in ACI 318 Section D.4.5 must be used for load combinations calculated in accordance with Appendix C of ACI 318.

This section provides amendments to ACI 318 Appendix D 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), ϕN_n and ϕV_n are the lowest design strengths determined from all appropriate failure modes. ϕN_n is the lowest design strength in tension of an anchor or group of anchors as determined from consideration of ϕN_{sa}, either ϕN_a or ϕN_{ag}, and either ϕN_{cb} or ϕN_{cbg}. ϕV_n is the lowest design strength in shear of an anchor or a group of anchors as determined from consideration of ϕV_{sa}, either ϕV_{cb} or ϕV_{cbg}, and either ϕV_{cp} or ϕV_{cpg}. For adhesive anchors subject to tension resulting from sustained loading, refer to D.4.1.4 for additional requirements.

Add ACI 318 D.4.1.2 as follows:

D.4.1.4— For adhesive anchors subjected to tension resulting from sustained loading, a supplementary design analysis 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 ϕN_n is determined as follows:

D.4.1.4.1—For single anchors: $\phi N_n = 0.75\phi N_{ao}$.

D.4.1.4.2—For anchor groups, Equation (D-1) shall be satisfied by taking $\phi N_n = 0.75\phi N_{ao}$ 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, interaction of tension and shear shall be analyzed in accordance with ACI 318 Section D.4.1.3.

4.1.2 Static Steel Strength in Tension: The nominal strength of an anchor in tension as governed by the steel, N_{sa}, in accordance with ACI 318 Section D.5.1.2 and strength reduction factors in accordance with ACI 318 Section D.4.4 are given in the tables outlined in Table 1 for the corresponding anchor steel.

4.1.3 Static Concrete Breakout Strength in Tension: The nominal concrete breakout strength in tension, N_{cb} or N_{cbg}, must be calculated in accordance with ACI 318 D.5.2 with the following addition:

D.5.2.9—(2006 IBC) or D.5.2.10 (2009 IBC) – The limiting concrete strength of adhesive anchors in tension shall be calculated in accordance withD.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:

$k_{c,cr}$ = 17 where analysis indicates cracking at service load levels in the anchor vicinity (cracked concrete)

$k_{c,uncr}$ = 24 where analysis indicates no cracking at service load levels in the anchor vicinity (uncracked concrete)

Additional information for the determination of the nominal concrete breakout strength (N_{cb} or N_{cbg}) is given in the tables outlined in Table 1 for the corresponding anchor steel. The value of f'_c must be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318 Section D.3.5.

4.1.4 Static Pullout Strength in Tension: In lieu of determining the nominal 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

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

(b) For a group of anchors

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

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 centerlines of the single 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):

$$A_{na0} = (s_{cr,Na})^2 \qquad \text{(D-16c)}$$

with

$s_{cr,Na}$ = *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:

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

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

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

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

where

$\tau_{k,cr}$ is the characteristic bond strength in cracked concrete

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

$$\psi_{g,Na}=\psi_{g,Na0}+\left[\left(\frac{s}{s_{cr,Na}}\right)^{0.5}\cdot\left(1-\psi_{g,Na0}\right)\right] \qquad \text{(D-16g)}$$

where:

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

where:

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

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

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

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

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

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

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 single adhesive anchors or anchor groups loaded in tension is:

$$\Psi_{ed,Na} = 1.0 \text{ for } c_{a,min} \geq c_{cr,Na} \qquad \text{(D-16l)}$$

or

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

D.5.3.13—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 nominal strength, N_a or N_{ag}, of a single adhesive anchor or a group of adhesive anchors shall be calculated according to Eq. (D-16a) and Eq. (D-16b) with $\tau_{k,cr}$ substituted for $\tau_{k,cr}$ in the calculation of the basic strength N_{ao} in accordance with Eq. (D-16f). The factor $\Psi_{g,Na0}$ shall be calculated in accordance with Eq. (D-16h) whereby the value of $\tau_{k,max,uncr}$ shall be calculated in accordance with Eq. (D-16n) and substituted for $\tau_{k,max,cr}$ in Eq. (D-16h).

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

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

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

$$\psi_{p,Na}=\left|\frac{c_{a,min;}\ c_{cr,Na}}{c_{ac}}\right| \text{ when } c_{a,min} < c_{ac} \qquad \text{(D-16p)}$$

where c_{ac} must be determined in accordance with Section 4.1.10 of this report.

For all other cases: $\psi_{p,Na}$ = 1.0

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

4.1.5 Static Steel Strength in Shear: The nominal static strength of an anchor in tension as governed by the steel, V_{sa}, in accordance with ACI 318 Section D.6.1.2 and strength reduction factors are given in the tables outlined in Table 1 for the corresponding anchor steel.

4.1.6 Static Concrete Breakout Strength in Shear: The nominal 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 Section D.6.2 based on information given in the tables outlined in Table 1 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 Section D.6.2.2 using the values of d and h_{ef} given in the tables as outlined in Table 1 for the corresponding anchor steel in lieu of d_o and ℓ_e, respectively. In no case must h_{ef} exceed $8d_o$. The value of f'_c must be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318 Section D.3.5.

4.1.7 Static Concrete Pryout Strength in Shear: In lieu of determining the nominal pryout strength in accordance with ACI 318 Section D.6.3.1, 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 a single adhesive anchor V_{cp} or group of adhesive anchors V_{cpg} shall not exceed:

(a) for a single adhesive anchor:

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

(b) for a group of adhesive anchors:

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

where:

k_{cp} = *1.0 for h_{ef} < 2.5 in. (64 mm)*

k_{cp} = *2.0 for $h_{ef} \geq 2.5$ in. (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},N_{cbg} are determined in accordance with D.5.2.1 to D.5.2.9.

4.1.8 Bond Strength Determination: Bond strength values are a function of concrete condition (cracked, uncracked), drilling method (hammer drill, core drill) and installation conditions (dry, water-saturated, etc.). Bond strength values must be modified with the factor κ_{nn} for cases where holes are drilled in water-saturated concrete (κ_{ws}), where the holes are water-filled at the time of anchor installation (κ_{wf}), or where the anchor installation is conducted underwater (κ_{uw}) as follows:

CONCRETE TYPES		HOLE DRILLING METHOD	PERMISSIBLE INSTALLATION CONDITIONS	BOND STRENGTH	ASSOCIATED STRENGTH REDUCTION FACTOR
	CRACKED		Dry concrete	$\tau_{k,cr}$	ϕ_d
			Water-saturated	$\tau_{k,cr} \cdot \kappa_{ws}$	ϕ_{ws}
	UNCRACKED		Dry concrete	$\tau_{k,uncr}$	ϕ_d
			Water-saturated	$\tau_{k,uncr} \cdot \kappa_{ws}$	ϕ_{ws}
			Water-filled hole	$\tau_{k,uncr} \cdot \kappa_{wf}$	ϕ_{wf}
			Underwater application	$\tau_{k,uncr} \cdot \kappa_{uw}$	ϕ_{uw}
			Dry concrete	$\tau_{k,uncr}$	ϕ_d
			Water saturated	$\tau_{k,uncr} \cdot \kappa_{ws}$	ϕ_{ws}

Figure 3 presents a selection flowchart. Where applicable, the modified bond strength values must be used in lieu of $\tau_{k,cr}$ and $\tau_{k,uncr}$ in Equations (D-16d), (D-16f), (D-16h) and (D-16j). The resulting nominal bond strength must be multiplied by the associated strength reduction factor ϕ_{nn}.

4.1.9 Minimum Member Thickness h_{min}, Anchor Spacing s_{min} and Edge Eistance c_{min}: In lieu of ACI 318 Section 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 Section 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:

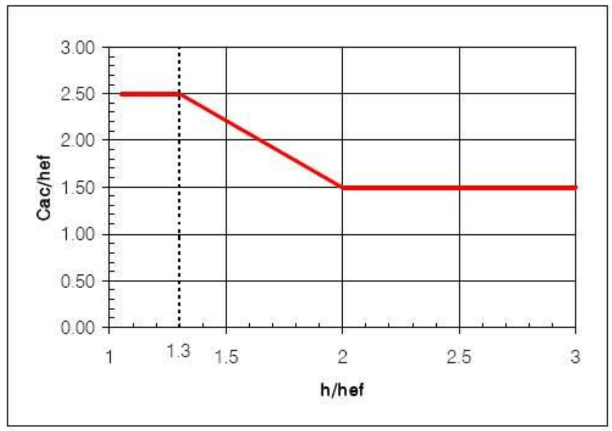
D.8.8—For adhesive anchors that will remain untorqued, the minimum edge distance shall be based on minimum cover requirements for reinforcement in Section 7.7. For adhesive anchors that will be torqued, the minimum edge distance and spacing shall be taken as $6d_o$ and $5d_o$, respectively.

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 Section 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.



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

For edge distance c_{a1}=1.75 inch (45 mm) T_{max} must be reduced according to the table provided below:

Edge distance, c_{a1}, in. (mm)	Element spacing, s, in. (mm)	T_{max}
1.75 (45)	5ϕ	0.30 T_{max}
1.75 (45)	16 (406)	0.50 T_{max}

4.1.11 Design Strength in Seismic Design Categories C, D, E and F: In structures assigned Design Category C, D, E or F under the IBC or IRC, the anchor strength must be adjusted in accordance with 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16. The nominal steel shear strength, V_{sa}, must be adjusted by $\alpha_{V,seis}$ as given in the tables summarized in Table 1 for the corresponding anchor steel. The nominal bond strength $\tau_{k,cr}$ must be adjusted by $\alpha_{N,seis}$ as given in the tables summarized in Table 1 for the corresponding anchor steel.

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 Section 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 the equations below:

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

and

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

where

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

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

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 Appendix D with amendments in Section 3.3 of this criteria, 2009 IBC Sections 1908.1.9 and 1908.1.10 and 2006 IBC Section 1908.1.16.

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 Appendix D with amendments in Section 3.3 of this criteria, 2009 IBC Sections 1908.1.9 and 1908.1.10 and 2006 IBC Section 1908.1.16.

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

Limits on edge distance, anchor spacing and member thickness described in this report must apply. Example calculations are provided in Table 35.

4.2.2 Interaction of Tensile and Shear Forces: Interaction shall be calculated in accordance with ACI 318 Section D.7 as follows:

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

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

For all other cases:

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

4.3 Installation:

Installation parameters are illustrated in Figure 1. Installation of the Hilti HIT-RE 500-SD Adhesive Anchor System must conform to the manufacturer's published installation instructions included in each unit package as described in Figure 5 of this report. Anchor locations must comply with this report and the plans and specifications approved by the code official.

4.4 Special Inspection:

Periodic special inspection must be performed where required in accordance with Section 1704.15 of the 2009 IBC, Sections 1704.4 and 1704.13 of the 2006, 2003 or 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 during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, and tightening torque. The special inspector must verify the initial installations of each type and size of adhesive anchor by construction personnel on site. Subsequent installations of the same anchor type and size by the same construction personnel must be 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 must require 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 and 1706 must be observed, where applicable.

5.0 CONDITIONS OF USE

The Hilti HIT-RE 500-SD Adhesive Anchor System described in this report complies with the codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Hilti HIT-RE 500-SD adhesive anchors must be installed in accordance with the manufacturer's published installation instructions as included in the adhesive packaging and described in Figure 5 of this report.

5.2 The anchors must be installed in cracked and 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 (55.1 MPa)

5.4 Anchors must be installed in concrete base materials in holes predrilled in accordance with the instructions in Figure 5.

5.5 Loads applied to the anchors must be adjusted in accordance with Section 1605.2 of the 2009, 2006, 2003 or 2000 IBC for strength design and in accordance with Section 1605.3 of the 2009, 2006, 2003 or 2000 IBC for allowable stress design.

5.6 Hilti HIT-RE 500-SD adhesive anchors are recognized for use to resist short- and long-term loads, including wind and earthquake, subject to the conditions of this report.

5.7 In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchor strength must be adjusted in accordance with 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16.

5.8 Hilti HIT-RE 500-SD adhesive anchors are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchor, subject to the conditions of this report.

5.9 Strength design values are established in accordance with Section 4.1 of this report.

5.10 Allowable design values are established in accordance with Section 4.2 of this report.

5.11 Minimum anchor spacing and edge distance as well as minimum member thickness must comply with the values described in this report.

5.12 The minimum anchor embedment for threaded rods (Tables 2 and 3) is limited to the following values:

d [in.]	$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_8$	$1^1/_4$
$h_{ef,min}$ [in.]	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	$3^1/_2$	*4d*	*4d*	*4d*

d [mm]	8	10	12	16	20	24	27	32
$h_{ef,min}$ [mm]	60	60	70	80	90	*4d*	*4d*	*4d*

The maximum anchor embedment for all anchor materials is limited to maximum of 20 times the outer diameter *d* of the fastening element.

5.13 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the building 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.

5.14 Anchors are not permitted to support fire-resistive construction. Where not otherwise prohibited in the code, Hilti HIT-RE 500-SD adhesive anchors are permitted for installation in fire-resistive construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support gravity load–bearing structural elements are within a fire-resistive envelope or a fire-resistive membrane, are protected by approved fire-resistive materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support nonstructural elements.

5.15 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.

5.16 Use of zinc-plated carbon steel anchors is limited to dry, interior locations.

5.17 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.

5.18 Hilti HIT-RE 500-SD adhesives are manufactured by Hilti GmbH, Kaufering, Germany, with quality control inspections by UL LLC (AA-668).

5.19 Hilti HIS-N and HIS-RN inserts are manufactured by Hilti (China) Ltd., Guangdong, China, with quality control inspections by UL LLC (AA-668).

6.0 EVIDENCE SUBMITTED

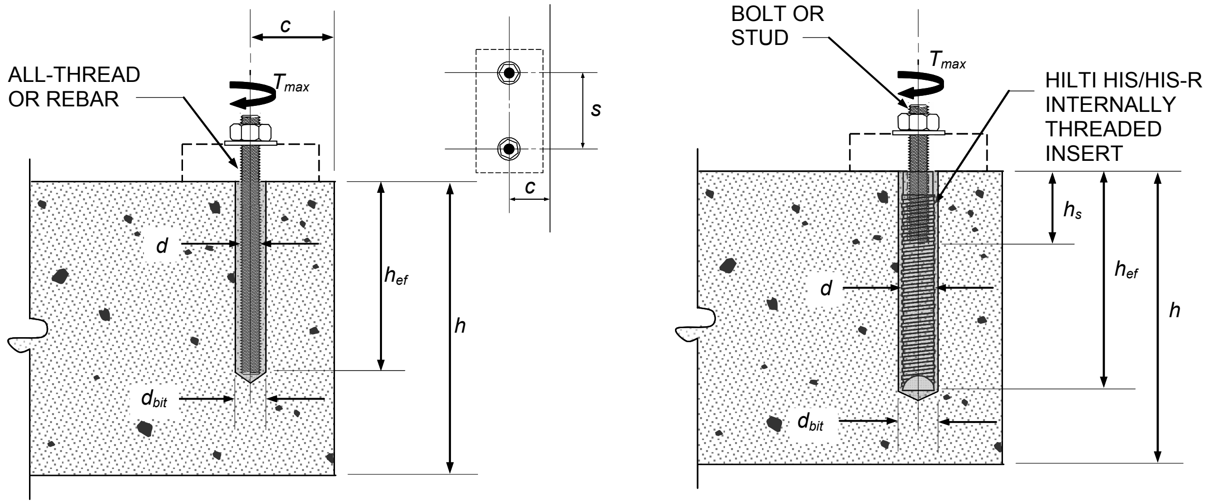
Data in accordance with the ICC-ES Acceptance Criteria for Post-installed Adhesive Anchors in Concrete (AC308), dated November 2009, including but not limited to tests under freeze/thaw conditions (Table 4.2, test series 6).

7.0 IDENTIFICATION

7.1 Hilti HIT-RE 500-SD adhesive is identified by packaging labeled with the manufacturer's name (Hilti Corp.) and address, anchor name, evaluation report number (ICC-ES ESR-2322), and the name of the inspection agency (UL LLC).

7.2 HIS-N and HIS-RN inserts are identified by packaging labeled with the manufacturer's name (Hilti Corp.) and address, anchor name, evaluation report number (ICC-ES ESR-2322), and the name of the inspection agency (UL LLC).

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.



THREADED ROD/REINFORCING BAR

HIS AND HIS-R INSERTS

FIGURE 1—INSTALLATION PARAMETERS

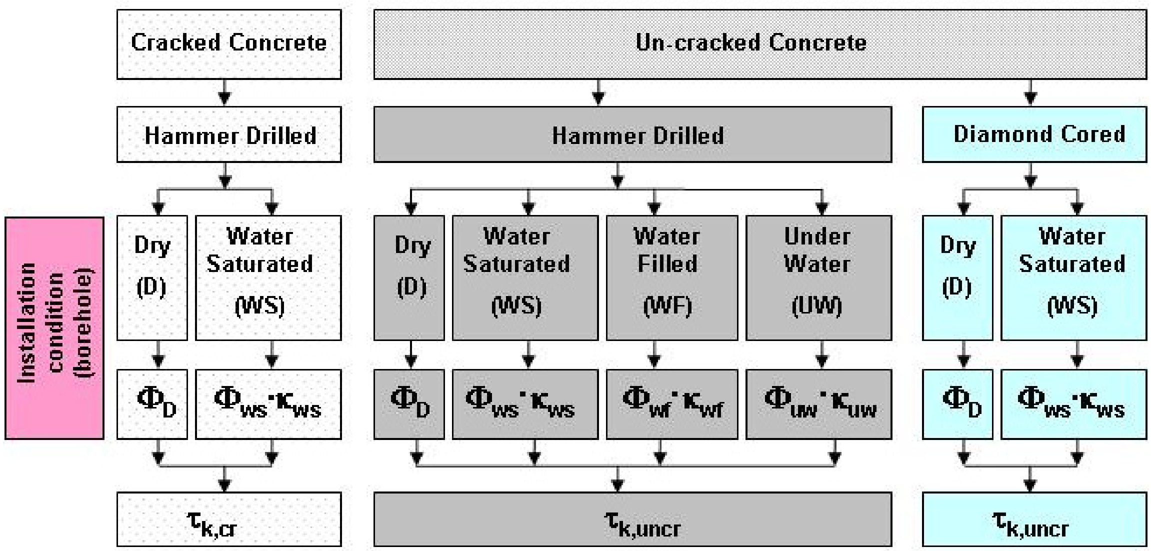


FIGURE 2—FLOW CHART FOR THE ESTABLISHMENT OF DESIGN BOND STRENGTH

TABLE 1—DESIGN TABLE INDEX

Design strength[1]			**Threaded rod**		**Hilti HIS internally threaded insert**		**Deformed reinforcement**		
			fractional	**metric**	**fractional**	**metric**	**fractional**	**metric**	**Canadian**
Steel	N_{sa}, V_{sa}		Table 7	Table 11	Table 15	Table 19	Table 23	Table 27	Table 31
Concrete	N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}		Table 8	Table 12	Table 16	Table 20	Table 24	Table 28	Table 32
Bond[2]	N_a, N_{ag}	hammer-drilled holes	Table 9	Table 13	Table 17	Table 21	Table 25	Table 29	Table 33
		diamond cored holes	Table 10	Table 14	Table 18	Table 22	Table 26	Table 30	Table 34

[1] Ref. ACI 318-05 D.4.1.2
[2] See Section 4.1 of this evaluation report

TABLE 2—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON CARBON STEEL THREADED ROD MATERIALS[1]

THREADED ROD SPECIFICATION		Minimum specified ultimate strength, f_{uta}	Minimum specified yield strength 0.2 percent offset, f_{ya}	f_{uta}/f_{ya}	Elongation, min. percent[5]	Reduction of Area, min. percent	Specification for nuts[6]
ASTM A 193[2] Grade B7 ≤ 2 1/2 in. (≤ 64 mm)	psi (MPa)	125,000 (862)	105,000 (724)	1.19	16	50	ASTM A 194
ASTM F 568M[3] 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[7]
ISO 898-1[4] Class 5.8	MPa (psi)	500 (72,500)	400 (58,000)	1.25	22	-	DIN 934 (8-A2K)
ISO 898-1[4] Class 8.8	MPa (psi)	800 (116,000)	640 (92,800)	1.25	12	52	DIN 934 (8-A2K)

[1]Hilti HIT-RE 500-SD must be used with continuously threaded carbon steel rod (all-thread) 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.
[2]Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
[3]Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners
[4]Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs
[5]Based on 2-in. (50 mm) gauge length except for A 193, which are based on a gauge length of 4d and ISO 898, which is based on 5d.
[6]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.
[7]Nuts for fractional rods.

TABLE 3—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON STAINLESS STEEL THREADED ROD MATERIALS[1]

THREADED ROD SPECIFICATION		Minimum specified ultimate strength, f_{uta}	Minimum specified yield strength 0.2 percent offset, f_{ya}	f_{uta}/f_{ya}	Elongation, min. percent	Reduction of Area, min. percent	Specification for nuts[4]
ASTM F 593[2] CW1 (316) 1/4 to 5/8 in.	psi (MPa)	100,000 (689)	65,000 (448)	1.54	20	-	ASTM F 594 Alloy group 1, 2 or 3
ASTM F 593[2] CW2 (316) 3/4 to 1 1/2 in.	psi (MPa)	85,000 (586)	45,000 (310)	1,89	25	-	ASTM F 594 Alloy group 1, 2, or 3
ISO 3506-1[3] A4-70 M8 – M24	MPa (psi)	700 (101,500)	450 (65,250)	1.56	40	-	ISO 4032
ISO 3506-1[3] A4-50 M27 – M30	MPa (psi)	500 (72,500)	210 (30,450)	2.00	40	-	ISO 4032

[1]Hilti HIT-RE 500-SD must be used with continuously threaded stainless steel rod (all-thread) 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.
[2]Standard Steel Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
[3]Mechanical properties of corrosion-resistant stainless steel fasteners – Part 1: Bolts, screws and studs.
[4]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—SPECIFICATIONS AND PHYSICAL PROPERTIES OF U.S. CUSTOMARY UNIT 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 EN 10088-3 X5CrNiMo 17-12-2	MPa	700	350
	(psi)	(101,500)	(50,750)

TABLE 5—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON BOLTS, CAP SCREWS AND STUDS FOR USE WITH HIS-N AND HIS-RN INSERTS[1,2]

BOLT, CAP SCREW OR STUD SPECIFICATION		Minimum specified ultimate strength f_{uta}	Minimum specified yield strength 0.2 percent offset f_{ya}	f_{uta}/f_{ya}	Elongation, min.	Reduction of Area, min.	Specification for nuts[6]
SAE J429[3] Grade 5	psi	120,000	92,000	1.30	14	35	SAE J995
	(MPa)	(828)	(634)				
ASTM A 325[4] 1/2 to 1-in.	psi	120,000	92,000	1.30	14	35	A 563 C, C3, D, DH, DH3 Heavy Hex
	(MPa)	(828)	(634)				
ASTM A193[5] Grade B8M (AISI 316) for use with HIS-RN	psi	110,000	95,000	1.16	15	45	ASTM F 594[7] Alloy Group 1, 2 or 3
	(MPa)	(759)	(655)				
ASTM A193[5] Grade B8T (AISI 321) for use with HIS-RN	psi	125,000	100,000	1.25	12	35	ASTM F 594[7] Alloy Group 1, 2 or 3
	(MPa)	(862)	(690)				

[1]Minimum Grade 5 bolts, cap screws or studs must be used with carbon steel HIS inserts.
[2]Only stainless steel bolts, cap screws or studs must be used with HIS-RN inserts.
[3]Mechanical and Material Requirements for Externally Threaded Fasteners
[4]Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
[5]Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
[6]Nuts must have specified minimum proof load stress equal to or greater than the specified minimum full-size tensile strength of the specified stud.
[7] Nuts for stainless steel studs must be of the same alloy group as the specified bolt, cap screw, or stud.

TABLE 6—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON STEEL REINFORCING BARS

REINFORCING BAR SPECIFICATION		Minimum specified ultimate strength, f_{uta}	Minimum specified yield strength, f_{ya}
ASTM A 615[1] Gr. 60	psi	90,000	60,000
	(MPa)	(620)	(414)
ASTM A 615[1] Gr. 40	psi	60,000	40,000
	(MPa)	(414)	(276)
DIN 488[2] BSt 500	MPa	550	500
	(psi)	(79,750)	(72,500)
CAN/CSA-G30.18[3] Gr. 400	MPa	540	400
	(psi)	(78,300)	(58,000)

[1]Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
[2]Reinforcing steel; reinforcing steel bars; dimensions and masses
[3]Billet-Steel Bars for Concrete Reinforcement

TABLE 7—STEEL DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD[1]

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (in.)						
				3/8	1/2	5/8	3/4	7/8	**1**	**1 1/4**
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)	1.25 (31.8)
Rod effective cross-sectional area		A_{se}	in.^{2} (mm^2)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ISO 898-1 Class 5.8[2]	Nominal strength as governed by steel strength	N_{sa}	lb (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)	70,260 (312.5)
		V_{sa}	lb (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)	42,155 (187.5)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70						
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65						
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60						
ASTM A 193 B7[2]	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)	121,135 (538.8)
		V_{sa}	lb (kN)	4,845 (21.5)	10,640 (47.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,680 (323.3)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70						
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.75						
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.65						
ASTM F593, CW Stainless[2]	Nominal strength as governed by steel strength	N_{sa}	lb (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)	82,370 (366.4)
		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)	49,425 (219.8)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70						
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65						
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60						

For **SI:** 1 inch ≡ 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

[1] Values provided for common rod material types are based on specified strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Nuts and washers must be appropriate for the rod.
[2] For use with the load combinations of ACI 318 Section 9.2, as set forth in ACI 318 D.4.4.

TABLE 8—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD[1]

DESIGN INFORMATION	Symbol	Units	Nominal rod diameter (in.)						
			$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7.1)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)						
Min. anchor spacing[3]	s_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	$3^1/_8$ (79)	$3^3/_4$ (95)	$4^3/_8$ (111)	5 (127)	$6^1/_4$ (159)
Min. edge distance[3]	c_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	$3^1/_8$ (79)	$3^3/_4$ (95)	$4^3/_8$ (111)	5 (127)	$6^1/_4$ (159)
Minimum member thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ (h_{ef} + 30)		$h_{ef} + 2d_0$				
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[2]	ϕ	-	0.65						
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	0.70						

For **SI:** 1 inch ≡ 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

[1]Additional setting information is described in Figure 5, installation instructions.
[2] Values provided for post-installed anchors under Condition B without supplementary reinforcement as defined in ACI 318 Section D.4.4.
[3]For installations with $1^3/_4$ inch edge distance refer to Section 4.1.10 for spacing and maximum torque requirements.

TABLE 9—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD[1,4]

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (in.)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Temperature range A[3]	Characteristic bond strength and minimum anchor embedment in cracked concrete	$\tau_{k,cr}$	psi (MPa)	1,090 (7.5)	1,075 (7.4)	1,045 (7.2)	1,000 (6.9)	920 (6.3)	850 (5.9)	730 (5.0)
		$h_{ef,min}$	in. (mm)	See Section 5.12						
	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	Psi (MPa)	2,285 (15.7)	2,235 (15.4)	2,140 (14.8)	2,065 (14.3)	2,000 (13.8)	1,945 (13.4)	1,860 (12.8)
		$h_{ef,min}$	in. (mm)	See Section 5.12						
Temperature range B[3]	Characteristic bond strength and minimum anchor embedment in cracked concrete[2]	$\tau_{k,cr}$	Psi (MPa)	445 (3.1)	430 (3.0)	380 (2.6)	345 (2.4)	315 (2.2)	295 (2.0)	260 (1.8)
		$h_{ef,min}$	in. (mm)	See Section 5.12						
	Characteristic bond strength and minimum anchor embedment in uncracked concrete[2]	$\tau_{k,uncr}$	Psi (MPa)	790 (5.4)	770 (5.3)	740 (5.1)	715 (4.9)	690 (4.8)	670 (4.6)	645 (4.4)
		$h_{ef,min}$	in. (mm)	See Section 5.12						
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.55	0.45	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.0	1.0	1.0	1.0	1.0	0.99	0.94
	Water-filled hole	ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{wf}	-	1.00	1.00	0.96	0.91	0.87	0.84	0.79
	Underwater application	ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{uw}	-	0.95	0.94	0.94	0.93	0.92	0.92	0.91

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Bond strength values are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), maximum long term temperature = 110°F (43°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.
[4] For structures assigned to Seismic Design Categories C, D, E or F, bond strength values must be multiplied by $\alpha_{N,seis}$ = 0.65.

TABLE 10—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A CORE DRILL[1,4]

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (in.)						
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Temperature range A[3]	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,740 (12.0)	1,705 (11.7)	1,555 (10.7)	1,440 (9.9)	1,355 (9.4)	1,280 (8.8)	1,170 (8.1)
		$h_{ef,min}$	in. (mm)	See Section 5.12						
Temperature range B[3]	Characteristic bond strength and minimum anchor embedment in uncracked concrete[2]	$\tau_{k,uncr}$	psi (MPa)	600 (4.1)	590 (4.1)	535 (3.7)	495 (3.4)	470 (3.2)	440 (3.1)	405 (2.8)
		$h_{ef,min}$	in. (mm)	See Section 5.12						
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.55	0.55	0.55	0.45	0.45
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.55	0.45	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.00	1.00	1.00	1.00	1.00	0.95	0.88

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), maximum long term temperature = 110°F (43°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.
[4] Bond strength values applicable to Seismic Design Categories A and B only.

TABLE 11—STEEL DESIGN INFORMATION FOR METRIC THREADED ROD[1]

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (mm)							
				8	**10**	**12**	**16**	**20**	**24**	**27**	**30**
Rod Outside Diameter		d	mm	8	10	12	16	20	24	27	30
			(in.)	(0.31)	(0.39)	(0.47)	(0.63)	(0.79)	(0.94)	(1.06)	(1.18)
Rod effective cross-sectional area		A_{se}	mm^2	36.6	58	84.3	157	245	353	459	561
			($in.^2$)	(0.057)	(0.090)	(0.131)	(0.243)	(0.380)	(0.547)	(0.711)	(0.870)
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength	N_{sa}	kN	18.5	29.0	42.0	78.5	122.5	176.5	229.5	280.5
			(lb)	(4,114)	(6,519)	(9,476)	(17,647)	(27,539)	(39,679)	(51,594)	(63,059)
		V_{sa}	kN	9.0	14.5	25.5	47.0	73.5	106.0	137.5	168.5
			(lb)	(2,057)	(3,260)	(5,685)	(10,588)	(16,523)	(23,807)	(30,956)	(37,835)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60							
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength	N_{sa}	kN	29.5	46.5	67.5	125.5	196.0	282.5	367.0	449.0
			(lb)	(6,582)	(10,431)	(15,161)	(28,236)	(44,063)	(63,486)	(82,550)	(100,894)
		V_{sa}	kN	14.5	23.0	40.5	75.5	117.5	169.5	220.5	269.5
			(lb)	(3,291)	(5,216)	(9,097)	(16,942)	(26,438)	(38,092)	(49,530)	(60,537)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60							
ISO 3506-1 Class A4 Stainless[3]	Nominal strength as governed by steel strength	N_{sa}	kN	25.6	40.6	59.0	109.9	171.5	247.1	229.5	280.5
			(lb)	(5,760)	(9,127)	(13,266)	(24,706)	(38,555)	(55,550)	(51,594)	(63,059)
		V_{sa}	kN	12.8	20.3	35.4	65.9	102.9	148.3	137.7	168.3
			(lb)	(2,880)	(4,564)	(7,960)	(14,824)	(23,133)	(33,330)	(30,956)	(37,835)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60							

For **SI:** 1 inch ≡ 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

[1] Values provided for common rod material types are based on specified strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Nuts and washers must be appropriate for the rod.
[2] For use with the load combinations of ACI 318 Section 9.2, as set forth in ACI 318 D.4.4.
[3] A4-70 Stainless (M8- M24); A4-502 Stainless (M27- M30)

TABLE 12—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	Symbol	Units	Nominal rod diameter (mm)							
			8	10	12	16	20	24	27	30
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (in-lb)	7.1 (17)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)							
Min. anchor spacing[3]	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[3]	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} + $1^1/_4$)		$h_{ef} + 2d_o$					
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[2]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	0.70							

For **SI:** 1 inch ≡ 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

[1]Additional setting information is described in Figure 5, installation instructions.
[2] Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.
[3]For installations with $1^3/_4$ inch edge distance refer to Section 4.1.10 for spacing and maximum torque requirements.

TABLE 13—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1,4]

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (mm)							
				8	10	12	16	20	24	27	30
Temperature range A[3]	Characteristic bond strength and minimum anchor embedment in cracked concrete	$\tau_{k,cr}$	MPa (psi)	7.5 (1,092)	7.5 (1,092)	7.5 (1,092)	7.2 (1,044)	6.5 (972)	6.0 (877)	5.5 (831)	5.5 (768)
		$h_{ef,min}$	mm (in.)	See Section 5.12							
	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	15.5 (2,264)	15.5 (2,264)	15.5 (2,264)	15.0 (2,142)	14.0 (2,039)	13.5 (1,974)	13.5 (1,927)	13.0 (1,880)
		$h_{ef,min}$	mm (in.)	See Section 5.12							
Temperature range B[3]	Characteristic bond strength and minimum anchor embedment in cracked concrete[2]	$\tau_{k,cr}$	MPa (psi)	3.0 (444)	3.0 (444)	3.0 (444)	2.5 (379)	2.5 (336)	2.0 (303)	2.0 (287)	2.0 (268)
		$h_{ef,min}$	mm (in.)	See Section 5.12							
	Characteristic bond strength and minimum anchor embedment in uncracked concrete[2]	$\tau_{k,uncr}$	MPa (psi)	5.5 (781)	5.5 (781)	5.5 (781)	5.0 (739)	5.0 (704)	4.5 (681)	4.5 (665)	4.5 (649)
		$h_{ef,min}$	mm (in.)	See Section 5.12							
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.55	0.55	0.45	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.95
	Water-filled hole	ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{wf}	-	1.00	1.00	1.00	0.96	0.90	0.86	0.83	0.81
	Underwater application	ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{uw}	-	0.95	0.95	0.95	0.94	0.93	0.92	0.92	0.91

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] For structures assigned to Seismic Design Categories C, D, E or F, bond strength values must be multiplied by $\alpha_{N,seis}$ = 0.65.

TABLE 14—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED ROD IN HOLES DRILLED WITH A CORE DRILL[1,4]

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (mm)							
				8	10	12	16	20	24	27	30
Temperature range A[3]	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	12.0 (1,740)	12.0 (1,740)	12.0 (1,740)	10.5 (1,553)	9.5 (1,413)	9.0 (1,310)	8.5 (1,254)	8.5 (1,197)
		$h_{ef,min}$	mm (in.)	See Section 5.12							
Temperature range B[3]	Characteristic bond strength and minimum anchor embedment in uncracked concrete[2]	$\tau_{k,uncr}$	MPa (psi)	4.0 (601)	4.0 (601)	4.0 (601)	3.5 (536)	3.5 (488)	3.0 (452)	3.0 (433)	3.0 (413)
		$h_{ef,min}$	mm (in.)	See Section 5.12							
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.65	0.55	0.55	0.55	0.45	0.45
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.55	0.55	0.45	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.00	1.00	1.00	1.00	1.00	0.97	0.93	0.90

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For short-term loads including wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] Bond strength values applicable to Seismic Design Categories A and B only.

TABLE 15—STEEL DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT HILTI HIS-N AND HIS-RN INSERTS[1]

DESIGN INFORMATION		Symbol	Units	Nominal bolt/cap screw diameter (in.)			
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$
HIS insert O.D.		d	in. (mm)	0.65 (16.5)	0.81 (20.5)	1 (25.4)	1.09 (27.6)
HIS insert length		l	in. mm)	4.33 (110)	4.92 (125)	6.69 (170)	8.07 (205)
Bolt effective cross-sectional area		A_{se}	(mm) (mm^2)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)
HIS insert effective cross-sectional area		A_{insert}	in.^{2} (mm^2)	0.178 (115)	0.243 (157)	0.404 (260)	0.410 (265)
ASTM A 193 B7	Nominal strength as governed by steel strength – ASTM A 193 B7[3] bolt/cap screw	N_{sa}	lb (kN)	9,690 (43.1)	17,740 (78.9)	28,250 (125.7)	41,815 (186.0)
		V_{sa}	lb (kN)	5,815 (25.9)	10,645 (47.3)	16,950 (75.4)	25,090 (111.6)
	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)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70			
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65			
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60			
ASTM A193 Grade B8M SS	Nominal strength as governed by steel strength – ASTM A193 Grade B8M SS bolt/cap screw	N_{sa}	lb (kN)	8,525 (37.9)	15,610 (69.4)	24,860 (110.6)	36,795 (163.7)
		V_{sa}	lb (kN)	5,115 (22.8)	9,365 (41.7)	14,915 (66.3)	22,075 (98.2)
	Nominal strength as governed by steel strength – HIS-RN insert	N_{sa}	lb (kN)	17,165 (76.3)	23,430 (104.2)	38,955 (173.3)	39,535 (175.9)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70			
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65			
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60			

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

[1] Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Nuts and washers must be appropriate for the rod.
[2] For use with the load combinations of ACI 318 9.2, as set forth in ACI 318 D.4.4. Values correspond to a brittle steel element for the HIS insert.
[3] For the calculation of the design steel strength in tension and shear for the bolt or screw, the ϕ factor for ductile steel failure according to ACI 318 D4.4 can be used.

TABLE 16—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT HILTI HIS-N AND HIS-RN INSERTS [1]

DESIGN INFORMATION	Symbol	Units	Nominal bolt/cap screw diameter (in.)			
			3/8	1/2	5/8	3/4
Effective embedment depth	h_{ef}	in. (mm)	4 3/8 (110)	5 (125)	6 3/4 (170)	8 1/8 (205)
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7.1)			
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)			
Min. anchor spacing[3]	s_{min}	in. (mm)	3 1/4 (83)	4 (102)	5 (127)	5 1/2 (140)
Min. edge distance[3]	c_{min}	in. (mm)	3 1/4 (83)	4 (102)	5 (127)	5 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[2]	ϕ	-	0.65			
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	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

[1]Additional setting information is described in Figure 5, installation instructions.
[2] Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.
[3]For installations with 1 3/4 inch edge distance refer to Section 4.1.10 for spacing and maximum torque requirements.

TABLE 17—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT HILTI HIS-N AND HIS-RN INSERTS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT [1,4]

DESIGN INFORMATION		Symbol	Units	Nominal bolt/cap screw diameter (in.)			
				3/8	1/2	5/8	3/4
Effective embedment depth		h_{ef}	in. (mm)	4 3/8 (110)	5 (125)	6 3/4 (170)	8 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 A[3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	1040 (7.2)	955 (6.6)	845 (5.8)	805 (5.6)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	2125 (14.6)	2030 (14.0)	1945 (13.4)	1910 (13.2)
Temperature range B[3]	Characteristic bond strength in cracked concrete[2]	$\tau_{k,cr}$	psi (MPa)	375 (2.6)	330 (2.3)	290 (2.0)	280 (1.9)
	Characteristic bond strength in uncracked concrete[2]	$\tau_{k,uncr}$	psi (MPa)	735 (5.1)	700 (4.8)	670 (4.6)	660 (4.5)
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.55	0.55
	Water-saturated concrete	ϕ_{ws}	-	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.00	1.00	0.99	0.97
	Water-filled hole	ϕ_{wf}	-	0.45	0.45	0.45	0.45
		κ_{wf}	-	0.95	0.89	0.84	0.82
	Underwater application	ϕ_{uw}	-	0.45	0.45	0.45	0.45
		κ_{uw}	-	0.93	0.93	0.92	0.92

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] For structures assigned to Seismic Design Categories C, D, E or F, bond strength values must be multiplied by $\alpha_{N,seis}$ = 0.65.

TABLE 18—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT HILTI HIS-N AND HIS-RN INSERTS IN HOLES DRILLED WITH A CORE DRILL[1,4]

DESIGN INFORMATION		Symbol	Units	Nominal bolt/cap screw diameter (in.)			
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$
Effective embedment depth		h_{ef}	in. (mm)	4$^3/_8$ (110)	5 (125)	6$^3/_4$ (170)	8$^1/_8$ (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 A[3]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,535 (10.6)	1,405 (9.7)	1,280 (8.8)	1,235 (8.5)
Temperature range B[3]	Characteristic bond strength in uncracked concrete[2]	$\tau_{k,uncr}$	psi (MPa)	530 (3.7)	485 (3.3)	440 (3.1)	425 (2.9)
Permissible installation conditions	Dry concrete	ϕ_d	-	0.55	0.55	0.45	0.45
	Water-saturated concrete	ϕ_{ws}	-	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.00	1.00	0.95	0.92

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] Bond strength values applicable to Seismic Design Categories A and B only.

TABLE 19—STEEL DESIGN INFORMATION FOR METRIC HILTI HIS-N AND HIS-RN INSERTS[1]

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)
HIS insert length		l	mm (in.)	90 (3.54)	110 (4.33)	125 (4.92)	170 (6.69)	205 (8.07)
Bolt effective cross-sectional area		A_{se}	mm² (in.²)	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}	mm² (in.²)	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)	29.5 (6,582)	46.5 (10,431)	67.5 (15,161)	125.5 (28,236)	196.0 (44,063)
		V_{sa}	kN (lb)	17.5 (3,949)	28.0 (6,259)	40.5 (9,097)	75.5 (16,942)	117.5 (26,438)
	Nominal strength as governed by steel strength – HIS-N insert	N_{sa}	kN (lb)	25.0 (5,669)	53.0 (11,894)	78.0 (17,488)	118.0 (26,483)	110.0 (24,573)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70				
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65				
	Strength reduction factor ϕ for shear[2]	ϕ	-	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)	25.5 (5,760)	40.5 (9,127)	59.0 (13,266)	110.0 (24,706)	171.5 (38,555)
		V_{sa}	kN (lb)	15.5 (3,456)	24.5 (5,476)	35.5 (7,960)	66.0 (14,824)	103.0 (23,133)
	Nominal strength as governed by steel strength – HIS-RN insert	N_{sa}	kN (lb)	36.0 (8,099)	75.5 (16,991)	118.5 (26,612)	179.5 (40,300)	166.5 (37,394)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70				
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65				
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60				

For **SI:** 1 inch ≡ 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

[1] Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Nuts and washers must be appropriate for the rod.
[2] For use with the load combinations of ACI 318 9.2 as set forth in ACI 318 D.4.4. Values correspond to a brittle steel element.

TABLE 20—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC HILTI HIS-N AND HIS-RN INSERTS [1]

DESIGN INFORMATION	Symbol	Units	Nominal bolt/cap screw diameter (in.)				
			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 cracked concrete	$k_{c,cr}$	SI (in-lb)	7.1 (17)				
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)				
Min. anchor spacing[3]	s_{min}	mm (in.)	63 (2.5)	83 (3.25)	102 (4.0)	127 (5.0)	140 (5.5)
Min. edge distance[3]	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[2]	ϕ	-	0.65				
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	0.70				

For **SI:** 1 inch ≡ 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

[1]Additional setting information is described in Figure 5, installation instructions.
[2]Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.
[3]For installations with $1^3/_4$ inch edge distance refer to Section 4.1.10 for spacing and maximum torque requirements.

TABLE 21—BOND STRENGTH DESIGN INFORMATION FOR METRIC HILTI HIS-N AND HIS-RN INSERTS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT [1,4]

DESIGN INFORMATION		Symbol	Units	Nominal bolt/cap screw diameter (in.)				
				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)	25.5 (1.00)	27.5 (1.09)
Temperature range A[3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa (psi)	7.5 (1,080)	7.0 (1,040)	6.5 (957)	6.0 (845)	5.5 (806)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	15.5 (2,245)	14.5 (2,124)	14.0 (2,030)	13.5 (1,946)	13.0 (1,908)
Temperature range B[3]	Characteristic bond strength in cracked concrete[2]	$\tau_{k,cr}$	MPa (psi)	3.0 (433)	2.5 (374)	2.5 (330)	2.0 (292)	2.0 (278)
	Characteristic bond strength in uncracked concrete[2]	$\tau_{k,uncr}$	MPa (psi)	5.5 (775)	5.0 (733)	5.0 (701)	4.5 (672)	4.5 (659)
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.65	0.55	0.55
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.00	1.00	1.00	0.99	0.97
	Water-filled hole	ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45
		κ_{wf}	-	1.00	0.95	0.89	0.84	0.82
	Underwater application	ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45
		κ_{uw}	-	0.94	0.93	0.93	0.92	0.92

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] For structures assigned to Seismic Design Categories C, D, E or F, bond strength values must be multiplied by $\alpha_{N,seis}$ = 0.65.

TABLE 22—BOND STRENGTH DESIGN INFORMATION FOR METRIC HILTI HIS-N AND HIS-RN INSERTS IN HOLES DRILLED WITH A CORE DRILL[1,4]

DESIGN INFORMATION		Symbol	Units	Nominal bolt/cap screw diameter (in.)				
				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)	25.5 (1.00)	27.5 (1.09)
Temperature range A[3]	Characteristic bond strength in uncracked concrete	$\tau_{k,cr}$	MPa (psi)	12.0 (1,712)	10.5 (1,534)	9.5 (1,403)	9.0 (1,282)	8.5 (1,235)
Temperature range B[3]	Characteristic bond strength in uncracked concrete[2]	$\tau_{k,cr}$	MPa (psi)	4.0 (591)	3.5 (530)	3.5 (484)	3.0 (442)	3.0 (426)
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.55	0.45	0.45	0.45
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.0	1.0	1.0	0.95	0.92

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] For structures assigned to Seismic Design Categories C, D, E or F, bond strength values must be multiplied by $\alpha_{N,seis}$ = 0.65.

TABLE 23—STEEL DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS[1]

DESIGN INFORMATION		Symbol	Units	Bar size							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal bar diameter		d	in. (mm)	$^3/_8$ (9.5)	$^1/_2$ (12.7)	$^5/_8$ (15.9)	$^3/_4$ (19.1)	$^7/_8$ (22.2)	1 (25.4)	$1^1/_8$ (28.6)	$1^1/_4$ (31.8)
Bar effective cross-sectional area		A_{se}	in.^{2} (mm^2)	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)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	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)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60							

For **SI:** 1 inch ≡ 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

[1] Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318-05 Eq. (D-3) and Eq. (D-20). Nuts and washers must be appropriate for the rod.
[2] For use with the load combinations of ACI 318 Section 9.2, as set forth in ACI 318 Section D.4.4.

TABLE 24—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS

DESIGN INFORMATION	Symbol	Units	Bar size							
			#3	**#4**	**#5**	**#6**	**#7**	**#8**	**#9**	**#10**
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7.1)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)							
Min. bar spacing[3]	s_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	$3^1/_8$ (79)	$3^3/_4$ (95)	$4^3/_8$ (111)	5 (127)	$5^5/_8$ (143)	$6^1/_4$ (159)
Min. edge distance[3]	c_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	$3^1/_8$ (79)	$3^3/_4$ (95)	$4^3/_8$ (111)	5 (127)	$5^5/_8$ (143)	$6^1/_4$ (159)
Minimum member thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ (h_{ef} + 30)		$h_{ef} + 2d_0$					
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[2]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	0.70							

For **SI:** 1 inch ≡ 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

[1]Additional setting information is described in Figure 5, installation instructions.
[2] Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.
[3]For installations with $1^3/_4$ inch edge distance refer to Section 4.1.10 for spacing and maximum torque requirements.

TABLE 25—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1,4]

DESIGN INFORMATION		Symbol	Units	Bar size							
				#3	#4	#5	#6	#7	#8	#9	#10
Temperature range A[3]	Characteristic bond strength and minimum anchor embedment in cracked concrete	$\tau_{k,cr}$	psi (MPa)	1,090 (7.5)	1,075 (7.4)	1,045 (7.2)	1,000 (6.9)	915 (6.3)	855 (5.9)	800 (5.5)	730 (5.0)
		$h_{ef,min}$	in. (mm)	See Section 5.12							
	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	2,265 (15.6)	2,235 (15.4)	2,145 (14.8)	2,065 (14.3)	2,000 (13.8)	1,945 (13.4)	1,900 (13.1)	1,860 (12.8)
		$h_{ef,min}$	in. (mm)								
Temperature range B[3]	Characteristic bond strength and minimum anchor embedment in cracked concrete[2]	$\tau_{k,cr}$	psi (MPa)	444 (3.1)	431 (3.0)	379 (2.6)	345 (2.4)	316 (2.2)	294 (2.0)	276 (1.9)	260 (1.8)
		$h_{ef,min}$	in. (mm)	See Section 5.12							
	Characteristic bond strength and minimum anchor embedment in uncracked concrete[2]	$\tau_{k,uncr}$	psi (MPa)	781 (5.4)	772 (5.3)	739 (5.1)	714 (4.9)	691 (4.8)	672 (4.6)	656 (4.5)	643 (4.4)
		$h_{ef,min}$	in. (mm)	See Section 5.12							
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.65	0.65	0.55	0.55	0.55	0.55
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.55	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.00	1.00	1.00	1.00	1.00	0.99	0.97	0.94
	Water-filled hole	ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{wf}	-	1.00	1.00	0.96	0.91	0.87	0.84	0.82	0.79
	Underwater application	ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{uw}	-	0.95	0.94	0.94	0.93	0.92	0.92	0.92	0.91

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] For structures assigned to Seismic Design Categories C, D, E or F, bond strength values must be multiplied by $\alpha_{N,seis}$ = 0.65.

TABLE 26—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A CORE DRILL[1,4]

DESIGN INFORMATION		Symbol	Units	Bar size							
				#3	#4	#5	#6	#7	#8	#9	#10
Temperature range A[3]	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,740 (12.0)	1,705 (11.7)	1,555 (10.7)	1,440 (9.9)	1,355 (9.4)	1,280 (8.8)	1,225 (8.4)	1,170 (8.1)
		$h_{ef,min}$	in. (mm)	See Section 5.12							
Temperature range B[3]	Characteristic bond strength and minimum anchor embedment in uncracked concrete[2]	$\tau_{k,uncr}$	psi (MPa)	600 (4.1)	590 (4.1)	535 (3.7)	495 (3.4)	470 (3.2)	440 (3.1)	425 (2.9)	405 (2.8)
		$h_{ef,min}$	in. (mm)	See Section 5.12							
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.55	0.55	0.55	0.45	0.45	0.45
	Water-saturated concrete	ϕ_{ws}	-	0.65	0.55	0.55	0.55	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.00	1.00	1.00	1.00	1.00	0.95	0.91	0.88

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] Bond strength values applicable to Seismic Design Categories A and B only.

TABLE 27—STEEL DESIGN INFORMATION FOR EU METRIC REINFORCING BARS[1]

DESIGN INFORMATION		Symbol	Units	Bar size								
				8	**10**	**12**	**14**	**16**	**20**	**25**	**28**	**32**
Nominal bar diameter		d	mm	8.0	10.0	12.0	14.0	16.0	20.0	25.0	28.0	32.0
			(in.)	(0.315)	(0.394)	(0.472)	(0.551)	(0.630)	(0.787)	(0.984)	(1.102)	(1.260)
Bar effective cross-sectional area		A_{se}	mm²	50.3	78.5	113.1	153.9	201.1	314.2	490.9	615.8	804.2
			(in.²)	(0.078)	(0.122)	(0.175)	(0.239)	(0.312)	(0.487)	(0.761)	(0.954)	(1.247)
DIN 488 BSt 550/500	Nominal strength as governed by steel strength	N_{sa}	kN	27.5	43.0	62.0	84.5	110.5	173.0	270.0	338.5	442.5
			(lb)	(6,215)	(9,711)	(13,984)	(19,034)	(24,860)	(38,844)	(60,694)	(76,135)	(99,441)
		V_{sa}	kN	16.5	26.0	37.5	51.0	66.5	103.0	162.0	203.0	265.5
			(lb)	(3,729)	(5,827)	(8,390)	(11,420)	(14,916)	(23,307)	(36,416)	(45,681)	(59,665)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70								
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65								
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60								

For **SI:** 1 inch ≡ 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

[1] Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Other material specifications are admissible. Nuts and washers must be appropriate for the rod.
[2] For use with the load combinations of ACI 318 Section 9.2, as set forth in ACI 318 Section D.4.4.

TABLE 28—CONCRETE BREAKOUT DESIGN INFORMATION FOR EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	Symbol	Units	Bar size								
			8	**10**	**12**	**14**	**16**	**20**	**25**	**28**	**32**
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (in-lb)	7.1 (17)								
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)								
Min. bar spacing[3]	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[3]	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$^1/_4$)		h_{ef} + 2d_o						
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[2]	ϕ	-	0.65								
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	0.70								

For **SI:** 1 inch ≡ 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

[1]Additional setting information is described in Figure 5, installation instructions.
[2] Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.
[3]For installations with 1$^3/_4$ inch edge distance refer to Section 4.1.10 for spacing and maximum torque requirements.

TABLE 29—BOND STRENGTH DESIGN INFORMATION FOR EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1,4]

DESIGN INFORMATION		Symbol	Units	Bar size								
				8	10	12	14	16	20	25	28	32
Temperature range A[3]	Characteristic bond strength and minimum anchor embedment in cracked concrete	$\tau_{k,cr}$	MPa	7.5	7.5	7.5	7.5	7.0	6.5	6.0	5.5	5.0
			(psi)	(1,092)	(1,092)	(1,092)	(1,068)	(1,044)	(972)	(862)	(806)	(732)
		$h_{ef,min}$	mm	60	60	70	75	80	90	100	112	128
			(in.)	(2.36)	(2.36)	(2.76)	(2.95)	(3.15)	(3.54)	(3.94)	(4.41)	(5.04)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	MPa	15.5	15.5	15.5	15.0	15.0	14.0	13.5	13.0	13.0
			(psi)	(2,264)	(2,264)	(2,264)	(2,198)	(2,142)	(2,039)	(1,955)	(1,908)	(1,862)
		$h_{ef,min}$	mm	60	60	70	75	80	90	100	112	128
			(in.)	(2.36)	(2.36)	(2.76)	(2.95)	(3.15)	(3.54)	(3.94)	(4.41)	(5.04)
Temperature range B[3]	Characteristic bond strength and minimum anchor embedment in cracked concrete[2]	$\tau_{k,cr}$	MPa	3.0	3.0	3.0	3.0	2.5	2.5	2.0	2.0	2.0
			(psi)	(444)	(444)	(444)	(410)	(379)	(336)	(298)	(278)	(260)
		$h_{ef,min}$	mm	60	60	70	75	80	90	100	112	128
			(in.)	(2.36)	(2.36)	(2.76)	(2.95)	(3.15)	(3.54)	(3.94)	(4.41)	(5.04)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete[2]	$\tau_{k,uncr}$	MPa	5.5	5.5	5.5	5.0	5.0	5.0	4.5	4.5	4.5
			(psi)	(781)	(781)	(781)	(759)	(739)	(704)	(675)	(659)	(643)
		$h_{ef,min}$	mm	60	60	70	75	80	90	100	112	128
			(in.)	(2.36)	(2.36)	(2.76)	(2.95)	(3.15)	(3.54)	(3.94)	(4.41)	(5.04)
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.55	0.55	0.55	0.55
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.55	0.55	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.94	0.94
	Water-filled hole	ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{wf}	-	1.00	1.00	1.00	0.96	0.93	0.87	0.82	0.79	0.79
	Underwater application	ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{uw}	-	0.95	0.95	0.94	0.94	0.93	0.92	0.92	0.91	0.91

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] For structures assigned to Seismic Design Categories C, D, E or F, bond strength values must be multiplied by $\alpha_{N,seis}$ = 0.65.

TABLE 30—BOND STRENGTH DESIGN INFORMATION FOR EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A CORE DRILL[1,4]

DESIGN INFORMATION		Symbol	Units	Bar size								
				8	**10**	**12**	**14**	**16**	**20**	**25**	**28**	**32**
Temperature range A[3]	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	12.0 (1,740)	12.0 (1,740)	12.0 (1,740)	11.5 (1,637)	10.5 (1,553)	9.5 (1,413)	9.0 (1,291)	8.5 (1,235)	8.0 (1,169)
		$h_{ef,min}$	mm (in.)	60 2.36	60 (2.36)	70 (2.76)	75 (2.95)	80 (3.15)	90 (3.54)	100 (3.94)	110 (4.41)	130 (5.04)
Temperature range B[3]	Characteristic bond strength and minimum anchor embedment in uncracked concrete[2]	$\tau_{k,uncr}$	MPa (psi)	4.0 (601)	4.0 (601)	4.0 (601)	4.0 (565)	3.5 (536)	3.5 (488)	3.0 (446)	3.0 (426)	3.0 (404)
		$h_{ef,min}$	mm (in.)	60 2.36	60 (2.36)	70 (2.76)	75 (2.95)	80 (3.15)	90 (3.54)	100 (3.94)	112 (4.41)	128 (5.04)
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.65	0.55	0.55	0.55	0.45	0.45	0.45
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.55	0.55	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.0	1.0	1.0	1.0	1.0	1.0	0.92	0.88	0.88

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] Bond strength values applicable to Seismic Design Categories A and B only.

TABLE 31—STEEL DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS[1]

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^2 ($in.^2$)	100.3 (0.155)	201.1 (0.312)	298.6 (0.463)	498.8 (0.773)	702.2 (1.088)
CSA G30	Nominal strength as governed by steel strength	N_{sa}	kN (lb)	54.0 (12,175)	108.5 (24,408)	161.5 (36,255)	270.0 (60,548)	380.0 (85,239)
		V_{sa}	kN (lb)	32.5 (7,305)	65.0 (14,645)	97.0 (21,753)	161.5 (36,329)	227.5 (51,144)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70				
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65				
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60				

For **SI:** 1 inch ≡ 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

[1] Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Other material specifications are admissible. Use nuts and washers appropriate for the rod strength.
[2] For use with the load combinations of ACI 318 Section 9.2, as set forth in ACI 318 Section D.4.4.

TABLE 32—CONCRETE BREAKOUT DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	Symbol	Units	Bar size				
			10 M	**15 M**	**20 M**	**25 M**	**30 M**
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (in-lb)	7.1 (17)				
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)				
Min. bar spacing[3]	s_{min}	mm (in.)	57 (2.2)	80 (3.1)	98 (3.8)	126 (5.0)	150 (5.9)
Min. edge distance[3]	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} + $1^1/_4$)	$h_{ef} + 2d_o$			
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[2]	ϕ	-	0.65				
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	0.70				

For **SI:** 1 inch ≡ 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

[1]Additional setting information is described in Figure 5, installation instructions.
[2] Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.
[3]For installations with $1^3/_4$ inch edge distance refer to Section 4.1.10 for spacing and maximum torque requirements.

TABLE 33—BOND STRENGTH DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1,4]

DESIGN INFORMATION		Symbol	Units	Bar size				
				10 M	15 M	20 M	25 M	30 M
Temperature range A[3]	Characteristic bond strength and minimum anchor embedment in cracked concrete	$\tau_{k,cr}$	MPa (psi)	7.5 (1,092)	7.0 (1,044)	7.0 (991)	6.0 (852)	5.5 (777)
		$h_{ef,min}$	mm (in.)	67 (2.65)	80 (3.15)	90 (3.54)	101 (3.97)	120 (4.71)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	15.5 (2,264)	15.0 (2,142)	14.0 (2,058)	13.5 (1,955)	13.0 (1,880)
		$h_{ef,min}$	mm (in.)	67 (2.65)	80 (3.15)	90 (3.54)	101 (3.97)	120 (4.71)
Temperature range B[3]	Characteristic bond strength and minimum anchor embedment in cracked concrete[2]	$\tau_{k,cr}$	MPa (psi)	3.0 (444)	2.5 (379)	2.5 (342)	2.0 (294)	2.0 (271)
		$h_{ef,min}$	mm (in.)	67 (2.65)	80 (3.15)	90 (3.54)	101 (3.97)	120 (4.71)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete[2]	$\tau_{k,uncr}$	MPa (psi)	5.5 (781)	5.0 (739)	5.0 (710)	4.5 (675)	4.5 (649)
		$h_{ef,min}$	mm (in.)	67 (2.65)	80 (3.15)	90 (3.54)	101 (3.97)	120 (4.71)
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.65	0.65	0.55	0.55
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.0	1.0	1.0	1.0	0.96
	Water-filled hole	ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45
		κ_{wf}	-	1.00	0.96	0.91	0.85	0.81
	Underwater application	ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45
		κ_{uw}	-	0.95	0.94	0.93	0.92	0.92

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] For structures assigned to Seismic Design Categories C, D, E or F, bond strength values must be multiplied by $\alpha_{N,seis}$ = 0.65.

TABLE 34—BOND STRENGTH DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A CORE DRILL[1,4]

DESIGN INFORMATION		Symbol	Units	Bar size				
				10 M	15 M	20 M	25 M	30 M
Temperature range A[3]	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	12.0 (1,740)	10.5 (1,553)	10.0 (1,431)	9.0 (1,291)	8.5 (1,197)
		$h_{ef,min}$	mm (in.)	67 (2.65)	80 (3.15)	90 (3.54)	101 (3.97)	120 (4.71)
Temperature range B[3]	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	4.0 (601)	3.5 (536)	3.5 (494)	3.0 (446)	3.0 (413)
		$h_{ef,min}$	mm (in.)	67 (2.65)	80 (3.15)	90 (3.54)	101 (3.97)	120 (4.71)
Permissible installation conditions	Dry concrete	ϕ_d	-	0.65	0.55	0.55	0.45	0.45
	Water-saturated concrete	ϕ_{ws}	-	0.55	0.45	0.45	0.45	0.45
		κ_{ws}	-	1.00	1.00	1.00	0.96	0.90

For **SI:** 1 inch ≡ 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

[1] Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 4,500 psi. For the range 4,500 psi < f'_c ≤ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < f'_c ≤ 8,000 psi, tabulated characteristic bond strengths may be increased by 10 percent.
[2] Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased 40 percent.
[3] Temperature range A: Maximum short term temperature = 110°F (43°C), Maximum long term temperature = 80°F (26°C).
Temperature range B: Maximum short term temperature = 162°F (72°C), Maximum long term temperature = 110°F (43°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.
[4] Bond strength values applicable to Seismic Design Categories A and B only.

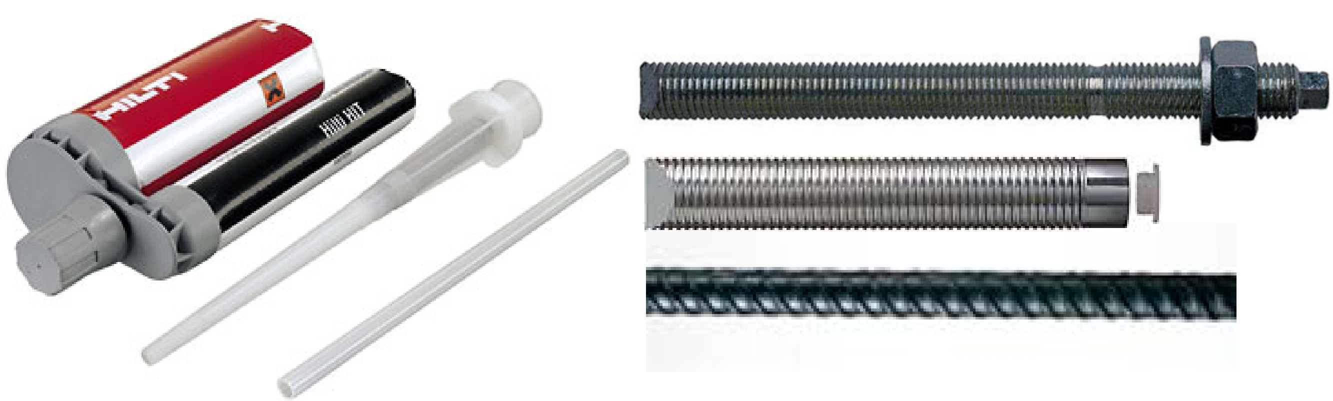


FIGURE 3—HILTI HIT-RE 500-SD ANCHORING SYSTEM & STEEL ELEMENTS.

TABLE 35—ALLOWABLE STRESS DESIGN EXAMPLE

Nominal anchor diameter d_o (in.)	Effective embedment depth h_{ef} (in.)	f'_c (psi)	k (-)	α (-)	Φ (-)	N_n (lb)	Allowable tension load $\phi N_n/\alpha$ (lb)
3/8	2 3/8	2,500	24	1.48	0.65	4,392	1,928
1/2	2 3/4	2,500	24	1.48	0.65	5,472	2,403
5/8	3 1/8	2,500	24	1.48	0.65	6,629	2,911
3/4	3 1/2	2,500	24	1.48	0.65	7,857	3,450*
7/8	3 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 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

Design Assumptions:

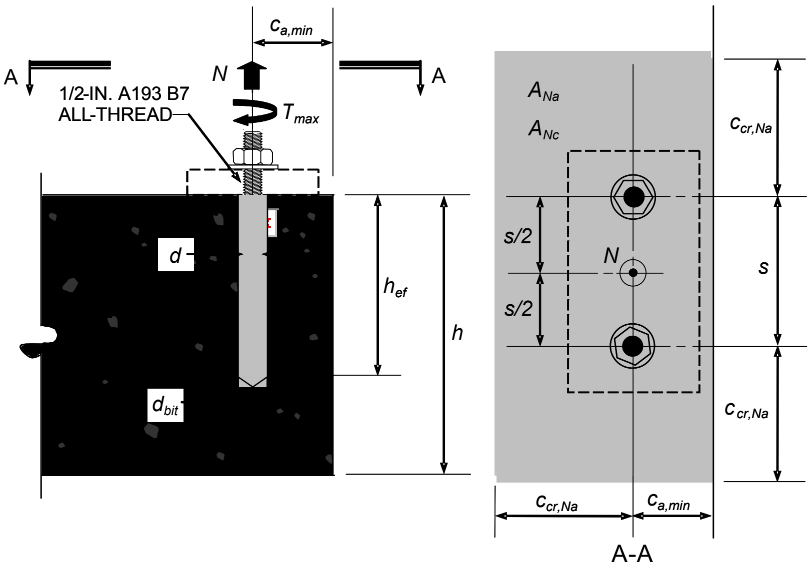
1. Single anchor with static tension load only; ASTM A 193 Grade B7 threaded rod
2. Vertical downward installation direction
3. Inspection Regimen = Periodic
4. Installation temperature = 41 – 104°F
5. Long term temperature = 80°F
6. Short term temperature = 110°F
7. Dry hole condition – carbide drilled hole
8. Embedment depth = h_{ef} min
9. Concrete determined to remain uncracked for the life of the anchorage
10. Load combination from ACI 318 Section 9.2 (no seismic loading)
11. 30% Dead Load (D) and 70% Live Load (L); Controlling load combination 1.2 D + 1.6 L
12. Calculation of α based on weighted average: α = 1.2 D + 1.6 L = 1.2 (0.30) + 1.6 (0.70) = 1.48
13. Normal weight concrete: f'_c = 2,500 psi
14. Edge distance $c_{a1} = c_{a2} > c_{ac}$
15. Member thickness $h \geq h_{min}$

*** Verify capacity**

Capacity	ACI 318 Section	Formula	Calculation	ϕ	ϕN_n
Steel	D.5.1	$N_{sa} = n\, A_{se,N}\, f_{uta}$	$N_{sa} = 0.3345 \cdot 125{,}000$	0.75	31,360 lb
Concrete	D.5.2	$N_{cb} = k\,(f'_c)^{0.5}\, h_{ef}^{1.5}$	$N_{cb} = 24 \cdot (2{,}500)^{0.5} \cdot 3.5^{1.5}$	0.65	5,107 lb
Bond	D.5.3[a]	$N_a = \pi\, d\, h_{ef}\, \tau_{k,uncr}$	$N_a = \pi \cdot 3/4 \cdot 3.5 \cdot 2{,}065$	0.65	11,069 lb

ΦN_n = 5,107 lb (concrete) is decisive hence the ASD value will be calculated as $\frac{5{,}107\text{ lb}}{1.48}$ = 3,450 lb

[a]Design equation provided in Section 4.1.4 Eq. (D-16f)



Dimensional parameters:

h_{ef}	= 9.0 in.
s	= 4.0 in.
$c_{a,min}$	= 2.5 in.
h	= 12.0 in.
d	= $^1/_2$ in.

Specifications/assumptions:

ASTM A193 Grade B7 all-thread rods, UNC thread, A 563 Grade HD hex nuts.
Normal weight concrete, f'_c = 4,000 psi.
Seismic Design Category (SDC) B
No supplementary reinforcing in accordance with ACI 318-05 D.1 will be provided.
Assume maximum short term (diurnal) base material temperature ≤ 100° F.
Assume maximum long term base material temperature ≤ 80 ° F.
Assume installation in dry concrete and hammer-drilled holes.
Assume concrete will remain uncracked for service life of anchorage.

Calculation in accordance with ACI 318-05 Appendix D and this report	***ACI 318 Code Ref.***	***Report Ref.***
***Step 1**. Check minimum edge distance, anchor spacing and member thickness:*	-	
$h_{ef,min} < h_{ef}$ therefore ok.		*Section 5.3*
c_{min} = 2.5 in. ≤ $c_{a,min}$ therefore ok.	-	*Table 8*
s_{min} = 2.5 in. ≤ s therefore ok.	-	*Table 8*
$h_{min} = h_{ef}$ + 1.25 = 9 + 1.25 = 10.25 in. ≤ h therefore ok.	-	*Table 8*
***Step 2**. Calculate steel strength:* $N_{sa} = n \cdot A_{se} \cdot f_{uta}$	*D.5.1.2*	-
ASTM A 193 Grade B7 rods comply as ductile. $\therefore \phi = 0.75$	*D.1 and D.4.4a)*	-
$\therefore \phi N_{sa} = \phi \cdot n \cdot A_{se} \cdot f_{uta} = 0.75 \cdot 2 \cdot 0.1419 \cdot 125{,}000$ *= 26,606 lb = 26.6 k* *or, using Table 7,* $\therefore \phi N_{sa} = 0.75 \cdot 2 \cdot 17{,}737 = 26.6$ k	*D.5.1.2*	*Table 7*
***Step 3**. Determine concrete breakout strength:* $N_{cbg} = \frac{A_{Nc}}{A_{Nc0}} \cdot \psi_{ec,N} \cdot \psi_{ed,N} \cdot \psi_{c,N} \cdot \psi_{cp,N} \cdot N_b$	*D.5.2.1 and Eq. (D-5)*	-
$A_{Nc} = (3 \cdot h_{ef} + s)(1.5 \cdot h_{ef} + c_{a,min})$ *= (27 + 4)(13.5 + 2.5) = 496 in^2*	-	-
$A_{Nc0} = 9 \cdot h_{ef}^2$ *= 729 in^2*	*D.5.2.1 and Eq. (D-6)*	-

FIGURE 4—DESIGN EXAMPLE

Calculation in accordance with ACI 318-05 Appendix D and this report	***ACI 318 Code Ref.***	***Report Ref.***
$\psi_{ec,N}$ = 1.0 no eccentricity of tension load with respect to tension-loaded anchors	D.5.2.4	
$\psi_{ed,N} = 0.7 + 0.3 \cdot \frac{c_{a,min}}{1.5\ h_{ef}}$ for $c_{a,min} \leq 1.5\ h_{ef}$	D.5.2.5 and Eq. (D-11)	-
$c_{a,min} = 2.5 < 1.5 \cdot 9$	-	-
$\therefore \psi_{ed,N} = 0.7 + 0.3 \cdot \frac{2.5}{1.5 \cdot 9} = 0.76$	-	-
$\psi_{c,N}$ = 1.0 uncracked concrete assumed ($k_{c,uncr}$ = 24)	D.5.2.6	Table 8
Determine c_{ac}: $h_{ef} + 5\left(c_{a,min}\right)^{0.75} = 9.0 + 5(2.5)^{0.75} = 18.9\text{ in.} > 12.0\text{ in.} \therefore c_{ac} = 2.5 \cdot h_{ef}$ $c_{ac} = 2.5(9.0\text{ in.}) = 22.5\text{ in.}$	D.5.2.7	Section 4.1.3
For $c_{a,min} < c_{ac}$ $\psi_{cp,N} = \frac{max\left\|c_{a,min}; 1.5 \cdot h_{ef}\right\|}{c_{ac}} = \frac{max\left\|2.5; 1.5 \cdot 9\right\|}{22.5} = 0.60$	D.5.2.7 and Eq. (D-13)	-
$N_b = k_{c,uncr}\sqrt{f'_c} \cdot h_{ef}^{1.5} = 24\sqrt{4,000} \cdot (9.0)^{1.5} = 40,983\text{ lb}$	D.5.2.2 and Eq. (D-7)	-
$N_{cbg} = \frac{496}{729} \cdot 1.0 \cdot 0.76 \cdot 1.0 \cdot 0.60 \cdot 40,983 = 12,715\text{ lb}$	-	-
$\phi N_{cbg} = 0.65 \cdot 12,715 = 8,265\text{ lb} = 8.3\text{ k}$	D.4.4c)	-
***Step 4**. Determine bond strength:* $N_{ag} = \frac{A_{Na}}{A_{Na0}} \cdot \psi_{ed,Na} \cdot \psi_{g,Na} \cdot \psi_{ec,Na} \cdot \psi_{p,Na} \cdot N_{a0}$	-	Section 4.1 Eq. (D-16b)
$s_{cr,Na} = min\left(20 \cdot d \cdot \sqrt{\frac{\tau_{k,uncr}}{1,450}}; 3h_{ef}\right) = 20 \cdot 0.5 \cdot \sqrt{\frac{2,235}{1,450}} = 12.4\text{ in.}$ $3 \cdot h_{ef} = 27\text{ in.} \geq 12.4\text{ in.} \therefore s_{cr,Na} = 12.4\text{ in.}$	-	Section 4.1 Table 9
$c_{cr,Na} = \frac{s_{cr.Na}}{2} = 6.2\text{ in.}$	-	Section 4.1 Eq. (D-16e)
$A_{Na} = \left(2c_{cr,Na} + s\right)\left(c_{cr,Na} + c_{a,min}\right) = 143.0\text{ in}^2$	-	Section 4.1 D.5.3.7
$A_{Na0} = \left(s_{cr,Na}\right)^2 = 154.2\text{ in}^2$	-	Section 4.1 D.5.3.7
For $c_{a,min} < c_{cr.Na}$: $\psi_{ed,Na} = \left(0.7 + 0.3 \cdot \frac{c_{a,min}}{c_{cr,Na}}\right)$	-	Section 4.1
$\psi_{ed,Na} = \left(0.7 + 0.3 \cdot \frac{2.5}{6.2}\right) = 0.82$	-	Section 4.1
$\tau_{k,max,uncr} = \frac{k_{c,uncr}}{\pi \cdot d}\sqrt{h_{ef} \cdot f'_c} = \frac{24}{\pi \cdot 0.5}\sqrt{9.0 \cdot 4,000} = 2,899\text{ psi}$	-	Section 4.1 Table 8
$\psi_{g,Na0} = \sqrt{n} - \left[\sqrt{n} - 1 \cdot \left(\frac{\tau_{k,uncr}}{\tau_{k,max,uncr}}\right)^{1.5}\right] = \sqrt{2} - \left[(\sqrt{2} - 1) \cdot \left(\frac{2,235}{2,899}\right)^{1.5}\right] = 1.13$	-	Section 4.1 Table 9

FIGURE 4—DESIGN EXAMPLE (Continued)

Calculation in accordance with ACI 318-05 Appendix D and this report	*ACI 318 Code Ref.*	*Report Ref.*
$\psi_{g,Na} = \psi_{g,Na0} + \left[\left(\frac{s}{s_{cr,Na}} \right)^{0.5} \cdot (1 - \psi_{g,Na0}) \right] = 1.13 + \left[\left(\frac{4.0}{12.4} \right)^{0.5} \cdot (1 - 1.13) \right] = 1.06$	-	*Section 4.1*
$\psi_{ec,Na}$ *= 1.0 no eccentricity - loading is concentric*	-	-
$\psi_{p,Na} = \frac{max\|c_{a,min}\,;c_{cr,Na}\|}{c_{ac}} = \frac{max\|2.5\,;6.2\|}{22.5} = 0.28$	-	-
$N_{a0} = \tau_{k,uncr} \cdot \pi \cdot d \cdot h_{ef} = 2{,}235 \cdot \pi \cdot 0.5 \cdot 9.0 = 31{,}610$ lb	-	*Section 4.1* *Eq. (D-16f)*
$N_{ag} = \frac{A_{Na}}{A_{Na0}} \cdot \psi_{ed,Na} \cdot \psi_{g,Na} \cdot \psi_{ec,Na} \cdot \psi_{p,Na} \cdot N_{a0}$ $N_{ag} = \frac{143.0}{154.2} \cdot 0.82 \cdot 1.06 \cdot 1.0 \cdot 0.28 \cdot 31{,}610 = 7{,}134\text{ lb}$	-	*Section 4.1* *Eq. (D-16h)*
$\phi = 0.65$	-	*Table 9*
$\therefore \phi N_{ag} = 0.65 \cdot 7{,}134 = 4{,}637\text{ lb} = 4.6\text{ k}$		-
***Step 5**. Determine controlling strength:*	*D.4.1.2*	-
Steel strength ϕN_{sa} *= 26.6 k* *Concrete breakout strength* ϕN_{cbg} *= 8.3 k* *Bond strength* ϕN_{ag} *= 4.6 k* *controls*		
Step 6. Convert strength to ASD using factor provided in Section 4.2: $N_{ag} = \frac{N_d}{\alpha} = \frac{\phi N_n}{\alpha} = \frac{4.6}{1.48} = 3{,}108\,lb$ *Note: For this example 30% dead load, 70% live load and a controlling load combination of 1.2D + 1.6L is assumed: α = 0.3*1.2 + 0.7*1.6 = 1.48.*		*Section 4.2*

FIGURE 4—SAMPLE CALCULATION (Continued)

HILTI

Hilti
HIT-RE 500-SD

Instructions for use — en

Mode d'emploi — fr

Instrucciones de uso — es

Hilti HIT-RE 500-SD
See the Material Safety Data Sheet for this product before handling.
For Industrial Use Only. Keep out of the reach of children!
Danger: Corrosive. Harmful if inhaled or swallowed. Can cause eye and skin burns. Risk of serious damage to eyes. Can cause sensitization with some individuals.
Contains: quartz sand.
Precautions: Wear suitable protection clothing, eye protection and gloves. Do not get in eyes. Avoid contact with the skin. Avoid inhalation of vapors. Avoid inhalation of dusts during demoltion/removal.
First Aid: For eye contact, flush with water for 15 minutes while holding the eyelids apart. Seek medical attention immediately. For skin contact, wash immediately with soap and water. If ingested, drink two glasses of water and seek medical attention immediately.

Hilti HIT-RE 500-SD
Se reporter á la Fiche de données de sécurité du produit déjà l'usage.
Pour usage industriel seulement. Tenir hors de la portée des enfants!
Danger: Corrosif. Nocif si respiré ou avalé. Peut brûler les yeux et la peau. Risque de lésions oculaires graves. Peut entraîner la sensibilisation chez certains individus.
Contient du: sable quartzeux.
Précautions: Pour travailler, porter des vêtements, des gants et une protection pour les yeux. Eviter tout contact avec les yeux. Eviter tout contact avec la peau. Eviter d'inhaler les vapeurs. Eviter d'inhaler les poussières lors de la démolition ou du retrait.
Premiers soins: En cas de contact avec les yeux, rincer à grande eau pendant 15 minutes en tenant les paupières ouvertes. Faire immédiatement appel à un médecin. En cas de contact avec la peau, se laver immédiatement avec de l'eau et du savon. En cas d'ingestion, boire deux verres d'eau et faire immédiatement appel à un médecin.

Hilti HIT-RE 500-SD
Consulte con las Hoja de datos de seguridad para este producto antes de usarlo.
Sólo Para Uso Industrial. Mantener alejado del alcance de los niños.
Peligro: Corrosivo. Nocivo en caso de ser inhalado o ingerido. Puede causar quemadura de la piel y de los ojos. Riesgo de lesiones oculares graves. Puede causar sensibilización en algunas personas.
Contiene: arena de Cuarzo.
Precaución: Utilice indumentaria y guantes adecuados y protección para los ojos/la cara. Evite contacto con los ojos y la piel. Evite inhalación de los vapores. Evite inhalación polvo durante la remoción o la demolición.
Primeros auxilios: Para contacto con los ojos, enjuague con agua por 15 minutos mientras aguante los párpados abiertos. Acudir atención medica. Para contacto con la piel, enjuague inmediatamente con agua y jabón. De ser ingerido, tome dos vasos de agua y acudir inmediatamente a un medico.

Hilti, Inc. Tulsa, OK 74146 / Hilti Canada Corp.

ICC-ES ESR - 2322

In Case of Emergency, call Chem-Trec: 1-800-424-9300 (USA, P.R., Virgin Islands, Canada)
En cas d'urgence, téléphoner Chem-Trec: 1-800-424-9300 (USA, P.R., Virgin Islands, Canada)
En Caso de Emergencia, llame Chem-Trec: 001-703-527-3887 (other countries/autres pays/otros países)

Hilti, Inc.
5400 South 122nd East Ave.
Tulsa, OK 74146 USA
Tel.: +1-800-879 8000
www.us.hilti.com

Hilti (Canada) Corp.
6790 Century Avenue, Suite 300
CDN-Mississauga, Ontario L5N 2V8
Tel.: +1-800-363 4458
www.ca.hilti.com

Made in Germany
Fabriqué en Allemagne
Hecho en Alemania
www.us.hilti.com
Hilti = registered trademark of Hilti Corporation, Schaan, LI

391163 / V05 02.2011

FIGURE 5—INSTALLATION INSTRUCTIONS

Hilti HIT-RE 500-SD

Adhesive anchoring system for fastenings in normal weight concrete

Prior to use of product follow instructions for use and recommended safety precautions.

Check expiration date: See expiration date imprint on foilpack manifold. (Month/Year). Do not use expired product.

Foil pack temperature: Must be between 41°F and 104°F (5°C - 40°C) when in use.

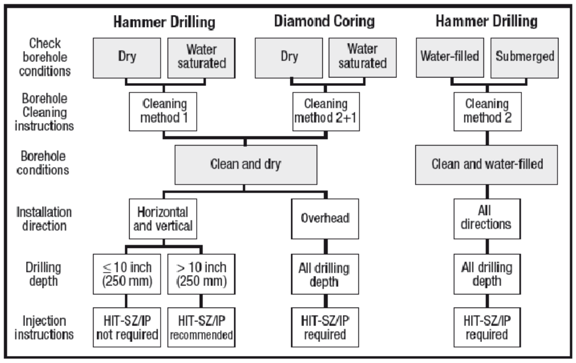
Base material temperature at time of installation: Must be between 41°F and 110°F (5°C - 43°C).

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

Material Safety Data Sheet: Review the MSDS before use.

Installation instructions: Follow the pictograms 1-14 for the sequence of operations and refer to tables 1-4 for setting details. **For any application not covered by this document** (e.g. "h_{ef}" beyond values specified in setting details), **contact Hilti.**

Installation flow chart



1 **Drill hole normal to the surface** with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit, or with a core rig and an appropriately sized diamond core bit, to the required embedment depth. See tables describing setting details.

2–4 **Clean hole:** Cleaning method has to be decided based on drilling method and borehole conditions (see flow chart above).
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):
- **Blow** from the back of the borehole with oil-free compressed air (min. 90psi at 3.5 CFM (6 bar at 6 m³/h)) fully retracting the air extension 2 times until return air stream is free of noticeable dust.
- **Brush 2 times** with the specified brush size (brush Ø ≥ bore hole Ø) 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 the proper brush diameter.
- **Blow** again with compressed air 2 times until return air stream is free of noticeable dust.

Method 2 - for water filled boreholes, submerged concrete or diamond cored boreholes:
- **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 brush size (brush Ø ≥ borehole Ø) 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 the proper brush diameter.
- **Flush again** 2 times until water runs clear.
- **Important!** For **diamond cored boreholes** and **if a dry borehole is required for injection (e.g. water flows into cleaned borehole)**, continue with borehole cleaning as described by methode 1. **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 ≤ 10 inch (250 mm) and required for borehole depth > 10 inch (250 mm).

The borehole must be free of dust, debris, ice, oil, grease and other contaminants prior to adhesive injection. Inadequate borehole cleaning = poor load values

5 **Insert foil pack in foil pack holder.** Never use damaged foil packs and/or damaged or unclean foil pack holders.

6 **Tightly attach Hilti HIT-RE-M mixer to foil pack manifold.** Attach new mixer prior to dispensing a new foil pack (snug fit). Do not modify the mixer in any way. Make sure the mixing element is in the mixer. Use only the type of mixer supplied with the 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 adhesive.** The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded. See pictogram 8 for discard quantities. 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.

9–10 **Inject adhesive from the back of the borehole without forming air voids:**
Verify if borehole conditions have changed (e.g. water in the borehole) after cleaning. If yes, repeat cleaning according points 2 - 4.
- **Inject** the adhesive starting at the back of the borehole (use the extension for deep boreholes), 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 adhesive along the embedment length. After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

Hilti HIT-RE 500-SD

- **Piston plug injection - HIT-SZ/IP recommended for borehole depth > 10 inch/250 mm. Water-filled bore- holes or submerged concrete, and overhead installation the injection is only possible with aid of piston plugs.** Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug HIT-SZ/IP. Insert piston plug to back of the borehole and inject adhesive as described in the injection method above. During injection the piston plug will be naturally extruded out of the borehole by the adhesive pressure.

11 **Insert anchor/rebar into borehole.** 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. After installing an anchor/rebar, the annular gap must be completely filled with adhesive. If the borehole is not completely filled along the embedment depth the installation should be rejected. Hilti should be contacted for further information.

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). Observe the gel time **"t gel"**, 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 **Do not disturb the anchor/rebar** once the gel time **"t gel"** has elapsed until **"t cure,ini"** has passed.

13 **Preparation work may continue for rebar applications.** Between **"t cure,ini"** and **"t cure,full"** the adhesive has a limited load bearing capacity, do not apply a torque or load on the anchor/rebar during this time.

14 **Apply load/torque after " t cure,full"** has passed, and the fixture to be attached has been positioned.

Partly used foil packs must be used up within **four weeks.** Leave the mixer attached to 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 reach of children.

Danger: Corrosive
Harmful if inhaled or swallowed.
Can cause eye and skin burns.
Risk of serious damage to eyes.
Can cause sensitization with some individuals.
Contains quartz sand.

Precautions:
Wear suitable protection clothing, eye protection and gloves.
Do not get in eyes.
Avoid contact with the skin. Avoid inhalation of vapors.
Avoid inhalation of dusts during demolition/removal.

First Aid:
For **eye contact**, flush with water for 15 minutes while holding the eyelids apart. Seek medical attention immediately. For **skin contact**, wash immediately with soap and water. If **ingested**, drink two glasses of water and seek medical attention immediately.

Ingredient	CAS Number		
Part A: (Large side)		**Part B: (Small side)**	
Quartz sand	14808-60-7	m-xylene diamine	01477-55-0
Bisphenol A epoxy resin	25068-38-6	Aliphatic polyamine (NJ TSRN)	19136100-5014*
Bisphenol F epoxy resin	28064-14-4	Quartz sand	14808-60-7
Diglycidyl ether (NJ TSRN)	19136100-5013*	Bonding agent	65997-16-2
Alkylglycidyl ether (NJ TSRN)	19136100-5012*	Aluminum oxide	01344-28-1
Amorphous silica	67762-90-7	Amorphous silica	67762-90-7

* NJ TSNR = New Jersey Trade Secret Registry Number

In Case of Emergency, call Chem-Trec: 1-800-424-9300 (USA, P.R., Virgin Islands, Canada)
En cas d'urgence, téléphoner Chem-Trec: 1-800-424-9300 (USA, P.R., Virgin Islands, Canada)
En Caso de Emergencia, llame Chem-Trec: 001-703-527-3887 (other countries/autres pays/otros países)

Made in Germany

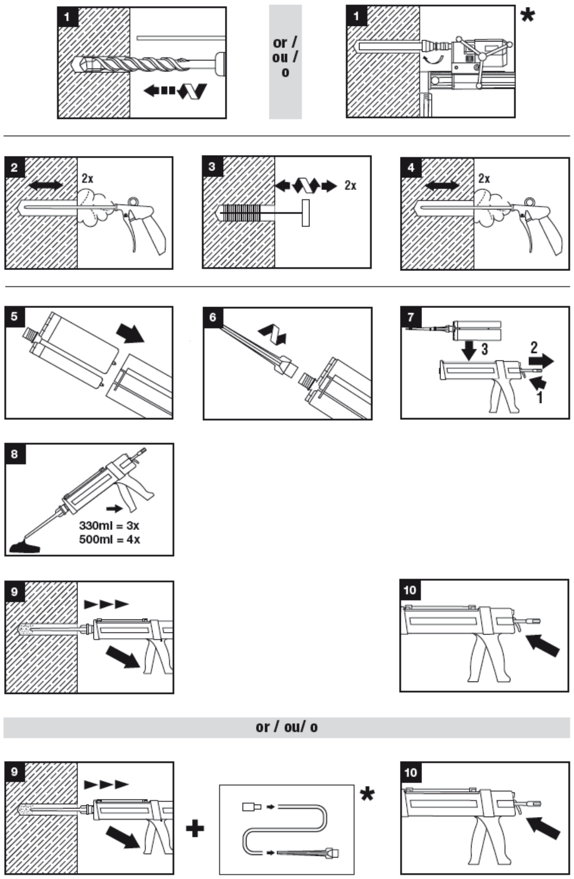
Net contents: 11.1 fl. oz (330 ml) /16.9 fl. oz (500 ml) **Net weight: 16.6 oz (470 g)/25.0 oz (710 g)**

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—INSTALLATION INSTRUCTIONS (Continued)

Hilti HIT-RE 500-SD



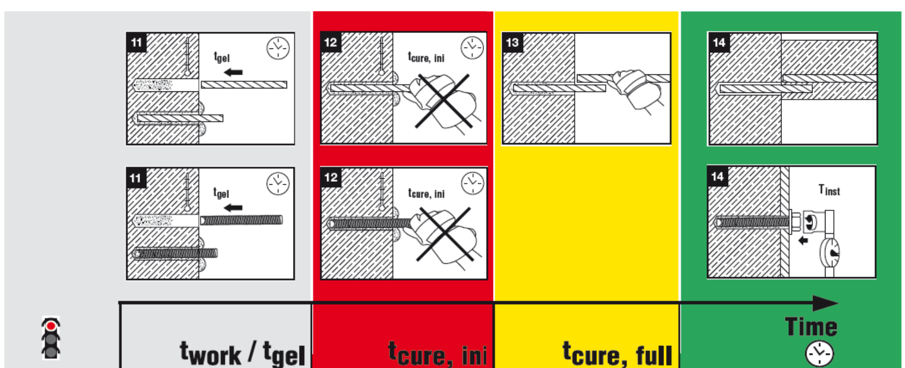
*) Please refer to technical literature (approvals, setting instructions) for detail
*) Voir littérature technique (agréments, manuels d'utilisation produits) pour plus de détail
*) Por favor vease la referencia técnica (normativa y manuales de uso) para mas detalle

Hilti HIT-RE 500-SD

Table 1

	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	371719
24	20			24	380918	24	380923	20	371719
25			20	25	336553	25	335027	25	371720
28	24	16		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
40			32	40	382260	40	380927	32	371721
Ø[inch]	Ø[inch]	Ø[inch]	Ø[inch]	HIT-RB	Item no.	HIT-IP	Item no.	HIT-DL	Item no.
7/16	3/8			7/16"	273203		–	–	–
1/2			#3	1/2"	273204	1/2"	274019	1/2"	38237
9/16	1/2		10 M	9/16"	273205	9/16"	274020	9/16"	38238
5/8			#4	5/8"	273207	5/8"	274021	9/16"	38238
11/16		3/8		11/16"	273209	11/16"	274022	11/16"	38239
3/4	5/8		#5 | 15 M	3/4"	273210	3/4"	274023	3/4"	38240
7/8	3/4	1/2	#6	7/8"	273211	7/8"	274024	7/8"	38241
1	7/8		#7 | 20 M	1"	273212	1"	274025	1"	38242
1 1/8	1	5/8	#8	1 1/8"	273214	1 1/8"	274026	1"	38242
1 1/4		3/4	25 M	1 1/4"	273216	1 1/4"	274027	1"	38242
1 3/8	1 1/4		#9	1 3/8"	273217	1 3/8"	274028	1 3/8"	38243
1 1/2			#10|30 M	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.



		t_{work} / t_{gel}		$t_{cure, ini}$	$t_{cure, full}$
5°C	41°F	0	2 ½ h	18 h	72 h
10°C	50°F	0	2 h	12 h	48 h
15°C	59°F	0	1 ½ h	8 h	24 h
20°C	68°F	0	30 min	6 h	12 h
30°C	86°F	0	20 min	4 h	8 h
40°C	104°F	0	12 min	2 h	4 h

- Linear interpolation for intermediate temperatures is possible.
- Une interpolation linéaire des données est possible pour les températures intermédiaires.
- Interpolación linear para temperaturas intermedios es posible.

FIGURE 5—INSTALLATION INSTRUCTIONS (Continued)

Hilti HIT-RE 500-SD

Setting Details of Hilti HIT-RE 500-SD with threaded rod

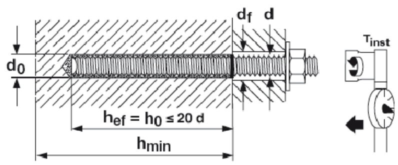


Table 2: HAS

d [inch]	d [mm]	d_0 [inch]	h_{ef} min-max [inch]	h_{ef} min-max [mm]	T_{inst} [ft-lb]	T_{inst} [Nm]	d_f [inch]	h_{min} [inch]
3/8	9.5	7/16	2 3/8 - 7 1/2	60 - 191	15	20	7/16	h_{ef} + 1 1/4 (30 mm)
1/2	12.7	9/16	2 3/4 - 10	70 - 254	30	41	9/16	
5/8	15.9	3/4	3 1/8 - 12 1/2	79 - 318	60	81	11/16	$h_{ef} + 2 d_0$
3/4	19.1	7/8	3 1/2 - 15	89 - 381	100	136	13/16	
7/8	22.2	1	3 1/2 - 17 1/2	89 - 445	125	169	15/16	
1	25.4	1 1/8	4 - 20	102 - 508	150	203	1 1/8	
1 1/4	31.8	1 3/8	5 - 25	127 - 635	200	271	1 3/8	
[mm]		[mm]	[mm]		[Nm]		[mm]	[mm]
M8		10	60 - 160		10		9	h_{ef} + 30
M10		12	60 - 200		20		12	
M12		14	70 - 240		40		14	
M16		18	80 - 320		80		18	$h_{ef} + 2 d_0$
M20		24	80 - 400		150		22	
M24		28	96 - 480		200		26	
M27		30	108 - 540		270		30	
M30		35	120 - 600		300		33	

Setting Details of Hilti HIT-RE 500-SD with HIS-N and HIS-RN Inserts

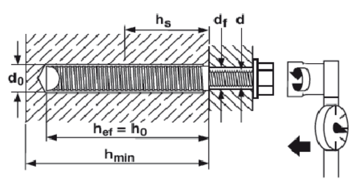


Table 3: HIS-(R)N

d [inch]	d [mm]	d_0 [inch]	h_{ef} [inch]	h_{ef} [mm]	T_{inst} [ft-lb]	T_{inst} [Nm]	d_f [inch]	h_{min} [inch]	h_{min} [mm]
3/8	9.5	11/16	4 3/8	110	15	20	7/16	5 3/4	150
1/2	12.7	7/8	5	125	30	41	9/16	6 3/4	170
5/8	15.9	1 1/8	6 3/4	170	60	81	11/16	9	230
3/4	19.1	1 1/4	8 1/8	205	100	136	13/16	10 3/4	270
[mm]		[mm]	[mm]		[Nm]		[mm]	[mm]	
M8		14	90		10		9	120	
M10		18	110		20		12	150	
M12		22	125		40		14	170	
M16		28	170		80		18	230	
M20		32	205		150		22	270	

Hilti HIT-RE 500-SD

Setting Details of Hilti HIT-RE 500-SD with reinforcement bars

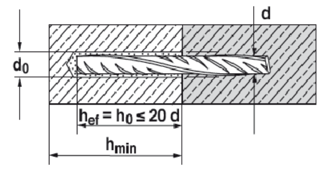


Table 4

d	d_0	h_{ef} min-max		h_{min}
US rebar	[inch]	[inch]	[mm]	[inch]
# 3	1/2	2 3/8 - 7 1/2	60 - 191	h_{ef} + 1 1/4 (30 mm)
# 4	5/8	2 3/4 - 10	70 - 254	$h_{ef} + 2 d_0$
# 5	3/4	3 1/8 - 12 1/2	79 - 318	
# 6	7/8	3 1/2 - 15	89 - 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]		[mm]
8	12	60 - 160		h_{ef} + 30
10	14	60 - 200		
12	16	70 - 240		$h_{ef} + 2 d_0$
14	18	75 - 280		
16	20	80 - 320		
20	25	90 - 400		
25	32	100 - 500		
28	35	112 - 560		
32	40	128 - 640		
CA rebar	[inch]	[mm]		[inch]
10 M	9/16	60 - 226		h_{ef} + 1 1/4 (30 mm)
15 M	3/4	80 - 320		$h_{ef} + 2 d_0$
20 M	1	90 - 390		
25 M	1 1/4	101 - 504		
30 M	1 1/2	120 - 598		

FIGURE 5—INSTALLATION INSTRUCTIONS (Continued)

ICC EVALUATION SERVICE

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ICC-ES Evaluation Report

ESR-2322 Supplement

Reissued February 1, 2012

This report is subject to renewal April 1, 2014.

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

REPORT HOLDER:

HILTI, INC.
5400 SOUTH 122ND EAST AVENUE
TULSA, OKLAHOMA 74146
(800) 879-8000
www.us.hilti.com
HiltiTechEng@us.hilti.com

EVALUATION SUBJECT:

HILTI HIT-RE 500-SD ADHESIVE ANCHORS IN 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-RE 500-SD Adhesive Anchoring System described in Sections 2.0 through 7.0 and in Tables 1 through 6 of 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-RE 500-SD Adhesive Anchoring System 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 9N-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master evaluation report reissued on February 1, 2012.