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DIVISION: 5 – CONCRETE**Section: 03151 – Concrete Anchoring****REPORT HOLDER:**

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EVALUATION SUBJECT:**HILTI HIT-RE 500-SD ADHESIVE ANCHORS IN CONCRETE****1.0 EVALUATION SCOPE****1.1 Compliance with the following codes:**

- 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)
- 1997 Uniform Building Code™ (UBC)

1.2 Property evaluated:

Structural

2.0 USES

Hilti HIT-RE 500-SD Adhesive Anchors are 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 anchors described in Sections 1911 and 1912 of the 2006 IBC, Sections 1912 and 1913 of the 2000 or 2003 IBC, and Section 1923 of the 1997 UBC. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the 2006 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 Anchor 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

Hilti HIT-RE 500-SD adhesive may be used with continuously threaded rod, Hilti HIS-N and HIS-RN internally-threaded inserts or deformed steel reinforcing bars. The primary components of the Hilti Adhesive Anchor System, including the Hilti HIT-RE 500-SD Adhesive, HIT-RE-M static mixing nozzle and steelanchoring 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 oz. (330 ml), 16.9 oz. (500 ml), and 47.3 oz. (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 is must be in accordance with Figure 5 of this report.

3.2.3 Dispensers: Hilti HIT-RE 500-SD adhesive 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. Specifications for grades of threaded rod and associated nuts included in the scope of the report are provided in TABLE 2 and TABLE 3. Carbon steel threaded rods must be furnished with a 5 µm thick zinc electroplated coating complying with ASTM B 633 SC 1 or must be hot-dipped galvanized in accordance 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 flat cut or cut on the bias (chisel point).

3.2.4.2 Steel reinforcing bars: Steel reinforcing bars are deformed bars (rebar). Tables 27 and 31 and Figure 5 summarize reinforcing bar size ranges. See Table 6 for specifications of permitted reinforcing bar types and grades. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust and other coatings that impair the bond with the adhesive. Reinforcing bars must not be bent after installation.

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 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 318-05 (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.

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strengths must be determined in accordance with ACI 318-05 (ACI 318) Appendix D and this report. A design example is given in Figure 4. Design parameters including strength reduction factors, ϕ , corresponding to each limit state and anchor steel are provided in Table 7 through Table . Strength reduction factors, ϕ , as described in ACI 318 D.4.4 must be used for load combinations calculated in accordance with Section 1605.2 of the 2000, 2003 or 2006 IBC or Section 1612.2 of the UBC. Strength reduction factors ϕ as described in ACI 318 D.4.5 must be used for load combinations calculated in accordance with Section 1909.2 of the UBC.

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} .

Add ACI 318 D.4.1.2 as follows:

D.4.1.4 – For adhesive anchors installed overhead and subjected to tension resulting from sustained loading, Eq. (D-1) shall also be satisfied taking $\phi N_n = 0.75\phi N_a$ for single anchors and $\phi N_n = 0.75\phi N_{ag}$ for groups of anchors, 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. Where shear loads act concurrently with the sustained tension load, interaction of tension and shear shall be analyzed in accordance with 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 D.5.1.2 is 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 – The limiting concrete strength of adhesive anchors in tension shall be calculated in accordance with D.5.2.1 to D.5.2.7 where the value of k_c to be used in Eq. (D-7) shall be:

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

$k_{c,un-cr}$ 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 is given in the tables outlined in Table 1 for the corresponding anchor steel.

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*

$$N_a = \frac{A_{Na}}{A_{Na0}} \cdot \psi_{p,Na} \cdot N_{a0} \quad (D-14a)$$

(b) *For a group of anchors*

$$N_{ag} = \frac{A_{Na}}{A_{Na0}} \cdot \psi_{ed,Na} \cdot \psi_{g,Na} \cdot \psi_{ec,Na} \cdot \psi_{p,Na} \cdot N_{a0} \quad (D-14b)$$

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 from the centerlines of the anchor, or in the case of a group of anchors, from a line through a row of adjacent anchors. A_{na} shall not exceed nA_{na0} where n is the number of anchors in tension in the group. In ACI 318 Figures RD.5.2.1a and RD.5.2.1b, the terms $1.5h_{ef}$ and $3.0h_{ef}$ shall be replaced with $C_{cr,Na}$ and $S_{cr,Na}$, respectively.

A_{Na0} is the projected area of the failure surface of a single anchor without the influence of proximate edges in

accordance with Eq. (D-14c):

$$A_{Na0} = (s_{cr,Na})^2 \quad (D-14c)$$

With

$s_{cr,Na}$ = as given by Eq. (D-14h)

D.5.3.8 – The critical spacing and critical edge distance shall be calculated as follows:

$$s_{cr,Na} = 20 \cdot d \cdot \sqrt{\frac{\tau_{k,uncr}}{1,450}} \leq 3 \cdot h_{ef} \quad (D-14h)$$

$$c_{cr,Na} = \frac{s_{cr,Na}}{2} \quad (D-14i)$$

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

$$N_{a0} = \tau_{k,cr} \cdot \pi \cdot d \cdot h_{ef} \quad (D-14j)$$

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

$$\psi_{g,Na} = \psi_{g,Na0} + \left[\left(\frac{s}{s_{cr,Na}} \right)^{0.5} \cdot (1 - \psi_{g,Na0}) \right] \geq 1.0 \quad (D-14k)$$

Where

$$\psi_{g,Na0} = \sqrt{n} - \left[(\sqrt{n} - 1) \cdot \left(\frac{\tau_{k,cr}}{\tau_{k,max,cr}} \right)^{1.5} \right] \geq 1.0 \quad (D-14l)$$

Where

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

$$\tau_{k,max,cr} = \frac{k_{c,cr}}{\pi \cdot d} \sqrt{h_{ef} \cdot f'_c} \quad (D-14m)$$

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

$$\psi_{ec,Na} = \frac{1}{1 + \frac{2e'_N}{s_{cr,Na}}} \leq 1.0 \quad (D-14n)$$

Eq. (D-14n) is valid for $e'_N \leq \frac{s}{2}$

If the loading on an anchor group is such that only certain anchors are in tension, only those anchors that are in tension shall be considered when determining the eccentricity e'_N for use in Eq. (D-14n).

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-14b).

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

$$\text{for } c_{a,min} \geq c_{cr,Na} \quad (D-14o)$$

$$\psi_{ed,Na} = 1.0$$

or for $c_{a,min} < c_{cr,Na}$

$$\psi_{ed,Na} = \left(0.7 + 0.3 \cdot \frac{c_{a,min}}{c_{cr,Na}} \right) \leq 1.0 \quad (D-14p)$$

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-14a) and Eq. (D-14b) with $\tau_{k,uncr}$ substituted for $\tau_{k,cr}$ in the calculation of the basic strength in accordance with Eq. (D-14j). The factor $\psi_{g,Na0}$ shall be calculated in accordance with Eq. (D-14l) whereby the value of $\tau_{k,max,uncr}$ shall be calculated in accordance with Eq. (D-14q) and substituted for $\tau_{k,max,cr}$ in Eq. (D-14l).

$$\tau_{k,max,uncr} = \frac{k_{c,uncr}}{\pi \cdot d} \sqrt{h_{ef} \cdot f'_c} \quad (D-14q)$$

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 shall be taken as

$$\psi_{p,Na} = 1.0 \quad \text{when } c_{a,min} \geq c_{ac} \quad (D-14r)$$

$$\psi_{p,Na} = \frac{\max\{c_{a,min}; c_{cr,Na}\}}{c_{cr}} \quad \text{when } c_{a,min} < c_{ac} \quad (D-14s)$$

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 D.6.1.2 is 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 in shear, V_{cb} or V_{cbg} , must be calculated in accordance with ACI 318 D.6.2 based on information given in the tables outlined in Table 1 for the corresponding anchor steel.

4.1.7 Static Concrete Pryout Strength in Shear: In lieu of determining the nominal pryout strength in accordance with ACI 318 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 an adhesive anchor or group of adhesive anchors shall not exceed

(a) for a single adhesive anchor

$$V_{cp} = \min \left[k_{cp} \cdot N_a; k_{cp} \cdot N_{cb} \right] \quad (D-28a)$$

(b) for a group of adhesive anchors

$$V_{cpg} = \min \left[k_{cp} \cdot N_{ag}; k_{cp} \cdot N_{cbg} \right] \quad (D-28b)$$

where

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

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

N_a shall be calculated in accordance with Eq. (D-14a)

N_{ag} shall be calculated in accordance with Eq. (D-14b)

N_{cb} , N_{cbg} are determined in accordance with D.5.2.8

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	Hole drilling method	permissible installation conditions	bond strength	Associated strength reduction factor
cracked	hammer drilled	dry concrete	$\tau_{k,cr}$	ϕ_d
		water-saturated	$\tau_{k,cr} \cdot \kappa_{ws}$	ϕ_{ws}
uncracked concrete	hammer drilled	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}
	core drilled	dry concrete	$\tau_{k,uncr}$	ϕ_d
		water-saturated	$\tau_{k,uncr} \cdot \kappa_{ws}$	ϕ_{ws}

Figure 3 presents a selection flow chart. Where applicable, the modified bond strength values must be used in lieu of $\tau_{k,cr}$ and $\tau_{k,uncr}$ in Equations (D-14d), (D-14f), (D-14j), (D-14m), and (D-14o). 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 distance c_{min} :

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

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

4.1.10 Critical edge distance c_{ac} :

In lieu of ACI 318 Section D.8.6, c_{ac} must be determined as follows:

$$\text{for } h = h_{min}: \quad c_{ac} = \frac{3(h_{ef})^2}{32d} + 1.63h_{ef}$$

$$\text{for } h \geq h_{ef} + 5(c_{a,min})^{3/4}$$

where

$$h_{ef} \leq 8d: \quad c_{ac} = 1.5h_{ef}$$

$$h_{ef} > 8d: \quad c_{ac} = \frac{(h_{ef})^2}{48d} + 1.33h_{ef}$$

$$\text{for all other } h \geq h_{min}: \quad c_{ac} = 2.5h_{ef}$$

4.1.11 Design strength in Seismic Design Categories C, D, E and F:

In structures assigned to Seismic Design Categories C, D, E or F under the IBC or IRC, or Seismic Zones 2B, 3 or 4 under the UBC, the anchor strength must be adjusted in accordance with 2006 IBC Section 1908.1.16. For brittle steel elements, the anchor strength must be adjusted in accordance with 2006 IBC Section 1908.1.16 D.3.3.5. 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 D.7.

4.2 Allowable Stress Design:

Design values for use with allowable stress design load combinations (working stress design) calculated in accordance with Section 1612.3 of the UBC or Section 1605.3 of the 2000, 2003 or 2006 IBC must be established as follows:

$$R_{allow,ASD} = \frac{R_d}{\alpha} \quad (21)$$

where $R_d = \phi \cdot R_k$ represents the limiting design strength

in tension (ϕN_n) or shear (ϕV_n) as calculated according to ACI 318 D.4.1.1 and D.4.1.2 and Section 4.1 of this report. Limits on edge distance, anchor spacing and member thickness described in this report must apply.

The value of α must be taken as follows:

Reference for strength reduction factors	α	
	Including Seismic	Excluding Seismic
ACI 318 Section D.4.4	1.1	1.4
ACI 318 Section D.4.5	1.2	1.55

4.2.1 Interaction: In lieu of ACI 318 D.7.1, D.7.2 and D.7.3, the interaction of tension and shear loads must be calculated as follows:

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

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

For all other cases:

$$\frac{T}{T_{allow,ASD}} + \frac{V}{V_{allow,ASD}} \leq 1.2 \quad (22)$$

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.

4.4 Special Inspection:

Periodic special inspection must be performed where required in accordance with Sections 1704.4, 1704.13 of the 2000, 2003 or 2006 IBC; or Section 1701.5 of the UBC, whereby periodic special inspection is defined in Section 1701.6.2 of the UBC or Section 1702.1 of the 2000, 2003 and 2006 IBC and this report. The special inspector must be on the jobsite initially 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.

4.5 Jobsite Quality Assurance:

Where anchors are used for seismic or wind load resistance, jobsite quality assurance must conform to Sections 1705 or 1706 of the IBC.

5.0 CONDITIONS OF USE

The Hilti HIT-RE 500-SD Adhesive Anchor System described in this report complies with the codes specifically 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 with carbide-tipped drill bits complying with ANSI B212.15-1994.
- 5.5 Loads applied to the anchors must be adjusted in accordance with Section 1605.2 of the 2000, 2003 or 2006 IBC or Sections 1612.3 or 1909.2 of the UBC for strength design and in accordance with Section 1612.3 of the UBC and Section 1605.3 of the 2000, 2003 or 2006 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 Categories C, D, E or F under the IBC or IRC, or Seismic Zones 2B, 3, or 4 under the UBC, anchor strength must be adjusted in accordance with 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 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 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.
- 5.13 Where not otherwise prohibited in the code, Hilti HIT-RE 500-SD adhesive anchors are permitted for use with fire-resistance rated construction provided that at least one of the following conditions is fulfilled:
 - Anchors are used to resist wind only.
 - Anchors that support fire-resistance rated construction or gravity load bearing structural elements are within a fire resistance-rated envelope or a fire resistance-rated membrane, are protected by approved fire-resistance rated materials, or have been evaluated for resistance

to fire exposure in accordance with recognized standards.

- Anchors are used to support nonstructural elements.

- 5.14 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.
- 5.15 Use of zinc-plated carbon steel anchors is limited to dry, interior locations.
- 5.16 Special inspection and jobsite quality assurance must be provided in accordance with Sections 4.4 and 4.5, respectively.
- 5.17 Hilti HIT-RE 500-SD adhesive are manufactured by Hilti GmbH, Kaufering, Germany with quality control inspections by Underwriters Laboratories, Inc. (AA-637).
- 5.18 Hilti HIS-N and HIS-RN inserts are manufactured by Hilti (China) Ltd., Guangdong, China with quality control inspections by Underwriters Laboratories, Inc. (AA-637).

6.0 EVIDENCE SUBMITTED

- 6.1 Data in accordance with the ICC-ES Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete (AC308), dated October 2007.

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 quality control agency, Underwriters Laboratories Inc.
- 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 quality control agency, Underwriters Laboratories Inc.
- 7.3 Threaded rods, nuts, washers, bolts, cap screws, and deformed reinforcing bars are standard elements and must conform to applicable national or international specifications.

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

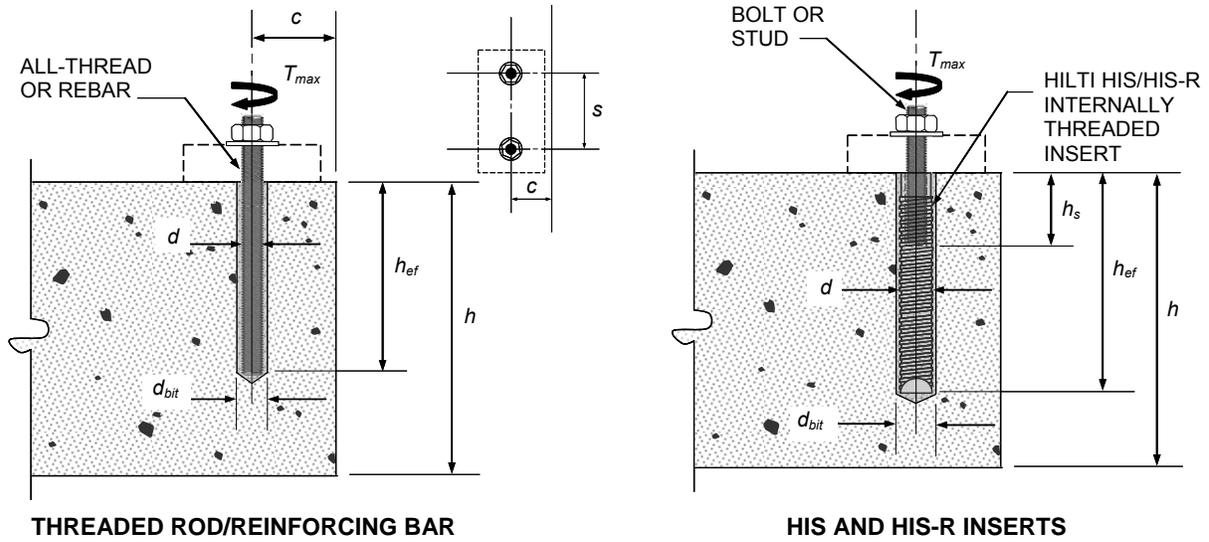


FIGURE 1 – INSTALLATION PARAMETERS

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	Table	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 MATERIALS¹**

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 563 Grade DH
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 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 MATERIALS¹**

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 F 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 F A193 ⁵ Grade B8M (AISI 316) 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-R 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 (MPa)	90,000 (620)	60,000 (414)
ASTM A 615 ¹ Gr. 40	psi (MPa)	60,000 (414)	40,000 (276)
DIN 488 ² BSt 500	MPa (psi)	550 (79,750)	500 (72,500)
CAN/CSA-G30.18 ³ Gr. 400	MPa (psi)	540 (78,300)	400 (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 ROD¹

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	-	0.75						
	Strength reduction factor ϕ for shear ²	ϕ	-	0.65						

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

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

¹ Values provided for common rod material types are 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 318-05 9.2, as set forth in ACI 318-05 D.4.4.

Table 8 - CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT¹

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	$k_{c,unscr}$	in-lb (SI)	24 (10)						
Min. anchor spacing	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	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)	$h_{ef} + 1-1/4$ ($h_{ef} + 30$)		$h_{ef} + 2d_o$				
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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa

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

¹Additional setting information is described in Figure 5, installation instructions.

²Values provided for post-installed anchors under Condition B without supplementary reinforcement as defined in ACI 318 Section D.4.4.

Table 9 – BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT^{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 (N/mm ²)	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)	2.43 (62)	2.81 (71)	3.14 (80)	3.44 (87)	3.71 (94)	4.0 (102)	5.0 (127)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm ²)	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)	2.43 (62)	2.81 (71)	3.14 (80)	3.44 (87)	3.71 (94)	4.0 (102)	5.0 (127)
Temperature range B ³	Characteristic bond strength and minimum anchor embedment in cracked concrete ²	$\tau_{k,cr}$	psi (N/mm ²)	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)	1.73 (44)	2.20 (56)	3.61 (66)	3.01 (76)	3.50 (89)	4.0 (102)	5.0 (127)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete ²	$\tau_{k,uncr}$	psi (N/mm ²)	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)	1.73 (44)	2.20 (56)	3.61 (66)	3.01 (76)	3.50 (89)	4.0 (102)	5.0 (127)
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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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 (N/mm ²)	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)	2.43 (62)	2.81 (71)	3.14 (80)	3.44 (87)	3.71 (94)	4.0 (102)	5.0 (127)
Temperature range B ³	Characteristic bond strength and minimum anchor embedment in uncracked concrete ²	$\tau_{k,uncr}$	psi (N/mm ²)	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)	1.57 (40)	2.0 (51)	2.5 (64)	3.0 (76)	3.5 (89)	4.0 (102)	5.0 (127)
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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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 ROD¹

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (mm)							
				8	10	12	16	20	24	27	30
Rod Outside Diameter		d	mm (in.)	8 (0.31)	10 (0.39)	12 (0.47)	16 (0.63)	20 (0.79)	24 (0.94)	27 (1.06)	30 (1.18)
Rod effective cross-sectional area		A_{se}	mm ² (in. ²)	36.6 (0.057)	58 (0.090)	84.3 (0.131)	157 (0.243)	245 (0.380)	353 (0.547)	459 (0.711)	561 (0.870)
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength	N_{sa}	kN (lb)	18.5 (4,114)	29.0 (6,519)	42.0 (9,476)	78.5 (17,647)	122.5 (27,539)	176.5 (39,679)	229.5 (51,594)	280.5 (63,059)
		V_{sa}	kN (lb)	9.0 (2,057)	14.5 (3,260)	25.5 (5,685)	47.0 (10,588)	73.5 (16,523)	106.0 (23,807)	137.5 (30,956)	168.5 (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 8.8	Nominal strength as governed by steel strength	N_{sa}	kN (lb)	29.5 (6,582)	46.5 (10,431)	67.5 (15,161)	125.5 (28,236)	196.0 (44,063)	282.5 (63,486)	367.0 (82,550)	449.0 (100,894)
		V_{sa}	kN (lb)	14.5 (3,291)	23.0 (5,216)	40.5 (9,097)	75.5 (16,942)	117.5 (26,438)	169.5 (38,092)	220.5 (49,530)	269.5 (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 (lb)	25.6 (5,760)	40.6 (9,127)	59.0 (13,266)	109.9 (24,706)	171.5 (38,555)	247.1 (55,550)	229.5 (51,594)	280.5 (63,059)
		V_{sa}	kN (lb)	12.8 (2,880)	20.3 (4,564)	35.4 (7,960)	65.9 (14,824)	102.9 (23,133)	148.3 (33,330)	137.7 (30,956)	168.3 (37,835)
	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							

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

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

¹ Values provided for common rod material types are 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 318-05 9.2, as set forth in ACI 318-05 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 BIT¹

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	s_{min}	mm (in.)	40 (1.6)	50 (2.0)	60 (2.4)	80 (3.2)	100 (3.9)	120 (4.7)	135 (5.3)	150 (5.9)
Min. edge distance	c_{min}	mm (in.)	40 (1.6)	50 (2.0)	60 (2.4)	80 (3.2)	100 (3.9)	120 (4.7)	135 (5.3)	150 (5.9)
Minimum member thickness	h_{min}	mm (in.)	$h_{ef} + 30$ ($h_{ef} + 1-1/4$)			$h_{ef} + 2d$				
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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa

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

¹Additional setting information is described in Figure 5, installation instructions.

²Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.

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	$\tau_{k,cr}$	N/mm ² (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.)	57 (2.23)	63 (2.49)	69 (2.73)	80 (3.15)	89 (3.52)	98 (3.86)	108 (4.25)	120 (4.72)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	N/mm ² (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.)	57 (2.23)	63 (2.49)	69 (2.73)	80 (3.15)	89 (3.52)	98 (3.86)	108 (4.25)	120 (4.72)
Temperature range B ³	Characteristic bond strength and minimum anchor embedment in cracked concrete ²	$\tau_{k,cr}$	N/mm ² (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.)	40 (1.57)	46 (1.80)	53 (2.10)	67 (2.62)	80 (3.15)	96 (3.78)	108 (4.25)	120 (4.72)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete ²	$\tau_{k,uncr}$	N/mm ² (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.)	40 (1.57)	46 (1.80)	53 (2.10)	67 (2.62)	80 (3.15)	96 (3.78)	108 (4.25)	120 (4.72)
Permissible installation conditions	Dry concrete	ϕ_t	-	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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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	$\tau_{k,uncr}$	N/mm ² (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.)	56 (2.19)	63 (2.49)	69 (2.73)	80 (3.15)	89 (3.52)	98 (3.86)	108 (4.25)	120 (4.72)
Temperature range B ³	Characteristic bond strength and minimum anchor embedment in uncracked concrete ²	$\tau_{k,uncr}$	N/mm ² (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.)	40 (1.57)	41 (1.61)	48 (1.89)	64 (2.52)	80 (3.15)	96 (3.78)	108 (4.25)	120 (4.72)
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
		K_{ws}	-	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.93

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

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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 INSERTS¹

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 – A 193 B7 bolt/cap screw	N_{sa}	lb (kN)	9,295 (41.3)	17,020 (75.7)	27,110 (120.6)	40,120 (178.5)
		V_{sa}	lb (kN)	5,575 (24.8)	10,210 (45.4)	16,265 (72.3)	24,075 (107.1)
	Nominal strength as governed by steel strength – HIS-N insert	N_{sa}	lb (kN)	12,650 (56.3)	16,195 (72.0)	26,925 (119.8)	27,360 (121.7)
	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 F A193 Grade B8M SS	Nominal strength as governed by steel strength – ASTM F A193 Grade B8M SS bolt/cap screw	N_{sa}	lb (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)
		V_{sa}	lb (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)
	Nominal strength as governed by steel strength – HIS-RN insert	N_{sa}	lb (kN)	18,070 (80.4)	24,645 (109.6)	40,975 (182.3)	41,640 (185.2)
	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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

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 318-05 9.2, as set forth in ACI 318-05 D.4.4. Values correspond to a ductile steel element.

Table 16 - CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT HILTI HIS-N AND HIS-RN INSERTS¹

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	s_{min}	in. (mm)	3-1/4 (83)	4 (102)	5 (127)	5-1/2 (140)
Min. edge distance	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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹Additional setting information is described in Figure 5, installation instructions.

²Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.

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 (N/mm ²)	1040 (7.2)	955 (6.6)	845 (5.8)	805 (5.6)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm ²)	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 (N/mm ²)	375 (2.6)	330 (2.3)	290 (2.0)	280 (1.9)
	Characteristic bond strength in uncracked concrete ²	$\tau_{k,uncr}$	psi (N/mm ²)	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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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	1,535	1,405	1,280	1,235
			(N/mm ²)	(10.6)	(9.7)	(8.8)	(8.5)
Temperature range B ³	Characteristic bond strength in uncracked concrete ²	$\tau_{k,uncr}$	psi	530	485	440	425
			(N/mm ²)	(3.7)	(3.3)	(3.1)	(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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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 INSERTS¹

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}	mm ² (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}	mm ² (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	-	0.75				
	Strength reduction factor ϕ for shear ²	ϕ	-	0.65				

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

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

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 318-05 9.2 as set forth in ACI 318-05 D.4.4. Values correspond to a ductile steel element.

Table 20 - CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC HILTI HIS-N AND HIS-RN INSERTS¹

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	s_{min}	mm (in.)	63 (2.5)	83 (3.25)	102 (4.0)	127 (5.0)	140 (5.5)
Min. edge distance	c_{min}	mm (in.)	63 (2.5)	83 (3.25)	102 (4.0)	127 (5.0)	140 (5.5)
Minimum member thickness	h_{min}	mm (in.)	120 (4.7)	150 (5.9)	170 (6.7)	230 (9.1)	270 (10.6)
Critical edge distance – splitting (for uncracked concrete)	c_{ac}	-	See Section 4.1.10 of this report.				
Strength reduction factor for tension, concrete failure modes, Condition B ²	ϕ	-	0.65				
Strength reduction factor for shear, concrete failure modes, Condition B ²	ϕ	-	0.70				

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

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

¹Additional setting information is described in Figure 5, installation instructions.

²Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.

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	$\tau_{k,cr}$	N/mm ² (psi)	7.5 (1,080)	7.0 (1,040)	6.5 (957)	6.0 (845)	5.5 (806)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm ² (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	$\tau_{k,cr}$	N/mm ² (psi)	3.0 (433)	2.5 (374)	2.5 (330)	2.0 (292)	2.0 (278)
	Characteristic bond strength in uncracked concrete ²	$\tau_{k,uncr}$	N/mm ² (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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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	$\tau_{k,cr}$	N/mm ²	12.0	10.5	9.5	9.0	8.5
			(psi)	(1,712)	(1,534)	(1,403)	(1,282)	(1,235)
Temperature range B ³	Characteristic bond strength in uncracked concrete ²	$\tau_{k,cr}$	N/mm ²	4.0	3.5	3.5	3.0	3.0
			(psi)	(591)	(530)	(484)	(442)	(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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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 BARS¹

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	-	0.75							
	Strength reduction factor ϕ for shear ²	ϕ	-	0.65							
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	-	0.75							
	Strength reduction factor ϕ for shear ²	ϕ	-	0.65							

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

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

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 318-05 9.2, as set forth in ACI 318-05 D.4.4.

Table 24 - CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT¹

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	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	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.	$h_{ef} + 1-1/4$			$h_{ef} + 2d$				
		(mm)	$(h_{ef} + 30)$							
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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹Additional setting information is described in Figure 5, installation instructions.

²Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.

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 (N/mm ²)	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)	2.43 (62)	2.81 (71)	3.14 (80)	3.44 (87)	3.71 (94)	4.00 (102)	4.50 (114)	5.00 (127)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm ²)	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)	2.43 (62)	2.81 (71)	3.14 (80)	3.44 (87)	3.71 (94)	4.00 (102)	4.50 (114)	5.00 (127)
Temperature range B ³	Characteristic bond strength and minimum anchor embedment in cracked concrete ²	$\tau_{k,cr}$	psi (N/mm ²)	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)	1.73 (44)	2.20 (56)	2.61 (66)	3.00 (76)	3.50 (89)	4.00 (102)	4.50 (114)	5.00 (127)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete ²	$\tau_{k,uncr}$	psi (N/mm ²)	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)	1.73 (44)	2.20 (56)	2.61 (66)	3.00 (76)	3.50 (89)	4.00 (102)	4.50 (114)	5.00 (127)
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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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 (N/mm ²)	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)	2.43 (62)	2.81 (71)	3.14 (80)	3.44 (87)	3.71 (94)	4.00 (102)	4.50 (114)	5.00 (127)
Temperature range B ³	Characteristic bond strength and minimum anchor embedment in uncracked concrete ²	$\tau_{k, uncr}$	psi (N/mm ²)	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)	1.57 (40)	2.00 (51)	2.50 (64)	3.00 (76)	3.50 (89)	4.00 (102)	4.50 (114)	5.00 (127)
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
		K_{ws}	-	1.00	1.00	1.00	1.00	1.00	0.95	0.91	0.88

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

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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 BARS¹

DESIGN INFORMATION		Symbol	Units	Bar size									
				8	10	12	14	16	20	25	28	32	
Nominal bar diameter		d	mm (in.)	8.0 (0.315)	10.0 (0.394)	12.0 (0.472)	14.0 (0.551)	16.0 (0.630)	20.0 (0.787)	25.0 (0.984)	28.0 (1.102)	32.0 (1.260)	
Bar effective cross-sectional area		A_{se}	mm ² (in. ²)	50.3 (0.078)	78.5 (0.122)	113.1 (0.175)	153.9 (0.239)	201.1 (0.312)	314.2 (0.487)	490.9 (0.761)	615.8 (0.954)	804.2 (1.247)	
DIN 488 BSt 550/500	Nominal strength as governed by steel strength		N_{sa}	kN (lb)	27.5 (6,215)	43.0 (9,711)	62.0 (13,984)	84.5 (19,034)	110.5 (24,860)	173.0 (38,844)	270.0 (60,694)	338.5 (76,135)	442.5 (99,441)
			V_{sa}	kN (lb)	16.5 (3,729)	26.0 (5,827)	37.5 (8,390)	51.0 (11,420)	66.5 (14,916)	103.0 (23,307)	162.0 (36,416)	203.0 (45,681)	265.5 (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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

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). Other material specifications are admissible. Nuts and washers must be appropriate for the rod.

² For use with the load combinations of ACI 318-05 9.2, as set forth in ACI 318-05 D.4.4.

Table 28 - CONCRETE BREAKOUT DESIGN INFORMATION FOR EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT¹

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	$k_{c,unscr}$	SI (in-lb)	10 (24)								
Min. bar spacing	s_{min}	mm (in.)	40 (1.6)	50 (2)	60 (2.4)	70 (2.8)	80 (3.1)	100 (3.9)	125 (4.9)	140 (5.5)	160 (6.3)
Min. edge distance	c_{min}	mm (in.)	40 (1.6)	50 (2)	60 (2.4)	70 (2.8)	80 (3.1)	100 (3.9)	125 (4.9)	140 (5.5)	160 (6.3)
Minimum member thickness	h_{min}	mm (in.)	$h_{ef} + 30$ ($h_{ef} + 1-1/4$)			$h_{ef} + 2d$					
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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹Additional setting information is described in Figure 5, installation instructions.

²Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.

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	$\tau_{k,cr}$	N/mm ² (psi)	7.5 (1,092)	7.5 (1,092)	7.5 (1,092)	7.5 (1,068)	7.0 (1,044)	6.5 (972)	6.0 (862)	5.5 (806)	5.0 (732)
		$h_{ef,min}$	mm (in.)	57 (2.23)	63 (2.49)	69 (2.73)	75 (2.95)	80 (3.15)	89 (3.52)	100 (3.94)	112 (4.41)	128 (5.04)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	N/mm ² (psi)	15.5 (2,264)	15.5 (2,264)	15.5 (2,264)	15.0 (2,198)	15.0 (2,142)	14.0 (2,039)	13.5 (1,955)	13.0 (1,908)	13.0 (1,862)
		$h_{ef,min}$	mm (in.)	57 (2.23)	63 (2.49)	69 (2.73)	75 (2.95)	80 (3.15)	89 (3.52)	100 (3.94)	112 (4.41)	128 (5.04)
Temperature range B ³	Characteristic bond strength and minimum anchor embedment in cracked concrete ²	$\tau_{k,cr}$	N/mm ² (psi)	3.0 (444)	3.0 (444)	3.0 (444)	3.0 (410)	2.5 (379)	2.5 (336)	2.0 (298)	2.0 (278)	2.0 (260)
		$h_{ef,min}$	mm (in.)	40 (1.57)	46 (1.80)	53 (2.10)	60 (2.37)	67 (2.62)	80 (3.15)	100 (3.94)	112 (4.41)	128 (5.04)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete ²	$\tau_{k,uncr}$	N/mm ² (psi)	5.5 (781)	5.5 (781)	5.5 (781)	5.0 (759)	5.0 (739)	5.0 (704)	4.5 (675)	4.5 (659)	4.5 (643)
		$h_{ef,min}$	mm (in.)	40 (1.57)	46 (1.80)	53 (2.10)	60 (2.37)	67 (2.62)	80 (3.15)	100 (3.94)	112 (4.41)	128 (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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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	$\tau_{k,uncr}$	N/mm ² (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.)	56 (2.19)	63 (2.49)	69 (2.73)	75 (2.95)	80 (3.15)	89 (3.52)	100 (3.94)	110 (4.41)	130 (5.04)
Temperature range B ³	Characteristic bond strength and minimum anchor embedment in uncracked concrete ²	$\tau_{k,uncr}$	N/mm ² (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.)	40 (1.57)	41 (1.61)	48 (1.89)	56 (2.20)	64 (2.52)	80 (3.15)	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
		K_{ws}	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.92	0.88

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

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi \leq $f'_c \leq$ 4,500 psi. For the range 4,500 psi < $f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < $f'_c \leq$ 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 BARS¹

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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

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). Other material specifications are admissible. Use nuts and washers appropriate for the rod strength.

² For use with the load combinations of ACI 318-05 9.2, as set forth in ACI 318-05 D.4.4.

Table 32 - CONCRETE BREAKOUT DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT¹

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	s_{min}	mm (in.)	57 (2.2)	80 (3.1)	98 (3.8)	126 (5.0)	150 (5.9)
Min. edge distance	c_{min}	mm (in.)	57 (2.2)	80 (3.1)	98 (3.8)	126 (5.0)	150 (5.9)
Minimum member thickness	h_{min}	mm	$h_{ef} + 30$	$h_{ef} + 2d$			
		(in.)	$(h_{ef} + 1-1/4)$				
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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹Additional setting information is described in Figure 5, installation instructions.

²Values provided for post-installed anchors installed under Condition B without supplementary reinforcement.

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	$\tau_{k,cr}$	N/mm ² (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)	88 (3.48)	101 (3.97)	120 (4.71)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	N/mm ² (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)	88 (3.48)	101 (3.97)	120 (4.71)
Temperature range B ³	Characteristic bond strength and minimum anchor embedment in cracked concrete ²	$\tau_{k,cr}$	N/mm ² (psi)	3.0 (444)	2.5 (379)	2.5 (342)	2.0 (294)	2.0 (271)
		$h_{ef,min}$	mm (in.)	51 (2.00)	67 (2.62)	78 (3.07)	101 (3.97)	120 (4.71)
	Characteristic bond strength and minimum anchor embedment in uncracked concrete ²	$\tau_{k,uncr}$	N/mm ² (psi)	5.5 (781)	5.0 (739)	5.0 (710)	4.5 (675)	4.5 (649)
		$h_{ef,min}$	mm (in.)	51 (2.00)	67 (2.62)	78 (3.07)	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 \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa

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

¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi $\leq f'_c \leq$ 4,500 psi. For the range 4,500 psi $< f'_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi $< f'_c \leq$ 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	$\tau_{k,uncr}$	N/mm ² (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)	88 (3.48)	101 (3.97)	120 (4.71)
Temperature range B ³	Characteristic bond strength and minimum anchor embedment in uncracked concrete	$\tau_{k,uncr}$	N/mm ² (psi)	4.0 (601)	3.5 (536)	3.5 (494)	3.0 (446)	3.0 (413)
		$h_{ef,min}$	mm (in.)	45 (1.78)	64 (2.52)	78 (3.07)	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

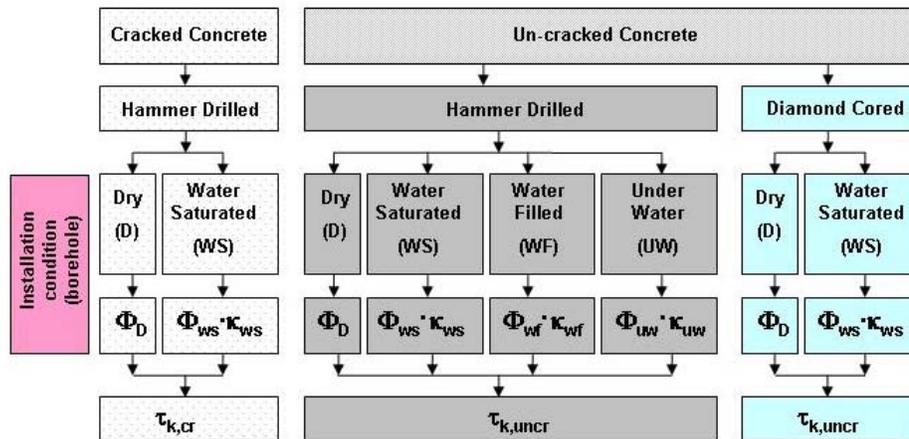
For **SI**: 1 inch \equiv 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa
 For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

- ¹ Bond strength values correspond to concrete compressive strength in the range 2,500 psi \leq $f_c \leq$ 4,500 psi. For the range 4,500 psi < $f_c \leq$ 6,500 psi, tabulated characteristic bond strengths may be increased by 6 percent. For the range 6,500 psi < $f_c \leq$ 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 2 -- HILTI HIT-RE 500-SD ANCHORING SYSTEM & STEEL ELEMENTS.

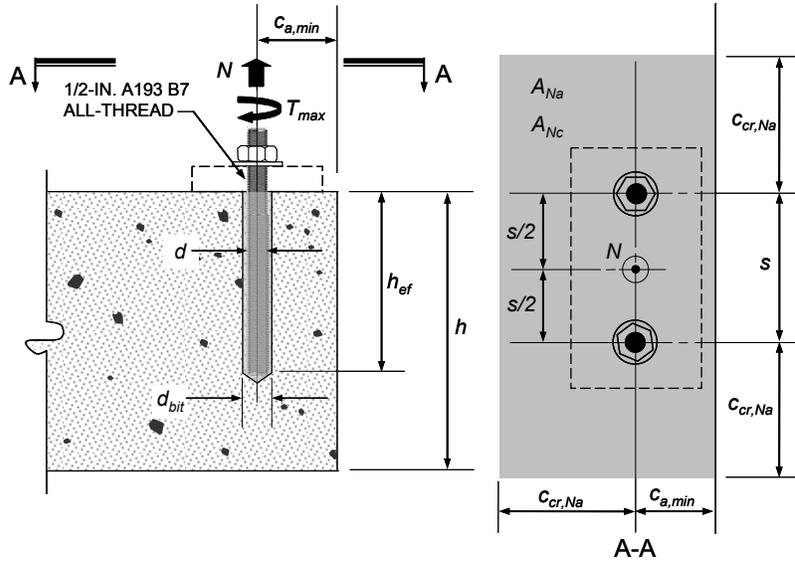
FIGURE 3 –FLOW CHART FOR THE ESTABLISHMENT OF DESIGN BOND STRENGTH



Given:

2 1/2-in. HIT RE
500-SD adhesive
anchors subjected
to a tension load
as shown.

Design objective:
Calculate the
design tension
resistance for this
configuration.



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

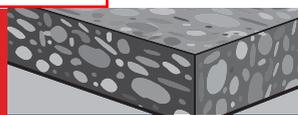
FIGURE 4 – DESIGN EXAMPLE

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)	-
$c_{a,min} = 2.5 < 1.5 \cdot 4.5$	-	-
$\therefore \psi_{ed,N} = 0.7 + 0.3 \cdot \frac{2.5}{1.5 \cdot 9} = 0.76$	-	-
$\psi_{c,N} = 1.0$ uncracked concrete assumed ($k_{c,uncr} = 24$)	D.5.2.6	Table 8
Determine c_{ac} : $h_{ef} + 5(c_{a,min})^{0.75} = 9.0 + 5(2.5)^{0.75} = 18.9 \text{ in.} > 12.0 \text{ in.} \therefore c_{ac} = 2.5 \cdot h_{ef}$ $c_{ac} = 2.5(9.0 \text{ in.}) = 22.5 \text{ in.}$	D.5.2.7	Section 4.1.3
For $c_{a,min} < c_{ac}$ $\psi_{cp,N} = \frac{\max c_{a,min}; 1.5 \cdot h_{ef} }{c_{ac}} = \frac{\max 2.5; 1.5 \cdot 9 }{22.5} = 0.60$	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-14b)
$s_{cr,Na} = \min\left(20 \cdot d \cdot \sqrt{\frac{\tau_{k,uncr}}{1,450}}; 3 h_{ef}\right) = 20 \cdot 0.5 \cdot \sqrt{\frac{2,236}{1,450}} = 12.4 \text{ in.}$ $3 \cdot h_{ef} = 27 \text{ in.} \geq 12.4 \text{ in.} \therefore s_{cr,Na} = 12.4 \text{ in.}$	-	Section 4.1 Table 9
$c_{cr,Na} = \frac{s_{cr,Na}}{2} = 6.2 \text{ in.}$	-	Section 4.1 Eq. (D-14i)
$A_{Na} = (2c_{cr,Na} + s)(c_{cr,Na} + c_{a,min}) = 143.0 \text{ in}^2$	-	Section 4.1 D.5.3.7
$A_{Na0} = (s_{cr,Na})^2 = 154.2 \text{ in}^2$	-	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
$\psi_{g,Na0} = \sqrt{n} - \left[(\sqrt{n} - 1) \cdot \left(\frac{\tau_{k,uncr}}{\tau_{k,max,uncr}} \right)^{1.5} \right] = \sqrt{2} - \left[(\sqrt{2} - 1) \cdot \left(\frac{2,236}{2,899} \right)^{1.5} \right] = 1.13$	-	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												
$\psi_{ec,Na} = 1.0 \text{ no eccentricity - loading is concentric}$	-	-												
$\psi_{p,Na} = \frac{\max c_{a,min}; c_{cr,Na} }{c_{ac}} = \frac{\max 2.5; 6.2 }{22.5} = 0.28$	-	-												
$N_{a0} = \tau_{k,unscr} \cdot \pi \cdot d \cdot h_{ef} = 2,236 \cdot \pi \cdot 0.5 \cdot 9.0 = 31,610 \text{ lb}$	-	Section 4.1 Eq. (D-14j)												
$N_{ag} = \frac{A_{Na}}{A_{Na0}} \cdot \psi_{ed,Na} \cdot \psi_{g,Na} \cdot \psi_{ec,Na} \cdot \psi_{p,Na} \cdot N_{a0}$ $N_{ag} = \frac{143.0}{154.2} \cdot 0.82 \cdot 1.06 \cdot 1.0 \cdot 0.28 \cdot 31,610 = 7,134 \text{ lb}$	-	Section 4.1 Eq. (D-14b)												
$\phi = 0.65$	-	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	-												
<table style="width: 100%; border: none;"> <tr> <td style="text-align: right;">Steel strength</td> <td>ϕN_{sa}</td> <td>= 26.6 k</td> <td></td> </tr> <tr> <td style="text-align: right;">Concrete breakout strength</td> <td>ϕN_{cbg}</td> <td>= 8.3 k</td> <td></td> </tr> <tr> <td style="text-align: right;">Bond strength</td> <td>ϕN_{ag}</td> <td>= 4.6 k</td> <td>controls</td> </tr> </table>	Steel strength	ϕN_{sa}	= 26.6 k		Concrete breakout strength	ϕN_{cbg}	= 8.3 k		Bond strength	ϕN_{ag}	= 4.6 k	controls		
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:														
$N_{allow,ASD} = \frac{N_d}{\alpha} = \frac{\phi N_n}{\alpha} = \frac{4.6}{1.4} = 3.3 \text{ k}$		Section 4.2												

FIGURE 4 – SAMPLE CALCULATION

FIGURE 5 - INSTRUCTIONS FOR USE**HILTI****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 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.**HILTI HIT-RE 500-SD****Se reporter à 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 quartzueux.**Précautions:** Pour travailler, porter des vêtements, des gants et une protection pour les yeux. Éviter tout contact avec les yeux. Éviter tout contact avec la peau. Éviter d'inhaler les vapeurs. Éviter 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. / Hilti Latin America Ltd., Tulsa, OK****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
HIT-RE 500-SD****Instructions for use** en**Mode d'emploi** fr**Instrucciones de uso** es

ICC-ES ESR - 2322

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391163/C 09.2007

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.

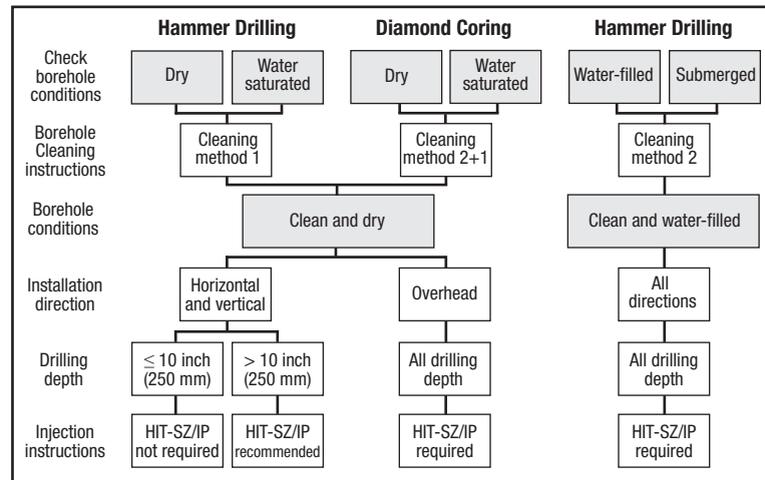
Base material temperature at time of installation: Must be between 41°F and 110°F (5°C - 43°C).

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 $\varnothing \geq$ bore hole \varnothing) by inserting the round steel brush to the back of the borehole in a twisting motion and removing it. The brush should resist insertion into the borehole - if not, the brush is too small and must be replaced with 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 $\varnothing \geq$ borehole \varnothing) by inserting the round steel brush to the back of the borehole with a twisting motion and removing it. The brush should resist insertion into the borehole - if not, the brush is too small and must be replaced with 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 \leq 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 B: (Small side)	
Part A: (Large side)			
Quartz sand	14808-60-7	m-xylene diamine	01477-55-0
Bisphenol A epoxy resin	25068-38-6	Aliphatic polyamine (NJ TSNR)	19136100-5014*
Bisphenol F epoxy resin	28064-14-4	Quartz sand	14808-60-7
Diglycidyl ether (NJ TSNR)	19136100-5013*	Bonding agent	65997-16-2
Alkylglycidyl ether (NJ TSNR)	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 paises)**

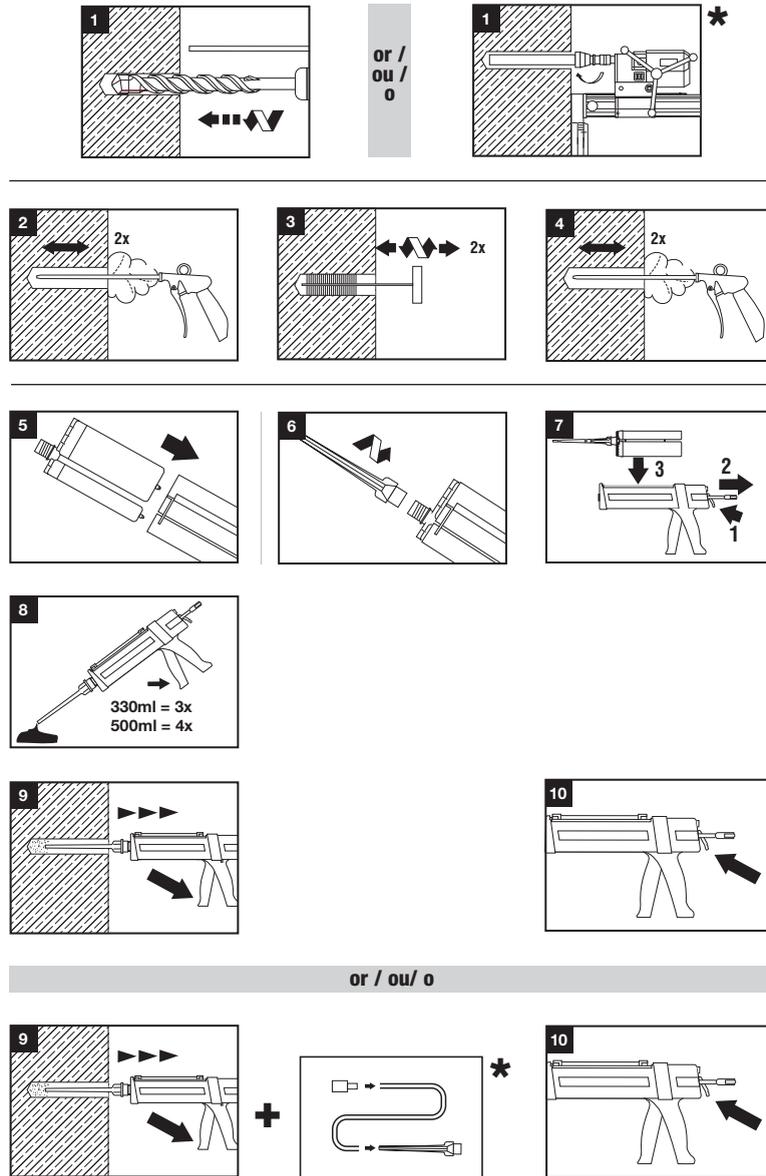
Made in Germany

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.

Hilti HIT-RE 500-SD



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

		t _{work} / t _{gel}		t _{cure, ini}
5°C	41°F	0	2 1/2 h	18 h
10°C	50°F	0	2 h	12 h
15°C	59°F	0	1 1/2 h	8 h
20°C	68°F	0	30 min	6 h
30°C	86°F	0	20 min	4 h
40°C	104°F	0	12 min	2 h

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

Hilti HIT-RE 500-SD

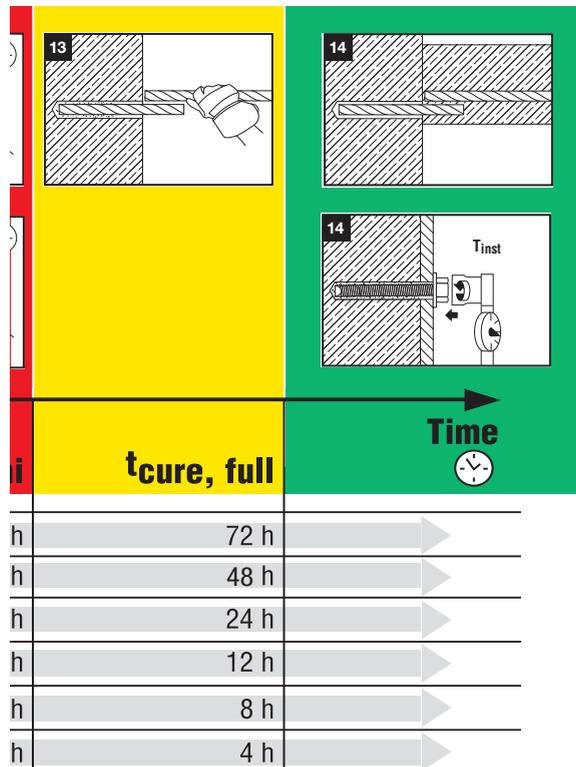
Table 1

	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.



Hilti HIT-RE 500-SD

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

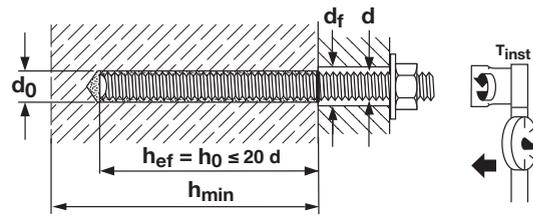


Table 2: HAS

d		d ₀	h _{ef} min-max		T _{inst}		d _f	h _{min}
[inch]	[mm]	[inch]	[inch]	[mm]	[ft-lb]	[Nm]	[inch]	[inch]
3/8	9.5	7/16	1 1/2 - 7 1/2	40 - 191	15	20	7/16	h _{ef} + 1 1/4 (30 mm)
1/2	12.7	9/16	2 - 10	51 - 254	30	41	9/16	
5/8	15.9	3/4	2 1/2 - 12 1/2	64 - 318	60	81	11/16	h _{ef} + 2 d ₀
3/4	19.1	7/8	3 - 15	76 - 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]	[mm]	[mm]	[Nm]	[mm]	[mm]	[mm]
M8	10		40 - 160		10		9	h _{ef} + 30
M10	12		41 - 200		20		12	
M12	14		48 - 240		40		14	
M16	18		64 - 320		80		18	
M20	24		80 - 400		150		22	h _{ef} + 2 d ₀
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

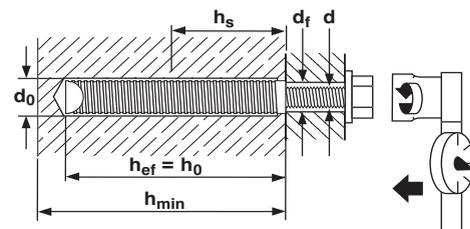


Table 3: HIS-(R)N

d		d ₀	h _{ef}		T _{inst}		d _f	h _{min}	
[inch]	[mm]	[inch]	[inch]	[mm]	[ft-lb]	[Nm]	[inch]	[inch]	[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]	[mm]	[mm]	[Nm]	[mm]	[mm]	[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

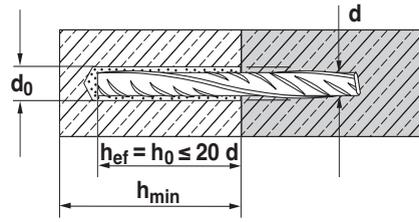
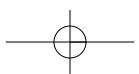


Table 4

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



Hilti HIT-RE 500-SD



Hilti HIT-RE 500-SD

9-10 Injecter la résine en commençant par le fond du trou et en évitant la formation de bulles d'air : Vérifier si l'état du trou a changé (p. ex., s'il y a de l'eau dans le trou) après le nettoyage. Le cas échéant, recommencer le nettoyage conformément aux options 2 – 4.

• **Injecter** la résine en commençant par le fond du trou (si le trou est profond, utiliser la rallonge de buse) et reculer progressivement avec le pistolet à injecter à chaque pression sur la détente.

Remplir environ 2/3 du trou, ou au niveau nécessaire pour s'assurer que l'espace annulaire entre la cheville / le fer d'armature et le béton est totalement comblé avec de la résine sur toute la profondeur d'encastrement. Après avoir rempli le trou, actionner le bouton de déverrouillage du pistolet à injecter. Ceci permet d'éviter que la résine continue d'être extrudée de la buse mélangeuse.

• **Bouchon d'injection HIT-SZ/IP recommandé pour les trous d'une profondeur >25 mm / 10 pouces. Pour les trous remplis d'eau ou le béton submergé et les installations en hauteur, l'injection n'est possible qu'avec l'aide d'un bouchon.** Assembler la buse mélangeuse HIT-RE-M, la ou les rallonge(s) et un bouchon HIT-SZ/IP de taille appropriée. Enfoncer le bouchon au fond du trou et injecter la résine comme décrit dans la méthode d'injection ci-dessus. Pendant le remplissage, le bouchon est naturellement éjecté du trou par la pression de la résine.

11 Insérer la cheville / le fer d'armature dans le trou. Marquer et positionner la cheville / le fer d'armature à la profondeur nécessaire. Avant d'utiliser la cheville / le fer d'armature, vérifier que l'objet est propre et exempt d'huile et autres contaminants. Pour faciliter la pose, la cheville / le fer d'armature peut être inséré en exerçant une rotation. Après la pose d'une cheville / d'un fer d'armature, l'espace annulaire doit être complètement comblé avec de la résine. Si le trou n'est pas totalement rempli sur toute la profondeur d'encastrement, l'installation doit être rejetée. Dans ce cas, contacter Hilti pour de plus amples informations.

Attention ! Pour les applications en hauteur, faire très attention lors de l'insertion de la cheville / du fer d'armature. Le surplus de résine est éjecté du trou ; prendre les précautions nécessaires pour éviter qu'elle ne tombe sur la personne qui réalise la pose. Positionner la cheville / le fer d'armature et l'empêcher de bouger / de tomber pendant le temps de prise (p. ex. avec des cales). Respecter le temps de manipulation "**t gel**", qui varie en fonction de la température du matériau support. Des ajustements mineurs de la cheville / du fer d'armature peuvent être apportés pendant le temps de manipulation. Voir le tableau.

12 Ne pas manipuler la cheville / le fer d'armature une fois le temps de manipulation "**t gel**" écoulé et jusqu'à la fin du temps de prise "**t cure,ini**".

13 Le travail de préparation peut se poursuivre dans le cas de l'utilisation d'un fer d'armature. Entre le temps de prise "**t cure,ini**" et le temps de durcissement complet "**t cure,full**", la résine a une résistance de charge limitée ; ne pas appliquer de couple de serrage ou une charge sur la cheville / le fer d'armature pendant cet intervalle.

14 Appliquer une charge / un couple de serrage uniquement après la fin du temps de durcissement complet "t cure,full**"** et après avoir positionner l'élément à fixer.

Toute recharge entamée doit être réutilisée dans les **4 semaines**. Laisser la buse mélangeuse vissée sur la recharge entamée et stocker la recharge conformément aux recommandations. Avant réutilisation, visser une nouvelle buse mélangeuse et jeter la résine extrudée lors des premières pressions, comme décrit au point 8.

Consignes de sécurité

Usage industriel uniquement. Conserver hors de la portée des enfants.

Danger : Corrosif

Nocif en cas d'inhalation et d'ingestion.

Peut entraîner des brûlures des yeux et de la peau.

Risque de lésions oculaires graves.

Peut entraîner une sensibilisation chez certaines personnes.

Contient du sable quartzeux.

Consignes :

Porter des vêtements de protection, des lunettes de protection pour les yeux et des gants adaptés.

Éviter tout contact avec les yeux.

Éviter tout contact avec la peau. Éviter d'inhaler les vapeurs.

Éviter d'inhaler les poussières lors de la démolition / du retrait.

Premiers soins :

En cas de **contact avec les yeux**, rincer avec de l'eau pendant 15 minutes en maintenant les paupières ouvertes. Consulter immédiatement un médecin. En cas de **contact avec la peau**, rincer immédiatement avec de l'eau et du savon. En cas d'**ingestion**, boire deux verres d'eau et consulter immédiatement un médecin.

Composition

Numéro de registre CAS

Partie A : (grand côté)

sable quartzeux	14808-60-7
résine époxy au bisphénol A	25068-38-6
résine époxy au bisphénol F	28064-14-4
éther de diglycidyle (NJ TSNR)	19136100-5013*
éther d'alkylglycidyle (NJ TSNR)	19136100-5012*
silice amorphe	67762-90-7

Partie B : (petit côté)

diamine de m-xylène	01477-55-0
polyamine aliphatique (NJ TSNR)	19136100-5014*
sable quartzeux	14808-60-7
agent de liage	65997-16-2
oxyde d'aluminium	01344-28-1
silice amorphe	67762-90-7

* NJ TSNR = New Jersey Trade Secret Registry Number

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En Caso de Emergencia, llame Chem-Trec : 001-703-527-3887 (other countries / autres pays / otros países)

Fabriqué en Allemagne

Volume net : 330 ml (1,1 fl. oz.) / 1 500 ml (6,9 fl. oz.)

Poids net : 470 g (16,6 oz.) / 710 g (25 oz.)

Garantie : pour des informations sur la garantie, se reporter aux conditions générales de vente Hilti.

Le non respect du mode d'emploi, l'utilisation de chevilles non distribuées par Hilti, un béton de mauvaise qualité ou de qualité douteuse, ou encore des utilisations particulières peuvent avoir des conséquences néfastes sur la fiabilité ou les performances des ancrages.

Hilti HIT-RE 500-SD

Sistema de anclaje con adhesivo para fijaciones en hormigón de peso normal

Antes de utilizar el producto, lea estas instrucciones de uso y las indicaciones de seguridad.

Verifique la fecha de caducidad: Véase la etiqueta que figura en el colector del cartucho (Mes/año). No utilice el producto una vez expirada la fecha de caducidad.

Temperatura del cartucho: Debe estar entre 5 °C y 40 °C (41 °F y 104 °F) en el momento de la aplicación.

Temperatura del material base al momento de la instalación: Debe estar entre 5 °C y 43 °C

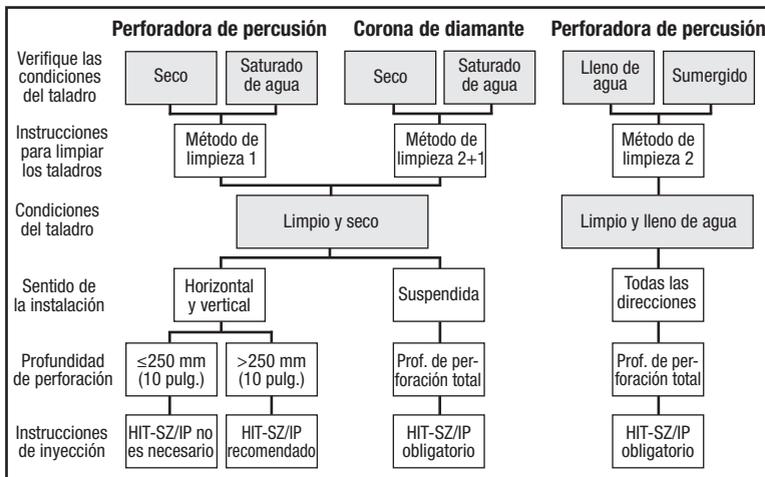
(41 °F y 110 °F) en el momento de la aplicación.

Instrucciones de transporte y almacenamiento: Mantener en un lugar fresco, seco y oscuro a una temperatura de entre 5 °C y 25 °C (41 °F y 77 °F).

Hoja de datos de seguridad de los materiales: Véase la MSDS del material antes de utilizarlo.

Instrucciones de montaje: Secuencia de operaciones: véanse los pictogramas 1 a 14. Detalles de fijación: véanse las tablas 1 a 4. **Para cualquier otra aplicación no incluida en este documento** (por ejemplo, "h_{ef}" fuera de los valores especificados en los detalles de fijación), **póngase en contacto con Hilti.**

Diagrama de flujo de instalación



1 Realice el taladro en perpendicular a la superficie con una perforadora de percusión fijada en modo de martillo perforador y emplee una broca de carburo del tamaño adecuado, o una perforadora con una corona de diamante del tamaño adecuado, según la profundidad de empotramiento necesario. Véanse las tablas en las que se describen los detalles de ajuste.

2-4 Limpieza del taladro: El método de limpieza debe seleccionarse en función del método de perforación y las condiciones del taladro (véase el diagrama de flujo anterior). Antes de proceder a la colocación del corrugado o anclaje, limpie el taladro para eliminar el polvo o la suciedad que pudiese tener. Para ello, utilice uno de los siguientes métodos:

Método 1: para hormigón seco o saturado de agua (véanse los pictogramas):

- **Aplique soplado a presión** desde la parte de atrás del taladro con aire comprimido libre de aceite (mínimo 90 psi a 3,5 CFM (6 bares a 6 m³/h)) y retire la boquilla de aire 2 veces hasta que la corriente de aire de retorno no contenga polvo visible.
- **Cepille 2 veces** con un cepillo del tamaño especificado (\varnothing de cepillo $\geq \varnothing$ de taladro). Para ello, inserte el cepillo metálico redondo en la parte trasera del taladro con un movimiento giratorio y sáque-lo. El cepillo debe presentar resistencia al ser introducido en el taladro. Si no es el caso, el cepillo es demasiado pequeño y deberá reemplazarse por otro cepillo que tenga el diámetro adecuado.
- **Vuelva a aplicar soplado a presión** con aire comprimido 2 veces hasta que la corriente de aire de retorno no contenga polvo visible.

Método 2: para taladros llenos de agua, de hormigón sumergido o taladros realizados con corona de diamante:

- **Lave el taladro 2 veces** insertando una manguera con agua (con presión normal de la línea de agua) en la parte trasera del taladro hasta que el agua salga limpia.
- **Cepille 2 veces** con un cepillo del tamaño especificado (\varnothing de cepillo $\geq \varnothing$ de taladro). Para ello, inserte el cepillo metálico redondo en la parte trasera del taladro con un movimiento giratorio y sáque-lo. El cepillo debe presentar resistencia al ser introducido en el taladro. Si no es el caso, el cepillo es demasiado pequeño y deberá reemplazarse por otro cepillo que tenga el diámetro adecuado.
- **Vuelva a lavarlo 2 veces** hasta que el agua salga limpia.
- **Importante:** En el caso de los taladros realizados con coronas de diamante y si se necesita un taladro seco para inyección (es decir, el agua fluye dentro del taladro limpio), prosiga con la limpieza del taladro tal y como se describe en el método 1.
Elimine completamente el agua retenida (por ejemplo, mediante vacío, aire comprimido u otro procedimiento adecuado).
Para conseguir un taladro seco, se recomienda emplear una boquilla para aire HIT-DL de Hilti en taladros de ≤ 250 mm (10 pulg.) de profundidad; su uso es obligatorio en taladros de profundidad > 250 mm (10 pulg.).

El taladro debe estar exento de polvo, suciedad, hielo, aceite, grasa o cualquier otro agente contaminante antes de proceder a la inyección del adhesivo. Limpieza insuficiente del taladro = valores de carga inadecuados.

5 Inserte el cartucho en el portacartuchos. No utilice cartuchos en mal estado o portacartuchos deteriorados o sucios.

6 Fije fuertemente el mezclador Hilti HIT-RE-M al colector del cartucho. Antes de utilizar un nuevo cartucho, coloque primero el nuevo mezclador (bien ajustado). No modifique el mezclador en ningún caso. Verifique que el elemento de mezcla se encuentre en el mezclador. Emplee únicamente el tipo de mezclador provisto con el adhesivo.

7 Inserte el portacartuchos con el cartucho en el aplicador HIT. Pulse el gatillo de bloqueo, retraiga el émbolo e inserte el cartucho en el aplicador Hilti que corresponda.

8 No utilice el adhesivo inicial. El cartucho se abre automáticamente al comenzar con la aplicación. En función del tamaño del cartucho, deberá desecharse una cantidad del adhesivo inicial. El pictograma 8 le muestra la cantidad correspondiente que se debe desechar. Si se instala un nuevo mezclador sobre un cartucho abierto con anterioridad, se debe desechar una cierta cantidad del adhesivo inicial, tal como se describió antes. Se debe utilizar un nuevo mezclador para cada cartucho nuevo.

Hilti HIT-RE 500-SD

9-10 Inyecte el adhesivo desde la parte trasera del taladro sin que se formen burbujas de aire: Verifique si se han modificado las condiciones del taladro (por ejemplo, si contiene agua) después de la limpieza. De ser así, vuelva a limpiarlo según lo detallado en los puntos 2 a 4.

• **Inyecte** el adhesivo comenzando por la parte de atrás del taladro (emplee la extensión para los taladros más profundos). Lentamente, retire el mezclador después de cada aplicación.

Rellene alrededor de 2/3 del taladro, o hasta donde sea necesario para asegurar que el espacio anular entre el corrugado o anclaje y el hormigón esté totalmente lleno con adhesivo todo a lo largo del empotramiento. Una vez finalizada la inyección, despresurice el aplicador pulsando el gatillo de bloqueo. Esto evitará que siga saliendo adhesivo del mezclador.

• **Inyección con tapón pistón: HIT-SZ/IP recomendado para taladros con una profundidad >250 mm/10 pulg. En casos de taladros llenos de agua o en hormigón sumergido e instalaciones suspendidas, sólo se puede inyectar el adhesivo utilizando un tapón pistón.** Ensamble el mezclador HIT-RE-M, las extensiones necesarias y un tapón HIT-SZ/IP de tamaño adecuado. Inserte el tapón pistón en la parte trasera del taladro e inyecte el adhesivo tal como se describió antes en el método de inyección. Durante la inyección, el tapón pistón será naturalmente extruido del taladro por la presión del adhesivo.

11 Inserte el corrugado o anclaje en el taladro. Marque y fije el corrugado o anclaje a la profundidad deseada del empotramiento. Antes de usarlo, verifique que el corrugado o anclaje esté seco y no contenga aceite ni otros agentes contaminantes. Para facilitar la instalación, gire lentamente el corrugado o anclaje a medida que lo va insertando. Después de haber instalado un corrugado o anclaje, debe llenar por completo el espacio anular con adhesivo. Si el taladro no está totalmente lleno a lo largo de la profundidad del empotramiento, se debería rechazar la instalación. Comuníquese con Hilti para obtener más información al respecto.

Atención: En el caso de aplicaciones suspendidas, tenga especial cuidado al insertar el corrugado o anclaje. El exceso de adhesivo saldrá del taladro. Tome las medidas necesarias para evitar que pueda caer encima del instalador. Coloque el corrugado o anclaje en su sitio y asegúrelo para evitar que pueda moverse o caer durante el tiempo de fraguado (por ejemplo, utilizando cuñas). Respete el tiempo de aplicación "**t gel**", el cual varía según la temperatura del material base. Durante ese período, se pueden realizar ajustes menores al corrugado o anclaje. Véase la tabla.

12 No toque el corrugado o anclaje una vez finalizado el tiempo "**t gel**" y hasta que haya transcurrido el tiempo "**t cure,ini**".

13 Puede continuar con el trabajo de preparación para las aplicaciones de corrugado. Entre las etapas de "**t cure,ini**" y "**t cure,full**", el adhesivo tiene limitada capacidad de soportar cargas. Por ello, no someta el corrugado o anclaje a torsión o carga durante ese tiempo.

14 Aplique carga o torsión sólo después de que el punto "t cure,full**"** haya transcurrido y el accesorio que se instalará esté situado en su lugar.

Los cartuchos no agotados por completo deberán utilizarse antes de **cuatro semanas**. Para ello, se los deberá guardar con el mezclador roscado al colector del cartucho en las condiciones de almacenamiento recomendadas. Antes de volver a utilizarlo, fije un nuevo mezclador y deseche el adhesivo de anclaje inicial, tal como se describe en el punto 8.

Instrucciones de seguridad

Sólo para uso industrial. Mantener alejado del alcance de los niños.

Peligro: Corrosivo

Peligroso si se inhala o ingiere.
Puede provocar quemaduras en los ojos y la piel.
Puede dañar seriamente los ojos.
Puede provocar sensibilización en algunas personas.
Contiene arena de cuarzo.



Precauciones:

Utilice indumentaria y guantes adecuados, y protección para los ojos.
Evite el contacto con los ojos.
Evite el contacto con la piel. Evite la inhalación de vapores.
Evite la inhalación de polvos durante su destrucción o extracción.

Primeros auxilios:

En caso de **contacto con los ojos**, enjuague con agua durante 15 minutos, manteniendo los párpados abiertos. Busque atención médica de inmediato. En caso de **contacto con la piel**, lave inmediatamente con agua y jabón. En caso de **ingestión**, beba dos vasos de agua y busque atención médica de inmediato.

Componente	Número CAS		
Parte A: (Lado grande)		Parte B: (Lado pequeño)	
Arena de cuarzo	14808-60-7	m-xilendiamina	01477-55-0
Resina epoxy Bisfenol A	25068-38-6	Poliamina alifática (NJ TSNR)	19136100-5014*
Resina epoxy Bisfenol F	28064-14-4	Arena de cuarzo	14808-60-7
Éter diglicidílico (NJ TSNR)	19136100-5013*	Aglutinante	65997-16-2
Éter alquil glicidílico (NJ TSNR)	19136100-5012*	Óxido de aluminio	01344-28-1
Silice amorfo	67762-90-7	Silice amorfo	67762-90-7

* NJ TSNR = Número de Registro de Secreto Comercial de Nueva Jersey

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 a Chem-Trec: 001-703-527-3887 (other countries/autres pays/otros países)

Hecho en Alemania

Contenido neto: 330 ml (11,1 oz. fl.)/500 ml (16,9 oz. fl.) Peso neto: 470 g (16,6 oz.)/710 g (25,0 oz.)

Garantía: Consulte los términos y condiciones estándar de venta de Hilti para obtener más datos sobre la garantía.

El incumplimiento de las instrucciones de uso y datos de fijación, el uso de anclajes no fabricados por Hilti, el estado deficiente o cuestionable del hormigón, o ciertas aplicaciones pueden afectar la fiabilidad o el rendimiento de la fijación.